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Injuries Among Hispanic/Latinx Agricultural Workers Seen in Illinois Hospitals

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ABSTRACT

Objective: Agriculture is a dangerous industry, with evidence indicating a disproportionate burden among Hispanic/Latinx workers. There is a need to expand the utilization of different data systems to improve the surveillance of precarious workers within agriculture. This analysis describes inclusion criteria to identify farm-related injuries and illnesses in hospital data utilizing ICD-10 codes to better assess health equity issues involving Hispanic/Latinx workers and their associated costs.

Methods: Discharge data of agriculture-related injuries and illnesses treated in Illinois hospitals and emergency departments from 2018 to 2021 were extracted using ICD-10 diagnosis and location of injury codes. Injury cause, nature, severity, and course of clinical care are stratified by ethnicity. Multivariable models were developed to assess differences in injury severity, level of care required, and cost of care.

Results: We identified 3,745 farm-related injuries and illnesses treated in Illinois hospitals between 2018 and 2021, of which 196 involved Hispanic/Latinx individuals. Hispanic/Latinx patients were substantially younger and disproportionately covered by workers' compensation insurance or uninsured. Compared to non-Hispanic/Latinx individuals, Hispanic/Latinx patients suffered injuries from different mechanisms, particularly involving animals and cutting/piercing instruments. While non-Hispanic/Latinx individuals demonstrated more severe injuries based on the descriptive statistics, after controlling for confounding (particularly age), we did not observe ethnic disparities in injury severity or level of care required. However, the cost of care was equivalent to or higher among Hispanic/Latinx persons.

Conclusion: The case definition used for this analysis identified agriculture-related cases and provided insights on the course of clinical care by ethnicity. This strategy would likely yield valuable information in states with larger and more diverse agricultural workforces. More targeted research to appropriately scope the issue and inform interventions is needed to understand differential exposure and reduce agricultural workplace hazards and address the financial burden resulting from farm-related injuries.

KEYWORDS

Agriculture; ethnic disparities; farm; hospital care; injury

Introduction

The agriculture industry is one of the most dangerous sectors of the U.S. economy.[1] In Illinois, agriculture sectors involving crop production (NAICS 111) and animal production and aquaculture (NAICS 112) had incidence rates of nonfatal injuries and illnesses of 3.9 and 14.8 per 100 full-time equivalent (FTE) workers in 2021, respectively.[2] This exceeds the overall private industry injury rate of 2.7 per 100 FTE workers in 2021.[2] In Illinois, the agriculture industry also had the highest fatal injury rate out of all major industrial sectors in 2021 at 27.1 per 100,000 FTE compared to the average fatality rate across all industries of 3.1 per 100,000 FTE.[3] Agriculture consistently has one of the highest fatality rates in Illinois and nationwide.[3–5]

Hispanic/Latinx workers are disproportionately employed in the agriculture industry and many other hazardous sectors.[6–9] A retrospective cohort study examined injuries from all occupations and found Hispanic/Latinx workers were twice as likely as their non-Hispanic/Latinx counterparts to be injured on the job.[10] In addition, Bureau of Labor Statistics data indicate workplace fatalities are declining in recent years for non-Hispanic /Latinx workers but rising for Hispanic/Latinx workers,[10] particularly among first-generation foreign-born Hispanic/Latinx workers.[11] Factors contributing to the injury risk, burden of injury, and ability to adequately recover to return to work of Hispanic/Latinx workers include language barriers, employer discrimination, lack of sufficient

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training and knowledge related to safe work practices, legal protections, insurance coverage and economic resources, and lower social support.[7,12,13]

Current surveillance methods regarding adverse health outcomes related to farming provide an incomplete picture. Studies utilizing national surveys to collect data on non-fatal farm injuries and illnesses report data quality issues, including non-response, underreporting, and the data's untimeliness.[14] In addition, while workers' compensation data are an important source for occupational health surveillance, a large proportion of persons working in agriculture are not covered by workers' compensation, and these data do not capture information on race-ethnicity, which limits its usefulness for assessing ethnic disparities within the agriculture sector. As an example, while researchers have assessed the cost of care for agriculture-related injuries and illnesses using workers' compensation claims, these analyses do not evaluate potential ethnic disparities in coverage, costs, and financial compensation because these data lack information on race and ethnicity.[15,16] There is a need to expand the utilization of different public health data sources and develop extraction criteria to identify agriculture-related cases to better inform the development of interventions.

