

Article

Identifying Agricultural Injuries Requiring Trauma Care in Florida

Madison W. Moore ¹, Serap Gorucu ^{1,*}, Daeun Choi ², Xu Wang ² and Nikolay A. Bliznyuk ^{1,3,*}

¹ Department of Agricultural and Biological Engineering, University of Florida, 1741 Museum Road, Gainesville, FL 32611, USA; moore.madison@ufl.edu

² Department of Agricultural and Biological Engineering, Gulf Coast Research and Education Center, University of Florida, Wimauma, FL 33598, USA; dana.choi@ufl.edu (D.C.); xuwang1@ufl.edu (X.W.)

³ Department of Statistics, University of Florida, Gainesville, FL 32611, USA

* Correspondence: serapgorucu@ufl.edu (S.G.); nbliznyuk@ufl.edu (N.A.B.)

Abstract

Agriculture remains one of the most hazardous industries in the United States, yet nonfatal surveillance remains incomplete. Prior studies have shown that trauma registries can support agricultural injury surveillance, but many approaches rely on text review, state-specific indicators, or coding frameworks that are not easily transferable across systems. In this study, Florida Trauma Registry records from 2016 to 2021 were screened using a reproducible case definition based on International Classification of Diseases, Tenth Revision (ICD-10) external cause of injury codes, registry occupation and industry fields, and the work-related indicator. Agricultural injuries were summarized descriptively and mapped to Occupational Injury and Illness Classification System (OIICS) categories. Injury severity scores (ISS) were modeled using generalized additive models (GAMs). The case definition identified 963 agricultural injuries requiring trauma care, including 17 fatalities. Most injuries were minor, and the leading event categories were contact incidents, falls, slips, and trips, and transportation incidents. Body region was the strongest correlate of severity, with head and abdomen/pelvic contents injuries showing the highest adjusted ISS. These findings suggest that the National Trauma Data Standard (NTDS)-aligned trauma registry fields may support reproducible agricultural injury surveillance when narrative text is unavailable.

Keywords: agricultural injury surveillance; trauma registry; ICD-10; injury severity score

1. Introduction

Agriculture remains one of the most hazardous industries in the United States, yet the true burden of nonfatal agricultural injury is difficult to quantify [1]. Many commonly used surveillance sources including workers' compensation claims, Bureau of Labor Statistics occupational injury surveillance systems, and electronic news clipping systems, are incomplete and may fail to capture all injuries [1,2]. In addition, industry and occupation are often incompletely recorded in routine health data, limiting the direct identification of agricultural injuries and motivating the development of alternative surveillance strategies based on diagnosis and external cause coding [2].

Trauma registries are one promising source for agricultural injury surveillance because they capture serious injuries requiring trauma system care and contain clinically rich information on injury mechanisms, body region, and severity [3–8]. Prior registry-based studies have shown that agricultural injuries can be identified using International Classification of Diseases (ICD)-coded hospital data, but the underlying methods have differed



Academic Editor: Raphael Grzebieta

Received: 14 May 2026

Revised: 19 July 2026

Accepted: 23 July 2026

Published: 27 July 2026

Copyright: © 2026 by the authors.

Licensee MDPI, Basel, Switzerland.

This article is an open access article distributed under the terms and conditions of the [Creative Commons Attribution \(CC BY\)](https://creativecommons.org/licenses/by/4.0/) license.

across settings. International Classification of Diseases, Tenth Revision (ICD-10) codes are standardized diagnostic and external cause codes used in administrative and clinical health data [8]. In Iowa, trauma registry data has been used to examine trends in nonfatal agricultural injuries requiring trauma care, to compare characteristics of injuries by workers' compensation coverage status, and to evaluate specific subsets of agricultural trauma such as tractor-related injuries [3,4,6,7]. Trauma registry data has also been used to examine agricultural trauma in South Dakota, where work-related agricultural injuries were a particular focus [5]. More recently, Cook et al. demonstrated the utility of a regional trauma registry in northeast Texas for agricultural injury surveillance, further supporting trauma systems as a valuable source for identifying severe agricultural injuries [8]. Together, these studies show that trauma registries can support agricultural injury surveillance across different geographic settings, but they also highlight substantial variation in case definitions, study populations, and available registry elements. Some studies relied on state-specific work or farm indicators, whereas others used free-text narratives or narrower injury subsets to improve case definition or classify mechanisms [3–8]. These approaches may improve case ascertainment within a single system but are less portable across jurisdictions that do not collect the same indicators or do not provide narrative text for research use.

