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Tractor Driving Among Kentucky Farm Youth: Results from the Farm Family Health and Hazard Surveillance Project

S. R. Browning, S. C. Westneat, R. Szeluga

Abstract

This article documents the extent of children's involvement in tractor operations among a representative sample of Kentucky children living and working on family farms. Specifically, we describe children's exposures to tractor-related work activities, profile their use of the tractor (number of days worked), and assess compliance with generally recommended safety measures, such as using tractors equipped with ROPS (rollover protective structures), avoiding riding as passengers on tractors, and operating tractors on public roadways. Data for this study were collected in 1994 and 1995 as part of the NIOSH-sponsored Farm Family Health and Hazard Surveillance Project (FFHHSP). Despite recognition in the health and safety community of the hazards associated with operating tractors without ROPS on public roadways and with extra riders, these practices remain common among youth on Kentucky farms. Farms with annual incomes greater than \$10,000, particularly with livestock commodities, appear to use youth for a greater number of days of tractor operation than other farms. Such farms may be an appropriate target for intervention.

Keywords. **Children, Agriculture, Tractors.**

Injuries and fatalities to children from tractor operation have been documented in several national and international studies (Cogbill et al., 1985; Rivara, 1985; Swanson et al., 1987; Etherton et al., 1991; Pickett et al., 1995; Lee et al., 1996; Byard et al., 1998). Farm machinery, especially tractors, remains the most common cause of fatal and nonfatal injury to children working in agriculture (Stallones and Gunderson, 1994; Rivara, 1997). Studies from the United States and Canada have im-

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plicated farm tractors in more than half of the machinery-related deaths of children living on farms (Salmi et al., 1989; Pickett and Brison, 1995; Rivara, 1997). Furthermore, riding as an extra rider on a tractor increases the risk of fatal and nonfatal injuries for children (Tevis and Finck, 1989; Centers for Disease Control, 1999). Fatalities and injuries from tractor rollovers, runovers, and power take-off (PTO) entanglements have also been documented among children operating tractors alone (Pickett and Brison, 1995).

Recommendations and guidelines have been developed regarding the use of tractors by children on farms (Donham et al., 1997; Myers, 1998; Lee and Marlenga, 1999). Policies aimed at reducing tractor-related injuries in the United States were developed at the Tractor Risk Abatement and Control (TRAC) conference in Iowa in 1997 and addressed children's use of tractors on farms (Donham et al., 1997). The recommendations included requirements for formal tractor operator training and the development of educational materials for parents regarding tractor operations for children. In addition, the development of guidelines for children's agricultural tasks, including tractor operations, was proposed and completed by the National Children's Center for Rural and Agricultural Health (Lee and Marlenga, 1999).

However, none of these policies or recommendations is enforceable within the context of children's participation in tractor operations on their own family farms. Family farming operations are excluded from the provisions of the Federal Fair Labor Standards Act (FFLSA), which addresses the use of hazardous farm equipment including tractors. While the FFLSA limits tractor operations for children employed on the farms of others, it does not limit or address work with hazardous equipment for children working on their own family farms.

Despite widespread recognition in the agricultural health and safety communities of the hazards associated with tractors, particularly for youth operators, there has been limited research to address the extent to which general tractor safety recommendations may voluntarily be followed on family farms (Hawk et al., 1994). With 71,331 family-owned and operated farms within Kentucky, children's participation in farm labor may be substantially greater than in other states (Bureau of the Census, 1997). Fatalities and injuries to children from tractor-related activities have been reported in several investigations in Kentucky over the last decade (Stallones, 1989; Centers for Disease Control, 1995; Browning et al., 2001). Currently, there are no state labor provisions in Kentucky to provide for tractor safety certification courses, to require rollover protective structures for tractors on family farms, or to limit tractor operations on public roadways to children of legal driving age.

The objective of this study was to determine the extent of children's involvement in tractor operations among a representative sample of children living and working on family farms in Kentucky. We describe children's exposures to tractor-related work activities, profile their use of the tractor (number of days worked), and assess compliance with recommended safety measures. Additionally, we characterize the determinants of children's hours of tractor operations in an effort to provide data for designing tractor safety interventions. Finally, we make recommendations for addressing youth tractor operator issues in the state.

Methods

Data for the study were collected as part of the NIOSH-sponsored Farm Family Health and Hazard Surveillance Project (FFHHSP), a research effort to assess the risks from work in production agriculture among farm families in Kentucky. A telephone survey, employing a two-stage cluster sampling design, was used to obtain data on participation in tractor operations and on the one-year incidence of nonfatal injuries among children age 18 and younger living on Kentucky farms.