The present analysis has three objectives (1) develop inclusion criteria to identify work-related agricultural injuries and illnesses in hospital data utilizing ICD-10 codes, (2) provide a descriptive analysis of farm-related adverse health outcomes stratified by Hispanic/Latinx ethnicity, and (3) evaluate the association between Hispanic/Latinx identity and the cost of hospital care for farm-related adverse health outcomes.

Methods

Data source

The dataset for analysis is sourced from Illinois hospital discharges and emergency department (ED) visits over the years 2018–2021. The hospital data are based on billing records that the Illinois Hospital Association compiles. The outpatient database includes all patients treated in EDs for less than 24 h who were not admitted as an inpatient to the hospital. The outpatient data only include patients seeking emergent care in the ED or those with referrals to clinics that require registration in the ED (e.g., orthopedic ambulatory procedures and surgical units, such as in orthopedics). The inpatient database includes all patients treated for 24 h or more in Illinois hospitals for any medical reason. Both datasets include information on patient demographics (age, race, ethnicity, and sex), clinical outcomes (diagnoses, hospital procedures, and discharge status), and economic outcomes (hospital charges and payer source). Based on the annual state audit of hospitals, 96.5% of all inpatient admissions statewide are captured by the participating hospitals in the dataset.[17,18]

Criteria to identify potential work-related agriculture adverse health outcomes

Because hospital data (1) does not capture information on a patient's occupation or industry and (2) workers' compensation does not cover most farmworkers, we could not rely solely on payer information to identify work-related farm injuries and illnesses. In alignment with efforts to use ICD-10 codes to expand work-related injury surveillance in hospital data,[19] we used a constellation of ICD-10 codes to identify potential work-related injuries and illnesses occurring on farms (Table 1). All cases with a workers' compensation payer and/or an occupational-related Z or Y code (Z56, Problems related to employment and unemployment; Z57, Occupational exposure to risk factors; Z04.2, Encounter for examination and observation following work accident; Y96, Work-related condition; Y99.0, Civilian activity done for income or pay) were classified as work-related and included in this analysis.

Cases identified using the Y92.7 code (Farm as the place of occurrence of the external cause) or involving exposure to pesticides (X48, Y18, T60) may still be misclassified and involve non-occupational activities arising from living/playing on farms. Of the remaining cases that did not have a workers' compensation payer and/or an occupational-related Z or Y code, we excluded injuries with a Y92.7 code that also had associated ICD-10 codes relating to injuries occurring within the home or sleeping quarters (e.g., falls from bed), relating to play or recreational activities (e.g., riding a bicycle or playing sports), cooking,

Table 1. Inclusion and exclusion criteria used to identify potential work-related agriculture adverse health outcomes using ICD-10-CM coding.

ICD-10-CM Code	Description
Inclusion criteria	
V84	Occupant of special vehicle mainly used in agriculture injured in transport accident
W30	Contact with agricultural machinery
W30.0	Contact with combine harvester
W30.1	Contact with power take-off devices (PTO)
W30.2	Contact with hay derrick
W30.3	Contact with grain storage elevator Excludes: explosion of grain store (W4.8)
W30.8	Contact with other specified agricultural machinery
W30.9	Contact with unspecified agricultural machinery
Y92.7	Farm/Ranch as the place of occurrence of the external cause. Excludes: a farmhouse and home premises of farm (Y92.01-)
Y92.71	Barn as the place of occurrence of the external cause
Y92.72	Chicken coop as the place of occurrence of the external cause
Y92.73	Farm field as the place of occurrence of the external cause
Y92.74	Orchard as the place of occurrence of the external cause
Y92.79	Other farm locations as the place of occurrence of the external
Z57.4	Occupational exposure to toxic agents in agriculture
X48	Accidental poisoning by and exposure to pesticides
Y18	Poisoning by and exposure to pesticides, undetermined intent
T60	Toxic effect of pesticides
Exclusion criteria	
W06	Fall Related – Fall from bed
W07	Fall Related – Fall from chair
W09	Fall Related – Fall on and from playground equipment
W21	Struck by or against – Sports equipment including balls, bats, clubs, footwear, diving board
V17, V18	Transportation incident – Bicyclist hit by a stationary object or fall from a bike
X16	Heat Sources – Contact with hot heating appliances, radiators, and pipes
W73	Drowning – Other including quenching tank, reservoir
X40, X41, X42, X43, X44, X45, T36, T37, T38, T39,T40, T41, T42, T43, T44, T45, T46, T47, T48, T49, T50, Y10, Y11, Y12, Y13, Y14, Y15	Poisoning – Adverse effects of prescription and illicit drugs
Work-related (CSTE Workgroup defined)	
Z56	Problems related to employment and unemployment
Z57	Occupational exposure to risk factors
Z04.2	Encounter for examination and observation following a work accident
Y96	Work-related condition
Y99.0	Civilian activity done for income or pay
Payer	Payer code related to workers compensation insurer

