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Prevalence of ROPS-Equipped Tractors on Minority Operated Farms in the US

John R. Myers, MS*

Background *Tractor overturns kill an average of 100 farmers and farm workers per year. Roll-over protective structures (ROPS) are a proven intervention, but are not on a sufficient number of tractors in the US to reduce these deaths. Little has been reported on ROPS use by racial minority farm operators.*
Methods *Data from the NIOSH OISPA survey were used to assess ROPS prevalence rates from a random sample of racial minority farm operators for the year 2003, and ROPS prevalence rates from a random sample of all US farms for the year 2004.*
Results *ROPS prevalence rates on minority farming operations follow similar patterns to ROPS prevalence rates on all US farms. A low prevalence of ROPS on farms was associated with operators over the age of 65 years, farms with small acreages, and farms operated on a part-time basis. The race of the operator had little impact on ROPS prevalence rates.*
Conclusions *Factors such as acreage, farm operator age, region of the US, and full- or part-time farming status influence ROPS prevalence rates on farms more than the race of the operator. Understanding how ROPS prevalence differs across these farm and farm operator characteristics has the potential to efficiently target areas for ROPS promotion programs across the US.* Am. J. Ind. Med. 52:408–418, 2009. © *2009 Wiley-Liss, Inc.*

KEY WORDS: racial minorities; tractors; ROPS; farms; odds ratio

INTRODUCTION

Agricultural tractor overturn deaths have been an identified problem for farm operators in the United States (US) since the 1920s, and continue to be the leading cause of agricultural occupational deaths to this day [Arndt, 1971; NIOSH, 2006]. There was an average of 200 tractor-related fatalities annually in the US between 1992 and 2005, with tractor overturn fatalities accounting for about one-half of these [NIOSH, 2006]. The roll-over protective structure (ROPS) was developed to protect tractor operators from death and disability by providing a protective zone for the tractor operator in the event of a tractor overturn. ROPS are most effective when used in conjunction with a seatbelt, which keeps the tractor operator inside the protective zone during an overturn.

The effectiveness of ROPS has been well documented [Lehtola et al., 1994; Springfeldt et al., 1998; Thelin, 1998; Reynolds and Groves, 2000; Myers et al., 2008]. The National Institute for Occupational Safety and Health (NIOSH) has estimated that tractor overturn fatality rates could be reduced by 71% or more [NIOSH, 1993] if all tractors were equipped with ROPS. Increasing the use of ROPS on tractors has long been a recognized public health need [NCASH, 1989; NIOSH, 1992] and has been shown to be a cost effective means of reducing fatalities from tractor overturns [Kelsey and Jenkins, 1991; Myers and Snyder, 1995; Pana-Cryan and Myers, 2000; Owusu-Edusei and Biddle, 2007].

The most effective effort to increase the use of ROPS to date was taken by the American Society of Agricultural Engineers (ASAE—now known as the American Society of Agricultural and Biological Engineers, or ASABE) [Myers, 2003, 2004; Loringer and Myers, 2008]. In 1985, the then

Division of Safety Research, National Institute for Occupational Safety and Health, Morgantown, West Virginia

The findings and conclusions in this report are those of the author and do not necessarily represent the views of CDC, NIOSH.

*Correspondence to: John R. Myers, MS, 1095 Willowdale Road, MS-1808, Morgantown, WV 26505. E-mail: jrmyers@cdc.gov

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ASAE adopted a voluntary standard that encouraged tractor manufacturers to install ROPS and seatbelts as standard equipment on all new tractors for use in the US market [ASAE Standards, 1985]. All major tractor manufacturers agreed to adopt this standard, and since 1986, nearly all new agricultural tractors sold in the US have been equipped with ROPS.

It was anticipated that the voluntary ROPS standard would lead to a decrease in the number and rate of tractor overturn deaths on US farms. Yet by the late 1990s, tractor overturn fatality rates had not decreased dramatically because of the large number of older tractors in use on US farms that were not equipped with ROPS [Myers, 2003; NIOSH, 2006]. Recent studies have reported that the prevalence of ROPS on farm operations across the US had increased to 51% by 2004 and 59% by 2006 [Loringer and Myers, 2008; NASS, 2008]. Loringer and Myers [2008] found that factors such as having a low farm value of sales, farming less than 301 acres, operating a farm on a part-time basis, and having a primary operator over the age of 54 years were associated with a low prevalence of ROPS-equipped tractors on farms.

One limitation of the Loringer and Myers study was the lack of information on ROPS prevalence patterns for the roughly 61,000 racial minority farm operators in the US [NASS, 2004]. The purposes of this study were: to assess the overall prevalence of ROPS-equipped tractors on US farms where the primary operator was a racial minority; to see if the prevalence of ROPS-equipped tractors was associated with the same farm demographic characteristics identified for the general farm operator population by Loringer and Myers [2008]; and to assess the benefit of targeting racial minority farm operators for ROPS interventions.

