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Health Concerns of Women in Agriculture in the Midwestern United States

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ABSTRACT

Objective: In 2022, the USDA Agricultural Census recognized that over one-third of agricultural producers in the United States were female. However, information on the health and safety needs of women working in agriculture is lacking. To help guide the direction of further research to understand the needs of women in agriculture, a brief survey was administered at a conference for agricultural women in the Midwest US. The goal was to understand the priority concerns and whether the concerns differed by age group or by occupational role.

Methods: The survey was conducted in person with women attending a Women in Ag Conference in 2024. Participants were asked their age in six categories, whether they were directly involved in agriculture, and how concerned they were about nine health and safety topics using a 5-point Likert scale. Occupational role was determined by classifying the self-reported job description into five categories, academic/professional, academic/professional and agricultural operator, crop producer, livestock producer, and crop and livestock producer ($n=111$). Descriptive statistics were calculated to describe the age distribution, occupational roles, and differences in concerns. Correspondence analysis was used to analyze and visualize frequency tables. Chi-square and Fisher's Exact tests, and logistic regression were used to explore differences.

Results: Injuries and respiratory exposures significantly differed between women who were both academic/professionals and agricultural operators and those who were only academic/professional. Academics were similar to crop producers, livestock producers were different from all others, and those who were both crop and livestock producers fell between the two. Fewer differences were seen among the age groups. Younger women were most concerned about reproductive health and older women more concerned about mental health and musculoskeletal disorders.

Conclusion: Concerns differed by occupational role and less by age group. Although injuries were of concern for women working in an academic/professional role, they were not a major concern when women also worked a farm or ranch. It is unclear why this might be and further studies need to be conducted to ascertain if these differences can be replicated.

KEYWORDS

Agricultural exposures;
agricultural health;
correspondence analysis;
women in agriculture

Introduction

Over the past several decades, there has been an increase in the number of women who are reporting agriculture as their occupation in the United States.¹ In 2022, the ag census counted 1.2 million female producers, with 58% of all U.S. farms having one or more female producers making decisions about the farm's operation.² In the Midwest between 2017 and 2022, the number of female producers grew by 4%.² However, these numbers may not accurately represent the women in the agricultural workforce due to changes the USDA made to the 2017 Census of Agriculture, which extended the number of reported farm operators from three to four but did not distinguish between

principal operator and other operator on the farm.³ Economists and others studying the increase in female producers have identified community benefits accompanying these trends and recognized the challenges for women working in a male-dominated occupation.^{4–8} Although the number of women working in agriculture is increasing, the representation of their concerns and perceptions in the safety and health literature is not.

A recent scoping review by Wheeler and Nye⁹ highlighted the lack of information on the experiences and perspectives of women in agriculture. Although farming men and women share the same concerns over weather, commodity prices, the cost

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of inputs, succession, and financial issues, women have additional burdens involving exposures that may impact pregnancy and reproductive outcomes, caring for children and other family members, providing insurance by working off the farm, and being a female operator in a male-dominated occupation. Other issues are associated with living in a rural area including loneliness, access to healthcare, broadband availability, and access to quality early childhood care and education for their children. Caring for children and keeping them safe on the farm is a frequently reported stressor for farm women.¹⁰

In addition to the issues highlighted in the Wheeler and Nye review,⁹ women in agriculture are at an increased risk of work-related injuries and illnesses. An article published in *Successful Farming* reports on the overlooked gender-specific risks for women in agriculture.¹¹ These include increased physical work strain that can cause musculoskeletal disorders with increased lower back pain and, in older women, increased risk of breaking bones due to reduced bone strength after menopause. Younger women may have concerns about in utero exposures to pesticides and reproductive outcomes. Few studies have focused on the risk of injuries in female agricultural operators, probably because they are the minority of those working in agriculture.¹² Gender has been identified as an important factor in both fatal and non-fatal agricultural injury, but previous studies tend to compare injury risks in women to those in men, although they perform different tasks.¹³ Men and women in farming are commonly at risk of injuries due to machinery, falls, animals, burns, chemicals, noise, and extreme weather events. However, there are risks that are specific to women, and studies are needed to better understand these risks so interventions targeted to women can be designed and implemented.