Sampling

The sampling frame for the study was constructed using a two-stage cluster sampling design (Browning et al., 1998). At the first stage, 60 counties were selected from the 120 counties in Kentucky using probability proportional to size sampling, where size was the number of farms in each of the counties based upon the 1992 Census of Agriculture for Kentucky (Bureau of the Census, 1992). Prior to the sampling, several counties in the eastern portion of the state were excluded because of logistical considerations, including the unavailability of telephones and the relatively small number of farms per county.

At the second stage, a systematic sample of farms in the 60 counties was selected from a listing maintained by the Kentucky Agricultural Statistics Service (KASS). Details of the coverage provided by KASS are given elsewhere (Browning et al., 1998). Farms were selected if they were family-owned and operated establishments with at least \$1,000 or more of agricultural production and had working telephones (Bureau of the Census, 1997). The result was a sample of approximately 125 farm households per county. A short telephone survey (Farm Hazard and Demographic Enumeration Survey, or FHADES) was conducted to enumerate children age 18 and younger living in the selected farm households. A total of 8,271 farm households were enumerated, producing a sample frame of 4,499 eligible children. This sample frame was then stratified by county. Within each county, a simple random sample of children living on farms was selected, yielding 1,189 children eligible for the 30-minute telephone survey. The only restriction in the selection process was that no more than two eligible children from the same household could be selected for the interview.

Data Collection and Analysis

A 30-minute telephone survey (Farm Health Interview Survey, or FHIS) was administered to proxy respondents (primarily mothers) of the children in the sample. At the initiation of the phone survey, the interviewers requested to speak with the mother of the target child, or if she were not available, any adult (age 18 or older) who resides in the household and is able to answer questions about the child's health and farm-related activities. The survey included questions on tractor operation activities, number of days of tractor operations, tractor safety procedures, and demographic characteristics of the child and the farm household. Standard questions from the National Health Interview Survey were used extensively in the interview (Massey et al., 1989). Data were collected between June 1994 and September 1995 by the Survey Research Center (SRC) at the University of Kentucky using a computer-assisted telephone interviewing (CATI) system. Interviewer training emphasized agricultural terms and questions. The University of Kentucky Institutional Review Board approved the data collection protocol.

Data from the 30-minute telephone interviews (FHIS) form the basis of the results reported. Data management and the descriptive analysis were performed using the SAS software system (SAS Institute, 1990). The data analyses for this report are unweighted and unadjusted for the design characteristics of the study. The unweighted analyses reflect the characteristics of the sample. Previous analyses have indicated that the unweighted estimates are not significantly different from the design-adjusted, weighted estimates, so unweighted figures are reported for ease of interpretation.

To understand the relationship and the relative strength of the predictors of days of tractor operation among youth age 10 to 18, adjusted differences in mean days of tractor operation were compared using analysis of covariance. The independent variables included in the analysis of covariance model (gender, age, farm income, and primary farm commodity) were selected based on a review of the literature and on associations between these risk factors and the “days of tractor driving alone in past 12 months” variable from the bivariate analyses conducted in this study. Multivariable analyses excluded any persons with missing values for any risk factor included in the model; only main effects of the variables were considered in the model. The dependent variable “days of tractor driving alone” was log transformed, and all covariates were modeled as indicator variables. All analyses were two-tailed, and p-values less than 0.05 were considered statistically significant. The overall performance of the model was evaluated by considering the adjusted R² value.

Results

Sample Frame

Interviews were completed for 999 children, yielding a response rate of 84%. Response rates for the telephone survey varied by county but were comparable across different regions of the state. Results from a comparison of the farm population enumerated in the FHADES survey and the farm population from the 1992 Kentucky Census of Agriculture indicated that the sample selected for our survey was representative of the population of farm households in the state (Browning et al., 1998). Since up to two children from the same household could be eligible for proxy interviews, 17.5% of the 999 interviews were from farm households that provided two age-eligible children for the sample.