swimming, and poisoning from prescription and illicit drugs. We also excluded exposures to pesticides that did not have a workers' compensation payer and/or an occupational-related Z or Y code. These cases were assumed to relate to domestic applications of pesticides. Final ICD inclusion/exclusion criteria is nearly identical to other studies using ICD-10 to identify cases related to agriculture, forestry, and fishing.[20]

Statistical analysis

The descriptive analysis characterizes demographics, the cause and nature of the adverse health outcome, and course of clinical treatment. Descriptive statistics are stratified by Hispanic/Latinx ethnicity. We utilized the 2013 U.S. Department of Agriculture (USDA) Rural-Urban Continuum Codes (RUCC) to stratify injured persons spatially by location of injury.[21] The USDA coding system categorizes counties by degree of urbanization based on population density and proximity to major metropolitan areas. Appropriate parametric (Pearson's chi-square; Student's t-test) and nonparametric tests (Wilcoxon ranked sum test) were used to evaluate bivariate relationships.

We developed three sets of multivariable models for this analysis to evaluate differences in injury severity, level of care required, and cost of care. First, we evaluated the association between Hispanic/Latinx ethnicity and injury severity as

measured by the trauma mortality prediction model (TMPM)[22] using ordinary least-squares regression model. In the adjusted model, we controlled for gender, age, Elixhauser Comorbidity Index,[23] cause of injury (high energy sources coded as a dummy variable), intent of injury, and season (July through October; major harvest periods). Second, we evaluated the association between Hispanic/Latinx ethnicity and the odds of being admitted to a hospital using a logistic regression model. In the adjusted model, because non-Hispanic patients were substantially older, we controlled for age, Elixhauser Comorbidity Index,[23] and injury severity based on TMPM.[22] Third, we developed multivariable models to assess the association between Hispanic/Latinx ethnicity and total hospital charges. Because hospital charges are not normally distributed (right-tailed distribution; skewness = 10.4; kurtosis = 154.4), we developed a median regression model. In the adjusted model, we controlled for the following variables recognized as key drivers of hospital costs: age, gender, comorbidities using the Elixhauser Comorbidity Index,[23] injury severity based on TMPM,[22] surgical intervention, region of treating hospital, as well as the length of stay and respiratory intubation for inpatient cases. For all models, statistical evaluation of covariates, model fit statistics, as well as a priori knowledge, were used to determine the inclusion of covariates in the final models. A two-sided p-value less than 0.05 was considered statistically significant. Parameter estimates or odds ratios are presented, including the 95% confidence intervals (CI 95%). No evidence of multicollinearity among the final independent variables was indicated based on evaluation of standard errors, and evaluation of variance of inflation and tolerance tests. We used SAS software for all statistical analyses (v.9.4; Cary, NC).