METHODS

Estimates of tractors with and without ROPS in use on US racial minority operated farms were derived from the NIOSH Minority Farm Operator Occupational Injury Surveillance of Production Agriculture (M-OISPA) survey for the calendar year 2003. Tractor information for the general farming population was obtained from the 2004 OISPA. Both the M-OISPA and the OISPA surveys were computer-assisted telephone interview surveys of a random sample of farming operators across the US. Both surveys were conducted for NIOSH by the US Department of Agriculture (USDA), National Agricultural Statistics Services (NASS). Participation in OISPA surveys was voluntary. The M-OISPA and OISPA surveys are part of an ongoing public health surveillance program within NIOSH. These data have an exemption from Human Subject Review Board approval because of their public health practice function, the lack of personal identifiers within the records provided to NIOSH by USDA, and through the USDA ownership of these data.

For the M-OISPA, the sample size was 15,656 farm operators. Data were collected between March and May of 2004, for the calendar year 2003. Sampling weights were calculated based on the number of racial minority farm operators reported in the 2002 US Census of Agriculture [NASS, 2004]. The responses were originally stratified by race within six designated NASS census weight classes (adjustment factors to account for non-list farms in the 2002 Census of Agriculture). The racial categories were Black, Native American, Asian, and Multiple Races. Operators who reported that their operation had gone out of business in the M-OISPA survey were retained in the weighting process because they were in the 2002 census counts. Because racial minority groups were heavily clustered geographically, the final sample weights were post-stratified by the respondent's race and census weight class within nine geographic regions defined by the US Bureau of the Census (BOC; Table I) [BOC, 1975]. Because of reporting restrictions, data from the New England and the Mid-Atlantic states were combined for all analyses.

For the 2004 OISPA (i.e., survey of all farm operators), the original sample size was 25,000 farm operators stratified by the same nine BOC geographic regions described previously. Samples were equally allocated within regions. Data were collected between February and April of 2005, for the calendar year 2004. Sampling weights were post-stratified based on the number of farms responding within three broad annual value of sales categories (<$10,000; $10,000–$99,999; >$99,999). Value of sales

TABLE I. Bureau of the Census Geographic Regions of the US

Region	State
New England	Connecticut, Maine, Massachusetts, New Hampshire, Vermont
Mid-Atlantic	New Jersey, New York, Pennsylvania
East North Central	Illinois, Indiana, Michigan, Ohio, Wisconsin
West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
South Atlantic	Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia
East South Central	Alabama, Kentucky, Mississippi, Tennessee
West South Central	Arkansas, Louisiana, Oklahoma, Texas
Mountain	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming
Pacific	Alaska, California, Hawaii, Oregon, Washington

was selected for the post-stratification process because it had been found in previous data to be strongly associated with a number of farm demographic variables, reducing the impact of non-response for the survey. Farm counts within the 27 strata were obtained from 2004 farm numbers published by NASS [2005]. Out of business farms were not retained in the weighting process because the 2004 farm numbers published by NASS already accounted for farms no longer in business.

Both surveys used the USDA definition of a farm, which is any operation with $1,000 or more of gross agricultural production within a calendar year [NASS, 2005]. The type of farming operation was classified using an existing NASS coding system based on the North American Industrial Classification System. The only farms excluded from the surveys were very large swine confinement operations because the operators and NASS have an agreement to limit the types of surveys these operators are asked to complete. The tractor portion of the survey requested the respondent provide information on the number of tractors on the farm and how many tractors were equipped with ROPS. Confidence intervals for percentages were derived using standard equations for a stratified simple random sample [Cochran, 1977] with programs developed using the Statistical Analysis System (SAS).

Univariate and multivariate logistic regression models were fit for both the M-OISPA and OISPA survey data using software available from the SAS Institute [SAS, 2003]. The dependent variable for each model was the percentage of farm tractors without ROPS. The independent variables used in the models were: race (M-OISPA only), age of the operator, acreage, full- or part-time status of the operation, type of farming operation (e.g., grain, cotton, beef, dairy), and region. Value of sales was not available for the racial minority survey preventing its use in any of the models. Finally, because region and type of farming operation were categorical variables with no underlying ordinal scale, the comparison group used to calculate odds ratios was the default category selected by the statistical software (i.e., the last value for a variable, sorted alphabetically). All models were constructed using the weighted survey results. Only farms with no missing values for the dependent and independent variables were used. Type III tests of significance and odds ratios were all obtained using SAS Proc SurveyLogistic.

RESULTS

Survey Response

A total of 10,197 minority operators responded to the 2003 M-OISPA survey, of which 9,500 were still farming. This gave a crude survey response rate of 65.1%. Of the 5,459 non-respondents, 5,137 were due to a failure to reach the farm operator by telephone during the survey period. Only 322 operators refused to participate in the survey once contacted. If non-contacts are removed, the adjusted response rate for contacted operators was 96.9%. The crude response rates by race ranged from a low of 53.1% for Asians to a high of 69.4% for Blacks. Native Americans and farm operators reporting to be of multiple races each had crude response rates above 63%.