Demographic Characteristics

Demographic characteristics of the children are given in table 1. Distributions across age groups for both males and females were similar. Ninety-eight percent (98%) of the children in the sample were white, reflecting the racial distribution of farm families within the state (Bureau of the Census, 1997). Of all children in the sample, 65% resided in homes with a gross annual household income of at least \$30,000; 7.6% of the children lived in households where the annual gross household income was less than \$20,000 per year. We calculate that the mean gross annual household income was \$46,450 and the gross annual farm income was \$17,480. Within Kentucky, the primary farm commodities are beef cattle and tobacco. Among the children surveyed, 41% live on farms that raise beef cattle. Mothers were the proxy respondents for the data collected in 92% of the interviews. Other proxy respondents were grandparents or other guardians (5%) and fathers (3%). Most of the

tabular analyses in the report are presented for a sample of 679 children age 10 to 18, which represents 68% of the sample of 999 completed interviews. Among the 679 interviews, 12% were from farm households from which interviews were obtained for two age-eligible children.

Tractor Operation

Children in Kentucky typically begin operating tractors at a young age. The mean age for beginning solo tractor operations is 11.4 years (range 5–17 years) for boys and 12 years (range 6–16 years) for girls. The age at which children begin driving a tractor alone varies, as reflected in figure 1. Sixty-four percent (64%) of all children who have driven tractors begin operation of the tractor by age 12.

Children's participation in tractor operations is common on family farms in Kentucky (table 2). Almost half (41%) of the 10–15 year old children drive a tractor alone on the farm. Among those surveyed, 65% of 16–18 year old children drive a tractor alone. The proportion of boys age 16–18 who live on farms and drive a tractor alone (86%) is more than twice (37%) that of similar-age girls who operate a tractor.

Table 1. Demographic characteristics of Kentucky farm children (age 1 to 18) surveyed for the Farm Family Health and Hazard Surveillance Project.

Characteristic	Children in Sample	
	Number	Percent
Gender/Age		
Male	532	53.3
0 to 4 years	60	11.3
5 to 9 years	102	19.2
10 to 15 years	207	38.9
16 to 18 years	163	30.6
Female	467	46.7
0 to 4 years	60	12.8
5 to 9 years	98	21.0
10 to 15 years	185	39.6
16 to 18 years	124	26.6
Gross annual household income		
< \$10,000	12	1.2
\$10,000 to 19,999	64	6.4
\$20,000 to 29,999	166	16.6
\$30,000 to 49,999	316	31.6
≥ \$50,000	335	33.5
Don't know/refused	106	10.6
Farm income		
< \$2,500	192	19.2
\$2,500 to 4,999	162	16.2
\$5,000 to 9,999	149	14.9
\$10,000 to 39,999	253	25.3
≥ \$40,000	112	11.2
Don't know/refused	131	13.1
Type of farm		
Beef cattle	287	28.7
Beef and tobacco	120	12.0
Tobacco	270	27.0
Other	322	32.2

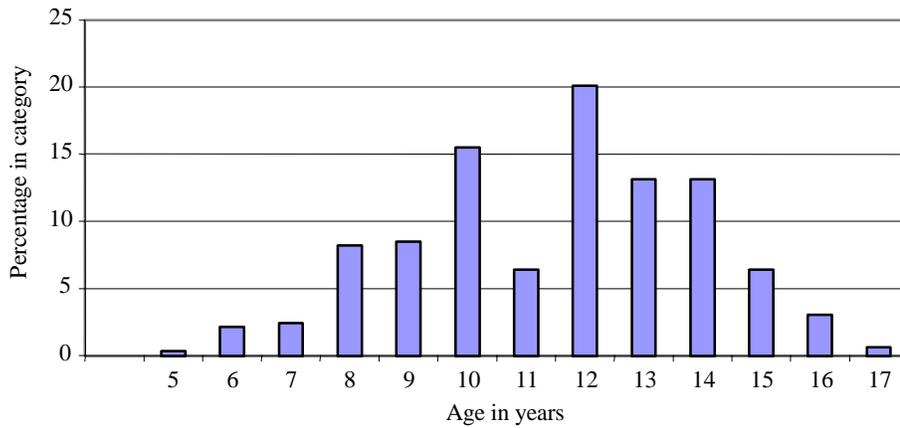


Figure 1. Distribution for age at which children first drove tractor alone (Kentucky Children’s FHIS Survey 1994/1995).

The median number of days spent operating the tractor is 30 days per year for the 16–18 year old boys, compared to a median of 5 days per year for girls in this age group.

