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A Review of 2016–2017 Agricultural Youth Injuries Involving Skid Steers and a Call for Intervention and Translational Research

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ABSTRACT

Skid steers or loaders are becoming prolific in U.S. agriculture – as are the injuries and fatalities related to their use. A review of incidents as queried in AgInjuryNews from 2016 to 2017 revealed an overrepresentation of youth being involved in these tragic incidents. This raises concerns over parental attitudes and beliefs about the safety of these machines. Skid steer incidents do not appear to be a result from a lack of safety education materials, however. Indeed, manufacturers, the Centers for Disease Control, and many state extension systems have safety manuals and general instruction, including YouTube videos and online resources. Thus, there appears to be a significant gap between safety knowledge and practice. There is also a lack of published research, including intervention strategies, training evaluation, and translational/implementation studies specific to skid steer machines. This review of youth incidents is therefore also a call for further research for foundational studies regarding attitudes and behaviors involving skid steers in agriculture, intervention models, and efforts to translate prevention knowledge beyond the existing materials.

KEYWORDS

Agriculture; farm; fatality; injury; loader; media; skid steer; youth

Introduction

Agricultural injuries involving skid steers (or skid loaders) in the U.S. have been largely unaddressed in injury prevention research. While there are a few Fatality Assessment and Control Evaluation (FACE) reports and news coverage of high-profile cases, these should be considered a low estimate in agriculture given the lack of consistent federal surveillance, especially among youth injuries. Given the popularity of these machines and their continued association with agricultural injuries (despite an abundance of safety materials), more prevention and translational research appears to be needed. This is especially true for fatal and non-fatal pediatric injuries. The following report summarizes the number of and severity of skid-steer-related incidents involving youth in 2016–2017 as collected through the AgInjuryNews.org system, a website designed to collect and disseminate agricultural-related injuries, illness, and fatalities reported through media.¹

Injuries and skid steers

Injuries related to skid steers are subject to many factors. Among them are engineering faults and operator error. Overall, engineering advancements accelerated the adoption of skid steers across industries. However, skid steers have fallen short with regard to some possible safety improvements. Being pinned or crushed by the bucket or arms, runovers, and slips, trips, and falls are common means of preventable injury. Side entry skid steers eliminate many of these common possible hazards. However, most manufacturers still produce front entry models. Moreover, older, front entry models are often still in use. Even these newer machines equipped with side entry, back-up cameras, and seat-weight sensors still pose safety risks. They can move fast, and to an untrained operator, the controls can be very sensitive, particularly when throttling high.

Across industries, adult fatalities from being pinned between the bucket or arms and the frame are particularly common.^{2,3} Between 1992 and 1995, 10 of 22 skid steer FACE reports

identified these pinning/crushing hazards as the cause of death. Similarly, in 2010, the Centers for Disease Control (CDC) reported that more than half of federally reported fatalities due to skid steer incidents between 1980 and 1995 were related to workers being pinned in such a manner. Injuries have also resulted from travel between/over the bucket in entering and exiting the cab, including crushes, slips, trips, and falls.

Operator visibility is often limited by large loader arms to the sides, engine compartment to the rear, lower seating, and a front-carried load (see [Figure 1](#)). The low visibility is especially perilous for bystanders, with children being particularly vulnerable because of shorter stature. Even when equipped with sliding windows, wipers, defrost, and back-up cameras, it is still difficult to see to the sides and rear.^{4,5} Visibility is even more limited for operators shorter in stature, again, like children. Given the limited field of vision, these conditions can equate to blind maneuvers often with implements or heavy loads. If the operator is

untrained or impulsive, the risks in these low-visibility conditions can be compounded given the skid steer's ability to turn quickly and tightly.

