

Jianfeng Zhou, Pranjali Dubey, Karen Funkenbusch, Marcia C. Shannon
University of Missouri, Columbia, MO (contact: zhoujianf@missouri.edu)

Introduction

More women farmers and producers

- Women principal farm operators in the US increased from 13.7% (2012) to 30% (2027) (*2017 census)
- 1.2+ million women farmers
- More women farmers in animal production than crop production

No suitable tools for women farmers

- Farm tools and equipment are designed for men farmers
- Significant difference in ergonomic features between men and women
- Current farm tools and equipment pose additional health and safety issues to women farmers

Goal

- Identify essential issues of farm tools and equipment used by women farmers/producers
- Provide education programs and solutions to improve health and safety of women farmers
- Develop next-generation tools using ergonomic, engineering, automation and smart technology standards

Health and safety risks for women farmers

Ergonomic features between men and women

- Different in body size, strength, grip force, arm length** (* Wichelhaus et al., 2018)
 - Hand-grip strength: the strongest 10% of women can only beat the bottom 10% of men (*Leyke et al., 2017)
 - Hand length: optimal handle diameter is 19.7% of the user's hand length
 - Women have smaller body size and muscle mass compared with men (* Xiao et al., 2013)
- More injuries on women farmers than men farmers** (* Wichelhaus et al., 2018)
 - Women have significantly greater risk than men for aching fingers and wrists (* Stål and Englund, 2005)
 - Women have more chronic pain compared to men for dairy workers (* Gustafsson et al., 1994)
- Known issues of farm tools and equipment** (* Yoder et al., 2010)
 - Tools were too heavy, too long and not appropriately balanced
 - Mechanized equipment were too heavy, too noisy and difficult to control
 - Handles and grips were not appropriately sized or placed
 - Pedals on tractors were too far from the seat

Example cases



Risks caused by strength

Risks caused by height

Risks caused by small hand

(* figures were from online materials and copyrights belong to original authors)

Agricultural injuries in Missouri – preliminary results

Objective

- Summarize the injuries related to agricultural production in Missouri using public available databases

Data resources

- From 2016 – 2021, focusing on agriculture, forestry, fishing and hunting in Missouri
- (1) Occupational Safety and Health Administration (OSHA) Severe Injury Database
- (2) National Institute for Occupational Safety and Health (NIOSH)
- (3) AgInjuryNews.org (AIN)
- Manually selected to remove duplications

Results

- Reported a total of 446 agricultural injuries (235 fatal and 211 non-fatal) during 2016-2021 in MO. More injuries happened in northern Missouri (**Figure 1**) that has more row crop farms
- Total injuries of each year varied substantially, with less number in 2019 - 2021 may be due to less reports during Covid-19 (**Figure 2**)
- Average monthly injuries in 2016 – 2021 (**Figure 3**) varied substantially, with highest total number of injury in May to July. Non-fatal injuries showed high numbers in September and October
- Less reported injuries involved women (58 cases) compared to men (378 cases), likely due to less serious injuries in incidents involving women that were not reported
- Public data relying on self-report may have substantial bias for analysis

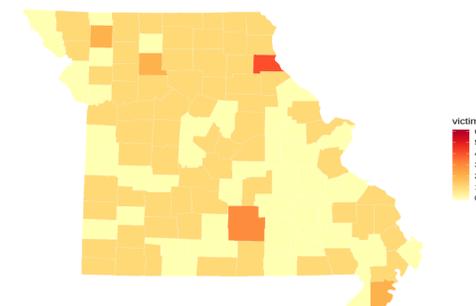


Figure 1. Distribution of injury in counties of Missouri from 2016 - 2021

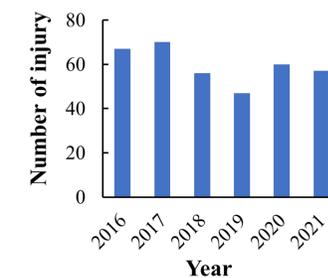


Figure 2. Total injuries of each year from 2016 - 2021

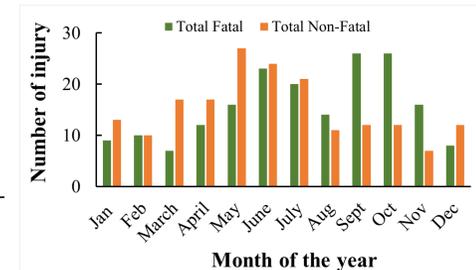


Figure 3. Average injuries of each month from 2016 - 2021

Summary and Future Work

Summary

- Agricultural injury has been less reported and very few data regarding agricultural injury are available
- Substantial difference in injury among month, year, gender and ages
- More fatality injuries than non-fatality injuries were reported, causing bias in data

Future work

- More on-farm and off-farm surveys need to be done regarding injury related to farm tools and equipment
- Evaluate existing tools and equipment using ergonomic assessment tools