For the 2004 survey of all farm operations, 16,707 farm operators responded to the survey for a crude response rate of 66.8%. Of the 8,761 non-respondents, 4,650 were due to a failure to reach the farm operator by telephone during the survey period. A total of 3,643 operators refused to participate in the survey once contacted. If non-contacts are removed, the adjusted response rate for contacted operators was 82.1%. The crude response rates by value of sales categories were similar, ranging from a low of 62.1% for farms with less than $10,000 of sales to a high of 66.9% for farms with sales between $10,000 and $99,999.

Basic Demographics

In 2003, there were an estimated 56,881 minority operated farms. Blacks accounted for the largest number of these farms (46.7%), followed by Native Americans (25.6%), Asians (15.1%), and multiple-race operators (12.6%). These minority operators reported an estimated 78,725 farm tractors, for an average of 1.38 tractors per farm. ROPS were estimated to be present on 49.3% of these tractors (Table II). For the general farm operator population, NASS (2005) reported 2,113,470 farms in 2004. There were an estimated 3,960,824 tractors in use on these farms, for an average of 1.87 tractors per farm. ROPS were estimated to be present on 51.0% of these tractors (Table II).

ROPS Prevalence Rates by Demographic Characteristics

Table II provides estimates of the number of tractors and the percentage with ROPS on racial minority farms by major demographic characteristics. Black farm operators accounted for the highest number of tractors, but reported the lowest proportion of tractors with ROPS (45.9%). Asian and Native American operators both reported ROPS prevalence rates above 50%. The prevalence of ROPS equipped tractors decreased as the age group of the farm operator increased, with farmers over the age of 64 years having the lowest ROPS prevalence rate (40.6%). All other age groups reported a ROPS prevalence of 50% or greater.

Sixty-four percent of the tractors in use on minority farming operations were reported on part-time farms (Table II). The proportion of these tractors on part-time farms that were equipped with ROPS was 44.2%. Full-time operations reported significantly higher percentages of their farm tractors being equipped with ROPS (58.4%). Farms reported to be greater than 100 acres in size had ROPS prevalence rates above 50%, while farms 1–100 acres in size reported a ROPS prevalence of 43.1%. These farms below 101 acres account

TABLE II. Estimated Number of Tractors and ROPS Prevalence Rates on Racial Minority Operated Farms (2003) and All Farms (2004) in the US by Major Demographic Characteristics

		Racial minorities, 2003			All farms, 2004		
Variable	Category	Tractors	% ROPS	% ROPS 95% C.I.	Tractors	% ROPS	% ROPS 95% C.I.
Race	Black	35,321	45.9	±1.1	—	—	
	Native American	20,507	52.2	±1.5	—	—	
	Asian	12,452	54.7	±2.2	—	—	
	Multiple race	10,445	48.3	±2.2	—	—	
Age of operator	<34	2,974	57.4	±3.8	162,641	59.9	±4.1
	35–44	10,039	56.9	±2.2	586,682	57.5	±2.2
	45–54	22,060	51.3	±1.5	1,066,962	52.0	±1.6
	55–64	20,366	50.9	±1.5	1,026,294	50.4	±1.6
	65+	21,501	40.6	±1.4	999,719	44.6	±1.6
	Unknown	1,785	54.2	—	118,526	57.2	—
Full- or part-time	Full-time	27,875	58.4	±1.6	1,757,475	61.8	±1.3
	Part-time	50,619	44.2	±0.9	2,189,519	42.4	±1.0
	Unknown	231	54.2	—	13,830	29.8	—
Acreage	1–100	45,217	43.1	±0.9	1,624,020	39.4	±1.1
	101–300	18,117	54.4	±1.8	932,262	47.7	±1.7
	301–500	5,443	59.1	±3.7	397,024	57.8	±2.8
	501–700	2,290	59.7	±6.0	213,349	63.2	±4.0
	700–999	1,540	63.5	±7.5	163,616	62.8	±4.8
	>999	5,369	66.6	±4.0	590,559	75.3	±2.3
	Unknown	749	41.7	—	39,993	58.1	—
Type of farm	Crops	32,913	52.1	±1.3	1,827,285	53.2	±1.2
	Livestock	44,771	47.5	±1.0	2,094,147	49.3	±1.1
	Unknown	1,041	34.4	—	39,393	35.5	—
	Total	78,725	49.3	±0.8	3,960,824	51.0	±0.8

for 57.4% of the tractors on minority operations. Finally, minority operated crop farms reported higher ROPS prevalence rates than minority operated livestock operations (52.1% and 47.5% respectively).

For all farming operations, the same general patterns described for racial minority operators were found (Table II): 55.3% of all tractors were on part-time farming operations; ROPS were reported on 51.0% of all tractors; ROPS prevalence decreased as the reported age group of the primary farm operator increased; full-time operations reported significantly higher prevalence of ROPS equipped tractors than part-time operations; ROPS prevalence rates were highest on farms with 1,000 or more acres; and crop operations reported a higher percentage of ROPS equipped tractors than did livestock operations.

