Journal of Adolescent Health 62 (2018) 605–611

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Original article

Social and Individual Influences on Tractor Operating Practices of Young Adult Agricultural Workers

Josie M. Rudolphi, Ph.D. [a,*], Shelly Campo, Ph.D. [b], Fred Gerr, M.D. [a], and Diane S. Rohlman, Ph.D. [a]

[a] Department of Occupational and Environmental Health, University of Iowa, Iowa City, Iowa
[b] Department of Community and Behavioral Health, University of Iowa, Iowa City, Iowa

Article history: Received August 4, 2017; Accepted November 20, 2017
Keywords: Agriculture; Safety; Health; Behaviors; Occupational; Young adults

A B S T R A C T

Purpose: Tractor-related incidents are the leading cause of agricultural-related fatalities in the United States. Injuries from rollovers can be prevented by equipping tractors with rollover protective structures (ROPS, an engineering approach) and by using seatbelts (a behavior-based approach). While adult farmers report low seatbelt use and frequent use of tractors without ROPS, it is unknown whether the young adult population has adopted similar tractor driving practices. This study was designed to identify tractor operating practices among young adult agricultural workers and the influence of supervisors, peers, and parents on their safety behaviors.

Methods: An online survey was conducted among college students enrolled in agricultural science classes in four Midwestern colleges and universities. Participants answered questions about their tractor operating practices, the influence of supervisors, peers, parents, and individual risk taking tendencies on their workplace practices. A tractor operation safety score was estimated from participants' responses. Linear regression was used to examine the association of these influences and the tractor operation safety score.

Results: Of the 193 respondents, most (78.8%) reported that they never or rarely wear a seatbelt when operating a tractor with a ROPS. Supervisory influences, such as being negatively evaluated by a supervisor, were found to be more strongly associated with tractor operating behaviors than peer or parent influence.

Conclusions: Young adult agricultural workers frequently reported unsafe tractor operating behaviors. Supervisors were found to have the most influence over reported behaviors of young adult agricultural workers.

IMPLICATIONS AND CONTRIBUTIONS

Tractor-related incidents are the leading cause of agricultural-related fatalities. Characterizing the tractor operating practices of young adult agricultural workers and identifying individuals who influence workplace practices are important first steps to developing interventions to improve the health and safety of this agricultural population.

Tractors are the leading cause of agriculture-related fatal and non-fatal injuries in the United States [1,2]. However, these injuries are preventable. Engineering solutions including rollover protective structures (ROPS) and seatbelts are effective in preventing operator injury and death [3]. In addition to engineering controls, tractor manufacturers publish operating manuals with recommendations on prevention of injuries. Common recommendations include using seatbelts, when so equipped, avoiding steep slopes or uneven terrain, and not allowing extra riders.

However, the effectiveness of most available prevention approaches for reducing tractor-related injuries is dependent on the tractor operator's compliance with recommended practices. For example, a driver must manually buckle the seatbelt to keep him/her from being ejected from or crushed by a ROPS-equipped tractor in the event of an overturn. Studies of adult farmers report that few use the seatbelt when operating a tractor with ROPS,

Conflict of Interest: The authors have no conflicts of interest to disclose.

* Address correspondence to: Josie M. Rudolphi, Ph.D., National Farm Medicine Center-ML1, 1000 N. Oak Avenue, Marshfield, WI 54449.
E-mail address: Rudolphi.josie@marshfieldresearch.org (J.M. Rudolphi).

1054-139X/
https://doi.org/10.1016/j.jadohealth.2017.11.300

and many are operating tractors not equipped with ROPS [4,5]. Similarly, adolescents (aged 10–19) report unsafe tractor operating behaviors [4]. However, previous research has not focused on young adult operators over the age of 19, whose behavioral profile and risk taking tendencies may be different from their younger peers nor has research focused on tractor operating practices other than seatbelt use, such as distracted driving or operating on various terrains.

The agricultural industry employs a large proportion of young adult workers, a population at increased risk of injury [6–8]. Tractor operation and maintenance are tasks commonly associated with injury among adolescents and young adults [9]. Exposure to tractors is known to begin at a young age. Youth report driving a tractor independently as young as age 10 years [10] and over 80% of college-aged agricultural students report using tractors consistently [11]. However, it is unknown how young adults are engaging with tractors and their specific operating behaviors.

