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Potential Exposure to Hazardous Work Activities: Tractor Usage Among Farmwomen

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ABSTRACT. Farmwomen are often an unacknowledged workforce, leading to a lack of targeted safety interventions. This study examined the involvement and work patterns of 665 women in Texas and 657 women in Louisiana who were 18 years old and older and whose family participated in farming operations. Surveys were used to gather specific data regarding tractor work patterns, tractor knowledge, sources of information about tractors, and demographic information in two southern states in which cattle and dairy were the major agricultural commodity. Among the sample of 1,322 women, 577 (43.6%) reported driving tractors at least one day a year. This subset was used to describe characteristics of tractors and tractor-related activities. Findings indicate that women learn to drive tractors in their 20s, use husbands as the primary source of their information about tractors, engage in a wide variety of farm activities including bush-hogging and plowing, and acknowledge knowing an average or less than an average amount about driving tractors. Women most often reported driving between 1 to 12 days/year (n = 321, 55.6%). When examining patterns of ROPS-equipped tractor use, women were 1.47 times more likely to drive a tractor without ROPS or enclosed when driving less than 12 days a year as opposed to 13-103 days/year or greater than 104 days/year. The results of this study support the need for health care professionals and safety specialists to design appropriate interventions that target women to become more knowledgeable regarding the injury risks associated with farm work while driving tractors. doi:10.1300/J096v11n03_04

KEYWORDS. Agriculture, women, tractor use, injury prevention

INTRODUCTION/BACKGROUND

Farmwomen are faced with a multitude of tasks and responsibilities, many of which have health risks and implications for the whole family. Family farms are rapidly being displaced by large-scale agricultural operations.[1] For those who continue family farming, it is speculated that the effect of these changes has led to relying on hired labor and seeking outside employment

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to sustain the family owned farm operation.[2] Therefore, women are often compelled to engage in agricultural work, including heavy machinery operation, to maintain viability of the farm.[3] Many women are engaged in work, both on and off of the farm.[4] The work that women participate in is determined by region, type of farming, race, and class.[3,5] Internationally, it is estimated that 43% of the agricultural workforce is comprised of women.[6] However, in the United States, according to results of the National Agricultural Workers Survey (NAWS) 2001-2002, 21% of all 6,472 farm workers surveyed in the United States were women.[7] While these data provide some insight for women farm workers, less is known about those women who participate in farm work as an owner/operator, or as an agricultural partner in owner/operator farm-related work.

Common roles that women fulfill include off-farm work, main operators of the farm, home and management activities, farm management, and ancillary services such as running errands, gardening, and bookkeeping.[8-9] In addition, women are participating in tasks traditionally done by men, such as tractor driving, operating machinery, hauling grain, and driving trucks part-time.[3,10] While their husbands provide a sustainable income from outside employment, often considered supplemental family income, women on small or specialized farms frequently assume major responsibility for the farm's operation and management.[3,10] These farm tasks, according to Gallagher and Delworth (1993), in addition to housework and off-farm employment, cause women to seek balance between all activities. They refer to this type of juggling as the "third shift" phenomenon.[11]

Literature supports the fact that women do not identify themselves in terms of work or tasks of farming, including roles as owner/operator, full-time laborer, accountant or bookkeeper, payroll supervisor, or work assistant.[12] In a study done by Reed, Westneat, Browning, and Skarke (1999), about half of the farmwomen surveyed classified themselves as homemakers.[3] However, this group of homemakers participates in farm work, and is at a risk of injury equal to women who define themselves as agricultural partners. Since farmwomen identify themselves as homemakers, there may be implications for safety specialists planning interventions. If women downplay their farming contributions, the risk for injury as a result of engaging in various activities is not recognized. Women engaged in multiple roles, both on and off the farm, could be potentially at greater risk for injury. While recent studies have examined the characteristics of tractors among those farmers[16] and children[17] who engage their use for farm work, very few studies have examined the experiences of farmwomen and tractor use.