Logistic Regression Results

Table III presents the unadjusted odds ratios for the proportion of tractors without ROPS on racial minority operations in 2003 and all farming operations in 2004 for the individual variables of race, operator age, acreage, full- or part-time operation, region, and type of farm. For the racial minority operations, Asian and Native American operators had lower unadjusted odds ratios than Black operators and farm operators of multiple races. The unadjusted odds ratios by age of the farm operator were similar for both racial minority operations and all farm operations with the oldest age group (65 years of age and older) having the highest odds ratio for non-ROPS tractors, followed by farm operators 55–64 years of age, then farm operators 45–54 years of age. Both farm operation groups had significant unadjusted odds ratios for part-time farm operations compared to full-time operations.

For the independent variable acreage, both groups had significant unadjusted odds ratios for farms 1–100 acres in size, 101–300 acres in size, 301–500 acres in size, and 501–700 acres in size when compared to farms greater than 999 acres in size. These odds ratios for smaller acreage farms were consistently 1.4–1.9 times greater for all farming operations than those seen for racial minority farm operations.

TABLE III. Unadjusted Odds Ratios for the Prevalence of Tractors Without ROPS for the Independent Variables Race, Age of the Operator, Full- or Part-Time Operation, Acreage, Region, and Type of Farm for US Minority Farm Operations and the General US Farm Population

		Racial minorities, 2003			All farms, 2004		
Variable	**Category**	**Unadjusted odds ratio**	**Lower 95% limit**	**Upper 95% limit**	**Unadjusted odds ratio**	**Lower 95% limit**	**Upper 95% limit**
Race	Black	1.11	0.99	1.25	—		
	Native American	**0.87**	**0.77**	**0.98**	—		
	Asian	**0.76**	**0.66**	**0.87**	—		
	Multiple race	1.00	—	—	—		
Age of operator	<34	1.00	—	—	1.00	—	—
	35–44	1.06	0.84	1.33	1.12	0.94	1.34
	45–54	**1.32**	**1.07**	**1.64**	**1.39**	**1.18**	**1.64**
	55–64	**1.35**	**1.09**	**1.67**	**1.48**	**1.25**	**1.75**
	65+	**2.04**	**1.65**	**2.53**	**1.84**	**1.55**	**2.18**
Full- or part-time	Part-time	**1.73**	**1.61**	**1.87**	**2.16**	**2.30**	**2.04**
	Full-time	1.00	—	—	1.00	—	—
Acreage	1–100	**2.52**	**2.20**	**2.88**	**4.68**	**4.28**	**5.12**
	101–300	**1.63**	**1.41**	**1.88**	**3.33**	**3.04**	**3.6**
	301–500	**1.34**	**1.13**	**1.61**	**2.34**	**2.01**	**2.49**
	501–700	**1.28**	**1.01**	**1.62**	**1.83**	**1.60**	**2.08**
	700–999	1.11	0.85	1.43	**1.81**	**1.56**	**2.09**
	>999	1.00	—	—	1.00	—	—
Type of farm	Grain	**0.74**	**0.62**	**0.90**	**0.78**	**0.64**	**0.95**
	Tobacco	**2.05**	**1.58**	**2.66**	**1.42**	**1.07**	**1.89**
	Cotton	**0.70**	**0.50**	**0.98**	**0.20**	**0.16**	**0.33**
	Vegetables, melons	1.00	—	—	1.00	—	—
	Fruit, nuts	1.14	0.94	1.38	**1.31**	**1.04**	**1.67**
	Nursery	0.77	0.58	1.02	0.93	0.68	1.27
	Other crop	0.90	0.73	1.10	**1.24**	**1.01**	**1.55**
	Beef	**1.19**	**1.02**	**1.39**	1.06	0.87	1.30
	Dairy	**0.71**	**0.51**	**0.99**	0.92	0.74	1.13
	Hogs	**1.75**	**1.18**	**2.60**	0.98	0.72	1.34
	Sheep, goats	0.80	0.54	1.19	**1.53**	**1.10**	**2.11**
	Equine	0.95	0.73	1.23	1.27	0.99	1.62
	Poultry, egg	1.24	0.90	1.71	0.83	0.61	1.13
	Other livestock	1.35	0.90	2.03	1.02	0.73	1.44
Region	Northeast	**2.08**	**1.52**	**2.84**	**1.78**	**1.59**	**2.00**
	East North Central	**1.61**	**1.33**	**1.96**	**1.79**	**1.58**	**2.02**
	West North Central	1.02	0.88	1.18	**1.27**	**1.13**	**1.43**
	South Atlantic	**1.27**	**1.13**	**1.43**	**1.20**	**1.04**	**1.39**
	East South Central	**1.31**	**1.17**	**1.48**	**1.19**	**1.02**	**1.39**
	West South Central	1.00	—	—	1.00	—	—-
	Mountain	1.11	0.94	1.31	**1.16**	**1.02**	**1.32**
	Pacific	0.96	0.86	1.07	**1.22**	**1.07**	**1.38**

Bolded odds ratios have a 95% confidence interval that does not include 1.