Results

From 2018 to 2021, we identified 3,745 farm-related injuries and illnesses treated in Illinois hospitals, of which 196 involved Hispanic/Latinx individuals (Table 2). Patients were predominantly male (76.0% among Hispanic/Latinx, 79.7% among non-Hispanic/Latinx) and residents of Illinois (89.8% among Hispanic/Latinx, 96.8% among non-Hispanic/Latinx). Hispanic/Latinx patients were younger on average, with a mean age of 36.7 years versus 48.2 years for their counterparts ($p < .01$). Hispanic/Latinx individuals, compared to non-Hispanics, were disproportionately covered by workers' compensation (32.7% vs 8.8%; $p < .01$) and self-pay/uninsured (21.9% vs. 6.9%; $p < .01$).

Seasonally, while hospital visits increase from early planting through harvest among non-Hispanics (March to October), visits peak between July and September among Hispanic/Latinx patients (Table 3). In addition, while hospital visits were relatively constant across the week among non-Hispanics, hospital visits appear to be highest early in the workweek among Hispanic/Latinx patients. When evaluating the spatial distribution, 47.2% of Hispanic/Latinx individuals experienced adverse health outcomes in counties with higher population densities of 250,000 or more (USDA RUCC regions 1 and 2) compared to only 17.3% of non-Hispanics ($p < .01$).

Among Hispanic/Latinx injuries, the top causes of injuries were transportation-related, involving special vehicles used in agriculture (16.8%), agricultural machinery (14.8%), bites or contact with animals (12.2%), and cuts or piercings from sharp objects (12.2%; primarily knives) (Table 4). By comparison, non-Hispanic/Latinx injuries consisted primarily of agricultural machinery (23.1%), falls (18.8%; primarily from lifting devices, from structures, or slips/trips at level), transportation-related primarily involving special vehicles used in agriculture and off-road vehicles (18.6%), and being struck by or against (10.7%). Similar distributions exist between ethnicities in the nature of injury, with open wounds, superficial injuries, and fractures accounting for approximately 80% of injuries (Table 4). Body parts affected were similarly distributed between the two groups, with the exception that upper extremity injuries may be more common in Hispanic/Latinx farmworkers while lower extremity and torso injuries were more common in non-Hispanic/Latinx workers (Table 4). Of the 322 non-injury (disease) cases identified, 309 (96.0%) were in non-Hispanic/Latinx workers. They were most commonly related to musculoskeletal and

Table 2. Characteristics of farmworker injuries and illnesses treated in Illinois hospitals, 2018–2021.

	Hispanic/Latinx (*N* = 196)	Non-Hispanic/Latinx (*N* = 3549)
Gender		
Male	149 (76.0%)	2828 (79.7%)
Female	47 (24.0%)	721 (2.3%)
Age		
0 to 4 yrs	5 (2.6%)	60 (1.69%)
5 to 9 yrs	4 (2.0%)	94 (2.65%)
10 to 14 yrs	9 (4.6%)	103 (2.9%)
15 to 19 yrs	13 (6.6%)	185 (5.2%)
20 to 24 yrs	20 (1.2%)	223 (6.3%)
25 to 34 yrs	43 (21.9%)	408 (11.5%)
35 to 44 yrs	38 (19.4%)	422 (11.9%)
45 to 54 yrs	29 (14.8%)	425 (12.0%)
55 to 64 yrs	21 (1.7%)	642 (18.1%)
65 to 74 yrs	12 (6.1%)	585 (16.5%)
75 yrs and up	2 (1.0%)	402 (11.3%)
Mean Age (sd)	36.7 (sd = 17.3)	48.2 (sd = 22.0)
Race/Ethnicity		
Hispanic/Latino	196 (100%)	0 (.0%)
White, Non-Hispanic/Latino	0 (.0%)	3254 (91.7%)
American Indian/Alaska Native	0 (.0%)	1 (.0%)
Asian	0 (.0%)	10 (.3%)
African American	0 (.0%)	77 (2.2%)
Multiracial	0 (.0%)	9 (.3%)
Native Hawaiian/Pacific Islander	0 (.0%)	2 (.1%)
Other Race	0 (.0%)	116 (3.3%)
Unknown	0 (.0%)	80 (2.3%)
Payer type		
Private Insurance	49 (25.0%)	1570 (44.2%)
Workers' Compensation	64 (32.7%)	311 (8.8%)
Self-pay Uninsured	43 (21.9%)	244 (6.9%)
Medicare	8 (4.1%)	902 (25.4%)
Medicaid	28 (14.3%)	441 (12.4%)
CHAMPUS or CHAMPVA	0 (.0%)	14 (.4%)
Charity	0 (.0%)	1 (.0%)
Other Unspecified	4 (2.0%)	66 (1.9%)