The transition from ICD-9 to ICD-10 expanded the specificity of external cause coding and improved the potential utility of health data for occupational injury surveillance [2,9]. Trauma registries that follow the National Trauma Data Standard (NTDS) collect ICD-10 diagnosis and external cause of injury codes as structured coded data elements, along with standardized registry fields such as injury location, work-relatedness, occupation, and occupational industry. Together, these NTDS-aligned fields can support agricultural injury surveillance because agricultural trauma is often difficult to identify from a single code alone and requires combining indicators of setting, mechanism, and work-related context. Recent work has emphasized that structured industry and occupation information in electronic health data could substantially strengthen occupational agricultural injury surveillance [2]. However, to our knowledge, no studies have evaluated whether the NTDS-aligned trauma registry variables alone are sufficient to support reproducible identification of agricultural trauma in a large, agriculturally diverse state.

Florida provides an important setting for this question. Its agricultural sector operates year-round, includes a heterogeneous workforce, and encompasses crop, livestock, and equine operations with mixed home, work, and road environments that may not be fully reflected in national summaries [10]. Additionally, systematic nonfatal agricultural injury data has not been captured in Florida since 2010, leaving an important gap in state-specific surveillance [11]. Despite these characteristics, Florida-specific evidence on agricultural injuries that required trauma care remains limited [10]. A transparent trauma registry method tailored to Florida could improve statewide surveillance and provide a framework for evaluation and adaptation in other NTDS-aligned registries.

Therefore, the objectives of this study were to develop a structured case definition for identifying agricultural injuries in the Florida Trauma Registry, to describe the demographic, mechanistic, and anatomic patterns of identified injuries, and to assess which injury characteristics were associated with higher injury severity score (ISS) after adjustment for demographic covariates. We hypothesized that a reproducible ICD-10 and registry-based case definition would identify a meaningful burden of agricultural trauma in Florida.

2. Materials and Methods

This research was reviewed and approved by both the Florida Department of Health Institutional Review Board (IRB) (Protocol #2023-013) and the University of Florida IRB (IRB202301661). The data granted for this study cannot be made publicly available.

2.1. Data Source

This study used the Florida Trauma Registry, a statewide trauma surveillance system containing records from verified and provisional trauma centers in Florida. The registry follows National Trauma Data Standard (NTDS) conventions and includes demographic, diagnostic, clinical, and outcome information for trauma patients. The data for this study span the years 2016 to 2021.

The Florida Trauma Registry contains linked tables with information on patient demographics, diagnoses, injury severity, outcomes, procedures, occupation and industry variables, and external cause coding. Records were linked using the unique trauma identifier assigned within the registry.

2.2. Case Definition Development

Agricultural case identification was performed programmatically using variables within the trauma registry. Indicators included ICD-10 external cause of injury codes, ICD-10 place of occurrence codes, patient occupation, and patient industry (Table 1).

Table 1. Selection Criteria for Agricultural Incidents.

Key Variables	Codes	Definition
Primary/Secondary ICD-10 Codes Starting With	W30	Contact with agricultural machinery
	V84	Occupant of special agricultural vehicle mainly used in agriculture injured in transport accident
	W55.2	Contact with cow
	W55.4	Contact with pig
Place of Injury Code	Y92.7	Farm as the place of occurrence of the external cause
Patient's Occupational Industry	5	Agriculture, Forestry, Fishing
Patient's Occupation	9	Farming, Fishing, and Forestry

The case definition was designed to identify injuries occurring during agricultural work or in agricultural settings while minimizing the inclusion of non-agricultural injuries captured through broad external-cause, place-of-occurrence, occupation, or industry categories. Candidate records were identified if they met at least one of the selection criteria listed in Table 1, including an agricultural-specific ICD-10 external cause code, farm as the place of occurrence, an agricultural occupational industry code, or an agricultural occupation code. Records meeting multiple criteria were combined at the unique trauma-record level before exclusions were applied.

Ambiguous records were evaluated based on the available ICD-10 external cause codes, place of occurrence codes, occupation, industry, and work-related indicator. Cases indicating forestry or fishing were removed because the registry occupation and industry categories combine agriculture with forestry and fishing. Horse-related injuries were retained only when the record was marked as work-related; horse-related records without a work-related indicator were excluded because they could represent recreational or leisure activities. Records indicating a residential setting were excluded unless another structured variable clearly supported an agricultural work context. Transportation-related injuries were retained when the external cause code identified a special agricultural vehicle or when occupation, industry, or work-relatedness supported an agricultural context. Otherwise, transportation injuries without evidence of an agricultural association were excluded. Additional records were removed when their coded circumstances indicated recreational, non-agricultural residential, non-agricultural industrial, forestry, fishing, or other clearly

non-agricultural contexts. The case identification logic and sequential exclusions are summarized in Figure 1.

