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## **Incidence and Cost of Injury Among Youth in Agricultural Settings, United States, 2001 –2006**

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# Incidence and Cost of Injury Among Youth in Agricultural Settings, United States, 2001–2006



**WHAT'S KNOWN ON THIS SUBJECT:** Several studies have analyzed fatal or nonfatal youth injury incidence in US agricultural settings, but none have combined those estimates to form an overall picture. The only detailed study of costs related to such injuries is restricted to nonfatal injury.



**WHAT THIS STUDY ADDS:** This study provides a comprehensive analysis of the annual incidence and cost of agricultural youth injuries in the United States. It analyzes them from different perspectives: fatal versus nonfatal, at work versus not at work, and requiring hospitalization versus not requiring hospitalization.

## abstract

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**OBJECTIVE:** Estimate the annual US incidence and cost of fatal and nonfatal youth injury in agricultural settings.

**METHODS:** We used 2001–2006 Childhood Agricultural Injury Survey data to estimate the incidence of nonfatal injury and 2001–2006 Multiple Cause of Death data to estimate the incidence of fatal injury. To estimate the costs for injuries suffered by youth working/living in agricultural settings, we multiplied the number of injuries times published unit costs by body part, nature of injury, and age group.

**RESULTS:** An average of 26 655 agricultural injury incidents occurred annually to youth (ages 0–19) in the United States during the period 2001–2006 (95% confidence interval [CI]: 24 263–29 046). These injuries cost society an estimated \$1.423 billion per year in 2005 dollars (95% CI: \$1.333 billion–\$1.513 billion). Fatalities alone cost an estimated \$420 million per year. Work related injuries annually cost \$347 million or 24.4% of the total cost (95% CI: 20.3%–28.5%). Most agricultural youth injuries were not work related.

**CONCLUSIONS:** We found that, similarly to adult agricultural injuries, youth agricultural injuries tend to be more severe and more costly than nonagricultural injuries. Only 1.4% of injured youth in the United States were hospitalized in 2000, but 14% of youth injured in agriculture were hospitalized in 2001–2006. To address this serious problem, prevention should focus on better controlling both child access to agricultural recreational activities and child assignment to agricultural work tasks that exceed developmental norms. *Pediatrics* 2012;129:728–734

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### KEY WORDS

agricultural youth, QALY, occupational

### ABBREVIATIONS

A\$—Australian dollars

CAIS—Childhood Agricultural Injury Survey

CI—confidence interval

MEPS—Medical Expenditure Panel Survey

QALY—quality-adjusted life year

Dr Zaloshnja was responsible for drafting the article and co-led the study concept and design. He also led the data analysis; Dr Miller co-led the study concept and design, and participated in the analysis and article preparation; and Dr Lawrence assisted with data analysis as well as the article preparation.

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Quantifying the costs associated with child agricultural injuries is important. Cost estimates can be used to translate different outcomes or injuries (traumatic brain injury in a tractor rollover, a leg fracture in a fall, pesticide poisoning in the strawberry patch) to a common metric. As Finkelstein et al<sup>1</sup> point out, although cost estimates do not shed light on what the intervention strategies should be, they provide a starting point for quantifying the potential benefits should those interventions prove successful. Injury cost estimates can be useful in selecting interventions that most efficiently reduce the burden of injury. For example, would it be better to spend a limited budget improving the safety of grain and pesticide storage, installing passive child safety barriers around the pig wallow, or putting a toddler into child care during the hours when agricultural chores make supervision most difficult? On a broader scale, comparably measured costs of injury and illness can provide insight into the relative magnitude of these problems and may inform resource allocation among primary prevention priorities, for example, between child agricultural injury prevention and child immunization for human papilloma virus. Finally, cost data can be used for advocacy purposes. They can better capture the attention of policy makers, farmers, ranchers, insurers, the media, and the general public. Communicating the benefits in monetary terms may provide useful insights for agribusiness leaders and policy makers concerned with cost control.