The presence of an extra rider is an ongoing concern across skid steers, all-terrain vehicles and other types of farm equipment. Skid steers have no designed trainer seat. Thus, any extra rider is at risk. Children and adults have been injured while riding in the bucket or on other parts of the machine. The case of a 9-year-old Wisconsin boy running over the skull of his 5-year-old brother who had fallen out of the bucket illustrates the issues of children, visibility, and extra riders (see [Table 1](#)).⁶

Youth injuries

This vulnerable population continues to fall victim to preventable on-farm injuries, many times under direct supervision of parents or other adults. Youth employed in agriculture are nearly seven times more likely to be killed at work than non-farm youth workers.⁷ And about every three days a

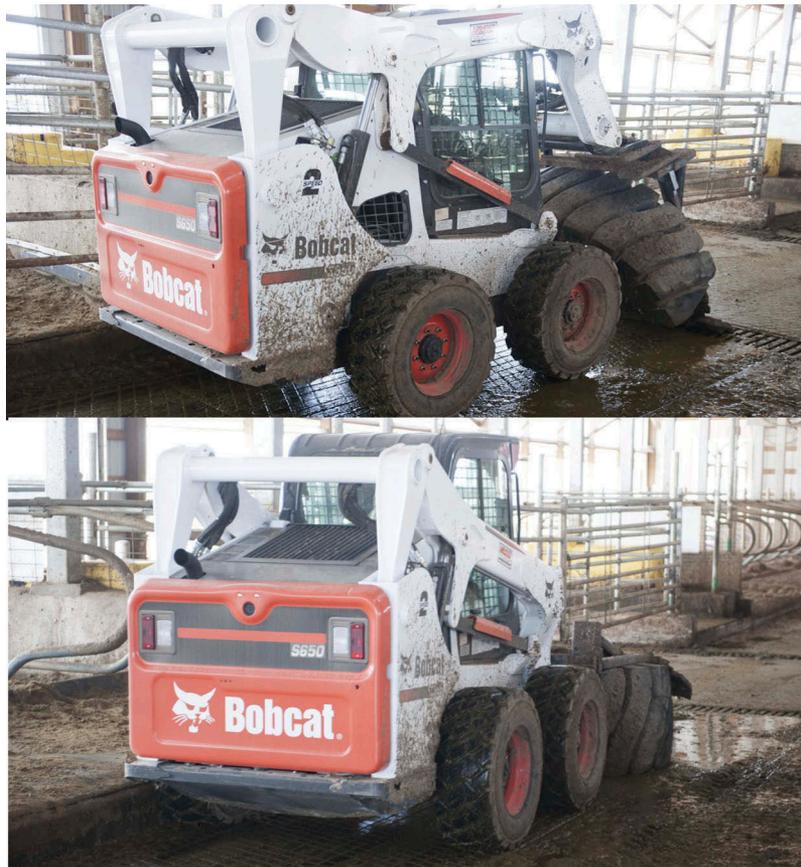


Figure 1. Skid steer scraping manure in a free-stall dairy barn.

Table 1. 2016–2017 Youth agricultural skid steer incidents from aginjurynews.

Date	State	Age	Gender	Fatal/ non-fatal	Summary
10/20/2017	WI	6	M	Non-fatal	It was reported that the victim will undergo >30 surgeries after his leg was degloved when he tried to climb into a skid steer
10/3/2017	MO	1	M	Fatal	11-year-old boy was driving a New Holland C185, 1-year-old victim walked into the path of the skid steer and was run over
9/25/2017	OH	3	M	Fatal	Victim run over by a skid loader
6/21/2017	MI	6	M	Fatal	Victim fell from a piece of farm equipment and was partially run over
5/15/2017	WI	3	M	Fatal	Victim run over by a skid loader operated by his 5-year-old brother
10/4/2016	IA	1	M	Fatal	Victim was sitting on his father's lap on the skid loader and either fell or jumped onto the ground
4/18/2016	OH	3	F	Fatal	Mennonite girl and her 2-year-old sister were in the bucket of a Bobcat skid steer operated by their father when she fell backward and got caught in the steel wheels of the vehicle
3/12/2016	IA	10	M	Fatal	A family member backed over the victim with a skid loader

child is killed in a farm-related incident in the U. S.⁸ Furthermore, researchers have estimated that farm-related non-fatal injuries of youth workers (aged <18) cost U.S. society \$1 billion annually (in 2005 dollars), and another \$420 million per year for fatal injuries.⁹