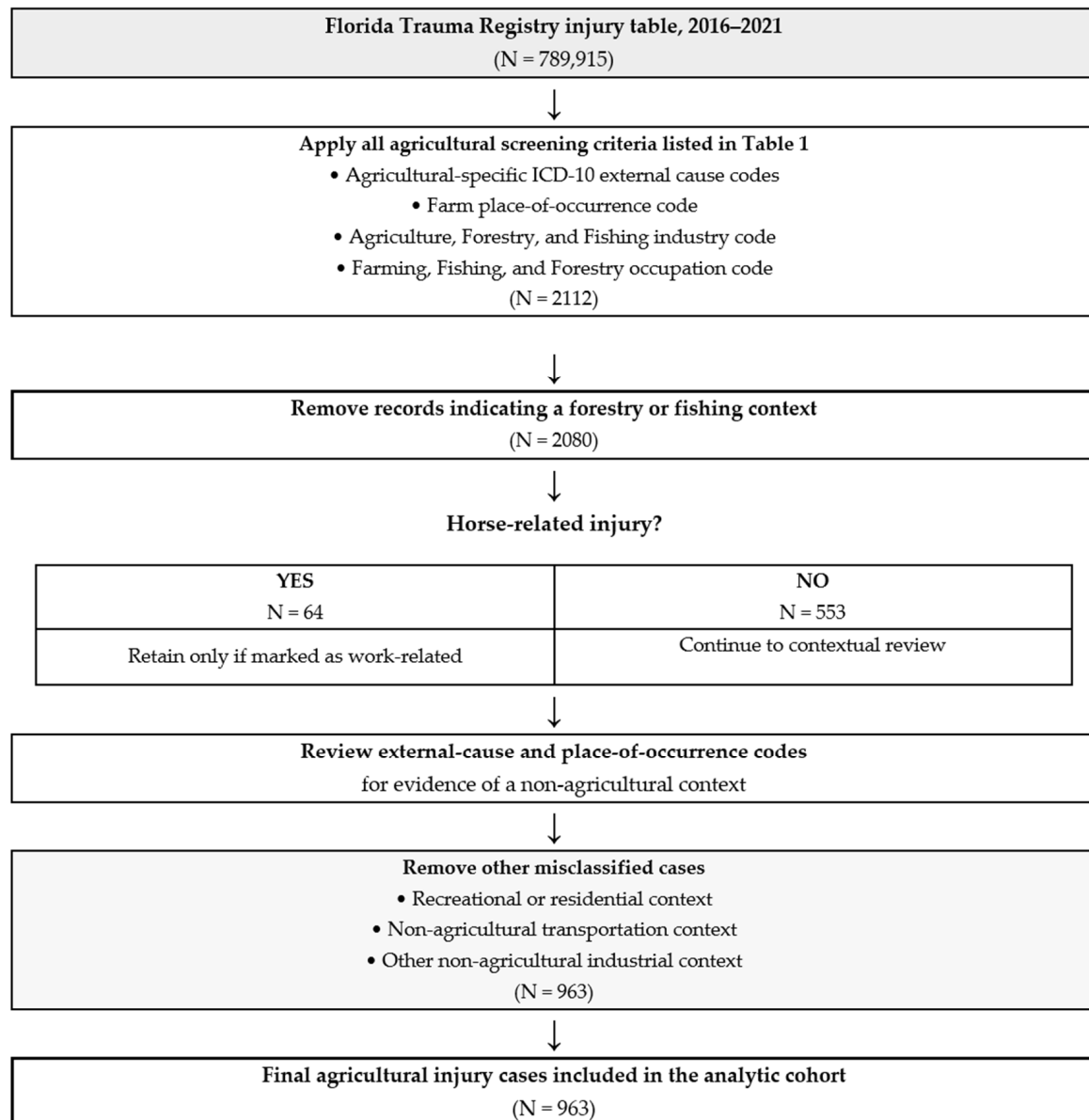


Figure 1. Agricultural Injury Case Selection Process.

Individuals younger than 16 years old were retained because the case definition was designed to identify agricultural-related injuries rather than injuries occurring exclusively during formal employment. Agricultural worksites and residences often overlap, potentially exposing children and other non-working family members to farm hazards while living on or visiting farms [12]. Pediatric cases may therefore include youth performing legally permitted work on a family-operated farm, unpaid family work, bystanders, passengers, or children injured in a farm setting. Federal agricultural labor provisions permit minors of any age to work for their parents on a farm owned or operated by their parent or parents [13].

2.3. Descriptive Measures and Analysis

Descriptive analyses were used to characterize the burden, severity, demographic distribution, anatomic distribution, and external cause patterns of identified agricultural

trauma cases. The principal descriptive measures included the number of identified agricultural injury cases, fatalities, demographic characteristics, ISS category, injured body region, and external cause patterns. Categorical variables were summarized using counts and percentages.

ISS was used as the primary measure of overall trauma severity. ISS is a standardized anatomical scoring system ranging from 1 to 75, with higher scores indicating more severe injury. Severity was categorized as minor (ISS 1–8), moderate (ISS 9–15), and severe/critical (ISS ≥ 16) [3].