connective tissue complaints (46.2% of Hispanic/Latinx non-injury visits; 38.5% of non-Hispanic/Latinx), symptoms (7.7% Hispanic/Latinx; 17.8% non-Hispanic/Latinx), diseases of the circulatory system (7.7% Hispanic/Latinx; 6.5% non-Hispanic/Latinx), skin diseases (7.7% Hispanic/Latinx; 5.5% non-Hispanic/Latinx), and diseases of the respiratory system (0.0% Hispanic/Latinx; 5.8% non-Hispanic/Latinx).

Of the farm-related hospital visits, the vast majority presented to EDs and did not require inpatient care (Table 5). Of those with acute injuries, the mean TMPM injury severity measure was insignificantly lower among Hispanic/Latinx patients compared to non-Hispanic/Latinx individuals (0.022 vs 0.029; $p = .28$). Non-Hispanic/Latinx individuals accounted for a higher proportion of inpatient cases at 12.4% and underwent surgery more frequently at 10.5% of cases, compared to 5.1% ($p < .01$) and 5.6% ($p = .03$), respectively, for Hispanic/Latinx patients. Unadjusted median hospital charges were higher for non-Hispanic/Latinx patients.

Multivariable models

Injury severity as measured by TMPM did not significantly differ by ethnicity in the crude OLS regression model beta = -0.69; $p = .28$) and remained insignificant in the final adjusted model beta = -0.55; $p = .39$). While the crude model showed that Hispanic/Latinx patients had lower odds of admission (crude OR = 0.38; CI95%: 0.19, 0.69), after controlling for age, comorbidities, and injury severity, Hispanic/Latinx patients did not significantly differ in odds of hospital admission (aOR =

Table 3. Temporal patterns of farm-related injuries and illnesses treated in Illinois hospitals, 2018–2021.

	Hispanic/Latinx (*N* = 196)	Non-Hispanic/Latinx (*N* = 3549)
Year		
2018	49 (25.0%)	987 (27.8%)
2019	62 (31.6%)	958 (27.0%)
2020	42 (21.4%)	935 (26.4%)
2021	43 (21.9%)	669 (18.9%)
Month		
January	16 (8.2%)	184 (5.2%)
February	4 (2.0%)	140 (3.9%)
March	13 (6.6%)	221 (6.2%)
April	17 (8.7%)	283 (8.0%)
May	12 (6.1%)	365 (1.3%)
June	15 (7.6%)	375 (1.6%)
July	26 (13.3%)	395 (11.1%)
August	31 (15.8%)	341 (9.6%)
September	22 (11.2%)	387 (1.9%)
October	14 (7.1%)	406 (11.4%)
November	15 (7.7%)	256 (7.2%)
December	11 (5.6%)	196 (5.5%)
Day		
Monday	42 (21.4%)	549 (15.5%)
Tuesday	32 (16.3%)	494 (13.9%)
Wednesday	26 (13.3%)	520 (14.7%)
Thursday	26 (13.3%)	497 (14.0%)
Friday	19 (9.7%)	506 (14.3%)
Saturday	30 (15.3%)	522 (14.7%)
Sunday	21 (1.7%)	461 (13.0%)

0.56; CI95%: 0.27, 1.11). The third set of multivariable models examined the association between Hispanic/Latinx identity and the total hospital charges, stratified by admission status (Table 6). After adjusting for important confounders, median hospital charges among ED cases were significantly higher among Hispanic/Latinx patients by $454 compared to non-Hispanic/Latinx patients. Median hospital charges did not differ significantly by ethnicity among inpatient cases.

Discussion

Using a case definition based on ICD-10 codes, this analysis identified 3,745 farm-related injuries and illnesses treated in Illinois hospitals from 2018 to 2021, of which 196 (5.2%) were experienced by Hispanic/Latinx patients. Most of these visits were for injuries, with only 322 illness cases (8.6%). Hispanic/Latinx patients suffering farm-related adverse health outcomes were disproportionately younger, were injured in more urbanized counties, and were primarily covered by workers' compensation insurance or did not have medical insurance.