An analysis of the past 5½ years of media reports in the AgInjuryNews system uncovered that 75% of reported skid steer incidents involved youth (age 17 and under).¹⁰ Furthermore, 50% of incidents during the same time period involved children 6 years old and younger. Such youth incidents are highly prevalent in the 2016–2017 report (see Table 1). Over this two-year period, 8 traumatic injuries were reported via news media, 7 (88%) of those were fatal, and 7 of the cases involved children 6-years-old or younger. Youth injuries in agriculture are often underreported, even fatal injury cases may go unreported, and non-fatal injuries are likely to be even more underreported.

Recommendations/immediate needs

Skid steer manufacturers have released safety manuals, videos, and recommendations (some specific to agriculture). The CDC and Prevention and Agricultural Extension have also issued reports and safety recommendations through the past decade. Many of these materials are engineering-based and draw upon the agricultural community's experience with tractors and front-end loaders (see Table 2 for a sample list of online materials).

Generally, there is often a gap between safety knowledge and practice in the field of agriculture.

However, after a review of existing peer-reviewed literature, there are hardly any attempts to evaluate materials or training, further investigate uses of and attitudes towards skid steers in agriculture, or test dissemination implementation strategies. The few studies in literature attempt to learn more about rearward visibility.^{4,5} Related, but from the field of construction, there is some research regarding high levels of whole-body vibration while operating skid steers.¹¹ Lastly, there has been research into the higher effectiveness of recommendation-focused imagery where the task under observation included skid steer operation.¹² The persistent rates of injury and fatalities related to skid steers, despite recent improvements to engineering and the amount of safety materials available, require further research regarding the agricultural community's attitudes, beliefs, and behaviors towards skid steers. These findings would likely improve the recommendations regarding safe operation. Consider the following lines of possible inquiry:

- Do current safety materials address the needs of agriculture as an industry and/or as an audience effectively?
- Are skid steers perceived as safer because they often have cages and rollover protection; are often utilized in safer industries; and/or are generally smaller than tractors?
- Are parents and/or employers more willing to allow youth to operate or be near skid steers compared to tractors or other pieces of equipment?

Table 2. Cross-sector sampling of online skid steer safety materials.