Furthermore, it is unclear *who* influences the tractor operating practices of young adults. In other occupational settings, supervisors, peers, and parents are known to affect the adoption of safe work practices. Among adult workers, supervisors who apply pressures on workers to be productive and supervisors who do not emphasize safety have been associated with workers performing unsafe work practices [12]. Among adolescents (participant mean age = 16.43) in agricultural and nonagricultural workplaces, risk taking at work was less likely when supervisors were clear about not allowing risks at the workplace [13]. Adolescents are especially vulnerable to peer pressure and adjust their practices to match the practices of those around them to gain acceptance [14].

Tractor operating safety practices are not well documented among young adult agricultural workers (ages 18–24) and determinants of safety practices are largely unknown within the young adult farmer population. Perceived risk taking activities of peers, parents, and supervisors have been found to influence adolescent and adult work practices; however, the effect of these social influencers on young adult agricultural work practices is undetermined. To address these gaps in knowledge, this study was conducted to characterize tractor operating safety practices of young adult agricultural workers and to examine the influence of supervisors, peers, parents, and individual risk taking on safety practices.

Methods

Participants

Young adult agricultural workers were recruited from among students enrolled in agricultural science courses at four postsecondary institutions in the Midwest. These institutions included four-year and two-year degree programs and were selected based on the agricultural science courses they offer emphasizing agricultural production, their high student enrollment in the agricultural programs, and their placement of graduates in production agricultural settings. To participate in the study, students must have been between the ages of 18 and 24 and reported participating in agricultural work at least 4 hours a week, on average.

Twelve 15-minute informational presentations were made by the project principal investigator to students enrolled in agricultural courses at the four institutions during the fall of 2014 and spring of 2015. The study objectives and methods were explained, and interested students were asked to provide their email address to receive the link to the online questionnaire. Of the 373 students enrolled in the classes, 351 provided their email address, 342 emails were delivered, 242 students completed the questionnaire, and 193 responded to the tractor operating questions for an overall participation rate of 51.7%.

Procedures

Survey materials were pilot tested for comprehension and clarity by recent graduates from agricultural programs who met the study inclusion criteria, and were revised in response to their recommendations.

Participants were emailed a link to the questionnaire administered through Qualtrics (Qualtrics Labs, Provo, UT). To increase participation, three reminder emails were sent to students. The questionnaire took 30 minutes to complete. Participants who completed the questionnaire were compensated $15. All procedures were approved by the Institutional Review Board at the University of Iowa.

Measures

The purpose of the survey was to characterize work practices of young adult agricultural workers. Six agricultural work areas were identified: (1) tractor operation, (2) all-terrian vehicle/utility vehicle use, (3) grain handling, (4) pesticide handling/application, (5) livestock handling, and (6) swine facility work. Within each of the six work areas, participants reported their frequency of engaging in specific operating practices. Between 6 and 12 operating practices were listed within each work area. In the present study, only the results relevant to tractor operation are presented.

Demographic information. Personal information including age, gender, race, educational status, institution type, and type of farm employed were collected from each participant (Table 1).

Tractor operating practices. Twelve questions related to tractor operation (e.g., "I wear a seatbelt if the tractor has a rollover protective structure") were presented to participants who indicated they operated or drove a tractor (Cronbach $\alpha = .83$) (Table 2). The 12 tractor operating activities included items related to personal protective equipment, distracted driving, and driving conditions/environment, and were selected based on manufacturer's recommended best practices. Respondents indicated on a five-point Likert scale (1 = Never to 5 = Always) how frequently they participate in each of the activities.

Social influence. Participants rated their level of agreement (disagree, neither agree nor disagree, agree) with statements (Table 3) regarding the influence of (1) their supervisors at work (two items, Cronbach $\alpha = .71$) [13], (2) peer/coworker risk taking (two items, Cronbach $\alpha = .93$) [13,15], and (3) parental risk taking (two items, Cronbach $\alpha = .72$) [13,16].

Global risk taking. Participants rated their level of agreement (disagree, neither agree nor disagree, agree) with statements regarding their individual risk taking tendencies (five items, Cronbach $\alpha = .80$) (Table 3). Westaby and Lee's five-item scale was used [8].