Tractor-related injury, caused by overturns, runovers, entanglements in power takeoffs (PTO), and roadway collisions, account for more than one-third of the agriculture-related fatalities in the U.S. each year.[18] Tractors are known to contribute in both fatal and nonfatal injuries.[8, 19-21] In a study conducted by Carruth, Skarke, Moffett, and Prestholdt,[8] women were almost 3.45 times more likely to sustain injuries if they drove tractors an average of one day a week, and 4.12 times more likely if they drove tractors an average of more than one day a week. Host and farm environment characteristics affect risk of injury. Men are 4.5 times more likely to sustain an injury than women.[22] However, when tractor driving hours are taken into account, men are at a decreased likelihood for sustaining an injury.[21,23]

While it is important to identify the factors surrounding injuries, it is equally important to examine risk exposure in order to develop hazard prevention interventions. The tasks that women are currently undertaking on the farm can potentially put them at risk for a number of hazards. Also, women working on farms are often an unacknowledged work force, greatly reducing the identification of the need for targeted safety interventions. The focus of this study is to examine the involvement, work patterns, and tractor usage of women who live and work on farms.

METHODS

This population-based, cross-sectional survey included women 18 years old and older who belonged to a household with family farming operation status. Data were initially collected in Texas in 1997 and replicated in Louisiana in 1998. The sample was selected from a

pool of 2,639 in Texas and 4,808 in Louisiana. To sample from all farm owners in the region of interest, names were obtained from county plat listing for five counties within the Texas panhandle, and mailing lists maintained by Louisiana State University Agricultural Center and Farm Service Agency for 10 parishes in southeast Louisiana. A stratified, random sampling design with counties/parishes comprising the strata and a simple random sample without replacement selected within each stratum was used to identify potential participants. Trained callers conducted 30-minute telephone interviews. Proportional allocation of the participating counties/parishes was employed to keep participation representative of population density. Households were coded as ineligible when the family no longer farmed or no women lived in the household. Of those who completed the eligibility screen, 665 women (response rate 51%) in Texas and 657 women (response rate 58%) in Louisiana completed surveys.

The Farm Family Health and Injury Prevention Survey (Texas and Louisiana versions) were revised from instruments used to collect data by researchers affiliated with the Southeast Center for Agricultural Health and Injury Prevention at the University of Kentucky. The survey consisted of several sections of questions eliciting information about farm work associated with the operation of the farm: direct and indirect farm tasks; tractor work patterns and tractor knowledge, source of information and demographic information. Each farm was classified by primary agricultural commodity. Current work status for these women and spouses, if married, were determined by asking whether he/she worked off-farm jobs. Participation in various farm tasks, including tractor driving, was grouped yes/no. Women were assigned to the Drive Tractor group if they answered yes to tractor driving as a farm task, yes to any activity requiring the use of a tractor (i.e., "Bush Hogging"), or yes to engaging in tractor work one or more days per year.

Data management and analyses were performed using SPSS (13.0 for windows) software systems. Descriptive cross tabulation statistical tests were used to examine data. Women in this study contributed to farm work through different roles. The analysis associated with tractor operation was inclusive of the subset of women who indicated they drive a tractor (n = 577).

RESULTS

Demographic data. Demographic characteristics of farmwomen from Texas and Louisiana were proportionally similar. Therefore, for analysis of tractor usage characteristics, data were pooled as one sample. Table 1 outlines demographic data for farmwomen who drive and do not drive. Of the 577 women who drive tractors, 382 (66.2%) indicated they drive a tractor regularly, 136 (23.6%) drive a tractor occasionally. Fifty-nine women did not indicate driving a tractor frequently or occasionally, but did report driving a tractor at least one day a year. For these women, the range of days driving a tractor is 1 to 365 days.

Women assigned to the Do Not Drive Tractor group less frequently lived in a house located on the farm. Husbands of women assigned to the Do Not Drive Tractor group less frequently work off the farm. While income was not asked, it is noted that more women in both groups have off-farm work than husbands. Possible reasons include working to sustain viability of the farm, and the need for health insurance.