In addition, the all farm operation group had a significantly higher unadjusted odds ratio for farms 701–999 acres in size compared to all farm operations greater than 999 acres in size. For type of farming operation, both the racial minority operations and the all farm operations groups had elevated unadjusted odds ratios for tobacco farms, and lower unadjusted odds ratios for grain and cotton operations when compared to vegetable and melon operations. The minority farm operations also had significantly higher unadjusted odds ratios for beef and hog operations, and a lower unadjusted

odds ratio for dairy operations compared to vegetable and melon operations. Finally, fruit and nut operations, other crop operations, and sheep and goat operations all had elevated unadjusted odds ratios for the all farm operations group when compared to vegetable and melon operations.

By region of the country, both the racial minority operations and the all farm operations groups had significant unadjusted odds ratios for the Northeast, East North Central, South Atlantic, and East South Central regions compared to the West South Central region. The all farm operation group also had significant unadjusted odds ratios for the West North Central, Mountain, and Pacific regions when compared to the West South Central region.

Table IV presents the multivariate logistic regression results for the proportion of tractors without ROPS on racial minority operations. All main effects variables were included in the model along with all two-way interactions of the main effects. The outcome of the model found that the main effects variables of race and full- or part-time operation were not significant, while all other main effect variables were significant. Because race was the least significant independent variable, it and all its interaction terms were removed from the model, and a new multivariate logistic model was considered. In the new model, the variable for full-time or part-time operations was significant ($\Pr > \chi^2 = 0.0077$). Because of this, full-time or part-time operation was retained in the model for minority farm operations. Table V provides the logistic regression results for the 2004 survey data of all farm operators. For this model, all main effects were significant.

TABLE IV. Multivariate Logistic Regression Results for the Proportion of Tractors on Racial Minority Farms in the US Without ROPS, and the Independent Variables of Race, Operator Age, Full- or Part-Time Operation, Acreage, Farm Type, and Region, 2003

Effect	df	Wald χ^2	$\Pr > \chi^2$
Race	3	5.3529	0.1477
Operator age	**4**	**50.8017**	**<0.0001**
Full or part	1	2.5371	0.1112
Acreage	**5**	**169.5095**	**<0.0001**
Farm type	**13**	**598.2144**	**<0.0001**
Region	**7**	**210.5078**	**<0.0001**
Race × operator age	12	13.4980	0.3339
Race × full or part	**3**	**8.8901**	**0.0308**
Race × acreage	**15**	**43.1455**	**0.0001**
Race × farm type	**38**	**164.7334**	**<0.0001**
Race × Region	21	24.2763	0.2799
Operator age × full or part	4	4.0311	0.4018
Operator age × acreage	**20**	**41.0744**	**0.0036**
Operator age × farm type	**52**	**180.8288**	**<0.0001**
Operator age × region	**28**	**49.2129**	**0.0079**
Full or part × acreage	**5**	**12.9327**	**0.0240**
Full or part × Farm type	13	8.3566	0.8196
Full or part × region	**7**	**24.2763**	**0.0027**
Acreage × farm type	**60**	**2011.2744**	**<0.0001**
Acreage × region	**35**	**365.7175**	**0.0387**
Farm type × region	**83**	**1539.5985**	**<0.0001**

Rows in bold are statistically significant at $\alpha = 0.05$.

TABLE V. Multivariate Logistic Regression Results for the Proportion of Tractors on All Farms in the US Without ROPS, and the Independent Variables of Operator Age, Full- or Part-Time Operation, Acreage, Farm Type, and Region, 2004

Effect	df	Wald χ^2	$\Pr > \chi^2$
Operator age	**4**	**13.6896**	**0.0084**
Full or part	**1**	**5.5408**	**0.0186**
Acreage	**5**	**53.6939**	**<0.0001**
Farm type	**13**	**33.6711**	**0.0013**
Region	7	0.6759	0.9985
Operator age × full or part	4	3.0377	0.5515
Operator age × acreage	**20**	**53.5812**	**<0.0001**
Operator age × farm type	**52**	**73.7980**	**0.0251**
Operator age × region	**28**	**80.5024**	**<0.0001**
Full or part × acreage	5	4.0007	0.5493
Full or part × farm type	**13**	**40.9642**	**<0.0001**
Full or part × region	**7**	**20.1741**	**0.0052**
Acreage × farm type	**64**	**148.3900**	**<0.0001**
Acreage × region	**35**	**120.2501**	**<0.0001**
Farm type × region	**83**	**177.2407**	**<0.0001**

Rows in bold are statistically significant at $\alpha = 0.05$.

Main effects models, which retained significant main effect variables from Tables IV and V, but dropped all interaction terms, were constructed for the 2003 racial minority farm operation data and the 2004 all farm operations data. The adjusted odds ratios from these models are provided in Table VI for both groups.

The adjusted odds ratios by farm operator age group and acreage did not change much from the unadjusted estimates, although the odds ratio for farms 501–700 acres in size became insignificant for minority farm operations. For the region variable, the adjusted odds ratios did change after adjusting for the other independent variables in the logistic models. The adjusted regional odds ratios were found to be more consistent between the two groups than the unadjusted odds ratios. The Northeast, East North Central, West North Central, Mountain, and Pacific regions were all found to have elevated adjusted odds ratios when compared to the West South Central region. For the minority operator group, the South Atlantic region was also found to have an elevated adjusted odds ratio compared to the West South Central region.