Table 1
Mean tractor safety scores by demographic characteristics (N = 193)

		N (%)	Mean tractor score[a] (SD)	*p* Value
Gender	Male	154 (79.79)	2.92 (.70)	.01
	Female	39 (20.21)	3.23 (.56)	
Age	18–19	68 (35.23)	2.92 (.73)	.47
	20–21	65 (33.68)	2.98 (.64)	
	22–24	60 (31.09)	3.07 (.67)	
Enrollment status	Full-time student	188 (97.41)	2.99 (.68)	.54
	Part-time student	5 (2.59)	2.80 (.68)	
Institution	2-year degree program	94 (49.47)	2.94 (.71)	.42
	4-year degree program	96 (50.53)	3.02 (.63)	
Farm primarily work on	Principal owner/operator	3 (1.82)	3.11 (.13)	.67
	Family farm	106 (64.24)	2.99 (.73)	
	Nonfamily farm	56 (33.94)	2.90 (.64)	

Not all demographic counts total 193.
1 = low safety score (report *NEVER* performing safety practice), 5 = high safety score (report *ALWAYS* performing safety practice).
[a] Tractor safety score range is 1–5.

Table 2
Tractor operating safety practices of young adult agricultural workers (N = 193)

Tractor safety practice	Never n (%)	Rarely n (%)	Sometimes n (%)	Usually n (%)	Always n (%)
Wear a seatbelt if the tractor has a rollover protective structure	118 (61.14)	34 (17.62)	26 (13.47)	7 (3.63)	8 (4.15)
Wear hearing protection when driving or operating a tractor without a cab	96 (49.47)	35 (18.13)	35 (18.13)	19 (9.84)	8 (4.15)
Avoid operating a tractor when excessively tired	89 (46.11)	43 (22.28)	36 (18.65)	15 (7.77)	10 (5.18)
Avoid operating or driving a tractor that does not have a rollover protective structure	47 (24.35)	41 (21.24)	58 (30.05)	35 (18.13)	12 (6.22)
Prohibit extra riders unless there is a designated passenger (buddy) seat	44 (22.80)	65 (33.68)	50 (25.91)	24 (12.44)	10 (5.18)
Avoid operating a tractor when under the influence of drugs or alcohol	31 (16.15)	38 (19.79)	64 (33.33)	42 (21.88)	17 (8.85)
Avoid talking on the cell phone when driving or operating a tractor	28 (14.15)	49 (25.39)	49 (25.39)	47 (24.35)	20 (10.36)
When tractor is stopped, set brakes securely and use park lock if available	26 (13.47)	43 (22.28)	77 (39.90)	26 (13.47)	21 (10.88)
Stay off slopes too steep for safe operation	8 (4.15)	11 (5.70)	41 (21.24)	54 (27.98)	79 (40.93)
Reduce speed when turning, crossing slopes, and on rough, slick, or muddy surfaces	5 (2.62)	17 (8.90)	40 (20.94)	69 (36.13)	60 (31.41)
Avoid texting, emailing, using the web or social media when operating a tractor	5 (2.62)	5 (2.62)	21 (10.99)	25 (13.09)	135 (70.68)
Avoid operating the tractor near ditches, embankments, and holes	4 (2.07)	8 (4.15)	37 (19.17)	57 (29.53)	87 (45.08)

Some behaviors responses had missing values. Not all rows total 193.

Risk taking orientation at work. Participants rated their level of agreement (disagree, neither agree nor disagree, agree) with statements regarding their perception of risks and hazards in their workplace (five items, Cronbach $\alpha = .84$) (Table 3). These questions were adopted from the risk taking ideology and psychology literature [13,17].

Survey materials were pilot tested for comprehension and clarity by recent graduates from agricultural programs who met the study inclusion criteria, and were revised in response to their recommendations. All procedures were approved by the Institutional Review Board at the University of Iowa.

Statistical analysis

Analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC). Means and frequency distributions were used to summarize the demographic characteristics of the study sample and the frequency of reported tractor operating practices.