Organization	Industry of focus	Published or last revised	Content type	Title	Hyperlink
Occupational Safety and Health Administration (OSHA)	All	Unknown	Document	Hazards Associated with Operating Skid-Steer Loaders with Bypassed and/or Improperly Maintained Safety Devices	https://www.osha.gov/dts/shib/shib011209.html
National Institute of Occupational Safety and Health (NIOSH)	All	February 1998	Document	Preventing Injuries and Deaths from Skid Steer Loaders	https://www.cdc.gov/niosh/docs/98-117/
Farm Safety Association, Inc.	Agriculture	2002	Document	Skid Steer Loader Safety	http://nasdonline.org/63/d001622/skid-steer-loader-safety.html
Farm and Ranch eXtension in Safety and Health (FReSH) Community of Practice	Agriculture	2012	Document	Skid Steer Safety	http://articles.extension.org/pages/64425/skid-steer-safety
Ohio State University	Agriculture		Presentation	Skid Loader (skid-steer) Operator Training	https://agsafety.osu.edu/sites/agsafety/files/imce/OSU%20CFAES%20Skid%20Loader%20Operator%20Training%202014.pdf
National Children's Center for Rural and Agricultural Health and Safety	Agriculture	2017	Document	Skid Steer Safety	https://www.cultivatesafety.org/wp-content/uploads/2017/09/2017-09-Skid-Steer-Prevention-Brief.pdf
National Children's Center for Rural and Agricultural Health and Safety	Agriculture	2016	Document	Operating a Skid Steer	https://doi.org/10.21636/nfmc.nccrahs.youthwork.skidsteer.g.2017
Bobcat	All	2018	Document	Bobcat Operator Training Kits and Safety Resources	https://www.bobcat.com/safety-training/resources/courses
UW-Extension	Agriculture	2017	Document	Skid Steer Loader Safety	https://learningstore.uwex.edu/Skid-Steer-Loader-Safety-P1867.aspx
360training.com, Inc.	All	2018	Online Course	Skid Steer (Rubber-tired & Track Loader) - Operator Safety Course Online	https://www.360training.com/environmental-health-safety/osha-training/forklift-heavy-equipment-training/skid-steer
U.S. Fish & Wildlife Service	All	2017	Online Course	Skid Steer Safety Training Course	https://training.fws.gov/nctcweb/catalog/CourseDetail.aspx?CourseCodeLong=FWS-SAF2004-UDT
Penn State Extension	Agriculture	2017	Document	Blind Spots and Skid Steers Demonstrations	https://extension.psu.edu/blind-spots-and-skid-steers-demonstrations
Kansas State University	All	2013	Video	Skid Steer Loader Safety	https://www.youtube.com/watch?v=STQ5khnfkUQ
Bobcat	All	2015	Video	Bobcat Loader Safety	https://www.youtube.com/watch?v=2ls6c1Znu1E
John Deere	All	2013	Video	John Deere Skid Steer and Compact Tractor Loader Safety Tips	https://www.youtube.com/watch?v=4d7F5xgP2hQ
Vermeer	All	2014	Video	Mini Skid Steer Safety & Operations	https://www.youtube.com/watch?v=5HvbjjqGbfq

- What engineering improvements can we consider given the kinds of cases being reported?
- What injuries are effectively mitigated with newer designs, e.g. side entry, and with additional technologies, e.g. sensors?

Until these kinds of questions are further explored, existing resources may be less than entirely effective. While many are evidence-based and akin to general machinery safety addressing the common injuries, it is likely that there are beliefs and attitudes that go

unacknowledged in their translation for agricultural audiences. Evidence-based work in skid steers seems to be an open-domain for further questioning. Until then, intervention researchers need to work with existing materials, including those that may be unspecific to skid steers.

Youth-specific injury prevention

Given the percentage of reported incidents involving children, skid steers appear to be especially

dangerous for young children (ages 0–6). Per evidence-based recommendations, these young children should not be in the worksite, much less in the vicinity of, or operating farm machinery. However, it seems that skid steers, despite their low visibility and powerful, quick movement are being treated the same as or safer than other kinds of machinery. Children are not allowed in a construction site, where many of the same pieces of equipment, skid steers included, are being used. As both home sites and work sites, farms and ranches must isolate their work from bystanders. Optimal prevention strategies include keeping young children out of the worksite, and constructing a designated safe play area with physical barrier(s).¹³

Recognizing stages of child development is crucial to understanding their capabilities and to assigning appropriate farm tasks. In an effort to protect young workers and guide decision making of responsible adults, the North American Guidelines for Children's Agricultural Tasks (NAGCAT) were developed.¹⁴ These voluntary guidelines provide recommendations for farm parents and supervisors in assigning age-appropriate work. Guidelines for hired youth and adolescents are also publicly available.¹⁵ In one study, the use of NAGCAT guidelines by farm parents/operators following a face-to-face educational encounter reduced youth injuries by 50%.¹⁶