For type of farm, there were five farm types operated by racial minorities that had adjusted odds ratios statistically

TABLE VI. Adjusted Odds Ratios for the Significant Logistic Regression Main Effects for US Minority Farm Operators and the General US Farm Population for the Dependent Outcome of Non-ROPS Tractors Per Farm: 2003 M-OISPA and 2004 OISPA Surveys

		Racial minority, 2003			All farms, 2004		
Variable	**Category**	**Adjusted odds ratio**	**Lower 95% limit**	**Upper 95% limit**	**Adjusted odds ratio**	**Lower 95% limit**	**Upper 95% limit**
Age of operator	<34	1.00	—	—	1.00	—	—
	35–44	1.00	0.78	1.26	1.12	0.93	1.35
	45–54	**1.29**	**1.03**	**1.61**	**1.34**	**1.13**	**1.60**
	55–64	**1.31**	**1.05**	**1.64**	**1.35**	**1.13**	**1.61**
	65+	**1.92**	**1.53**	**2.41**	**1.74**	**1.45**	**2.08**
Full- or part-time	Part-time	**1.49**	**1.36**	**1.64**	**1.35**	**1.24**	**1.45**
	Full-time	1.00	—	—	1.00	—	—
Acreage	1–100	**2.10**	**1.79**	**2.47**	**4.27**	**3.80**	**4.80**
	101–300	**1.43**	**1.21**	**1.22**	**2.89**	**2.60**	**3.20**
	301–500	**1.28**	**1.06**	**1.55**	**2.02**	**1.80**	**2.26**
	501–700	1.26	0.99	1.61	**1.78**	**1.57**	**2.06**
	701–999	1.09	0.84	1.40	**1.69**	**1.45**	**1.96**
	>999	1.00	—	—	1.00	—	—
Type of farm	Grain	0.82	0.67	1.00	0.87	0.71	1.07
	Tobacco	**2.04**	**1.55**	**2.68**	**1.84**	**1.37**	**2.49**
	Cotton	0.91	0.64	1.30	**0.54**	**0.32**	**0.90**
	Vegetables, melons	1.00	—	—	1.00	—	—
	Fruit, nuts	**1.30**	**1.07**	**1.59**	1.22	0.95	1.56
	Nursery	0.83	0.62	1.12	0.79	0.57	1.10
	Other crop	0.88	0.71	1.08	1.02	0.82	1.27
	Beef	**1.24**	**1.04**	**1.48**	1.09	0.89	1.34
	Dairy	0.78	0.55	1.10	1.06	0.85	1.31
	Hogs	**1.84**	**1.24**	**2.74**	0.98	0.72	1.35
	Sheep, goats	0.68	0.47	1.00	1.15	0.83	1.60
	Equine	0.79	0.61	1.02	0.91	0.71	1.17
	Poultry, egg	**1.45**	**1.04**	**2.02**	0.97	0.71	1.32
	Other livestock	1.30	0.86	1.94	0.86	0.61	1.22
Region	Northeast	**3.00**	**2.23**	**4.04**	**1.74**	**1.53**	**1.99**
	East North Central	**2.11**	**1.71**	**2.60**	**2.30**	**2.00**	**2.65**
	West North Central	**1.53**	**1.30**	**1.78**	**2.05**	**1.79**	**2.34**
	South Atlantic	**1.14**	**1.01**	**1.30**	1.06	0.90	1.24
	East South Central	1.10	0.97	1.25	1.00	0.85	1.18
	West South Central	1.00	—	—	1.00	—	—
	Mountain	**1.67**	**1.40**	**2.00**	**1.65**	**1.42**	**1.90**
	Pacific	**1.20**	**1.02**	**1.41**	**1.28**	**1.11**	**1.49**

Bolded odds ratios have a 95% confidence interval that does not include 1.

higher than the reference group of vegetable and melon farms: tobacco farms, fruit and nut operations, beef operations, hog operations, and poultry operations. For the general farm operator model, only one type of farm had an adjusted odds ratio statistically higher than the reference group of vegetable and melon farms: tobacco farms. Cotton operations had an adjusted odds ratio lower than vegetable and melon farms in the all farm operation group. The confidence intervals of the racial minority operations and the all farm operations adjusted odds ratios overlapped for each of the 13 farm types. However, hog operations, poultry and egg operations, and other livestock operations did have much higher adjusted odds ratio point estimates compared to the all farm operation results.

DISCUSSION

Prevalence of ROPS-Equipped Tractors on Racial Minority Farm Operations

From a public health perspective, the basic results of this study show that the prevalence of ROPS on racial minority farms was similar in many respects to the general farm operator population, with the possible exception of Black farm operators who had the lowest ROPS prevalence rate of all groups examined (Table II). While this finding is encouraging because racial minority farm operators are adopting ROPS at a similar rate as that seen for the general farming population, these ROPS prevalence rates do not appear adequate to result in a significant decrease in tractor overturn fatality rates.