A report funded by the Canadian Agricultural Partnership aimed to understand the experiences of Canadian farm women by surveying 1,025 diverse farm women.¹⁴ The results showed women were thinking about safety. Nearly half (46%) said they were responsible for creating a safety plan for their farms, 68% reported they could not find personal protective equipment (PPE) that fit them, 42% said equipment and

machinery were not designed for women, 59% said women were excluded from safety training too frequently, 65% reported that the possibility of being injured caused them stress, and 64% worried about the safety of their children because they could not find daycare. These are concerns expressed by women working in agriculture that they navigate daily.

A vast literature exists on the study of perceived risks in farmers, but nearly all of it is related to production variables such as crop production, input prices, and reduction in income, and how farmers make financial decisions. A review of the literature on perceived assessment of risks in farmers identified 3,283 papers published between 1974 and 2019.¹⁵ Among these 3,283 reports, only 60 reports assessed perceived personal risks. Those reports that examined personal risks included the risk of injury, diseases, and challenging interpersonal relationships that might impact the productivity of the farm, such as divorce.

The preference for a risky option when making a farm decision has been modeled as a combination of expected benefits and perceived risk, and this varies by the specific factor being considered.¹⁶ Farmers make decisions based on their perceived impacts on farm productivity. The same approach to risk assessment could be undertaken to understand how agricultural operators, both male and female, perceive the risks to their health from exposure to agricultural hazards, and how these risks are cognitively associated with farm productivity. The risk assessment literature demonstrates males and females perceive farm risks differently.¹⁷ However, perceived risk is not identical to health concerns. Concerns express objective realities, whereas perceived risks are subjective evaluations. Therefore, concerns and perceived risk are not equivalent, and care must be taken when assessing objective and subjective evaluations. Yet, there has not been a focused analysis on the perceived risk of injury and its impact on farm productivity. We do not know how farmer decision making proceeds when evaluating a risky behavioral option and how potential adverse consequences might impact productivity assessments. This study addresses the gap in understanding health concerns reported by agricultural women in the Midwest. Future research should aim to

understand risk perceptions related to these concerns.

Aside from potential impacts on productivity, injury on a farm or ranch operation is another source of stress. Exposure to chemicals, noise, long work days, awkward working positions involving manual labor, hazardous machinery, working at heights, sun exposure, zoonotic diseases, and other exposures can impact health and are part of the agricultural operator's daily experience. In this report, we examine the concerns of 120 agricultural women in Nebraska. We examine the prevalence of the most common concerns reported in the literature and examine whether these concerns differ by age, by the type of commodity grown, or by occupational role in agriculture. Failure to understand the work-related concerns of agricultural women will hamper efforts to address their health and safety needs and their ability to succeed as agricultural operators.

Methods

Sample

A brief survey was designed to identify health concerns of women involved in agriculture. The paper survey was administered anonymously to women participating in the 2024 Women in Ag Conference in Nebraska. The Central States Center for Agricultural Safety and Health (CS-CASH) intended to use this information to identify research, education, and outreach efforts that could be conducted to address priority issues.

A total of 120 conference attendees responded to the survey. A male and a person who preferred not to report their sex were deleted from the sample, since the focus was on women working in agriculture. Women were asked "Are you currently involved in agriculture," with response options "yes" or "no". If the response was "yes," then women were asked to "briefly describe your involvement in agriculture (example: I raise bees and sell honey). Women were included if they responded to the open-ended question and described their agricultural activity.

Nine questions asked about specific health concerns on a 5-point Likert Scale (not at all concerned, slightly concerned, moderately concerned,

very concerned, and extremely concerned). The topics included musculoskeletal disorders, reproductive health concerns, respiratory issues, skin disorders, mental health challenges, injuries, exposure to zoonotic diseases, limited access to health-care, and personal protective equipment (PPE). Each topic heading was followed by a brief description of the issue area, generated using the generative AI program ChatGPT to help provide context to respondents.