The role of media

Given that much of the surveillance of injuries and fatalities in agriculture is likely to occur in regional and online news sources, the media may play a crucial role in reducing the prevalence of skid-steer-related incidents. In 2017, a past Media Workshop attendee, Colleen Kottke of the Wisconsin State Farmer, wrote a comprehensive article about a skid steer fatality in central Wisconsin.¹⁷ The article provides an ideal example of how farm safety can be leveraged in reporting. The journalist focused on issues of safety and prevention while capturing crucial incident details. Unfortunately, detailed reporting within the industry is the exception, not the norm. In fact, less than 12% of ag-related news reports mention protective equipment (e.g. helmets) and only 6% note a prevention message such as keeping young

children out of worksites or assigning age-appropriate work.¹⁸ Meanwhile, notation of alcohol and seatbelt use is standard practice in motor vehicle crash reports. Similar kinds of basic, consistent facts should also be obtained in reporting farm injuries and fatalities.

One example of media providing mixed messaging regarding youth and skid steers occurred in 2017. The fatal incident involved a 3-year-old run over by a skid steer driven by his 5-year-old brother. A local television network affiliate reported on the incident. In an apparent effort to provide perspective, and rather than highlight prevention and safety tips, they interviewed a different farm mom who defended putting a 5-year-old in the driver's seat of a skid steer. The entire message of safety was lost. The entire focus of the 3-year-old, whose life was taken, was lost.

Media coverage can save lives. From road conditions, product recalls, tornado and severe weather warnings, to amber alerts, to an active shooter scene, media can inform and guide the public away from dangerous and life-threatening situations. While research has not yet been published regarding impact among farm parents' intended behaviors post-exposure to media's messaging, media reporting has shown to have impact on other behavior change.¹⁹ Furthermore, in the agricultural health literature, there is an editorial describing the authors' personal reactions to reading childhood agricultural death certificates.²⁰ The case of the 5-year-old skid steer operator further highlights a need for expanded and scalable media education, such as the past journalist workshops that were funded through the National Institute for Occupational Health and Safety.²¹

In addition to referencing existing materials including the Prevention Brief about Skid Steer Safety, we encourage journalists to continue investigative reporting efforts, asking for statements from farm organizations, gathering data from the Bureau of Labor Statistics (BLS), and pulling together well-rounded coverage of the issue at hand.²²

Limitations

Agricultural injuries in the U.S. are not tracked as rigorously as other industrial sectors. The BLS continues to collect occupational fatalities, but has an

ongoing challenge in collecting non-fatal injuries within the sector, particularly from the more than 2 million small U.S. farms that fall outside the purview of Occupational Safety and Health Administration (OSHA). Additionally, those injured on agricultural operations that were not specifically involved in the work as an employee may not be captured by any formal reporting system (e.g. a child run over by farm equipment or a visitor kicked by an animal). The AgInjuryNews system fills a gap by regularly tracking injury reports, but it can only capture and store reports that are written and published for public consumption – media, police, coroner, etc.^{1,23}

Conclusions

Farms continue to claim the lives of many people each year, increasingly in some subsectors, such as hobby farms.²⁴ Previously, researchers have concluded that “NIOSH studies in the 1990s suggested that employers, supervisors, and workers may not fully appreciate the potential hazards associated with operating or working near skid-steer loaders and they may not follow safe work procedures for controlling these hazards.”³

It seems as though the problem persists. Additionally, parents' desire to include their children in farm work and have them present in the worksite also persist. In the case of skid steers, these parents may have a false sense of reduced risk given some characteristics of the machine. Overall, there is little previous intervention or evaluation research on skid-steer-related injuries and fatalities in agriculture. This is compounded given the under-surveillance of agricultural injury in general and the youth-related incidents specifically. Therefore, injuries and fatalities involving skid steers may be more complex than currently described. Further research is needed to properly address this ongoing problem.

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Institution and Ethics approval and informed consent

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Author contributions

All authors participated in the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; drafting the work and revising it critically for important intellectual content; final approval of the version to be submitted/published; and all agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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