The average age at which the women first drove a tractor, and the age of women currently driving tractors, were examined. All women in the Drive Tractor group reported Age First Driving Tractors. Surprisingly, 424 women in the Do Not Drive Tractors group (65.7%) reported Age First Driving. Therefore, this subset was used to compare the average Age First Driving Tractor between the groups. The age range of first driving a tractor in the Drive Tractor Group is 4 to 80, $M = 21.2$, $SD = 10.9$, and in the Do Not Drive Tractor group is 5-62, $M = 22.8$, $SD = 10.4$. An independent t-test to evaluate the differences in mean age of Age First Driving was performed. Those women who currently drive a tractor were significantly more likely to begin driving a tractor at a younger age; $t = 2.22$, $p = .03$. Current age for both groups was then compared. In this sample, women assigned to the Do Not Drive group are significantly older than those assigned to the Drive Tractor group. The mean age for women

TABLE 1. Demographic Characteristics of Farmwomen Who Drive and Do Not Drive Tractors

Characteristics	Drive Tractors n = 577		Do Not Drive Tractors n = 745	
	Number	Percent	Number	Percent
Age				
18-30	23	3.9	8	1.1
31-40	89	15.5	60	8.1
41-50	150	26.0	135	18.1
51-60	154	26.8	161	21.6
61-70	112	19.4	183	24.6
> 71	48	8.3	198	26.6
Missing	1	.1		
House Located on Farm	496	86.0	498	67.0
Most Often Reported Type of Farm				
Beef	269	46.6	297	39.9
Marital Status				
Married	543	94.1	663	88.9
Other	34	5.9	82	11.1
Off Farm Work Status				
Farmwomen	285	49.6	302	40.7
Husbands	227	39.3	207	27.8
Educational Level				
< High School	38	6.6	64	8.6
High School	226	39.2	278	37.3
> High School	313	54.2	403	54.1
Ethnic Background				
White	563	97.6	702	94.2
Other	14	2.4	43	5.8

in the Do Not Drive tractor group is 60.1 years (SD = 18.1) compared to those women in the Drive Tractor group, whose mean age is 52.2 years (SD = 13.1). An independent t-test to evaluate differences in current age status between the two groups was conducted. Those women in the Drive Tractor group are significantly more likely to be younger than those in the Do Not Drive a tractor group; t = 9.2, p = .0001.

Views of the hazards farm work. To analyze farmwomen's perception of driving tractors as hazardous, women were first asked if they considered farming as hazardous. Of the entire sample of women, only 278 women (21.1%) reported that the work of farming is hazardous. If women identified farming as hazardous, they were then asked to identify hazards that they were most concerned about. The responses of this open-ended question were recorded verbatim, coded and quantified and included: working with animals (n = 75); equipment work (n = 75); tractor work (n = 47); pesticide application (n = 40); field/crop work (n = 23); other (n = 15); don't know (n = 3). In the study, a very small proportion of women spontaneously identified tractor work as hazardous. It is possible that identified tasks such as pesticide application

and equipment work are done while driving a tractor or in conjunction with driving tractors. If this is assumed true, then the major concern of farm work is driving tractors or working around tractors. The fact that this question was open-ended and analyzed by coding responses into categorical data is a limitation and limits the ability to explore data beyond descriptive statistics.

Farm tasks. Women were more likely to be involved in spring or summer farm activities (N = 688, 52%). To objectively compare the overall level of involvement in various farm activities of women who drive a tractor and those who do not, the frequency with which women participated in farm tasks is examined (Table 2). Women who operate tractors are more likely to be engaged in more farm activities, compared to other farmwomen who do not drive a tractor. Two-way contingency table analyses were conducted using tractor driving status as one variable and the participation status of farm tasks (yes/no) as the second variable, in order to answer the research question: "Are farmwomen who drive a tractor engaged greater proportion of other farm tasks than those who do not drive a tractor." Tractor driving status was found to be statistically significant to all farm tasks.

Tractor activities. Women were asked which activities they engage in most often while driving the tractor (Table 3). Women were more likely to engage in rotary cutting (i.e., "Bush Hogging") and plowing than any other activity. This finding may be explained in part by the fact that the southern states experience relatively warm winters, therefore women have the opportunity to engage in plowing and rotary cutting throughout the year.