A total of 120 women reported being involved in agriculture. Age was collected in six categories (<18, 19–30, 31–40, 41–50, 51–60, 60+), but due to small numbers in some of the categories, age categories were collapsed into three categories (≤ 30 = young, 31–50 = middle, ≥ 51 = older). One person did not report age. The open-ended, agricultural role question was recoded into five occupational groups based on their reported involvement in agriculture. These groups were based on commodity type and whether they were in an academic or professional position with an agricultural focus. The five categories were academic/professional ("academic"), academic/professional and agricultural operation ("academic ag"), crop operation, livestock operation, or both crop and livestock operation. Nine women could not be coded into these five categories, because they were not directly involved in agricultural work and were excluded from the analysis for a final sample size of 111.

The responses to the health concern questions were reported descriptively as a mean and standard deviation and were recoded to a binary variable due to the sample size. Not at all concerned or slightly concerned were coded as a zero and being moderately, very, or extremely concerned were coded as a one. Women were given the option of responding "not applicable", depending on relevance to their specific area of agriculture, leading to variance in the sample size by concern.

Statistical analysis

Numbers and frequencies were reported for each age group, agricultural commodity group, and safety and health concerns ("concerns"). Concerns were summarized with a mean and

standard deviation using the original 5-point Likert scale and using frequency of those expressing at least moderate concern after recoding the data into a binary variable.

The goal of the statistical analysis was to determine whether concerns differed by age group or by the occupational commodity group women were assigned based on self-reports. We chose correspondence analysis (CA) as a way of analyzing and visualizing a contingency table to understand the relationships between the table rows and columns.^{18,19} CA resembles principal components analysis (PCA) for continuous variables. CA compares the conditional probabilities by row or column to the marginal probabilities to generate either a row or column profile, which are symmetric and equivalent. The idea is to assess whether the data are independent from one another by calculating the distance between the row or column profiles and comparing them to the row or column marginals (the means), which is a measure of deviations from independence. The first dimension represents the most general pattern in the data, because it explains the most variance. The subsequent dimensions represent more specific relationships in the data, because they explain consecutively lesser amounts of the variance between the rows and columns.

Two contingency tables were created, one for age group by concern and a second for commodity group by concern and used in separate analyses. We calculated the chi-square to test for overall independence but did not expect to see significant differences, since the cell sizes were somewhat small in a few columns of these tables. We calculated the eigenvalues generated after partitioning the data into dimensions, as in PCA. The dimensions represent a grouping of the common concerns expressed by the respondents and can be thought of as patterns in the variables. The number of dimensions possible is the number of categories minus one. Three age categories will produce two dimensions, and five occupational categories will produce four dimensions. The eigenvalue is a measure of how much variance is explained by the variables in the table.

The biplot was used to visualize how the age or commodity categories differed by the safety and health concern categories. If the two variables were

independent, all points would be centered around the origin of the graph. The further the data are from the origin in the x or y direction, the further the variables are from being independent from one another. Concerns closer together are more similar, and those farther apart are more different, and these are plotted by how close they are to either the woman's age or her role in agriculture. When observed differences were noted in the age or commodity/role groups, additional analyses were conducted to understand these differences. These analyses included Fisher's exact tests and logistic regression. We report p-values for the Fisher's exact test with statistical significance set at $\alpha = 0.05$. We report odds ratios (OR) and 95% confidence intervals from logistic regression models. The CA was conducted in R,²⁰ and the additional analyses were conducted in SAS 9.4 (The SAS Institute, Cary NC).

Results

Description of the sample

The number of women in each age category was similar, although there were fewer women in the middle age category. The numbers in each occupational agricultural group were also similar, except for the academic/professional and operator having the fewest number of respondents (Table 1). The percentage of those reporting being moderately, very, or extremely concerned about each of the issues ranged from 40.5% for exposure to zoonotic diseases to 78.0% for work-related injuries. The means of the concern questions showed respiratory issues were of most concern at 3.53 and zoonotic diseases were of lowest concern at 2.41. The means indicate that for most women, all the issues were of slight to moderate concern.