Only 1 study in the United States has explored the cost of agricultural injury in depth. Leigh et al<sup>2</sup> estimated that in 1992, 841 deaths and 512 539 nonfatal injuries occurred in US agriculture. The nonfatal injuries included 281 896 that led to at least 1 full day of work loss. Agricultural occupational injuries cost an estimated \$4.57 billion (range \$3.14

billion–\$13.99 billion) in 1992. Per worker, agriculture contributed roughly 30% more than the national average to occupational injury costs. Direct medical and administrative costs were estimated at \$1.66 billion and indirect costs of lost work at \$2.93 billion. A separate estimate for child agricultural injuries was not provided. Rautiainen et al<sup>3</sup> estimated the cost of compensated injuries and occupational diseases in agriculture in Finland. They found that the total insurance cost of injuries in 1996 was Euro 16.5 million, or 1.5% of the net agricultural income. Low and Griffith<sup>4</sup> estimated that the average cost of an Australian agricultural injury was ~1000 Australian dollars (A\$), and the average cost of a serious injury was ~A\$2500. The maximum estimated cost exceeded A\$26 000. Approximately half of the average costs were accounted for by medical treatment, and approximately one-third of the average costs were accounted for by on-farm production losses, replacement labor costs, and repairs to damaged equipment.

Hendricks et al<sup>5</sup> estimated that ~1.1 million youth were living on US farms and ranches in 2001. Children and youth who work in agriculture are exposed to agricultural production hazards. The Fair Labor Standards Act of 1938 and its amendments do not apply to youth working for their parents or guardians of the family's agricultural operation; it only covers farms with at least 11 hired employees, whose work involves production of agricultural goods that are part of interstate commerce. These household youth account for more than 70% of all youth work injuries in agriculture.<sup>6</sup> Moreover, youth on farms/ranches have virtually no protection against injuries from nonwork activities that expose them to the same hazards as work activities. For example, a child playing in the field and a child working in the field face similar risks of pesticide poisoning, insect stings, and being hit by agricultural vehicles.

In 2000, ~18 000 children and adolescents were killed by injuries, and another 160 000 were permanently disabled because of an injury in the United States.<sup>7</sup> During 1991–1993, Rivara<sup>8</sup> found an average of 104 deaths per year due to injuries occurring in agricultural settings among US children and adolescents 19 years and younger. The rate of 8.0 deaths per 100 000 child farm/ranch residents was 39% lower than in 1979–1981. More of the deaths occurred in hospitals than previously. On average, 22 288 youth agricultural injuries were treated in emergency departments annually. The rate of 17.2 injuries per 1000 child farm/ranch residents was 10.7% higher than in 1979–1983. Boys were injured more frequently than girls.

Hendricks et al<sup>5</sup> found that the injury rate for agricultural household youth declined from 18.7 per 1000 youth in 1998 to 15.7 per 1000 youth in 2001. However, this difference was not statistically significant. One significant decrease in agricultural household injury rates was for boys, whose injury rate decreased from 27.5 per 1000 household boys in 1998 to 18.7 per 1000 household boys in 2001. The injury rate for working household boys also declined significantly from 20.2 per 1000 in 1998 to 11.9 per 1000 in 2001. The most common injury for agricultural household youth was a broken bone or fracture (5321), followed by cuts and lacerations (2925). The arm (2713) was the most commonly injured body part, followed closely by the hand, wrist, and fingers (2686) and the foot, ankle, and toes (2682).

This study analyzes the annual incidence and cost of agricultural youth injuries in the United States from 2001 to 2006. It analyzes them from different perspectives: fatal versus nonfatal, at work versus not at work, and requiring hospitalization versus not requiring hospitalization.