Studies from Europe suggest that ROPS prevalence rates between 75% and 80% are required before decreases in tractor overturn fatality rates begin to approach zero [Springfeldt, 1996; Springfeldt et al., 1998; Thelin, 1998]. Data from Sweden further suggest that the decreases in overturn fatalities are not linear with respect to increasing ROPS prevalence rates [Springfeldt et al., 1998; Thelin, 1998]. The Swedish data found that fatality rates remained stable for ROPS prevalence rates between 40% and 75%, mirroring the current experience within the US [NIOSH, 2006].

Based on the Swedish data, Myers and Snyder [1995] estimated that the general farm operator population would not be using a sufficient number of ROPS-equipped tractors to have a measurable impact on the tractor fatality rate until sometime in the range of 2017–2020. Loringer and Myers [2008] concluded an adequate level of protection could even be slightly longer (sometime between 2024 and 2028). The ROPS prevalence rates found in this study show that racial minority farm operators are at a similar stage of ROPS coverage as other farm operators. If minority operators have a similar ROPS adoption rate as the general farm operator population, then they also are 10–20 years away from reaching an adequate protective ROPS prevalence rate on their farm tractors.

Factors Related to the Prevalence of ROPS-Equipped Tractors on Racial Minority Farm Operations

The farm demographic characteristics identified by Loringer and Myers [2008] that were related to the prevalence of ROPS-equipped tractors for the general farm operator population are also strong indicators of the prevalence of ROPS equipped tractors on racial minority operated farms (Tables II and VI). The region where the farm is located and the acreage of the farm appear to be the strongest indicators, although the age of the farm operator, the type of farm operation, and whether the farm is a full- or part-time operation are also useful for assessing ROPS prevalence on minority farms. Race itself was not a significant factor in assessing ROPS prevalence rates after accounting for these other factors.

There is very little information available in the literature on the use of ROPS by minority operators. In a series of focus group interviews with Black farmers from Kentucky, Mississippi, North Carolina, and Tennessee, Arcury [1997] reported many of these farmers understood the value of safety equipment like ROPS, but that they did not retrofit their older tractors with them. He also found that these Black farmers primarily used older tractors and farm machinery that were not equipped with modern safety devices. Richardson et al. [1997] in a study of agricultural fatalities in North Carolina found the highest fatality rates among Black farmers. They suggested that the small-scale nature of Black operated farms did not provide sufficient sales to allow them, or other farmers with limited resources, the means to invest in newer, safer farm equipment. Sanderson et al. [2006] drew this same conclusion regarding farmers with limited resources in general, concluding that the low prevalence of ROPS on these farms may have more to do with economics and the size of the farming operation than information received in safety and health training encouraging the use of ROPS.

Several state studies of the general farming population have reported increasing ROPS prevalence rates with increasing acres farmed [Browning et al., 1999; Wilkins et al., 2003; May et al., 2006; Sanderson et al., 2006]. Wilkins et al. [2003], in a study that looked at ROPS prevalence rates for full- and part-time farms, found the same general pattern of a higher ROPS prevalence rate for full-time operators, although the difference was less than identified here for minority operators.

The age of the farm operator has also been reported to be a strong indicator of the prevalence of ROPS equipped tractors on farms in several state studies of the general farming population [Whitman and Field, 1995; Wilkins et al., 2003; May et al., 2006; Sanderson et al., 2006]. A national survey of senior farmers (more than 60 years of age) determined that many older farmers saw no need or cost benefit to retrofitting their older tractors with ROPS even though they knew the life-saving value of a ROPS [Whitman and Field, 1995]. They concluded that senior farmers perceived operating tractors without ROPS as a moderate risk that was more than offset by their years of experience as tractor operators. These findings by Whitman and Field [1995] for the general farm operator population agree well with findings reported by Arcury [1997] for Black farm operators, who were mostly 50 years of age or older: the operators knew the risks of farming, but made decisions to not remove or reduce these risks on their farms, or in their work practices.

ROPS-Equipped Tractors on Racial Minority Farm Operations Compared to All Farm Operations

The results for racial minority farm operators and those for the general farming population show that the two groups have similar risk profiles with respect to the prevalence of ROPS-equipped tractors on farms (Tables II–VI). The comparison of ROPS prevalence rates (Table II) and adjusted odds ratios for farm demographic risk factors for non-ROPS equipped tractors on farms (Table VI) lead to the same general conclusions for these two groups with respect to where ROPS prevalence rates are high and low, although the effect of acreage on ROPS prevalence rates does appear to be much stronger for all farm operations than on minority farm operations.

These results indicate that one set of demographic characteristics should be effective in targeting areas of the US with low ROPS prevalence rates for both racial minority and other farm operators. All of the identified demographic factors in this study are readily available from the 2002 Census of Agriculture, and will soon be available from the 2007 Census of Agriculture. These census data could be used to screen areas of the US, down to the county level, where there is a high probability of low percentages of ROPS-equipped tractors.