A dimensionless *tractor operating safety score* ranging from 1 to 5 was calculated for each participant who responded to the 12 tractor operating behavior items by averaging the 12 item responses. A score of 5 indicated a participant reported *always* participating, or complying with the 12 safety practices (i.e., *always* wear their seatbelt when operating a tractor with a ROPS), whereas a score of 1 indicated a participant reported *never* participating in the 12 safety practices.

A dimensionless *supervisor influence score*, *peer influence score,* and *parental influence score* were calculated for each participant who responded to the items related to supervisory influence, peer influence, and parental influence. *Supervisor influence scores* ranged from –1 to 1. A score of –1 indicated that a participant disagreed with the statement that his/her supervisor encouraged him/her to take risks in the workplace, whereas a score of 1 indicated that a participant agreed with the statement that his/her supervisor encouraged him/her to take risks in the workplace. *Peer influence scores* and a *parental influence scores* also ranged from –1 to 1. A score of –1 indicated a participant disagreed their peer or parents were risk takers, whereas a score of 1 indicated a participant agreed their peer or parents were risk-takers.

Individual *global risk-taking scores* and *risk-taking at work scores* were calculated for each participant who responded to the five items related to individual risk taking and the five items related to risk and hazards in their workplace. A *global risk-taking score* of –1 indicated a participant did not report participating in risky activities, whereas a score of 1 indicated a participant did report participating in risky activities. A *risk-taking at work score* of –1 indicated a participant disagreed to statements suggesting their work is hazardous, whereas a score of 1 indicated a participant agreed the work they do is hazardous.

Items contributing to the *supervisor influence score*, *peer influence score*, *parental influence score*, *global risk-taking score*, and *risk-taking at work score* were equally weighted.

Table 3
Association between tractor safety scores and statements related to parental, peer, supervisor, and individual risk taking

			n (%)	Mean tractor score[a] (SD)	*p*-value
Supervisor risk taking (2 items)	My boss does not allow me to take risks.	Disagree	46 (24.73)	2.64 (.64)	<.01
		Neither	68 (36.56)	2.89 (.63)	
		Agree	72 (38.71)	3.24 (.68)	
	I would be negatively evaluated if I took risks at work (supervisor influence).	Disagree	52 (27.96)	2.78 (.63	<.01
		Neither	64 (34.41)	2.85 (.67)	
		Agree	70 (37.63)	3.25 (.68)	
Peer risk taking (2 items)	Other people take risks at work.	Disagree	32 (17.20)	3.20 (.72)	.07
		Neither	63 (33.87)	3.02 (.63)	
		Agree	91 (48.92)	2.89 (.71)	
	My coworkers take risks.	Disagree	38 (24.43)	3.14 (.77)	.16
		Neither	65 (34.95)	3.01 (.67)	
		Agree	83 (44.62)	2.89 (.66)	
Parental risk taking (2-items)	My parents take risks.	Disagree	40 (21.62)	3.09 (.74)	.50
		Neither	54 (29.19)	2.97 (.66)	
		Agree	91 (49.19)	2.95 (.69)	
	My parents could be considered risk takers.	Disagree	52 (28.26)	3.05 (.72)	.32
		Neither	69 (37.50)	3.02 (.65)	
		Agree	63 (34.24)	2.87 (071)	
Global risk taking (5 items)	I would rather take risks than be overly cautious.	Disagree	54 (29.03)	3.13 (.66)	.03
		Neither	79 (42.47)	3.01 (.69)	
		Agree	53 (28.49)	2.79 (.69)	
	In the past month, I've done some exciting things that other people think are dangerous.	Disagree	37 (19.89)	3.10 (.72)	.09
		Neither	54 (29.03)	3.09 (.62)	
		Agree	95 (51.08)	2.87 (.71)	
	I love to take risks even when there is a small chance I could get hurt.	Disagree	61 (32.80)	3.15 (.69)	.03
		Neither	62 (33.33)	2.97 (.65)	
		Agree	63 (33.87)	2.83 (.70)	
	I value having fun more than being safe.	Disagree	78 (41.94)	3.12 (.66)	.05
		Neither	75 (40.32)	2.91 (.67)	
		Agree	33 (17.74)	2.81 (.77)	
	Sometimes people get on my nerves when they tell me how to act more safely.	Disagree	54 (29.35)	3.11 (.68)	.02
		Neither	71 (38.59)	3.04 (.66)	
		Agree	59 (32.07)	2.78 (.70)	
Risk taking orientation at work (5 items)	Dangerous tasks have to get done at work.	Disagree	29 (15.59)	3.32 (.76)	.01
		Neither	60 (32.26)	2.99 (.63)	
		Agree	97 (32.07)	2.87 (.67)	
	There is a chance I will do something at work that could get me hurt.	Disagree	24 (13.79)	3.23 (.76)	.12
		Neither	55 (31.61)	3.03 (.63)	
		Agree	95 (54.60)	2.91 (.72)	
	I like taking risks at work.	Disagree	78 (41.94)	3.24 (.64)	<.01
		Neither	74 (39.78)	2.83 (.62)	
		Agree	34 (18.28)	2.72 (.77)	
	I sometimes do things at work that may get me injured.	Disagree	43 (23.24)	3.22 (.72)	<.01
		Neither	52 (28.11)	3.10 (.67)	
		Agree	90 (48.65)	2.78 (.63)	
	I get my job done faster by taking risks.	Disagree	67 (36.02)	3.27 (.98)	<.01
		Neither	73 (39.25)	2.95 (.61)	
		Agree	46 (24.73)	2.63 (.65)	