Approximately one fourth of the children age 10–15 and half of the children age 16–18 operate tractors on public roadways (table 2). The annual median number of days for operating a tractor on a public roadway was relatively few (5 days for the 10–15 year olds and 7 days for the 16–18 year olds). However, nearly one third (31%) of the 10–18 year old children were reported to have driven tractors on public roads greater than two weeks per year. Boys age 10–15 were five times more likely to drive tractors on public roads than similar-age girls, and boys age 16–18 were twice as likely as girls to engage in this task. Riding as an extra rider on a tractor is prevalent among children on family farms; 60% of the 10–15 year olds engage in this practice 10 days per year, and 49% of the 16–18 year olds participate as extra riders about 5 days per year, on average.

Table 2. Characteristics of tractor driving among Kentucky children by age and gender (FHIS 1995).

Age/Gender Category	Tractor Driving on Farm			Tractor Driving on Public Road			Riding as a Passenger on Tractor		
	% Drive Tractor	Median Days	Range	% Drive Tractor	Median Days	Range	% Ride as Passenger	Median Days	Range
10 to 15 Years									
Male (N ^[a] = 207)	54.5	10	1–365	33.3	5	1–365	63.0	10	1–300
Female (N =185)	25.1	3	1–60	6.5	1	1–1	52.0	5	1–264
Total (N = 392)	40.6	7.5	1–365	25.5	5	1–365	57.8	10	1–300
16 to 18 Years									
Male (N = 163)	85.5	30	2–365	60.2	10	1–365	50.3	10	1–150
Female (N =124)	37.4	5	2–100	25.0	6	1–20	46.9	4	1–60
Total (N = 287)	64.8	20	2–365	51.2	7	1–365	48.9	5	1–150

[a] The numbers (N) are for all children within the age/gender category in the sample for which complete data were available from the FHIS survey. This N includes both children who drove and did not drive tractors in the past 12 months.

Similarly, participation in various tractor-related tasks varies by the child's age and gender. The most common tractor tasks, stratified by child's age and gender, are listed in table 3. Transporting equipment and hauling crops with the tractor are consistently among the most common tasks for boys and girls age 10–18. For girls age 10–15, learning to drive the tractor is the most common activity. Bushhogging (i.e., operating the tractor with an attached rotary mower) is the most common activity for the 16–18 year old males.

Annual farm income significantly influences the median number of days that children operate farm tractors per year, as well as the safety features of the tractor being operated (table 4). Boys living on farms with an annual farm income in excess of \$10,000 per year operated a tractor alone about twice as many days per year as boys living on the farms earning less than \$10,000 annual farm income. The median number of days of tractor operation for girls did not vary with annual farm income. Children living and working on farms with an annual farm income in excess of \$10,000 per year were more likely to drive a tractor equipped with a rollover protective structure (ROPS). Overall, less than half of the children driving tractors were operating a tractor with a rollover protective structure, with the proportion of children driving tractors without ROPS more prevalent on the farms with annual farm incomes less than \$10,000.

An analysis of covariance model (table 5) examining the predictors of the number of days that 10–18 year old children are involved in the operation of farm tractors confirms the previous results. The “days of tractor driving alone in the past 12 months” was log transformed in the model, and we report the least square means for the ANCOVA model, which accounts for 29% of the variance in tractor driving by children. The results indicated that male gender, older age (16–18 years compared to 10–15 years), annual farm income in excess of \$10,000 per year, and farms with livestock were significantly related to the number of days that children spent operating a tractor alone. Male gender alone accounts for more than 2 full weeks (difference in adjusted mean days = 15.5 days) of tractor operation compared to female children. Older age and greater farm income accounted for slightly more than one week of additional tractor driving for farm youth, while controlling for the other covariates. When controlling for the influence of age, gender, and farm income, dairy farms averaged about 19 days of tractor operation for 10–18 year old children, compared to an adjusted mean of 6.5 days per year for crop farms.

Table 3. Distribution of most common tractor-related tasks by age and gender for Kentucky farm children age 10 to 18.

Tractor Tasks	Age and Gender Categories			
	10 to 15 years		16 to 18 years	
	Male (N ^[a] = 109) (% in category)	Female (N = 45) (% in category)	Male (N = 130) (% in category)	Female (N = 43) (% in category)
1st common task ^[b]	Transporting equipment (14.7)	Learning to drive (15.6)	Bushhogging (10.8)	Transporting equipment (18.6)
2nd common task	Hauling crops (13.8)	Hauling crops (13.3)	Transporting equipment (10.0)	Loading hay (14.0)
3rd common task	Loading hay (13.8)	Mowing/Transporting equipment (8.9)	Plowing/Hauling crops (9.2)	Hauling crops (11.6)

[a] The numbers (N) are for those children who were reported to have driven a tractor alone in the past 12 months and for which complete data for the analysis were available.