ICD-10 external cause of injury codes were mapped to Occupational Injury and Illness Classification System (OIICS) categories to describe injury mechanisms using a classification system commonly used in occupational injury surveillance. Codes were first aligned with an available ICD-10 to OIICS crosswalk and then updated to OIICS version 3.0 [2]. OIICS event and source categories were summarized.

2.4. Statistical Analysis

The main analytic objective was to evaluate factors associated with higher ISS among agricultural trauma cases. ISS was used as the primary measure of overall trauma severity. Because ISS is a positive, right-skewed continuous outcome, two generalized additive model (GAM) specifications were compared: a Gaussian GAM fit to the natural logarithm of ISS and a Gamma GAM with a log link fit to ISS on its original scale.

GAMs provide a flexible extension of generalized linear models by allowing selected predictors to have smooth, nonlinear relationships with the outcome rather than requiring all relationships to be linear [14]. This flexibility is achieved by “learning” these nonlinear associations from the data, commonly through penalized spline terms, while still permitting conventional parametric terms for categorical predictors [15–18]. GAMs are therefore useful for injury surveillance applications where relationships between severity and predictors such as age may not follow a simple linear pattern and where the shapes of the nonlinear associations are not known in advance and must be estimated from data using basis function expansions [19,20].

For the log-Gaussian model, ISS was log-transformed before modeling to reduce skewness and improve agreement with Gaussian model assumptions. For the Gamma model, ISS was modeled directly as a positive continuous outcome using a log link. Under this specification, the logarithm of the expected ISS was modeled as a function of demographic, mechanistic, and anatomic characteristic. The candidate predictors included injured body region, OIICS event category, sex, age, and ethnicity. Age was included nonparametrically as a penalized cubic regression spline to allow a nonlinear association with ISS, while categorical variables were included as parametric model terms.

Missing values for categorical predictors were retained in the analysis by assigning them to an Unknown category. This approach allowed records with incomplete categorical information to remain in the GAM analysis rather than being excluded through complete-case analysis.

OIICS event and OIICS source were not included together in the same multivariable model because the two classifications describe related aspects of the injury mechanism and may be correlated. OIICS event was retained as the primary mechanistic predictor in the final severity model. Smoothing parameters were estimated using restricted maximum likelihood.

Model diagnostics and performance were evaluated to compare the Gaussian model fit to the log-transformed ISS and the Gamma model with a log link. Model evaluation included assessment of the observed ISS distribution, consideration of whether each model specification was appropriate for a positive, right-skewed outcome, and comparison of

predictive performance using five-fold cross-validation. Predictive accuracy was assessed using root mean square error and mean absolute error calculated on held-out folds to evaluate out-of-sample performance. Folds were stratified across key variables to preserve representation of sparse subgroups of the categorical variables. The selected model was refit to the full analytic dataset for inference. Model coefficients were exponentiated to obtain adjusted ISS ratios, which were used to summarize proportional differences in expected ISS for each predictor relative to its reference category. Statistical analyses were conducted in R version 4.5.1 [21], and GAMs were fit using the mgcv package version 1.8-42 [22].

3. Results

3.1. Demographic and Severity Characteristics

The case definition identified 963 agricultural injuries requiring trauma care in Florida from 2016 to 2021, including 17 fatalities. Most injuries were classified as minor (55.7%), followed by moderate (29.8%) and severe/critical (14.5%). The median ISS was 5. The cohort was predominantly male (76.2%), non-Hispanic, and White (80.3%). The largest age groups were 35–59 years, followed by 60–74 years and 20–34 years (Table 2). Cases involving individuals younger than 16 years may include youth performing legally permitted work on a family-operated farm, unpaid family workers, bystanders, or children injured in an agricultural setting and should not be interpreted as injuries among formally employed agricultural workers.

Table 2. Demographic Characteristics.

Characteristic	Counts (%)
Sex	
Male	734 (76.2%)
Female	217 (22.5%)
Unknown	12 (1.2%)
Age Group	
<5	17 (1.8%)
5–14	47 (4.9%)
15–19	38 (3.9%)
20–34	178 (18.5%)
35–59	342 (35.5%)
60–74	223 (23.2%)
≥75	101 (10.5%)
Unknown	17 (1.7%)
Ethnicity	
Hispanic or Latino	160 (16.6%)
Not Hispanic or Latino	751 (78.0%)
Unknown	52 (5.4%)
Race	
White	773 (80.3%)
Black or African American	54 (5.6%)
Asian	4 (0.4%)
Native American	1 (0.1%)
Unknown	131 (13.6%)