Knowledge of tractors. Women were asked how much they know about driving a tractor. Table 4 outlines knowledge categorized by tractor use. As expected, those who drive tractors are more likely to report knowledge of tractors. Interestingly, greater than 30% of women who reported driving tractors indicated that they knew very little or nothing about tractors.

Tractor characteristics. Women in the Drive Tractor group were asked if they wore a safety belt while driving a tractor. Of the women who drive a tractor with a ROPS (n = 288), only 63 (21.9%) reported wearing safety belt while driving a tractor. Table 5 analyzes the frequency of tractor use with no ROPS or enclosed

TABLE 2. Descriptive Comparison of Farm Tasks Among Farmwomen Involved and Not Involved in Tractor Driving

	Drive Tractor n = 577		Do Not Drive Tractor n = 745		Pearson chi-square	p-value
Characteristics	N	%	n	%	Π^2	p
Run errands	555	96.2	546	73.3	122.5	.0001
Pay farm bills	503	87.2	494	66.3	76.4	.0001
Prepare farm income tax forms	262	45.4	227	30.5	31.1	.0001
Order farm supplies	420	72.8	294	39.5	145.4	.0001
Haul goods to market	244	42.3	116	15.6	117.1	.0001
Haul animals to market	230	39.9	101	13.6	119.1	.0001
Mow fields	300	52.0	58	7.8	321.8	.0001
Rake hay	167	28.9	26	3.5	168.9	.0001
Operate combine	78	13.5	9	1.2	80.1	.0001
Apply pesticides	193	33.4	75	10.1	109.9	.0001
Repair farm machinery	219	38.0	50	6.7	195.8	.0001
Work with farm animals	261	45.2	111	14.9	147.9	.0001
Attend farm meetings	278	48.2	215	28.9	51.9	.0001

TABLE 3. Type of Tractor Work Reported by Farmwomen (n = 577)*

	n	%
Rotary cutting	160	27.7
Plowing	138	23.9
Baling Hay	67	11.6
Feeding livestock	34	5.9
Harvest	35	6.1
Transporting feed	21	3.6
Transporting self from one location to another	14	2.4
Pulling stumps	10	1.7
Joy Riding	9	1.6
Spraying chemicals	4	.7
Teaching someone to drive	4	.7
Front end loader work	4	.7

*May be involved in more than one activity

TABLE 4. Comparison of Knowledge of Tractor Involvement

	Drive Tractor n = 577		Do Not Drive Tractor n = 745	
	n	%	n	%
Nothing	24	4.2	277	48.0
A little bit	157	27.2	301	52.2
An average amount	221	39.7	106	18.4
Quite a bit	174	30.1	38	6.6
Don't know	1	.1	17	2.9

TABLE 5. Tractor Characteristics of Drive Tractor Group (n = 577)

	Tractor without ROPS or Enclosed Cab		Tractor with ROPS or Enclosed Cab	
Characteristics	n	%	n	%
1-12 days/year (n = 321)	169	65.0	152	47.9
13-103 days/year (n = 200)	71	27.3	129	40.7
104-365 (n = 56)	20	7.7	36	11.4
Total	260		317	

cab compared to tractor use with ROPS or enclosed cab by the number of days women report driving a tractor each year. Overall, 260 (45.1%) drove tractors with no ROPS.

Women most often reported driving between 1 to 12 days/year (n = 321, 55.6%). Survey questions were not asked to determine the number of days driving a tractor occurred seasonally (clustered) or sporadically interspersed throughout the year. Of concern is the trended pattern that a greater proportion of women drive tractors 1-12 days a year with no ROPS than those women who drive the same number of days on a tractor with ROPS or an enclosed cab.

A two-way contingency table analysis was conducted to evaluate whether those who drive tractors with no ROPS or enclosed cab drive tractors proportionately more often than those women who drive tractors without ROPS or enclosed cabs. The two variables, tractor ROPS status and number of days driving tractor category were found to be significantly related, Pearson O^2 (2, n = 577) = 16.8, p = .0001, Cramer's V = .17. The proportion of women driving tractors without ROPS or enclosed cabs driving 1-12 days, 13-103 days, and > 103 days were .53, .36, .36, respectively. Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. Table 6 show the results of these analyses. The Holm's sequential Bonferroni method was used to control for Type I error at the .05 level across all three comparisons. Two differences were significant: 1-12 days vs 13-103 days and 1-12 days and 104-365 days. The probability of women in the study driving a tractor without ROPS or enclosed cab is 1.47 times (.53/.36) more likely when driving occurs less than 12 days a year as opposed to 13-103 days/year or greater than 104 days/year.