[b] Indicates the tractor tasks that the child did most often in the past 12 months when driving the tractor alone.

Table 4. Rollover Protective Structure (ROPS) status of most often used tractor and median days of tractor driving for Kentucky farm children who drove tractors by age, gender, and farm income.

Age/Gender Category	Farm Income ≤ \$10,000/year				Farm Income > \$10,000/year			
	% Drive ROPS Tractor ^[a]	(95% CI)	Median Days Driving- Tractor Alone	Range	% Drive ROPS Tractor	(95% CI)	Median Days Driving Tractor Alone	Range
10 to 15 years								
Male (N ^[b] = 103)	36.7	(23.8 – 51.7)	10	1 – 150	38.9	(26.2 – 53.1)	20	1 – 365
Female (N = 42)	10.5	(1.8 – 34.5)	3	1 – 21	52.2	(31.1 – 72.6)	3	1 – 60
Total (N =145)	29.4	(19.3 – 41.9)	10	1 – 150	42.9	(31.8 – 54.6)	20	1 – 365
16 to 18 years								
Male (N = 119)	40.3	(28.7 – 53.0)	20	1 – 365	50.0	(36.0 – 64.0)	55	2 – 365
Female (N = 38)	25.0	(9.6 – 49.4)	5.5	2 – 100	33.3	(14.4 – 58.8)	7.5	2 – 50
Total (N = 157)	36.8	(26.9 – 47.9)	20	1 – 365	45.7	(33.9 – 58.0)	55	2 – 365

[a] The proportion of children within the age/gender category who were reported to have most often driven a tractor with a rollover protective structure among all children who were reported to have driven a tractor in the past 12 months.

[b] The numbers (N) represent the total number of the children within the age/gender category who were reported to have driven tractors in the past 12 months.

Table 5. Predictors of days of tractor operation for Kentucky farm children age 10 to 18, analysis of covariance^[a].

Factor	Adjusted Mean Days for Referent Category	Difference in Adjusted Mean Days Compared to Referent Category	P for Difference
Gender			
(Male ^[b] v. Female)	20.4	15.5	0.0001
Age			
(16–18 years ^[b] vs. 10–15 years)	18.1	8.8	0.0001
Farm income			
(> \$10,000 ^[b] vs. less)	18.2	7.0	0.0003
Primary farm commodity			
Dairy	19.0	12.5	0.009
Cattle	12.8	6.3	0.04
Tobacco	9.8	3.3	0.17
Other	6.9	0.4	0.89
Crops ^[b]	6.5	—	—

[a] Results from main effects analysis of covariance model for predictors of days driving tractor alone in past 12 months. R2 for the model = 0.29 for full model. Variables were rank ordered by the F statistic. Days of tractor driving was log transformed in model. Least square means are adjusted for age, gender, farm income, and primary farm commodity (agricultural product or service which is leading money-maker for farm).

[b] Referent category.

Discussion

This study documents the widespread use of tractors among youth performing chores on family-operated farms in Kentucky. Confirming previous reports (Hawk et al., 1994; Freeman et al., 1998), we document the common use of tractors, especially among older male youth, although participation in tractor-related activities was common across all age and gender groups.

Despite the widespread availability of information within the agricultural health and safety community, recommended safety practices for tractor operations, such as not allowing extra riders and not driving on public roadways for youth less than 16 years of age, have been sporadically adopted on family farms. The failure of voluntary standards regarding tractors has been documented for decades (Karlson and Noren, 1979). While use of tractors with ROPS appears to be gradually increasing in Kentucky (Steven R. Browning, unpublished data, 2000), the issues of extra riders and the operation of tractors on public roads by youth are common practices in the state.

Children living and working on family-owned and operated farms in Kentucky begin tractor driving, on average, at age 12, with a substantial proportion beginning to operate a tractor at age 10 or younger (37%). The national committee that developed the North American Guidelines for Children's Agricultural Tasks advised 12–13 years as the age for beginning to operate a 20–70 horsepower tractor with no equipment attached (Lee and Marlenga, 1999). We estimate that approximately 44% of farm children in Kentucky are beginning to use tractors earlier than recommended.

Tractor safety certification courses have been recommended in preparation for beginning tractor operations (Donham et al., 1997; Myers, 1998). Data from other studies ongoing in Kentucky indicate that few youth have completed a tractor certification course because there is no requirement for such training (Deborah Reed, personal communication, December 2000). Wilkinson et al. (1993) evaluated youth safety training for operator certification and found that certified operators were more likely to wear a safety belt, more likely to inspect the equipment prior to operation, and less likely to be an extra rider on a tractor.