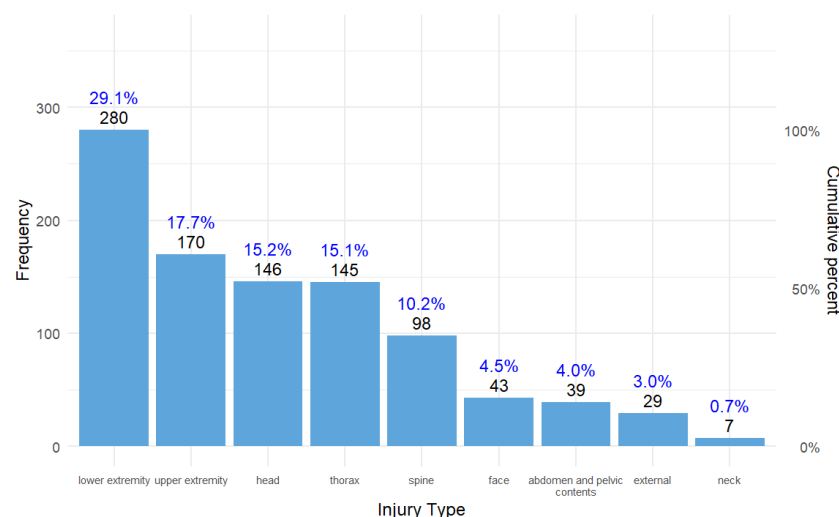
3.2. Injury Events, Sources, and Body Regions

The leading OIICS event category was contact incidents (37.8%), followed by falls, slips, and trips (29.9%) and transportation incidents (26.2%). The leading OIICS source categories were vehicles (25.9%), structures and surfaces (25.0%), animals/persons/plants (17.0%), and machinery (10.7%) (Table 3).

Table 3. OIICS Event and Source.

OIICS Category	Counts (%)
Event	
Contact Incidents	364 (37.8%)
Falls, Slips, and Trips	288 (29.9%)
Transportation Incidents	252 (26.2%)
Explosions and Fires	19 (2.0%)
Violent Acts	17 (1.8%)
Overexertion/Repetitive Motion/Bodily Conditions	13 (1.3%)
Exposure to Harmful Substances and Environments	9 (0.9%)
Unknown	1 (0.1%)
Source	
Vehicles	249 (25.9%)
Structures and Surfaces	241 (25.0%)
Animals, Persons, and Plants	163 (17.0%)
Machinery	103 (10.7%)
Tools, Instruments, and Equipment	50 (5.2%)
Safety and Environmental Factors and Conditions	16 (1.7%)
Parts and Materials	11 (1.1%)
Containers, Furniture, Fixtures	7 (0.7%)
Unknown	123 (12.8%)

The most frequently injured body region was the lower extremity (29.1%), followed by the upper extremity (17.7%), head (15.2%), and thorax (15.1%) (Figure 2). These distributions indicate that agricultural trauma captured by the Florida Trauma Registry spans both environmental and transportation-related hazards.

**Figure 2.** Frequency of Injured Body Regions.

3.3. Injury Severity Modeling

ISS showed substantial right-skew, supporting the use of nonlinear and non-Gaussian modeling approaches. The log-Gaussian and Gamma GAMs showed similar predictive performance in five-fold cross-validation, with root mean square error near 7.0 and mean absolute error near 4.7, indicating that prediction error was substantial relative to the scale and variability of ISS. The Gamma model was retained for inference because it better aligned with the observed mean-variance relationship and supported direct interpretation on the original ISS scale.

Body region was the strongest adjusted correlate of injury severity. Because the chosen Gamma GAM used a log link, coefficients were exponentiated to obtain adjusted ISS ratios. These ratios represent proportional differences in expected ISS for each predictor level relative to its reference category, holding the other variables in the model constant. Relative to head injuries, upper extremity injuries were associated with an expected ISS approximately 68% lower ($\beta = -1.15$, $p < 0.001$). Expected ISS was also approximately 71% lower for external injuries ($\beta = -1.25$, $p < 0.001$), 62% lower for face injuries ($\beta = -0.97$, $p < 0.001$), 46% lower for lower-extremity injuries ($\beta = -0.61$, $p < 0.001$), 68% lower for neck injuries ($\beta = -1.13$, $p < 0.001$), and 33% lower for spine injuries ($\beta = -0.40$, $p < 0.001$). The magnitude of these differences suggests that the associations between body region and injury severity were not only statistically significant but also potentially clinically meaningful, particularly when comparing head or abdomen and pelvic contents injuries with injuries involving the extremities, external structures, face, or neck.

Adjusted differences across event categories were more modest. Contact incidents were associated with an expected ISS approximately 15% lower than the reference event category ($\beta = -0.16$, $p = 0.006$). Transportation incidents were associated with an expected ISS approximately 13% higher than the reference category ($\beta = 0.12$), although this association did not reach statistical significance ($p = 0.063$). Other event categories were not significantly associated with ISS. Compared with the body region findings, the smaller effect sizes across event categories suggest more limited practical or clinical importance.