Some statement responses had missing values. Not all statements total 193.
1 = low safety score (report *NEVER* performing safety practice), 5 = high safety score (report *ALWAYS* performing safety practice).
[a] Tractor safety score range is 1–5.

We examined bivariate relationships between all potential explanatory variables and tractor safety scores, the continuous outcome variable, using *t* test or analysis of variance. Explanatory variables included the supervisor influence score, peer influence score, parental influence score, global risk taking score, risk taking at work score, and demographic characteristics.

Linear regression was used to examine associations between social (supervisor, parental, and peer influence scores) and individual influence scores (global risk taking and risk taking at work scores), and tractor safety score. The first step was to separately estimate crude associations between each of the five influence scores and the continuous tractor safety score. The analyses were then repeated controlling for gender and age, and again controlling for gender, age, and all five social/individual influence scores.

Results

Demographics

Of the 242 students who completed the online survey, 80% (n = 193) indicated they routinely drove tractors and responded to the 12 tractor operating activity items. Of the 193 in this analysis, 80% were male, 97% reported being a full-time student, and 99% were white. Age groups and institution types were equally represented. Sixty-four percent indicated they were primarily employed on their family farm, 34% indicated they were primarily employed on a nonfamily or nonrelatives farm, and 2% indicated they were the principal owner/operator (Table 1).

Table 4
Individual associations of each social and individual influence score and tractor safety score; Unadjusted, adjusted for gender and age, and adjusted for gender, age, and all other social influence scores

Variable	Unadjusted, crude estimate		Adjusted for gender and age		Adjusted for gender, age, and all social influence scores	
	β (95% CI)	*p* Value	β (95% CI)	*p* Value	β (95% CI)	*p* Value
Supervisor influence	–.32 (–.46–-.19)	<.001	–.34 (–.47–-.20)	<.001	–.27 (–.43–-.13)	<.001
Peer influence	–.15 (–.28–-.02)	.03	–.15 (–.28–-.02)	.02	–.005 (–.16–.15)	.94
Parent influence	–.10 (–.24–.03)	.13	–.10 (–.23–.04)	.14	.068 (–.09–.22)	.38
Global risk taking	–.30 (–.47–-.13)	<.001	–.28 (–.44–-.11)	.001	–.05 (–.26–.16)	.63
Risk taking at work	–.43 (–.58–-.26)	<.001	–.40 (–.56–-.24)	<.001	–.28 (–.49–-.06)	.01

CI = confidence interval.

The mean tractor safety score was 2.98 (standard deviation (SD) = .68). Scores were normally distributed (Shapiro-Wilk test $p = .10$) and ranged from 1.00 to 4.92. Female participants had a significantly higher mean tractor safety score than male participants (males = 2.92, females = 3.23, p-value $p = .01$). No statistically significant difference in tractor safety scores were observed across other demographic characteristics (Table 1).