Our data highlight the diversity of tasks children participate in with respect to tractor operations. Tractor tasks considered not appropriate for children less than 16 years old due to their increased hazard and complexity (e.g., hitching the tractor to move stuck objects or pulling stumps, pesticide application, or operating the tractor with a person on a trailing implement) occur on Kentucky farms. In particular, use of the rotary mower on the tractor ("bushhogging") is the most common task for older male youth, and based on reports of adult tractor fatalities, may be among one of the most hazardous practices (Centers for Disease Control, 1995). Continued efforts to promote the age-appropriate tractor operation guidelines among youth on Kentucky farms, especially with respect to the complex and hazardous tasks, should be emphasized in community-based tractor safety interventions.

The risk of fatal and nonfatal tractor-related injuries has been associated with the duration of exposure (days or work hours) of tractor operations (Lee et al., 1996). While the median days of tractor operation reported in this study may be appropriate for most farm youth, 21% of the 10–18 year old children reported operating the tractor for more than 60 days in the past year. While we acknowledge the potential for inaccuracies from proxy reporting, the data indicate that a proportion of Kentucky farm children may be devoting a sizeable number of hours to tractor-related chores on the farm each week. In addition to tractor rollover hazards, exposures to noise,

vibration, dusts, and pesticide aerosols increase with duration of use (Myers, 1998). However, since we did not obtain the usual hours of tractor operation on a daily basis for these children, our estimates remain imprecise.

The North American Guidelines for children recommends that driving a tractor on public roads should be restricted to children age 16 and older, only in daylight under good weather conditions, and with a tractor equipped with approved ROPS and a seatbelt (Lee and Marlenga, 1999). Within Kentucky, there are currently no restrictions regarding youth operation of tractors on public roadways. About one third of the Kentucky males age 10–15 were reported to have driven a tractor on the public road. Pratt and Hard (1997) profiled three adolescents' deaths that occurred while the youth were driving a tractor on a public road; speed and inability to properly operate the tractor were factors involved in these fatalities.

Approximately half of all children in the 10–18 age range were extra riders on tractors in the past year, a common practice that places children at increased risk for falls and rollover-related injuries. Within Kentucky, several recent fatalities were reported involving children who were extra riders on a tractor (Associated Press, 2000). National campaigns, such as those implemented through Farm Safety 4 Just Kids chapters, have addressed the issue through the “no riders” initiatives; however, the effectiveness of these media campaigns is limited. Addressing the problem of extra riders on tractors remains one of the most difficult public health issues related to tractor safety.

The North American Guidelines recommend that children should only operate wide-front tractors equipped with ROPS and seatbelts. For the 10–18 year old youth in our survey, the parents reported that 39% usually operated a tractor equipped with ROPS. It is evident from our data that farms with a farm income in excess of \$10,000 per year were more likely to provide their children with ROPS-equipped tractors compared to farms making less than \$10,000 per year. Furthermore, older children may be more likely than younger children to operate ROPS-equipped tractors.

While recent data indicate that children's use of ROPS-equipped tractors is improving in Kentucky, at present rates of replacement and retrofit of tractors with ROPS, it will be decades before most children are operating tractors with this safety equipment. Previous research in Kentucky indicates that the majority (71%) of the farm tractors used in the state do not have ROPS, and it has been estimated that only 24% of tractors have safety belts (Browning et al., 1999). Overall, the majority of children operating tractors in the state do so without the benefit of ROPS and seatbelts.

Male gender and the older age of the child are the strongest predictors in determining the number of days that children operate a tractor alone on the farm. In addition, farms with beef and dairy cattle and higher annual farm incomes are also significant predictors of the number of days that children operate a tractor alone. The increased exposure to tractor operations for older male youth may partially account for the disparate gender-specific rates of tractor-related injuries reported in most investigations (Pickett and Brison, 1995; Lee et al., 1996). While none of the identified predictors for days of tractor operations for youth in our investigation are modifiable, the results suggest targeting intervention activities at farms with livestock operations.

Strengths and Limitations

The results of this study provide baseline data by which to judge intervention efforts promoting safe tractor operations among youth in Kentucky. The data are from

a representative sample of half of the counties in the state, with selection premised on those counties with the majority of the farms. We believe that the data accurately reflect the prevalence of these practices among the farm youth in the state at the time of the survey. The response rate from the phone survey was excellent (84%).