Age was not significantly associated with ISS ($p = 0.138$), and no significant association was observed for sex. The Unknown categories were included in the models but were not statistically significant and were therefore omitted from Table 4 for conciseness.

Table 4. GAM Results.

Predictor	β	SE	Adjusted ISS Ratio, Exp(β)	95% CI for ISS Ratio	p-Value
IIICS event category					
Falls, slips, and trips					
Contact incidents	−0.161	0.059	0.85	0.76–0.96	0.006
Explosions and fires	0.309	0.278	1.36	0.79–2.35	0.266
Exposure to harmful substances/environments	0.019	0.270	1.02	0.60–1.73	0.944
Overexertion/repetitive motion/bodily conditions	−0.146	0.199	0.86	0.58–1.28	0.465
Transportation incidents	0.116	0.063	1.12	0.99–1.27	0.063
Violent acts	0.321	0.190	1.38	0.95–2.00	0.091
Sex					
Male					
Female	−0.091	0.056	0.91	0.82–1.02	0.103
Body region					
Head					
Abdomen and pelvic contents	−0.002	0.128	1.00	0.78–1.28	0.988
External	−1.251	0.238	0.29	0.18–0.46	<0.001
Face	−0.971	0.123	0.38	0.30–0.48	<0.001
Lower extremity	−0.609	0.072	0.54	0.47–0.63	<0.001
Neck	−1.126	0.322	0.32	0.17–0.61	<0.001
Spine	−0.398	0.092	0.67	0.56–0.81	<0.001
Thorax	−0.165	0.083	0.85	0.72–1.00	0.047
Upper extremity	−1.148	0.082	0.32	0.27–0.37	<0.001
Ethnicity					
Hispanic or Latino					
Not Hispanic or Latino	0.028	0.064	1.03	0.91–1.16	0.660

4. Discussion

This study developed a transparent and reproducible structured case definition for identifying agricultural injuries in the Florida Trauma Registry and used it to characterize injury patterns and severity among trauma patients in Florida from 2016 through 2021. The primary case definition identified 963 agricultural injuries requiring trauma care, including 17 fatalities, demonstrating that NTDS-aligned trauma registries can support agricultural injury surveillance even when narrative text is unavailable.

The findings contribute to the existing literature [1–8] in two important ways. First, they provide Florida-specific evidence on the burden and patterning of agricultural trauma requiring higher acuity care. Similar to prior trauma registry studies conducted in Iowa, South Dakota, and northeast Texas [3–8], injuries were distributed across multiple mechanisms, indicating that agricultural trauma in Florida reflects a diverse set of hazards. Vehicles and structures/surfaces were the most common OIICS source categories, reinforcing the importance of both transportation-related and environmental risks in agricultural settings.

The severity analysis also offers clinical and prevention-relevant insight. Body region was the strongest predictor of ISS, with head and abdomen/pelvic contents injuries showing the highest adjusted severity. This pattern suggests that interventions that reduce head and torso trauma may yield the greatest reductions in severe agricultural injury.

Second, this study extends prior work by developing a reproducible case identification framework that relies exclusively on ICD-10 and NTDS-aligned registry variables. Previous trauma registry studies have demonstrated the utility of these data for agricultural injury surveillance but often relied on state-specific indicators or free-text narratives to refine case identification [3–8]. In contrast, the present approach emphasizes portability and transparency within the available structured data. The framework may be adaptable to other NTDS-aligned trauma registries, but local coding practices, data completeness, and variable availability should be evaluated before implementation.

The methodological contribution of this study is particularly relevant given persistent challenges in agricultural injury surveillance, including undercounting and incomplete occupational coding [1–3]. While prior studies have demonstrated that trauma registries can support agricultural injury surveillance [3–8], many approaches depend on local data structures or narrative review. By using structured ICD-10 and registry variables only, this study provides a structured framework that may inform similar surveillance efforts in other NTDS-aligned datasets. However, external validation and adaptation to local registry practices would be necessary before broader application.

5. Limitations

Several limitations should be considered. First, the case definition may still misclassify some injuries because agricultural context is not perfectly captured in structured registry variables. Second, free-text narratives were unavailable, limiting external validation and refinement of ambiguous cases. Third, although the case definition was developed using ICD-10 codes and NTDS-aligned variables, its portability across trauma registries cannot be assumed. Differences in coding completeness, occupation and industry data, work-related indicators, and local abstraction practices may affect case identification. Because the case definition could not be validated against narrative review or an external gold standard, its performance in other registries remains uncertain. Fourth, some event and body region categories were relatively sparse, which may have contributed to wider uncertainty for selected contrasts. Fifth, the trauma registry captures injuries that required trauma care and therefore does not represent the full burden of agricultural injury in Florida. Finally, because

this was an observational study, the identified associations should not be interpreted as causal effects.