Tractor operating practices

Nearly 80% of respondents indicated they *never* or *rarely* wore a seatbelt when operating a tractor with a ROPS and over 60% report they *never* or *rarely* avoided using a tractor that did not have a ROPS, or wear hearing protection. Conversely, a majority of respondents reported they *usually* or *always* avoided operating a tractor near ditches, embankments, and holes (83.61%), avoided slopes too steep for safe operation (68.91%), and avoided using a cell phone while operating a tractor (83.77%) (Table 2).

Social and individual influences

Participants who agreed their supervisor does not allow them to take risks and they would be negatively evaluated if they took risks at work had a significantly higher tractor safety scores than participants who disagreed with the statements (Table 3). Young adult agricultural workers who identified their parents or peers as risk takers did not report different tractor scores than those who did not (Table 3).

In general, participants who agreed with the global risk-taking statements (i.e., *I would rather take risks than be overly cautious*) reported lower tractor safety scores than those who did not agree with the statements. Additionally, participants who agreed with the risk taking orientation at work statements (i.e., *dangerous tasks at work have to get done)* reported lower tractor safety reported lower tractor safety scores than those who did not agree with the statements (Table 3).

Social and individual influence scores

The mean supervisor influence score was –.14 (SD = .69). The mean peer influence score was .26 (SD = .74). The mean parent influence score was .13 (SD = .74). The mean global risk taking score was –.03 (SD = .60). The mean risk taking at work score was .09 (SD = .60). All five scores had a range of –1 to 1 and had a median score of .00.

Unadjusted and adjusted individual associations between social and individual influence scores and tractor safety score are presented in Table 4. All five social and individual influence scores were negatively associated with the tractor safety score outcome. As participants reported agreeing with statements indicating higher levels of supervisor, peer, parent, or individual risk taking, and mean influence scores increased, tractor safety scores decreased. Among social influences, supervisors contributed most substantially to reported tractor safety scores. Results from the adjusted (age and gender and all other social and individual scores) linear regression indicate a decrease in tractor safety score of .27 for every one-unit increase in supervisor influence score and a decrease in tractor safety score of .28 for every one-unit increase in risk taking at work score. Of the five social and individual influence scores, parent influence score, peer influence score, and global risk taking did not contribute significantly to tractor safety scores, when considering all other social and individual influences.

Discussion

Similar to the demographic characteristics of the Midwest where the farming population is over 95% white, the study population was 99% white and majority male, consistent with agricultural workers and farmers in the Midwest (United States Department of Agriculture, 2014) [18].

Consistent with previous findings of adult farmers, results from this study indicate a majority of young adult agricultural workers do not wear the seatbelt when operating a tractor that has a ROPS, do not wear hearing protection when operating a tractor without a cab, and many report operating a tractor when they are excessively tired. Previous studies have also found low use of seatbelts among experienced farmers [4,5] and high prevalence of tractors without ROPS [5].

Females reported participating in safe tractor operating practices more often than males. This finding is consistent with previous research, though not in agriculture specifically, that has identified males as being more likely to engage in risky behaviors [19].

Social influences including supervisory influence, peer risk taking, and parental risk taking have been found to influence workplace practices among young adult and adult workers.

In our study, the two items related to supervisory influence were found to be significantly associated with safer tractor operating practices. Results from previous studies have found that if management is committed to safety, employees will also demonstrate a commitment to safety [20,21]. Pressures to perform by management or supervisors [21], management that does not emphasize safety [20], and lack of training [21] have all been found to contribute to unsafe work practices in occupational settings. Results from our study suggest an association between tolerance for risk taking among supervisors and reported behaviors among young adults operating tractors, echoing previous findings.

Peers have been found to influence work and risk taking practices across age groups. Adolescent and young workers are especially vulnerable to peer pressure, and peer risk taking has been associated with individual risk taking orientation at work among high school–aged (14–18 years old) agricultural workers. Among employed adults, coworkers who disregard safety and bully others to ignore safety protocol lead individuals to participate in unsafe work behaviors [8]. We did not find peer risk taking to be significantly associated with tractor operating behaviors, when considered in conjunction with the four other social and individual influence scores. It is unknown how many agricultural workers in the present study are working with coworkers. Agricultural workers and farmers often work in isolation and it is possible that interaction with coworkers is limited which would then limit their influence.