## METHODS

### Incidence

To estimate the incidence of fatal agricultural youth injury, we used the 2001–2006 Multiple Cause of Death mortality census data, which were compiled from death certificates.<sup>9</sup> We selected decedents younger than 20 years old whose cause of death, based on *International Classification of Diseases, 10th Revision* external-cause-of-injury codes, was an injury. We further narrowed the data subset to records with a place of injury recorded as “Farm/Ranch,” or with injury codes W30 or V84 (contact with agricultural machinery; occupant of special vehicle mainly used in agriculture injured in transport accident), leaving 503 cases of fatal injuries to children in agricultural settings over the 6-year period. This estimate omits injuries that occurred off-the-operation during production processes (eg, a crash death while traveling to a farmer’s market).

To estimate the incidence of nonfatal youth injury, we used 3 waves of the US government’s Childhood Agricultural Injury Survey (CAIS) data (public use files for 2001, 2004, and 2006). Following CAIS methodology, we used the cases from CAIS files where youth younger than age 20 were injured in agricultural settings. For consistency with previous child agricultural injury research, we included assaults and deliberate self-harm. CAIS is based on a stratified random sample of 50 000 agricultural operations weighted to provide national estimates. The strata for the sampling design are the 4 Bureau of the Census geographic regions. An equal sample allocation of 12 500 operations is selected in each region. An operation is considered to be a valid member of the sample regardless of whether youth were on it in the year covered by the survey. The selection of the farms within a stratum is random (with no preliminary clustering), regardless of

farm type and size. The average response rate for the 3 waves was 71%. CAIS data are described further in several publications.<sup>1,5,6,10,11</sup> The analysis was conducted in SAS 9.2 (SAS Institute, Inc, Cary, NC) with its survey procedures, which used the Taylor series linearization method to account for sample stratification. This method is appropriate for designs where the number of first-stage sampling strata is small.

### Injury Costs

To develop injury costs, one estimates the number of injuries in a given year by a certain grouping scheme (eg, by treatment setting, body part, and nature of injury) and the corresponding cost per injury, then multiplies these numbers together to estimate the total cost of injuries that occurred in that year.

We estimated childhood agricultural injury costs by using pre-existing incidence-based costs by treatment setting and diagnosis groups.<sup>7,12,13</sup> Incidence-based costs are the present value of the lifetime costs that may result from injuries that occur during 1 year. For example, the incidence-based cost of head injuries in 2010 estimates total costs associated with all head injuries that occurred in 2010 regardless of how far in the future those costs are incurred. Incidence-based costs measure the total savings over a lifetime that prevention could yield and are the appropriate costs for cost-effectiveness and cost-benefit analysis. The present value reveals the amount that would be invested today to pay future costs when they come due. It is computed by using a discount rate, essentially an inflation-free interest rate. We used the 3% discount rate prescribed by the Panel on Cost-Effectiveness in Health and Medicine.<sup>14</sup> We estimated costs from society’s perspective (ie, we counted all costs of the injury, regardless of who pays them). The costs we used are divided into medical costs, work loss costs, and the

value of pain, suffering, and lost quality of life. Medical costs include emergency medical services, physician, hospital, rehabilitation, prescription, and related treatment costs, as well as ancillary costs for crutches, physical therapy, etc, and coroner/medical examiner expenses for fatalities. The available costs, for lack of data, omit the costs of mental health care for the injured and their families and friends traumatized by an injury incident. Work loss costs include victims’ lost wages and the value of lost household work. Quality of life costs include the monetary value of pain, suffering, disfigurement, and lost capacity to function physically including lost sensory, mobility, and cognitive functioning, as well as ability to work and to perform activities of daily living. We included both monetary and non-monetary measures of these losses as some people find the monetary measures distasteful or question their validity. The quality of life measures explicitly exclude work losses to avoid double-counting.