Correspondence analysis: age and safety and health concerns

As expected, the first dimension explained most of the variance in the data (81.5%), and the second dimension explained 18.5% (Figure 1). These dimensions represent characteristics that differ by age. There were no statistically significant differences in concerns by the woman's age group in a chi-square test overall. However, the

Table 1. Descriptive statistics for age category, commodity/occupational group, and recoded safety and health concerns; means and standards for health concerns questions prior to recoding, 2024.

Variable	n (%)	Mean (SD)
Age		
Young (≤ 30 years of age)	46 (38.0)	NA
Middle (31–50 years of age)	32 (26.5)	
Older (≥ 51 years of age)	43 (35.5)	
Commodity/Occupational Group		
Academic/Professional	22 (19.5)	NA
Academic/Professional + operator (crop and/or livestock)	13 (11.5)	
Crop operation	28 (24.8)	
Livestock operation	27 (23.9)	
Crop and livestock operation	23 (20.3)	
Health concerns *		
Musculoskeletal disorders	63 (52.9)	2.67 (1.14)
Reproductive health concerns	58 (52.7)	2.75 (1.44)
Respiratory issues	93 (77.5)	3.53 (1.24)
Skin disorders	73 (61.3)	2.93 (1.16)
Mental health challenges	86 (71.7)	3.41 (1.33)
Work-related injuries	92 (78.0)	3.26 (1.10)
Exposure to zoonotic diseases	45 (40.5)	2.41 (1.19)
Limited access to healthcare	70 (58.3)	2.82 (1.34)
Personal protective equipment, fit and availability	60 (50.0)	2.63 (1.27)

*Leftmost column is the percentage responding that they were moderately, very, or extremely concerned about this topic and rightmost column is the mean and standard deviation for the full 5-point Likert scale before recoding the variables.

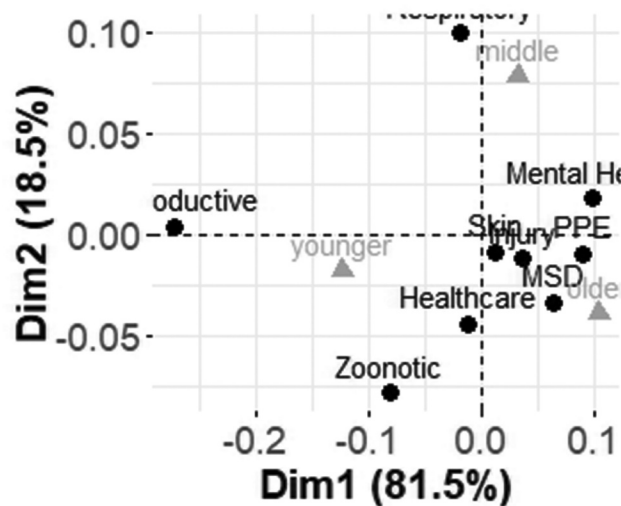


Figure 1. Biplot from correspondence analysis showing spatial representation of concerns by age.

correspondence analysis was able to identify categories that contributed most to separation of the three age groups. In younger women, who contributed 57.7% to dimension 1, reproduction (67.6%) and mental health (13.3%) were of greatest concern, and all other concerns contributed less than 4%. For women in the middle age category,

who contributed 70.9% to dimension 2, respiratory exposures were a primary concern (63.3%). Older women fell between the two dimensions (39.5% to dimension 1 and 24.2% to dimension 2) and had a wider range of concerns (PPE use, musculoskeletal disorders (MSD), injury, skin disorders, healthcare access).