High school and college-aged agricultural workers report adopting agricultural-related behaviors through observational learning and modeling by a parent/adult farm worker. Young workers watch adults perform agricultural tasks and work under the supervision of an adult before eventually performing the task independently, often adopting the unsafe behaviors they observed from a parent or authority figure [22,23]. In regards to tractor operating behaviors specifically, fathers have been found to play an important role as teachers and role models [4,22]. Results from our study, however, indicate parental risk taking may be the least influential on individual work behaviors. No significant associations were found between the parental risk taking items and tractor safety score. We know over half of the participants report working primarily on a family farm or a relative's farm, but postulate that by early adulthood workers may have some autonomy in how they perform work-related tasks.

Even when considered among the four other social and individual influence scores, risk taking orientation at work remained significantly associated with tractor safety scores. Results from these items indicate young adult agricultural workers are aware of the risks associated with farm work and have accepted the risk as part of the job. This is consistent with previous studies that indicate farmers are well aware of agricultural hazards but interact with them regardless. The Farm Safety—Risk Paradox is a term used to explain the disconnect between what farmers know and how they behave. Although many farmers report being aware of agricultural safety and health hazards, they nonetheless elect to perform unsafe behaviors [24]. Results from this study suggest the Farm Safety—Risk Paradox may persist among young adult agricultural workers and farmers.

Global risk taking was not significant in the final multivariable model, which considered the four other social and individual influence scores. We speculate risk taking behaviors outside of work are not associated with risk taking at work, which warrants additional research.

The results of this study should be interpreted in light of some limitations. The sample was limited to young adult agricultural workers who were enrolled in agricultural science courses at four post-secondary institutions in the Midwest, which may limit the generalizability of these findings. Agricultural colleges and universities provided access to some of the population, but not all young adult agricultural workers in the Midwest. Additionally, characterizing the tractor operating behaviors relied on self-report from the study participants, which may not reflect their true work practices. However, field observations were not feasible given the resources.

Additional limitation to the questionnaire included terminology used and interpretation by participants. Participants responded to the 12 tractor operating behaviors if they indicated they *routinely* operate a tractor. We did not define *routinely* or attempt to quantify tractor operation. Ascertaining exposures and frequency of tasks is difficult in agriculture given the cyclical nature of work, and complicated by our population—college students with varying work and school schedules. Requiring participants operate a tractor at least once a day may have disqualified students who completed the survey in February and do not operate a tractor at least once a day, despite working fulltime on a farm in the summer, fall, or late spring. We recommend future studies collect data during a busy agricultural season and attempt to quantify tractor exposure and compare operating behaviors across exposure categories.

Another limitation was the lack of definition for the terms supervisor, peers, and parents in the social influence questions and subsequent social influence scores. We used an instrument that had been used among adolescent agricultural workers, which allowed for the terms to be defined by the participant. It was not clear who young adults identified as supervisors and if, in some situations, supervisors and parents and/or peers were synonymous. Over 60% of our sample reported working *primarily* on a family farm and over 95% of all participants responded to the statement about a supervisor, which suggest young adults on family farms identified a supervisor of some kind, perhaps even a parent. It is also possible young adults were also working on a nonfamily farm or school-run farm, in addition to primarily on a family farm, in which case they would have a supervisor who is not a parent. Some participants were recruited from courses that required a certain amount of hours each week on a school farm. Additional research into supervisors of young adult agricultural workers is necessary, especially given the association between supervisor influence and reported safety behaviors. Correctly identifying supervisors is important to designing appropriate interventions.

Results of this study should be considered when planning agricultural safety and health interventions for the young adult population. Recognizing the potential influence of supervisors, peers, and parents can help direct and guide an intervention.

Funding Sources

This project was funded by the National Institute for Occupational Safety and Health by the Great Plains Center for Agricultural Health (NIOSH U54 OH007548). In addition, tuition and stipend support was provided from the Heartland Center for Occupational Safety and Health (42OH008491) from the Centers for Disease Control/National Institute for Occupational Safety and Health.

References

[1] Hard DL, Myers JR, Gerberich SG. Traumatic injuries in agriculture. J Agric Saf Health 2002;8:51–65.

[2] Dogan KH, Demirci S, Sunam GS, et al. Evaluation of farm tractor-related fatalities. Am J Forensic Med Pathol 2010;31:64–8. doi:10.1097/PAF.0b013e3181c21bf0.