Despite these limitations, this study strengthens the evidence base for agricultural injury surveillance in Florida and provides a practical framework for using trauma registry data in other states with similar NTDS-aligned systems.

6. Conclusions

A structured, ICD-10-based case definition identified 963 agricultural injuries requiring trauma care in Florida from 2016 to 2021. Contact incidents, falls, and transportation incidents were the leading mechanisms, while vehicles and structures/surfaces were the leading sources. Injury severity was driven primarily by anatomic region, with head and abdomen/pelvic contents injuries showing the highest adjusted severity. These findings reinforce that injury severity in this setting is driven more strongly by the nature of the injury event and the affected body region than by demographic characteristics.

The Florida Trauma Registry may serve as a reproducible and portable source for agricultural injury surveillance when narrative text is unavailable. The case definition framework may be useful for other NTDS-aligned registries, but its performance should be evaluated and adapted within each registry system. These findings support prevention priorities focused on transportation safety and protection against head and torso trauma in agricultural environments.

Author Contributions: Conceptualization, M.W.M. and S.G.; methodology, M.W.M., S.G., N.A.B., D.C. and X.W.; validation, M.W.M. and S.G.; formal analysis, M.W.M., S.G. and N.A.B.; investigation, M.W.M.; resources, S.G. and N.A.B.; data curation, M.W.M. and S.G.; writing—original draft preparation, M.W.M. and S.G.; writing—review and editing, M.W.M., S.G., N.A.B., D.C. and X.W.; visualization, M.W.M.; supervision, S.G. and N.A.B.; project administration, S.G.; funding acquisition, S.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Research Capacity Fund (Hatch) program, project award no. 7010872 and 1025545, from the U.S. Department of Agriculture's National Institute of Food and Agriculture.

Institutional Review Board Statement: This research was reviewed and approved by both the Florida Department of Health Institutional Review Board and the University of Florida Institutional Review Board. The Florida Department of Health IRB approved the study (Protocol #2023-013) under expedited review on 14 April 2023. The University of Florida IRB approved the related protocol (IRB202301661) as exempt research on 14 September 2023 under the category of secondary research involving identifiable health information.

Informed Consent Statement: Not applicable.

Data Availability Statement: The dataset presented in this article was obtained from the Florida Trauma Registry, managed by the Florida Department of Health, and is not publicly available due to confidentiality protections. Restrictions apply to the availability of the dataset because it contains confidential patient information. Requests to access the dataset should be directed to the Florida Department of Health.

Acknowledgments: During the preparation of this study, the authors used ChatGPT-5.4 Thinking for the purpose of improving the readability and language of the manuscript. The authors have reviewed and edited the output and take full responsibility for the content of this publication.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Abbreviations

The following abbreviations are used in this manuscript:

ICD-9	International Classification of Diseases, Ninth Revision
ICD-10	International Classification of Diseases, Tenth Revision
ISS	Injury Severity Score
GAM	Generalized Additive Model
NTDS	National Trauma Data Standard
IRB	Institutional Review Board
OIICS	Occupational Injury and Illness Classification System