Correspondence analysis: commodity/ag role and safety and health concerns

The eigenvalues of the four dimensions were 52.9%, 25.0%, 17.8%, and 4.3%, indicating about half of the variance was explained in the first dimension and over 75% in the first two dimensions. Dimension 1 was dominated by reproductive (40.4%) and respiratory (18.5%) health concerns; the remaining concerns contributed less than 5% each. The second dimension was dominated by musculoskeletal disorders (51.5%) and less so, reproductive health (9.9%) with the remaining at less than 6% each. The third dimension was dominated by injury concerns (39.8%) and mental health (10.3%), with the remaining concerns at less than 7% each. The fourth

dimension was evenly split between reproductive and mental health concerns at about 17% each, with the remaining concerns at less than 6% each. Overall, three of four dimensions were clearly dominated by specific issues (reproductive, musculoskeletal disorders, and injury).

The groups of women separated out based on their self-reported roles in agriculture (Figure 2). The group that was purely academic were 59.3% of dimension 4. Women who were both in academic or professional roles and were agricultural operators were 63.2% of dimension 2. Women who reported being crop producers were dominant in dimension 1 (25.3%) and dimension 3 (33.8%). Livestock producers were the majority of dimension 1 at 59.4%. Women who were both crop and livestock producers were split between dimensions 2 and 3.

The biplot of the first two dimensions shows that the women who were academic operators were separated from the other groups in both the x and y directions (Figure 3). Livestock producers were most defined by their concerns about reproductive and respiratory exposures. Academics and crop producers endorsed similar concerns such as healthcare access, mental health, PPE use, skin disorders, injury, and zoonotic diseases. Those who were both crop and livestock producers fell in the center of the graph. Musculoskeletal disorders were more closely related to being both a crop and livestock producer and only a livestock

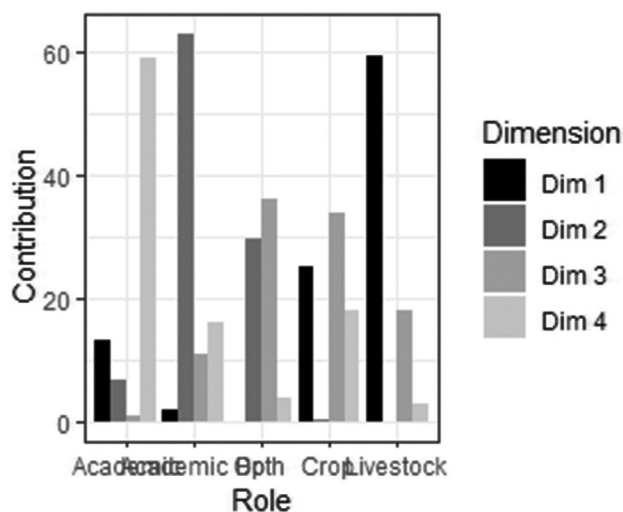


Figure 2. Contributions to the four dimensions differed by agricultural commodity and academic group.

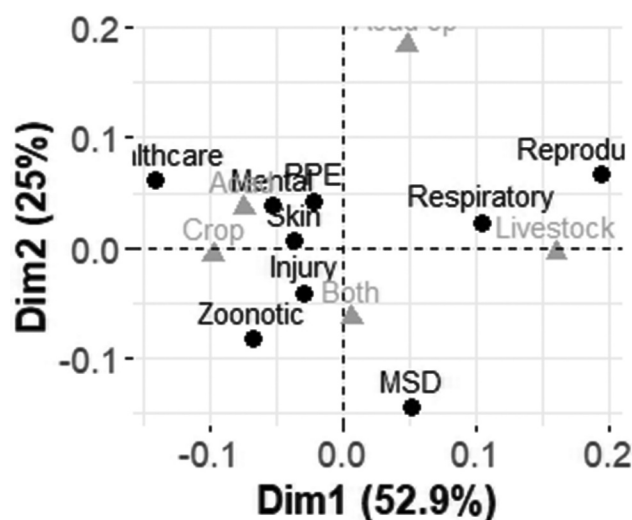


Figure 3. Biplot from correspondence analysis showing spatial representation of concerns by commodity produced and agricultural role.

producer, but far from academics, crop producers, and academic agricultural operators. Livestock producers may be most concerned with musculoskeletal disorders, respiratory, and reproductive exposures.