We used unit costs from Finkelstein et al,<sup>1</sup> Miller et al,<sup>7</sup> and Corso et al,<sup>13</sup> by treatment setting (hospital-admitted, treated in the emergency department and released, treated in the physician’s office), body part, and nature of injury, to estimate medical and other resource costs and work losses due to agricultural injury to children and youth. They estimated medical costs separately for hospitalized and nonhospitalized cases. They derived estimates of direct costs for hospitalized injuries from the 2000 Health Care Cost and Utilization Project–Nationwide Inpatient Sample data supplemented by Medstat’s Market-Scan database for nonfacility fees, the Uniform Data System for Medical Rehabilitation, the 1999 Medical Expenditure Panel Survey (MEPS), and hospital cost-to-charge ratios provided by the Agency for Health Care Research and Quality. For nonhospitalized injuries,

they used the 1999 MEPS data to quantify direct medical costs. MEPS participants with injury-related expenditures but without an inpatient admission were divided into 3 categories by primary treatment location: (1) any emergency department utilization; (2) any outpatient but no office-based or emergency department utilization; and (3) any office-based utilization but no emergency department utilization. For each diagnosis grouping (classified by using the Barell Injury Diagnosis Matrix, [http://www.cdc.gov/nchs/data/ice/final\\_matrix\\_post\\_ice.pdf](http://www.cdc.gov/nchs/data/ice/final_matrix_post_ice.pdf)), by primary treatment location, they calculated mean 18-month medical costs by summing costs across all treatment locations of the same type (including prescription drug costs) and dividing by the number of individuals who received treatment in that primary location type.

We tailored the costs of short-term wage loss to agricultural youth's specific working schedules. We estimated quality of life loss per case by using estimated quality-adjusted life years (QALYs) by body part and nature of injury from Miller et al.<sup>7</sup> A detailed description of costing procedures is provided in Zaloshnja et al.<sup>12</sup> We separately computed costs by hospitalization status. To compute them, we used the published costs for hospitalized and nonhospitalized injuries, attaching costs specific to hospitalization status to the individual CAIS cases. Then we computed an average

cost by hospitalization and work status by using the weights in the CAIS data.

## RESULTS

An average of 26 655 injury incidents occurred annually to agricultural youth (ages 0–19) in the United States (Table 1) from 2001 to 2006 (95% confidence interval [CI]: 24 263–29 046). These injuries cost society an estimated \$1.423 billion per year (95% CI: 1333–1513). The bulk of the total cost (\$817 million) came from QALYs lost (6687). The annual number of fatal injuries was 84, costing an estimated \$420 million per year. Approximately 86% of fatalities were not work-related. Only 29.3% of all injuries occurred at work (95% CI: 20.2%–38.4%). The annual cost of work-related injuries was \$347 million or 24.4% of the total cost (95% CI: 20.3%–28.5%).

Injuries caused by machinery and fire/explosions were the most frequent among fatalities, costing \$90 million and \$60 million, respectively (Table 2). Falls and transportation incidents were the main cause of nonfatal injuries, costing \$399 million and \$198 million, respectively. However, among nonfatal injuries, those caused by assaults and deliberate self-harm were the costliest; the average cost per incident was \$76 943.

An estimated 3732 youth or 14% (95% CI: 11.9%–16.1%) survived an injury that resulted in hospitalization (Fig 1). Their estimated annual cost was \$773 million or 54.4% of the total. An estimated 22 839 youth or 85.7% (95% CI: 77.6%–93.8%)

survived injury without hospitalization. Their estimated annual cost was \$229 million or 16.1% of the total.

Among nonfatal injuries, 11.6% of work-related injuries required hospitalization, compared with 15.1% of nonwork-related injuries (*P* value of *t* test: 0.047). Approximately 53% of the total cost of nonfatal injuries (\$529 million) came from hospitalized, nonworking injuries, followed by hospitalized work-related injuries at 24% or \$245 million (Table 3).

The estimated mean cost of an agricultural youth injury incident (including fatal and nonfatal injuries) was \$53 385. The estimated mean cost of a fatal injury incident was \$5 010 021; monetized QALYs accounted for 66.6% of the costs, long-term work loss accounted for 33.3% of the costs, and medical costs were negligible. The estimated mean cost of a nonfatal injury incident was \$37 744. A nonfatal injury incident that required hospitalization cost \$207 275 on average, and 1 that did not require hospitalization cost \$10 046.