Sources of tractor information. In both groups, the most common sources of information for operating a tractor are spouse, equipment dealer, and manufacturer's instructions (Table 7). Interestingly the extension agent was not often a source of information but was the only instance where women in the do not drive tractor sought information with greater proportion than women in the drive tractor group. Post hoc analysis using Pearson chi-square analysis was conducted to test for relationships between

TABLE 6. Results for the Pairwise Comparisons Using the Holm's Sequential Bonferroni Method

Comparison	Pearson chi-square	p-value	Required p-value for significance	Significance	Cramer's V
13-103 days vs. 104-365 days	.001	.55	.0167	NS	.002
1-12 days vs. 104-365	5.5	.014	.025	*	.12
1-12 vs. 13-103 days	14.6	.0001	.05	*	.17

* significant $p \leq .05$

TABLE 7. Sources of Information on Tractor Operation*

	Drive Tractor		Do Not Drive Tractor	
	Frequency	%	Frequency	%
Spouse	262	45.4	233	31.3
Equipment Dealer	171	29.9	166	22.3
Manufacturers Instructions	117	33.9	85	27.2
Other equipment information	80	13.9	69	9.3
Farm Magazine	50	8.7	53	7.1
Other family member	34	5.9	27	3.6
Extension Agent	18	5.1	19	6.0
Neighbor	16	2.8	10	1.3

* May have chosen more than one source of information

the groups. In two instances, information from spouse ($X^2 = 27.7$, $p = .001$) and equipment dealer ($X^2 = 9.3$, $p = .003$) were significant. Women in the Drive Tractor group were significantly more likely to seek information from these two sources than those in the Do Not Drive Tractor group.

DISCUSSION

This population-based study represents one of the few surveys to examine tractor-use patterns in women, characteristics of tractors used by women on farms, and sources of tractor operation information among actively working farmwomen. In general, women learn to drive tractors in their early 20s, get their information from spouses, engage in a wide variety of farm activities including rotary cutting and plowing, and know an average or less-than-average amount about driving a tractor. Of the women surveyed in the current study, a slightly greater than one-third of women drive a tractor occasionally or regularly.

In this study,women who currently drive tractors at least one day a year are significantly younger, and started driving a tractor at a younger age, than those who do not currently drive a tractor at least one day a year. The finding that women drove at some point in time, and now do not drive tractors, raises concerns regarding potentially sporadic patterns of work using tractors. Patterns of tractor use were not explored in the study. At least one study has explored injury risk among older farmers and found machinery use predictive of farm-related injury.[24] Given the fact that women start driving at an early age, rely on spouses for information and do not feel they know a great deal about a tractors, it stands to reason that there is a need to examine tractor work patterns among women based not only on types of work during various seasons such as harvest and hay baling, but also based on various developmental stages (e.g., child bearing/intimacy versus child launching/generational) and influences of marital/family and cultural experiences.

For example, future research might explore that the reasons women frequently report not knowing much about tractors might be due to the patriarchal society in which farmwomen live. This type of social structure contributes to farmwomen acting less confident in their knowledge of tractors because of the social hierarchy.[25] Women might consider the males' knowledge of tractors superior to their own. This may also explain why farmwomen get the majority of information from spouses rather than through formal training. What is not known is how these social cultural influences

impact the ability of women to confidently and safely operate machinery.

In this study, one-third of the women who drive tractors report knowing very little or nothing about tractors. It may be concluded that many of these women either lack confidence regarding the amount of tractor knowledge they know, or they might not have adequate knowledge of the tractor to operate it safely. The concern for women who drive tractors is that they may not be adequately trained to understand the relevance of the use of safety belts and ROPS to the relationship to injury prevention. Patterns of tractor use among women and the extent of operator skill should be further explored in future studies.