Only 13 women populated the academic ag operator category. Despite this, they were significantly less likely to express concerns about injuries ($p = .0016$) and respiratory exposures ($p = .04$) compared to the other combined categories of women in a Fisher's exact test. To further understand this result, a logistic regression model was used with injury concerns as the outcome, and four indicator variables were included for each of the agricultural commodity roles, with the academic role as the reference group. Only the academic ag operator significantly differed from an academic only respondent (OR 6.40, 95% confidence interval 1.53, 26.8). Women who were in an academic role were more than six times more likely to report injuries as a concern than women who were both agricultural academics and farm/ranch operators.

Discussion

The perception that work-related injuries are a concern of interest statistically significantly differed when women were both an academic/

professional and an agricultural operator compared to being only an academic/professional involved in agriculture. This result suggests that compared to those working in ag, academic safety and health specialists might overemphasize injury compared to all other adverse occupational hazards experienced by women. Academic and other agricultural professionals see injuries as more of a problem than their counterparts who are working on an agricultural operation who have many other occupational hazards in their daily lives. The academic/professionals are more likely to agree with crop producers about safety and health concerns than they are with academic/professionals who also farm or ranch. Differences were more apparent by agricultural role/commodity than by age in this sample of women.

Younger women, and probably younger women in the middle age category, expressed concerns about reproductive risks in agriculture. Few studies have been conducted to understand the concerns around reproductive hazards that agricultural women worry about. Older women had greater concerns about several issues including musculoskeletal disorders. Previous studies have found musculoskeletal symptoms are associated with increased stress,²¹ and in ag women an increased number of musculoskeletal symptoms were associated with a greater risk of a work-related injury.²² The women in the current study probably understand the burden that experiencing a musculoskeletal disorder has on their work lives, especially as they get older. There are not many proven prevention strategies that address these issues in women, whose bodies experience more strain than male bodies.¹¹

It was somewhat surprising that mental health was not of wider concern in younger women and was reported more by older women. The literature suggests younger women are experiencing greater stress due to raising families and working on and off the farm.^{23,24}

Three of the five occupational groups dominated a particular dimension. This result supports the separation of the groups by specific concerns. The academic/professional group dominated dimension four, the academic/professional operator group dominated dimension two, and the

livestock operator dominated dimension three. The groups that were both crop and livestock producers and crop producers did not dominate strongly any single dimension, but were not identical either, showing broader concerns than the other three groups.

This survey was conducted for the purpose of collecting data for a larger survey of farm and ranch women to better understand the work they are doing on the operation and what their needs are. One challenge is the need for PPE that fits women, also a concern expressed in Canadian farming women.¹⁴ There is a lack of development and marketing of PPE that fits different female body types.²⁵ Making PPE for women does not necessarily mean just reducing the size, it also means changing the shape and structure based on anthropometric data. Fit testing of respirators in rural areas can also be a challenge due to the lack of qualified individuals that can do fit testing. It is not known whether these women were mixing or applying pesticides, but because of their proximity to crops and livestock, they were probably exposed to pesticides. Whether pesticide exposures were of concern in relation to reproductive worries requires additional research.

The concerns of women in agriculture are not simply a problem of developed countries but are even more urgent in developing countries. According to Oxfam International, 80% of the world's food production comes from small farms, and on these farms, women are doing 43% of the agricultural labor.²⁶ This is a group of agricultural workers and operators whose health and safety needs are not being addressed. More effort is needed to provide affordable PPE designed to fit a woman's body and resources and education to prevent injury and musculoskeletal disorders, among other concerns of women in agriculture.

Although this report focuses on concerns of women working in agriculture, it does not inform us as to the perceived risks of these concerns and how these risks might impact their agricultural operations' productivity. More work needs to be done to understand how women make decisions about wearing PPE, taking preventive measures to avoid an MSD, and other concerns expressed in this and other reports. Women may be more risk-averse in economic matters related to the farm operation, but are

they more risk-averse in safety behaviors also? Qualitative studies might be useful to provide more depth to the relationship between concerns women expressed in the current report and their perceptions and understanding of the risks.