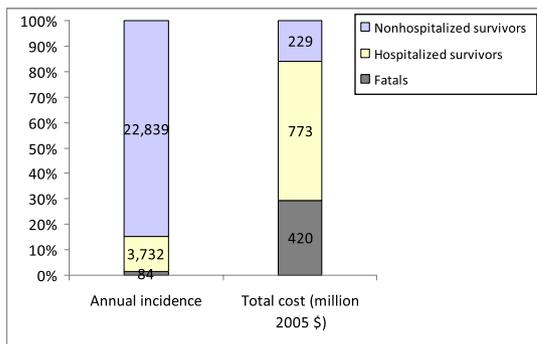
As Table 4 indicates, most agricultural youth injuries occurred to older youth (10–14 and 15–19 years old) and to boys (9570, 8650, and 15 458, respectively). The 0 to 4 age group had the highest percentage of fatalities (0.59%) and the highest contribution of fatalities to total cost (39.8%). In boys of this age group, these patterns were even more visible; the percentage of fatalities was 0.88% and the contribution of

**TABLE 1** Annual Incidence and Costs of Agricultural Youth Injury in 2001–2006 by Survival and Work Status, Ages 0 to 19

Survival and Work Status	Annual Incidence	Medical Cost (million 2005 \$)	Short-term Work Loss (million 2005 \$)	Long-term Work Loss (million 2005 \$)	Monetized QALYs (million 2005 \$)	Total Cost (million 2005 \$)	Total QALYs Lost
All injuries	26 655	93.5	37.9	475	817	1423	6687
At work	7807	38.1	9.4	131	169	347	1363
Not at work	18 848	55.4	28.5	344	648	1076	5324
Fatal	84	0.5	0.0	140	280	420	2365
At work	12	0.1	0.0	22	38	60	322
Not at work	72	0.4	0.0	118	242	360	2043
Nonfatal	26 570	93.0	38.0	335	537	1003	4322
At work	7795	38.0	9.4	108	131	287	1041
Not at work	18 776	55.0	28.5	227	406	716	3281

**TABLE 2** Annual Incidence and Costs of Agricultural Youth Injury in 2001–2006 by Survival Status and Mechanism of Injury, Ages 0 to 19

Survival Status and Mechanism	Annual Incidence	Medical Cost (million 2005 \$)	Short-term Work Loss (million 2005 \$)	Long-term Work Loss (million 2005 \$)	Monetized QALYs (million 2005 \$)	Total Cost (million 2005 \$)	Total QALYs Lost
All injuries	26 655	93.5	37.9	475	817	1423	6687
Fatal	84	0.53	0	139.9	279.6	420.0	2365
Falls	4	0.05	0	6.9	13.9	20.9	118
Machinery	18	0.07	0	28.6	61.0	89.7	516
Transportation	9	0.09	0	14.6	29.6	44.3	250
Fire and explosions	12	0.04	0	21.1	38.7	59.8	327
Drowning	8	0.03	0	12.7	27.8	40.5	235
Assaults and violence	5	0.01	0	7.1	14.9	22.1	126
Other	28	0.23	0	48.8	93.7	142.8	793
Nonfatal	26 570	93.0	37.9	334.9	537.2	1002.9	4322
Falls	9375	24.2	16.0	117.6	241.2	399.0	1960
Machinery	976	1.6	1.0	6.8	7.3	16.7	57
Transportation	3835	20.5	7.7	74.7	94.7	197.6	752
Fire and explosions	157	0.4	0.1	0.9	0.8	2.2	7
Assaults and self-harm	3125	29.5	4.4	85.3	121.2	240.5	972
Other	9103	16.8	8.7	49.4	72.0	146.9	575



**FIGURE 1** Annual incidence and costs of agricultural youth injury in 2001–2006 by severity level, ages 0 to 19.

fatalities to total cost was 56.6%. The 15 to 19 age group had by far the highest percentage of work-related injuries (52.4%) and the highest estimated cost of injury, \$609 million, of which \$361 million came from boys. The percentage of fatalities in this age group was 0.47%, and the contribution of fatalities to total cost was 34.2%.