[3] The National Institute for Occupational Safety and Health. Agricultural safety; 2015. Available at: https://www.cdc.gov/niosh/topics/aginjury/default.html. Accessed February 22, 2017.

[4] Jinnah HA, Soneman Z, Rains G. Involving fathers in teaching youth about farm tractor seatbelt safety—a randomized control study. J Adolesc Health 2014;54:255–61. doi:10.1016/j.jadohealth.2013.10.010.

[5] Schenker MB, Orenstein MR, Samuels SJ. Use of protective equipment among California farmers. Am J Ind Med 2002;42:455–64.

[6] Hard DL, Myers JR. Fatal work-related injuries in the agriculture production sector among young in the United States, 1999–2002. J Agromedicine 2006;11:57–65.

[7] McCallum DM, Murphy S, Reed DB, et al. What we know about the effectiveness of farm safety day programs and what we need to know. J Rural Health 2013;29:20–9. doi:10.1111/j.1748-0361.2012.00426.x.

[8] Westaby JD, Lee BC. Antecedents of injury among youth in agricultural settings: A longitudinal examination of safety consciousness, dangerous risk taking and safety knowledge. J Safety Res 2003;34:227–40.

[9] DeWit Y, Pickett W, Lawson J, Dosman J. for the Saskatchewan Farm Injury Cohort Team. Farm activities and agricultural injuries in youth and young adult workers. J Agromedicine 2015;20:318–26. doi:10.1080/1059924X.2015.1042614.

[10] Browning SR, Westneat SC, Szeluga R. Tractor driving among Kentucky farm youth; Results from the farm family health and hazard surveillance project. J Agric Saf Health 2001;7:155–67.

[11] Rudolphi JR, Sheridan C, Rohlman DS. Agricultural work among college students. Paper presented at the International Society for Agricultural Safety and Health, Bloomington, IL; 2015.

[12] Bartling J, Hutchison I. Commitment vs. control-based safety practices, safety reputation, and perceived safety climate. Can J Adm Sci 2000;17:76–84.

[13] Westaby JD, Lowe JK. Risk-taking orientation and injury among youth workers; examining the social influence of supervisors, coworkers, and parents. J Appl Psychol 2005;90:1027–35. doi:10.1037/0021-9010.90.5.1027.

[14] Aloise-Young PA, Graham JW, Hansen WB. Peer influence on smoking initiation during early adolescence: A comparison of group members and group outsiders. J Appl Psychol 1994;79:281–7.

[15] Gibbons FX, Helweg-Larsen M, Gerrard M. Prevalence estimates and adolescent risk behavior: Cross-cultural differences in social influence. J Appl Psychol 1995;80:107–21.

[16] Raffaelli M, Crockett LJ. Sexual risk taking in adolescence: The role of self-regulation and attraction to risk. Dev Psychol 2003;39:1036–46. doi:10.1037/0012-1649.39.6.1036.

[17] Kowaleski-Jones L, Mott FL. Sex, contraception and child bearing among high-risk youth: Do different factors influence males and females? Fam Plann Perspect 1998;30:163–9.

[18] United State Department of Agriculture. 2012 Census of Agriculture—United States Summary and State Data; 2014. Available at: https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf. Accessed February 21, 2017.

[19] Weber E, Blais A, Betz N. A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. J Behav Decis Mak 2002;15:263. doi:10.1002/bdm.414.

[20] Barling J, Loughlin C, Kelloway EK. Development and test of a model linking safety-specific transformational leadership and occupational safety. J Appl Psychol 2002;87:488–96.

[21] Hofmann D, Stetzer A. A cross-level investigation of factors influencing unsafe behaviors and accidents. Pers Psychol 1996;49:307–39.

[22] Darragh A, Stallones L, Sample P, Sweitzer K. Perceptions of farm hazards and personal safety behavior among adolescent farm workers. J Agric Saf Health 1998;1:159–69.

[23] Sanderson LL, Dukeshire SR, Rangel C, Garbes R. The farm apprentice: Agricultural college students' recollections of learning to farm "safely". J Agric Saf Health 2010;16:229–47.

[24] Murphy D. Safety and health for production agriculture. American Society of Agricultural Engineers; 1992.