One of the primary limitations of the study is the self-report of all information from the telephone surveys. There was no attempt in this study to validate the reporting of the children's tractor-related activities by the proxy respondents. While there is some evidence that the father is typically more likely to make assignments of farm chores (Kidd et al., 1997), we are not certain whether the reporting of tractor-related information by the mothers in this study may be biased toward either an underestimate or overestimate of the child's actual exposure. Other studies have indicated a relatively high level of reliability and validity of proxy respondent information in studies of childhood injury and illness, although such reporting may be influenced by the time frame of reporting (temporally proximal vs. delayed) and the gender and health status of the parent (Macarthur et al., 1997; Peterson et al., 1993; Waters et al., 2000). For this study, mothers were the respondents for 92% of the interviews. This level of standardization for the respondent should serve to reduce bias with regard to the between-groups comparisons reported in the results. Since the time frame ("in the past 12 months") for the questions regarding tractor operation was relatively broad, it is likely that the estimates provided by the proxy respondents reflect an approximation of the usual number of days that children were engaged in tractor operations. The usual limitations of cross-sectional data are applicable and have been described elsewhere (Browning et al., 1998).

Recommendations and Conclusions

The data from this study offer ideas warranting attention in the design of safety interventions and the development of policy initiatives for preventing youth tractor injuries and fatalities in the state. Age of beginning tractor operation, extra riders, use of tractors on public roadways, providing tractors with ROPS and seatbelts, and tractor safety certification training are important areas to address in a comprehensive plan (Myers, 1998; Lee and Marlenga, 1999). Continued surveillance of children's tractor operations, study of injuries and fatalities associated with the operation of farm tractors, and research on the etiology of tractor-related injuries need to continue as complements to intervention efforts for safe tractor operation.

Model legislation for tractor safety has been proposed, and a national effort to consider tractor safety standards is underway (Donham et al., 1997; Myers, 1998). Kentucky, as well as other states that employ children in agricultural operations, may wish to follow closely the Washington state program, under a Department of Labor Directive, in which a safety standard requires that tractors manufactured before 1976 be retrofitted with ROPS (Myers, 1998). Significant progress in reducing tractor-related injuries and fatalities may best be accomplished when progress is made in the state and national policy arena.

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References

- Associated Press. 2000. Georgetown boys, 2, 5, die as tractor overturns. *Lexington Herald-Leader* (Lexington, Ky.) 21 Feb.: B2
- Browning, S., H. Trusczyńska, D. Reed, and R. McKnight. 1998. Agricultural injuries among older Kentucky farmers: Results from the Farm Family Health and Hazard Surveillance Study. *Am. J. Ind. Med.* 33(4): 341–353.
- Browning, S., S. Westneat, C. Donnelly, and D. Reed. 2001. Injuries among Kentucky farm children: Results from the Farm Family Health and Hazard Surveillance Project. Unpublished manuscript, The University of Kentucky.
- Browning, S., S. Westneat, H. Trusczyńska, D. Reed, and R. McKnight. 1999. Farm tractor safety in Kentucky, 1995. *Public Health Rep.* 114(1): 53–59.
- Bureau of the Census. 1992. *Census of agriculture. Part 17: Kentucky state and county data. Vol. 1. Geographic Area Series No. AC92 A–17.* Washington, D.C.: Government Printing Office.
- _____. 1997. *Census of agriculture. Part 17: Kentucky state and county data. Vol. 1. Geographic Area Series No. AC97 A–17.* Washington, D.C.: Government Printing Office.
- Byard, R., J. Gilbert, J. Lipsett, and R. James. 1998. Farm and tractor-related fatalities in children in South Australia. *J. Pediatr. Child Health* 34(2): 139–141.
- Centers for Disease Control. 1995. Farm-tractor-related fatalities: Kentucky, 1994. *MMWR* 44(26): 481–4.
- _____. 1999. Deaths among children less than or equal to 5 years from farm machinery runovers: Iowa, Kentucky, and Wisconsin, 1995–1998, and United States, 1990–1995. *MMWR* 48(28): 605–8.
- Cogbill, T., H. Busch, and G. Stiers. 1985. Farm accidents in children. *Pediatrics* 76(4): 562–566.
- Donham, K., D. Osterberg, M. Myers, and C. Lehtola. 1997. Tractor risk abatement and control. In *The Policy Conference*, 4–39. 10–12 September. Iowa City, Iowa: The University of Iowa.
- Etherton, J., J. Myers, R. Jensen, J. Russell, and R. Braddee. 1991. Agricultural machine-related deaths. *Am. J. Public Health* 81(6): 766–768.
- Freeman, S., S. Whitman, and R. Tormoehlen. 1998. Baseline childhood farm safety data for Indiana. *J. Agric. Safety and Health* 4(2): 119–130.
- Hawk, C., K. Donham, and J. Gay. 1994. Pediatric exposure to agricultural machinery: Implications for primary prevention. *J. Agromed.* 1(1): 57–74.
- Karlson, T., and J. Noren. 1979. Farm tractor fatalities: The failure of voluntary standards. *Am. J. Public Health* 69(2): 146–149.
- Kidd, P., K. Townley, H. Cole, R. McKnight, and L. Piercy. 1997. The process of chore teaching: Implications for farm youth injury. *Farm Community Health* 19(4): 78–89.
- Lee, B., and B. Marlenga. 1999. *Professional Resource Manual: North American Guidelines for Children's Agricultural Tasks.* Marshfield, Wisc.: Marshfield Clinic.
- Lee, T., S. Gerberich, R. Gibson, W. Carr, J. Shutscke, and C. Renier. 1996. A population-based study of tractor-related injuries: Regional rural injury study-I (RRIS-I). *J. Occup. Environ. Med.* 38(8): 782–93.
- Macarthur, C., G. Dougherty, and I. Pless. 1997. Reliability and validity of proxy respondent information about childhood injury: An assessment of a Canadian surveillance system. *Am. J. Epidemiol.* 145(9): 834–41.
- Massey, J. T., T. F. Moore, V. L. Parsons, and W. Tadros. 1989. Design and estimation for the National Health Interview Survey, 1985–1994. National Center for Health Statistics. *Vital Health Stat.* 2(110): 1–33.