## DISCUSSION

Agricultural youth injuries are significant child health and occupational health problems. They cost society at least \$1.4 billion annually from 2001 to 2006. The bulk of these costs (~\$817 million) came from QALYs lost. Nonfatal agricultural youth injuries alone cost society at least \$1 billion annually,

equivalent to the \$1 billion cost of fatal and nonfatal unintentional poisonings at ages 0 to 19 in the United States in 2000.<sup>7</sup> Combined annual medical and productivity costs of work-related farm youth injuries were \$178 million. By comparison, the cost of work-related needle sticks and associated infections for health care workers was \$188 million in 2004.<sup>15</sup> The annual medical cost of farm youth injury was \$93.5 million, ~60% of the \$152 million hospitalization cost for pediatric inflammatory bowel disease in 2006.<sup>16</sup>

Our incidence and cost estimates are consistent with findings from previous studies.<sup>1,5,7</sup> For example, Hendricks et al.<sup>5</sup> estimated that 5807 of the agricultural household youth injuries in

2001 were work-related and 11 045 were not work-related. We estimate that 7807 injuries were work-related and 18 848 were not work-related, but our estimate, in addition to household youth injuries, includes injuries to visitors and hired youth. Miller et al.<sup>7</sup> estimated that the mean combined medical and work productivity cost of hospitalized youth injury in the United States was \$71 882 (in 2000 dollars). Our comparable estimate for farm youth injuries was \$96 385 (in 2005 dollars). For nonhospitalized cases, the estimates were \$3698 and \$4642, respectively. Finkelstein et al.<sup>1</sup> estimated that only 0.3% of injured persons in 2000 did not survive injury in the United States, but fatal injury costs represented 35% of the total cost of injury. Our estimates are similar. Only 0.3% of injured agricultural youth did not survive injury, but fatal injury costs represented 30% of the total cost of injury (Fig 1). Our estimate of the portion of cases hospitalized differs from Finkelstein et al.<sup>1</sup> and from Miller et al.<sup>7</sup> (14% vs 4% and 1.4%, respectively); agricultural injury is more severe.<sup>2</sup>

The cost of traumatic injuries to preschool aged children (0–4 years old) represents more than 12% of the total farm youth injury costs. These children are often killed or traumatically injured

**TABLE 3** Annual Incidence and Costs of Nonfatal Agricultural Youth Injury in 2001–2006 by Work and Hospitalization Status, Ages 0 to 19

Work and Hospitalization Status	Annual Incidence	Medical Cost (million 2005 \$)	Short-term Work Loss (million 2005 \$)	Long-term Work Loss (million 2005 \$)	Monetized QALYs (million 2005 \$)	Total Cost (million 2005 \$)	Total QALYs Lost
All youth	26 570	93.0	37.9	335	537	1003	4322
Youth working	7795	38.0	9.4	108	131	287	1041
Hospitalized	902	31.7	3.6	95	114	245	909
Nonhospitalized	6893	6.3	5.8	13	17	42	132
Youth not working	18 776	55.0	28.5	227	406	716	3281
Hospitalized	2829	39.6	13.0	177	299	529	2419
Nonhospitalized	15 946	15.4	15.4	50	107	187	863