The limitation of this study was that the questionnaire was brief, but it needed to be at an agricultural event. The disadvantage is we could not ask about many other possible safety and health concerns that might have been relevant to this sample. This was a convenience sample, so there is the possibility of self-selection bias, where it is likely that those who think about the exposures and hazards of living and working on a farm or ranch operation would be most likely to respond. Also, the number of respondents who were both academic/professional and agricultural operators was small. However, even in a somewhat small sample, we found statistically significant differences.

Correspondence analysis was an informative and meaningful way to analyze contingency table data. Being able to visualize how the groups formed around concerns was useful in understanding what most mattered to them. A larger sample size would likely have produced more significant results, but a follow-up study can be conducted to confirm these initial findings.

Conclusion

Based on preliminary data, agricultural operators who are also in academic or professional agricultural roles have fewer concerns about health and safety than those who were not agricultural operators but were academics or professionals. Specifically, injuries were of greater concern to those in academic or professional agricultural occupations but not in those who also worked in an agricultural operation. More follow-up is needed on this finding. Age was less important at classifying concerns compared to their occupational role in agriculture. Livestock and crop producers have different concerns and agricultural safety and health resources may need to be tailored and targeted to these two groups.

Disclosure statement

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Data availability statement

Data are available upon reasonable request to the corresponding author.

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References

1. USDA. National Agricultural Statistics Service. Female producers. https://www.nass.usda.gov/Publications/Highlights/2019/2017Census_Female_Producers.pdf. 2019.
2. USDA. Census of agriculture. National Agricultural Statistics Service. <https://www.nass.usda.gov/AgCensus/>. 2022.
3. Pilgeram R, Dentzman K, Lewin P, Conley K. How the USDA changed the way women farmers are counted in the Census of Agriculture. *Choices*. 2020;35:1–10.
4. Fremstad A, Paul M. Opening the farm gate to women? The gender gap in US agriculture. *J Econ Issues*. 2020;54(1):124–141. doi: 10.1080/00213624.2020.1720569.
5. Schmidt C, Goetz SJ, Tian Z. Female farmers in the United States: research needs and policy questions. *Food Policy*. 2021;101:102039. doi: 10.1016/j.foodpol.2021.102039.
6. Schmidt C, Deller SC, Goetz SJ. Women farmers and community well-being under modeling uncertainty. *Appl Econ Perspect Policy*. 2024;46(1):275–299. doi: 10.1002/aep.13406.
7. Trauger A. “Because they can do the work”: women farmers in sustainable agriculture in Pennsylvania, USA. *Gend Place Cult*. 2004;11(2):289–307. doi: 10.1080/0966369042000218491.
8. Trauger A, Sachs C, Barbercheck M, Brasier K, Kiernan NE. “Our market is our community”: women farmers and civic agriculture in Pennsylvania, USA. *Agric Hum Values*. 2010;27(1):43–55. doi: 10.1007/s10460-008-9190-5.
9. Wheeler R, Nye C. The health and well-being of women in farming: a systematic scoping review.