- Myers, M. 1998. NIOSH perspective on tractor-related hazards. *J. Agric. Safety and Health* 4(4): 205–230.
- Peterson, L., C. Harbeck, and A. Moreno. 1993. Measures of children's injuries: Self-reported versus maternal-reported events with temporally proximal versus delayed reporting. *J. Pediatric Psych.* 18(1): 133–47.
- Pickett, W., and R. Brison. 1995. Tractor-related injuries in Ontario. *Can. J. Public Health* 86(4): 243–6.
- Pickett, W., R. Brison, and J. Hoey. 1995. Fatal and hospitalized agricultural machinery injuries to children in Ontario, Canada. *Injury Prevention* 1(2): 97–102.
- Pratt, S., and D. Hard. 1997. Risk factors associated with agricultural workplace fatalities. Presented at the *National Institute for Farm Safety* as Paper 97–7. 22–26 June. Columbia, Missouri.
- Rivara, F. P. 1985. Fatal and nonfatal farm injuries to children and adolescents in the United States. *Pediatrics* 76(4): 567–573.
- _____. 1997. Fatal and non-fatal farm injuries to children and adolescents in the United States, 1990–1993. *Injury Prevention* 3(3): 190–194.
- Salmi, L., H. Weiss, P. Peterson, R. Spengler, R. Sattin, and H. Anderson. 1989. Fatal farm injuries among young children. *Pediatrics* 83(2): 267–271.
- SAS Institute. 1990. *SAS/STAT User's Guide*. 6th ed. Cary, N.C.: SAS Institute, Inc.
- Stallones, L. 1989. Fatal unintentional injuries among Kentucky farm children: 1979–1985. *J. Rural Health* 5(3): 246–256.
- Stallones, L., and P. Gunderson. 1994. Epidemiological perspectives on childhood agricultural injuries in the United States. *J. Agromed.* 1(4): 3–18.
- Swanson, J., M. Sachs, K. Dahlgren, and S. Tinguely. 1987. Accidental farm injuries in children. *Am. J. Diseases of Children* 141(12): 1276–1279.
- Tevis, C., and C. Finck. 1989. We kill too many kids: Special report from Successful Farming. *Successful Farming* 89(2): 18a–18p.
- Waters, E., J. Doyle, R. Wolfe, M. Wright, M. Wake, and L. Salmon. 2000. Influence of parental gender and self-reported health and illness on parent-reported child health. *Pediatrics* 106(6): 1422–1428.
- Wilkinson, T., R. Schuler, and C. Skjolaas. 1993. The effect of safety training and experience of youth tractor operators. Presented at the *National Institute for Farm Safety Summer Conference* as Paper 93–6. 13–17 June. Columbia, Missouri.