**TABLE 4** Annual Incidence and Costs of Agricultural Youth Injury in 2001–2006 by Gender and Age Group, Ages 0 to 19

Gender and Age Group	Annual Incidence	Percent Fatal	Percent at Work	Medical Cost (million 2005 \$)	Work Loss (million 2005 \$)	Monetized QALYs (million 2005 \$)	Total Cost (million 2005 \$)	Percent Fatal	Total QALYs Lost
All youth, y	26 655	0.31	29.3	93.5	513	817	1423	29.5	6687
0–4	2439	0.59	0.0	8.5	54	112	175	39.8	929
5–9	5996	0.21	15.2	13.8	91	133	238	25.8	1081
10–14	9570	0.17	25.9	28.8	152	220	401	20.2	1790
15–19	8650	0.47	52.4	42.4	216	351	609	34.2	2887
Boys, y	15 458	0.44	33.6	40.8	291	483	815	42.8	3987
0–4	1159	0.88	0.00	2.8	28	58	89	56.6	485
5–9	3262	0.28	17.5	8.3	48	85	141	32.1	699
10–14	5434	0.23	28.8	15.5	84	125	224	28.9	1018
15–19	5603	0.65	56.6	14.1	132	215	361	52.2	1785
Girls, y	11 196	0.14	23.5	52.7	221	334	608	11.7	2700
0–4	1280	0.33	0.00	5.7	26	54	86	22.3	443
5–9	2734	0.13	13.1	5.5	44	48	97	16.6	382
10–14	4136	0.08	22.2	13.2	68	96	177	9.2	772
15–19	3047	0.14	44.7	28.3	84	136	248	7.8	1103

by industrial hazards when they are brought by adults into the worksite. Efficacious strategies for the prevention of this pattern of injury are elusive but clearly must include educational and regulatory measures to keep children out of the worksite.<sup>10,11,17,18</sup>

Most of the agricultural youth injuries (~71%) were not work related. Past research<sup>11,19</sup> identified recreational horse riding, the operation of all-terrain vehicles, and falls from structures as major agricultural injury prevention priorities. Possible solutions include the imposition of regulations for recreational activities that exceed developmental norms, as well as better training and more attentive, proximal, and continuous supervision of children engaged in these tasks.

Nevertheless, many agricultural children are killed or injured while at work. A clear need exists to match children's developmental abilities to the demands

of agricultural tasks, such that children are not assigned work that is inappropriate to their developmental stage. This was the basis for the NAGCAT initiative, which covers most common work assignments observed among US children engaged in agricultural tasks.<sup>20,21</sup> Analogously, the content of existing child labor laws requires updating to ensure that these laws are contemporary and relevant and that their content is consistent with child protection measures applied to other occupational sectors. This is particularly relevant for work involving tractors, all-terrain vehicles, and other major classes of agricultural machinery that are common to traumatic pediatric injury on agricultural operations.<sup>22</sup>

Our cost estimates have several limitations. For lack of data, they exclude police and fire department costs. Due to the remoteness of some farms/ranches, these costs can be large. Also the costs

estimated in this study are costs of injury, not costs of injury incidents, because data on the costs of associated property damage are not available. They also exclude mental health care costs for posttraumatic stress and other disorders associated with injury incidents. Losses in household work/chores were estimated based on the days lost and cost per day by age group and gender reported in Miller et al.<sup>7</sup> To the extent that agricultural children do more chores than most children, we underestimate these losses. Depending on the agricultural cycle, injury to a youth may cost a family farm operator more than just the hours spent taking the injured to the emergency department or visiting him/her in hospital. The operator's presence on the farm at that time may be critical to crop yield. To the extent that youth injuries have caused such collateral economic damage, we underestimate the cost of injury. Like CAIS

itself and Rivara,<sup>8</sup> we include all injuries to children and youth that occur in agricultural settings, regardless of intent and regardless of whether they are production-related, home-related, or play-related. We also include all off-operation fatalities while riding on/in agricultural machinery. However, lack of incidence data forced exclusion of injuries that occurred off-the-operation during production processes (eg, a

crash injury while traveling to a farmers market).

## CONCLUSIONS

The cost of youth agricultural injury is substantial, comparable to the costs of more frequently discussed risks such as unintentional child poisoning or occupational needle stick injury. This study provides a comprehensive analysis of

the annual incidence and cost of agricultural youth injuries in the United States. Those injuries tend to be more severe and more costly than non-agricultural ones. To address the child agricultural injury problem, prevention should focus on better controlling both child access to agricultural recreational activities and child assignment to agricultural work tasks that exceed their developmental norms.

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