When asked what farm activities are hazardous, very few women identified the operation of tractors as hazardous. This is surprising given that tractors are the leading cause of farm-related fatalities in the U.S. Approximately half of the 4.8 million tractors in the U.S. are equipped with ROPS.[26] The probability of women driving a tractor without ROPS or enclosed cab is 1.47 times more likely when driving less than 12 days a year as opposed to 13-103 days/year or greater than 104 days/year. This supports other studies that found when operators use tractors more hours a year, the tractors were more likely to be equipped with ROPS.[16,27]

Among women who drive tractors, only one-third reported wearing safety belts. Not wearing a safety belt increases the risk for injury in the event of a tractor rollover. Even if the tractor is equipped with a crush-resistant enclosed cab, an unrestrained passenger can be thrown out of the cab. Being thrown from a cab or tractor seat or being pinned under the chassis or the wheel increases the risk of head and spinal cord injury. Worse yet, the tractor's attachment (e.g., Bush Hog) can cause severe trauma if the operator is not thrown clear of the machinery.

Evidence from research conducted in Sweden and other northern European studies demonstrate that the mandatory use of ROPS has essentially eliminated rollover fatalities.[28-30] In the Kentucky study, it was determined that most of the tractor-related fatalities could have been prevented if the tractors had been equipped with ROPS and the operators had secured their safety belts.[31] These precautions ensure that the operator remains within the ROPS-protected zone during a rollover. In this study, it was found that 45.1% of the tractors driven by women were not equipped with ROPS. This is a higher proportion than reported in a recent study in Ohio that found 38.2% of farms were without ROPS-equipped tractors.[16] Without ROPS on tractors, women are at greater risk of injury.

Farm tractor rollovers in the United States result in approximately 200 fatalities every year.[15] Since almost half of the tractors driven by women in this study do not have ROPS, possible explanations include they were driving tractors that were manufactured before the advent of ROPS, or the ROPS had been dismantled. These findings underscore the need for educational programs that focus on overcoming barriers to retrofitting tractors and using safety belts when tractors are in operation. If women drive tractors seasonally, or when there is an increased need for additional help, it is possible that husbands are driving the newer tractors, while the wives operate a second available tractor, often older or without a ROPS.

There were several limitations of the study. Farm tractors are a significant source of potential traumatic injury for women on farms. However, this study did not collect relevant and detailed data regarding types of tractors. For example, no data were collected that examined the types of tractors (e.g., front-end loaders etc.), the size of the tractors, or the horsepower of the engines, all variables that contribute to a better understanding of tractor usage in this population. Another limitation is that the information on ROPS status and safety belt use was self-reported. This self-report bias could cause the under-representation or over-representation of responses on certain questions of the survey. Also, the respondents' answers might be different by telephone than by pen and paper surveys. Another limitation of this study is that the response rate was 51% of women in Texas and 58% in Louisiana. This leads to the possibility of bias being present in women who fully completed this survey compared to women who did not complete the survey, because women who completed the survey might be extremely different from women who did not complete the survey. There is also a possibility

that the survey length could be a drawback, deterring participants from fully completing the survey.

Findings of this study may have been influenced by the fact that Texas and Louisiana are both southern states with relatively long growing seasons. Longer growing seasons might mean different farm work patterns and, therefore, different patterns of tractor driving by women.

Future research needs to determine the prevalence of women driving tractors. National studies to develop predictive models of women and farm characteristics such as farm size, acres farmed, farm income, number of workers, age, education and time commitment and availability and use of ROPS-equipped tractors to injury is needed. The results of this study illustrate the need for interventions that target women as farm operators given the fact that they are engaged in many different types of farm tasks and potentially at risk of performing these farm tasks with older tractors without ROPS and minimal safety belt use. Health professionals should incorporate assessment questions in the health history with cues to further evaluate women who downplay their role on the farm. These women are at risk for many occupationally-related disorders, including tractor-related injuries. Educational programs and educational materials should be designed specifically for farmwomen, emphasizing unique tractor risks associated with farm tasks.

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