Actions to Increase the Prevalence of ROPS-Equipped Tractors

Currently, there is no nationally organized program in place to increase the number of ROPS-equipped tractors on US farms. Proposals have been presented to increase the percentage of ROPS-equipped tractors through the use of a mixture of approaches [Karlson and Noren, 1979; NCASH, 1989; Kelsey and Jenkins, 1991; Donham et al., 1998; Swenson, 2004]. These include using education programs to inform farm operators of the value of ROPS, providing farm operators with an incentive to place ROPS on older farm tractors used on their farms [NCASH, 1989; Donham et al., 1998; Reynolds and Groves, 2000; Hallman, 2005], providing voluntary standards or other programs to encourage farm equipment dealers to retrofit tractors with ROPS before resale to farm operators [Freeman, 1999], purchasing and scrapping older farm tractors without ROPS [Myers and Snyder, 1995; Swenson, 2004], reducing the cost of ROPS retrofit kits [Harris et al., 2002, 2005; Owusu-Edusei and Biddle, 2007], and enacting some form of state or national regulation to require tractors used on farms to be equipped with ROPS after some designated time period [Karlson and Noren, 1979; NCASH, 1989; Kelsey and Jenkins, 1991; Donham et al., 1998; Swenson, 2004]. Programs requiring the use of ROPS have been shown to be effective in reducing overturn-related fatalities in Europe [Springfeldt, 1996; Springfeldt et al., 1998; Thelin, 1998].

To date, these proposals have failed to garner much long lasting support from the agricultural community. Reasons suggested for this include: an aversion among farmers to accept any new form of regulation; small farmer's internal assessment that installing ROPS on unprotected tractors is not cost-effective given their time and monetary constraints [Sorensen et al., 2008]; and the difficulty and inconvenience in getting a ROPS installed on an older tractor [Hallman, 2005].

The most successful approach used to date in the US to encourage the retrofitting of older tractors with ROPS is in the state of New York [Sorensen, 2006]. The New York program is designed to address many of the barriers raised by farmers about retrofitting older tractors with ROPS. It involves a large social marketing campaign using messages and promotional activities tailored to the New York farming community, an economic incentive to reduce the cost of the ROPS, and a ROPS locator service to reduce the burden on farmers in identifying ROPS suppliers [May, 2008]. This combination of marketing and other services is showing promise in getting farm operators to equip older farm tractors with ROPS. What is not clear is what would be the best method to approach minority farm operators with such a program, and how they would respond to it. While a New York-like program could be used as a model to encourage minority farm operators to retrofit tractors with ROPS, it is likely that it will require new attitudinal and marketing research to ensure the messages, promotional activities, and media channels are appropriate to garner interest within the minority farming community.

The one major hurdle to expanding incentive programs on a large scale is the cost. Assuming an average incentive of between $500 and $532 per retrofitted tractor, as in New York [May, 2008], a national program would require $1,000,000,000 to $1,064,000,000 to retrofit the approximately 2,000,000 tractors without a ROPS. These high costs emphasize the need to target limited resources to those parts of the farm population with the lowest ROPS prevalence rates.

Limitations

Some of the limitations of this study include the inability to assess the overall impact of the non-respondents to the two surveys. Farm demographic estimates derived from this study agree well with farm data published by NASS, suggesting that the post-stratification of the 2004 survey weights by the value of sales for the farm and post-stratifying the 2003 survey weights by racial census counts within specific regions of the US were successful in reducing the non-response impact. In addition, the results obtained in this study on the number of farm tractors per farm, the number of tractors with ROPS, and the key farm demographic factors associated with a low prevalence of ROPS on farms, agree well with the past literature. A second limitation is that all the data on farm

tractors were self-reported by the farm operator. It was not possible to verify the accuracy of the information being provided by the farm operator. A third limitation is the removal of large swine confinement operators from the sample. These large operators would be expected to have a high proportion of their tractors equipped with ROPS because of their high value of sales, which would result in a lower odds ratio for hog operators than presented here. Finally, the regional information provided in this analysis cover large geographic areas of the US, and as such may mask variations in ROPS prevalence between states or parts of states within each region.

CONCLUSIONS

The prevalence of ROPS-equipped tractors on racial minority farms was found to be similar to those for all farm operations. While there were differences between race-specific ROPS prevalence rates, these differences were explained by differences in farm demographic characteristics between the racial groups. The farm demographic characteristics that best identified the prevalence of ROPS-equipped tractors on minority farms were similar to those identified for all farm operations: age of the operator, acreage farmed, full- or part-time farming operation, region of the US, and the type of farming operation. Given the ROPS adoption rates found by this study, minority farm operations, as well as the overall farm population, appear to be years away from having a ROPS prevalence rate sufficient to decrease tractor overturn fatality rates comparable to the level seen in Europe.

The solution to increasing the number of ROPS-equipped tractors in the US will involve developing a program using a mixture of approaches, including economic incentives and marketing programs targeting those farm operators with the lowest ROPS prevalence rates. It is important that such programs include minority farm operators. To do this effectively, research is needed to determine the best methods to approach minority farm operators with ROPS promotion programs.

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