The case definition utilizing ICD-10 codes identified potential work-related agricultural injuries and illnesses treated in Illinois and allowed for important comparisons of detailed clinical data by Hispanic/Latinx ethnicity. While workers' compensation is widely used for occupational health surveillance, many farmworkers are not covered by workers' compensation,[24] and these data systems lack comprehensive clinical information and, more importantly, data on race and ethnicity. However, the current case definition likely misses many agriculture-related injuries that do not have an overt agriculture-related ICD-10 cause of injury code (e.g., W30 Contact with agricultural machinery) or are missing a corresponding Y92.7 "location of injury" code for farms. In Illinois discharge data, approximately 50% of all injury cases and almost all the acute illness cases are missing a Y92 "location of injury" code. Capturing industry and occupation in EMR, as advocated by NIOSH and the National Academies, would improve the capture of work-related agricultural injuries within this data system.[25]

The distribution of causes of injury differed for Hispanic/Latinx patients. In Illinois, only 0.8% of agriculture producers (owner-operators) are Hispanic, Latino, or Spanish origin,[26] with nearly all Hispanic/Latinx persons working in agriculture as hired farmworkers in hourly wage or salary positions.[8,27] Employment data show that Hispanic/Latinx workers are more likely to be hired seasonally and engage in animal husbandry and manual field labor, while their counterparts are more likely to be owner-operators who work directly with harvesting machinery, vehicles, and storage/feed silos.[8,26,28] Farm workers are younger, have lower educational attainment, and are more likely to be Hispanic or Mexican origin and less likely to be citizens than other agriculture occupations and the US workforce, as a -whole.[29] The average wage for crop and livestock workers is around 60% of the nonfarm wage, as of 2021.[29] Job tasks are more likely to entail manual labor and less likely to entail equipment operation or high-skilled jobs.[30] The differences in employment status and related work activities likely explain the differences in the cause of injury profiles.

Table 4. Cause and nature of farm-related adverse health outcome treated in Illinois hospitals, 2018–2021.

	Hispanic/Latinx (*N* = 196)	Non-Hispanic/Latinx (*N* = 3549)
Cause of Injury		
Accidental explosion	0 (.0%)	4 (.1%)
Animals	24 (12.2%)	268 (7.6%)
Assault or homicide	2 (1.0%)	7 (.2%)
Contact with a nonpowered hand tool	1 (.5%)	17 (.5%)
Cut or piercing instrument	24 (12.2%)	200 (5.6%)
Electric current	0 (.0%)	5 (.1%)
Ergonomic and motion-related hazards	14 (7.1%)	143 (4.0%)
Falls	22 (11.2%)	667 (18.8%)
Firearm non-assault cases	1 (.5%)	5 (.1%)
Heat sources	0 (.0%)	26 (.7%)
Machinery	29 (14.8%)	821 (23.1%)
Medical error	0 (.0%)	8 (.2%)
Nature or environment	0 (.0%)	5 (.1%)
Poisoning	8 (4.1%)	53 (1.5%)
Radiation	0 (.0%)	1 (.0%)
Struck by or against	17 (8.7%)	378 (1.7%)
Suicide	0 (.0%)	1 (.0%)
Temperature related injury	2 (1.0%)	20 (.6%)
Transportation incident	33 (16.8%)	659 (18.6%)
Travel and privation	10 (5.1%)	97 (2.7%)
Unspecified means of injury	9 (4.6%)	164 (4.6%)
Nature of Injury & Body Part Affected		
Traumatic Brain Injury	18 (9.2%)	476 (13.4%)
Fracture	43 (21.9%)	930 (26.2%)
Skull	5 (2.6%)	45 (1.3%)
Face	2 (1.0%)	52 (1.5%)
Vertebral Column	3 (1.5%)	137 (3.9%)
Torso	8 (4.1%)	222 (6.3%)
Upper Extremities	19 (9.7%)	366 (1.3%)
Lower Extremities	9 (4.6%)	260 (7.3%)
Unspecified body region	0 (.0%)	0 (.0%)
Dislocation	0 (.0%)	60 (1.7%)
Internal	13 (6.6%)	256 (7.2%)
Brain	9 (4.6%)	163 (4.6%)
Spinal Cord	1 (.5%)	13 (.4%)
Torso	3 (1.5%)	95 (2.7%)
Open Wound	64 (32.7%)	1092 (3.8%)
Involving skull and brain	9 (4.6%)	311 (8.8%)
Torso	1 (.5%)	15 (.4%)
Upper Extremities	44 (22.5%)	541 (15.2%)
Lower Extremities	10 (5.1%)	243 (6.9%)
Amputation	4 (2.0%)	63 (1.8%)
Burns	1 (.5%)	53 (1.5%)
Blood vessels	0 (.0%)	13 (.4%)
Crush	5 (2.6%)	119 (3.4%)
Superficial Injury or Contusion	47 (24.0%)	872 (24.6%)
Foreign Body	4 (2.0%)	23 (.7%)
Poisoning or Toxic Effects	9 (4.6%)	75 (2.1%)