- J Agromed.* 2025;30(1):132–152. doi: [10.1080/1059924X.2024.2407385](https://doi.org/10.1080/1059924X.2024.2407385).
10. Becot F, Inwood S, Budge H. “The source of all my joy and all my stress”: children and childcare as under-appreciated sources of stress that affect farm women. *J Agromed.* 2025;30(1):114–131. doi: [10.1080/1059924X.2024.2427800](https://doi.org/10.1080/1059924X.2024.2427800).
 11. Prater LF. Health needs of women in Ag overlooked. *Successful Farming*. Family: Health and Safety. [about 8 screens]. <https://www.agriculture.com/family/health-safety/health-needs-of-women-in-ag-overlooked#:~:text=Broken%20bones:%20Emanuel%20noted%20that,seats%20that%20are%20continuously%20vibrating>. May 18, 2022. Accessed March 26, 2025.
 12. Dimich-Ward H, Guernsey JR, Pickett W, Renie D, Hartling L, Brison RJ. Gender differences in the occurrence of farm related injuries. *Occup Environ Med.* 2004;61(1):52–56.
 13. Karttunen JP, Rautiainen RH, Quendler E. Gender division of farm work and occupational injuries. *J Agric Saf Health.* 2019;25(3):117–127. doi: [10.13031/jash.13177](https://doi.org/10.13031/jash.13177).
 14. Allin M, Wilbur B, Watson H. Expanding opportunities for Canadian agriculture by understanding the experience of farm women. Farm Management Canada and Centric Engine, Inc. <https://casa-acsa.ca/wp-content/uploads/Understanding-the-Experience-of-Farm-Women.pdf>. 2023.
 15. Komarek AM, De Pinto A, Smith VH. A review of types of risks in agriculture: what we know and what we need to know. *Agric Syst.* 2020;178:102738. doi: [10.1016/j.agry.2019.102738](https://doi.org/10.1016/j.agry.2019.102738).
 16. Hansson H, Lagerkvist CJ. Measuring farmers’ preferences for risk: a domain-specific risk preference scale. *J Risk Res.* 2012;15(7):737–753. doi: [10.1080/13669877.2012.657217](https://doi.org/10.1080/13669877.2012.657217).
 17. Osiemo J, Ruben R, Girvetz E. Farmer perceptions of agricultural risks; which risk attributes matter most for men and women. *Sustainability.* 2021;13(23):12978. doi: [10.3390/su132312978](https://doi.org/10.3390/su132312978).
 18. Moser EB. Exploring contingency tables with correspondence analysis. *Comput Appl Biosci.* 1989;5(3):183–189. doi: [10.1093/bioinformatics/5.3.183](https://doi.org/10.1093/bioinformatics/5.3.183).
 19. Sourial N, Wolfson C, Zhu B, et al. Correspondence analysis is a useful tool to uncover the relationships among categorical variables. *J Clin Epidemiol.* 2010;63(6):638–646. doi: [10.1016/j.jclinepi.2009.08.008](https://doi.org/10.1016/j.jclinepi.2009.08.008).
 20. R Core Team. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing; 2021. <https://www.R-project.org/>.
 21. Chengane S, Beseler CL, Duysen EG, Rautiainen RH. Occupational stress among farm and ranch operators from a seven state surveillance system in the Midwestern United States. *BMC Public Health.* 2021;21(1):2076. doi: [10.1186/s12889-021-12053-4](https://doi.org/10.1186/s12889-021-12053-4).
 22. Beseler CL, Rautiainen RH. Using machine learning to understand injuries in female agricultural operators in the Central United States. *Safety.* 2025;11(1):9. doi: [10.3390/safety11010009](https://doi.org/10.3390/safety11010009).
 23. Beseler CL, Rautiainen RH. Injury, musculoskeletal symptoms, and stress as a function of aging in agricultural operators. *Workplace Health Saf.* 2023;17(12):597–605. doi: [10.1177/21650799231186155](https://doi.org/10.1177/21650799231186155).
 24. Nichols CE, Davis J. The women farmer stress inventory: examining women farmer stress in the United States Corn Belt. *J Rural Health.* 2024;40(3):457–466. doi: [10.1111/jrh.12808](https://doi.org/10.1111/jrh.12808).
 25. Flynn MA, Keller B, DeLaney SC. Promotion of alternative-sized personal protective equipment. *J Saf Res.* 2017;63:43–46. doi: [10.1016/j.jsr.2017.08.004](https://doi.org/10.1016/j.jsr.2017.08.004).
 26. Oxfam International. Empowering women farmers to end hunger and poverty. Rural Women. [about 4 screens]. <https://www.oxfam.org/en/empowering-women-farmers-end-hunger-and-poverty#:~:text=About%2080%20percent%20of%20the,the%20barriers%20holding%20back%20women>. 2025. Accessed April 6, 2025.