References

1. Gorucu, S.; Michael, J.; Chege, K. Nonfatal agricultural injuries treated in emergency departments: 2015–2019. *J. Agromed.* **2022**, *27*, 41–50. [\[CrossRef\]](#)
2. Scott, E.; Hirabayashi, L.; Graham, J.; Krupa, N.; Jenkins, P. Using hospitalization data for injury surveillance in agriculture, forestry and fishing: A crosswalk between ICD10CM external cause of injury coding and The Occupational Injury and Illness Classification System. *Inj. Epidemiol.* **2021**, *8*, 6. [\[CrossRef\]](#) [\[PubMed\]](#)
3. Missikpode, C.; Peek-Asa, C.; Young, T.; Swanton, A.; Leinenkugel, K.; Torner, J. Trends in non-fatal agricultural injuries requiring trauma care. *Inj. Epidemiol.* **2015**, *2*, 30. [\[CrossRef\]](#) [\[PubMed\]](#)
4. Missikpode, C.; Peek-Asa, C.; Ramirez, M.; Wright, B. Characteristics of agricultural and occupational injuries by workers' compensation coverage status among patients receiving trauma care in Iowa. *Am. J. Ind. Med.* **2019**, *62*, 969–977. [\[CrossRef\]](#) [\[PubMed\]](#)
5. Simpkins, J.; Sturdevant, D.; Timmerman, G. An initial analysis of agricultural trauma in South Dakota with an emphasis on work-related. *Aesculapius* **2020**, *1*, 2. [\[CrossRef\]](#)
6. Swanton, A.R.; Young, T.L.; Leinenkugel, K.; Torner, J.C.; Peek-Asa, C. Nonfatal tractor-related injuries presenting to a state trauma system. *J. Saf. Res.* **2015**, *53*, 97–102. [\[CrossRef\]](#) [\[PubMed\]](#)
7. Ramirez, M.R.; Boonstra, D.E.; Moskowitz, A.F.; Gerr, F.; Cavanaugh, J.E.; Casteel, C. Improving agricultural injury surveillance: Comparing injuries captured by Iowa's workers' compensation and trauma registry data. *Inj. Prev.* **2025**, 1–8. [\[CrossRef\]](#) [\[PubMed\]](#)
8. Cook, A.; Fry, R.; Desai, Y.; Swindall, R.; Boyle, J.; Wadle, C.; Casanova, V.; Cloonan, M.; Rogers, F.; Horst, M.; et al. Agricultural injury surveillance using a regional trauma registry. *J. Surg. Res.* **2022**, *273*, 181–191. [\[CrossRef\]](#) [\[PubMed\]](#)
9. Centers for Disease Control and Prevention. *International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)*; National Center for Health Statistics: Hyattsville, MD, USA, 2026. Available online: <https://www.cdc.gov/nchs/icd/icd-10-cm/index.html> (accessed on 1 June 2024).
10. Gorucu, S.; Weichelt, B.; Diehl, D.; Galindo, S. An overview of agricultural injuries in Florida from 2015–2019. *J. Agric. Saf. Health* **2021**, *27*, 135–146. [\[CrossRef\]](#) [\[PubMed\]](#)
11. U.S. Bureau of Labor Statistics. *Nonfatal Occupational Injuries and Illnesses by Industry*; U.S. Bureau of Labor Statistics: Washington, DC, USA, 2024. Available online: <https://www.bls.gov/iif/oshsum1.htm> (accessed on 10 May 2024).
12. Pate, M.L.; Görücü, S. Agricultural work-related fatalities to non-working youth: Implications for intervention development. *J. Agric. Saf. Health* **2020**, *26*, 31–43. [\[CrossRef\]](#) [\[PubMed\]](#)
13. U.S. Department of Labor. *Agricultural Employment*; U.S. Department of Labor: Washington, DC, USA, 2026. Available online: <https://www.dol.gov/general/topic/youthlabor/agricultureemployment> (accessed on 1 June 2026).
14. Wood, S.N. *Generalized Additive Models: An Introduction with R*, 2nd ed.; Chapman and Hall/CRC: Boca Raton, FL, USA, 2017. [\[CrossRef\]](#)
15. Moore, M.; Gorucu, S.; Bliznyuk, N. Exploratory analysis of farm vehicle and farm labor transportation-related crashes. *J. Agromedicine* **2024**, *29*, 277–288. [\[CrossRef\]](#) [\[PubMed\]](#)
16. Bouzid, M.; Colón-González, F.J.; Lung, T.; Lake, I.R.; Hunter, P.R. Climate change and the emergence of vector-borne diseases in Europe: Case study of dengue fever. *BMC Public Health* **2014**, *14*, 781. [\[CrossRef\]](#) [\[PubMed\]](#)
17. Moore, M.W.; Gorucu, S.; Bliznyuk, N.A. Florida golf cart crashes (2011–2021): A statewide analysis of crash patterns and predictors. *Traffic Inj. Prev.* **2026**, 1–7. [\[CrossRef\]](#) [\[PubMed\]](#)
18. Ravindra, K.; Rattan, P.; Mor, S.; Aggarwal, A.N. Generalized additive models: Building evidence of air pollution, climate change and human health. *Environ. Int.* **2019**, *132*, 104987. [\[CrossRef\]](#) [\[PubMed\]](#)
19. Bliznyuk, N.; Paciorek, C.J.; Schwartz, J.; Coull, B. Nonlinear predictive latent process models for integrating spatio-temporal exposure data from multiple sources. *Ann. Appl. Stat.* **2014**, *8*, 1538–1560. [\[CrossRef\]](#) [\[PubMed\]](#)

20. Merrill, H.R.; Grunwald, S.; Bliznyuk, N. Semiparametric regression models for spatial prediction and uncertainty quantification of soil attributes. *Stoch. Environ. Res. Risk Assess.* **2017**, *31*, 2691–2703. [CrossRef]
21. R Core Team. *R: A Language and Environment for Statistical Computing*; R Foundation for Statistical Computing: Vienna, Austria, 2023. Available online: <https://www.R-project.org/> (accessed on 30 June 2024).
22. Wood, S.N. *Mgcv: Mixed GAM Computation Vehicle with Automatic Smoothness Estimation*, version 1.8-42; R Package: Vienna, Austria, 2023. Available online: <https://CRAN.R-project.org/package=mgcv> (accessed on 1 December 2024).

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.