While non-Hispanic/Latinx patients generally presented with more severe injuries and required a higher level of care based on the descriptive statistics, after adjusting for confounding, there were no significant differences in TMPM and odds of being admitted to a hospital. The difference in descriptive statistics is likely explained by confounding caused by age, since non-Hispanic/Latinx patients were substantially older than Hispanic/Latinx patients. Census of Agriculture data shows that owner-operator farmers are aging with an average age of 57.5 years in the latest census in Illinois,[26] and nationally, the average of farm laborers is 39.7.[29] Injury severity is strongly associated with increasing age.[31]

Table 5. Severity of injury and discharge status of patients treated in Illinois hospitals for farm-related injuries, 2018–2021.

	Hispanic/Latinx (*N* = 196)	Non-Hispanic/Latinx (*N* = 3549)
Admission Type		
Elective (generally ambulatory procedures including surgery and imaging)	13 (6.6%)	251 (7.1%)
Emergency	162 (82.7%)	2827 (79.7%)
Trauma Center (admitted directly to trauma unit)	8 (4.1%)	154 (4.3%)
Urgent Care	9 (4.6%)	250 (7.0%)
Unknown	4 (2.0%)	67 (1.9%)
Hospital Treatment		
Inpatient Cases (>24 hrs at initial hospital)	10 (5.1%)	439 (12.4%)
Treated in Facility with a Level 1 or 2 Trauma Unit	77 (39.3%)	1071 (30.2%)
Mean Days in initial hospital (sd)	5.00 (sd = 9.59)	5.59 (sd = 6.30)
Required mechanical ventilation	1 (0.5%)	37 (1.0%)
Underwent operation at initial hospital	11 (5.6%)	371 (10.5%)
Median Hospital Charges	$2601 (IQR = 7224)	$2990 (IQR = 8494)
Severity of Injury		
Died at initial hospital or Hospice	0 (0.0%)	26 (0.7%)
Discharge Status		
Routine Discharge (Home/Home Health/Home Care Services)	184 (93.9%)	3135 (88.3%)
Discharge to Another Acute Care Facility	8 (4.1%)	171 (4.8%)
Discharge to Intermediate or Long-Term Care Facility	0 (0.0%)	82 (2.3%)
Discharge to a Psychiatric Facility	0 (0.0%)	1 (0.0%)
Discharged to Court/Law Enforcement	0 (0.0%)	4 (0.1%)
Discharged with Home Health Care	2 (1.0%)	82 (2.3%)
Expired During Hospitalization or Discharged to Hospice	0 (0.0%)	26 (0.7%)
Left Against Medical Advice	0 (0.0%)	19 (0.5%)
Other/Unspecified	2 (1.0%)	29 (0.8%)

Table 6. Multivariable median regression models evaluating the association of ethnicity and cost of treatment in farm-related adverse health outcomes treated in Illinois hospitals, 2018–2021, stratified by ED visits and inpatient admission.

Variable	Estimate	95% Confidence Interval	
Inpatient			
Intercept	1278.44	1058.47	1473.14
Hispanic/Latinx	454.31	82.65	757.65
Total Comorbidities	759.34	542.69	1137.32
Injury Severity	90.41	72.22	107.40
Age	14.84	11.00	19.61
Surgical Intervention	21803.32	18569.21	24709.26
Gender	183.97	-3.30	397.20
Rural Hospital	-444.46	-582.83	-242.24
Emergency Department Visits			
Intercept	10370.14	-3844.64	22466.09
Hispanic/Latinx	-4143.07	-20708.58	8772.13
Length of Stay	7091.90	5043.95	9523.24
Total Comorbidities	251.40	-1386.81	2369.76
Injury Severity	472.59	-194.98	1608.08
Age	-121.63	-302.75	101.89
Surgical Intervention	42264.56	32897.44	50558.12
Respiratory Intubation	72861.31	28400.49	116349.80
Gender	-374.33	-6795.53	5436.89
Rural Hospital	-25091.60	-44286.87	-5406.28

Median hospital charges for ED visits were significantly higher among Hispanic/Latinx individuals compared to non-Hispanic/Latinx individuals, while inpatient charges did not significantly differ by ethnicity. However, the long-term costs incurred by these farm-related injuries still pose a greater burden to Hispanic/Latinx individuals as these injuries occur at a younger age, may cause substantial economic hardship if the injury results in a loss of income for a young family, and these workers may lack the social and structural support needed to recover and eventually return to work after being discharged. In addition, a significant proportion of Hispanic/Latinx individuals were uninsured, similar to what has been reported nationally,[8,9,32] While health insurance coverage varies within farmworker groups (e.g., operators, authorized workers, unauthorized workers, etc.), states that expanded coverage under the Affordable Care Act, and other factors, it is estimated that in 2019–2020, overall 28% of farmworkers had access to employer offered health insurance.[9] Similarly, based on state laws, workers' compensation coverage substantially varies.[24] While some reports indicate that 79% of farmworkers report employer offered workers' compensation coverage,[9] this is likely much lower in Illinois, which only requires employers to carry coverage if the total number of working days of all laborers exceeds 400 per quarter of the previous calendar year.[24] Also, wage data show that agricultural Hispanic/Latinx workers earn substantially less than the

average owner-operator in agriculture.[8,26,27,29] While hospital charges do not represent the total amount paid, the burden to lower-wage workers is likely substantially greater from direct medical costs and lost wages. Research shows the cost of medical care, including emergent hospital care, is one of the top causes of economic hardship among low- and middle-income persons in the U.S.[33]

There are several limitations to this analysis. First, the case definition undoubtedly undercounts work-related injuries and illnesses in agriculture. However, this study utilizes a high-quality dataset to gain a detailed understanding of the more severe subset of farm-related injuries and highlights the importance of improving the surveillance of worker health and well-being in the agriculture sector. The limitation of the case definition illustrates the need for (1) more accurate and comprehensive descriptions of the agricultural workforce so that rates and the burden of injuries could be better defined, (2) collection of workforce attrition data to determine if agricultural workers are leaving their jobs due to work-related injury or illness, and (3) establishing partnerships with migrant health centers and other clinic systems where workers may be accessing health services outside of the hospital system. Second, hospital data does not capture information on employment arrangements, such as a worker being hired as a migrant or seasonal farmworker; this limits the discussion of findings to terms of farm-related injuries, rather than farmworkers as a subset of the workforce. Third, hospital data also likely misclassifies ethnicity, which reflects the overall challenges with defining, collecting, and reporting race and ethnicity data.[34]

Conclusion

Farm-related injuries can be life-changing, with steep long-term costs, both physical and financial. Hospital data can elucidate important ethnic disparities in clinical outcomes of acute injuries and illnesses requiring hospital care. The case definition developed for this analysis needs further validation so that the utilization of hospital discharge data can be better leveraged for research and the development of interventions to improve workplace safety in agriculture, emphasizing health equity.

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Data availability statement

Due to the nature of the research, supporting data is unavailable in a public repository or upon request because of ethical, legal, and commercial restrictions.

Human protections

This study received IRB approval under the University of Illinois at Chicago's protocol #2022–0917.

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