Nonfatal Farm Injury Incidence and Disability to Children

A Systematic Review

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Objective: To summarize the literature on farm child nonfatal injury incidence and the subsequent disability to children.

Search Strategy: We used a systematic process to search the following databases: MEDLINE, EMBASE, ERIC, NTIS and NIOSHTIC. The reference lists from each potentially eligible study were checked and experts in the field contacted for additional reports.

Selection Criteria: Studies for selection had to meet the following criteria: published in the last 20 years (1979–1998); located in North America; and include nonfatal farm injury cases for children under age 20.

Data Collection and Analysis: Thirty-two studies met the inclusion criteria and were examined for study design, location, sample size, injury rate, injury sources, and functional outcomes.

Results: Among the 32 studies, there were 9 case series, 11 secondary analyses of administrative databases, 2 case-control studies, 6 cross-sectional surveys, one mixed-method study, 2 prospective case series reports, and 1 cohort study. Twenty-two of the studies confined the sample to agriculture, but nine of these combined children within a larger sample, creating considerable difficulty in examining only agricultural injuries to children. Only one study focused on outcome measurement. Although nearly all the reports provided some discussion about injury severity, these comments were generally limited to injury severity scores or injury type.

Conclusions: Despite increasing attention on farm-related child injury, the literature continues to report primarily descriptive studies that rely on small samples focusing on the nature of the injury event and immediate consequences. Analysis of larger databases, such as worker compensation claims, trauma registries, and agricultural injury surveillance, still lacks valid denominators; thus, incidence rates cannot be calculated. Very little was found regarding disability among children who experienced agricultural injury, even though the literature clearly proclaims the severity and seriousness of child injury on farms. To complete the portrait of the burden of this continuing problem, research must include functional outcome measures.

Medical Subject Headings (MeSH): child, agriculture, wounds and injuries, disability, disabled children, review literature (Am J Prev Med 2000;18(4S):70–79)

Introduction

The risk to life and limb has long been apparent in agriculture and has even been accepted by its workers.[1–3] In 1989, Merchant et al.[4] reported that between 80,000 and 170,000 farmers suffer a disabling injury each year, at a cost of $2.5 billion for hospitalization and rehabilitation. Annually, one out of every four farm families experiences a farm-related injury.[5] Estimates of permanently disabling injury in the farm population range from 2%[6] to 4%[7]. The prevalence of permanent injury is generally considered to be grossly underestimated, since 95% of U.S. farms are exempt from the regulations of the Occupational Safety and Health Administration (OSHA) and rates are based on voluntary reporting from 35 states.[2,8]

About 1.298 million farm children live, play, and work surrounded by the animals, machinery, and struc-

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tures that provide their families' incomes.[9] Farm work may begin in early childhood and be maintained for a lifetime. Children live and work in the same place in which their parents work, so children are consequently exposed to hazards that are otherwise found only in heavy industry. The symbiotic relationship between workplace and home that exists in agriculture exposes the family unit to risks for injury that may not be present in other settings.[10]

According to best estimates, in 1985, the fatality rate for farm child injuries was 13.2 per 100,000 farm child residents, with 129 injuries reported for every fatality.[11] A decade later, Rivara reported that the mortality rate for farm child injuries had declined by 39%; however, the morbidity rate had increased 10.7%.[9] While fewer farm children lost their lives due to farm injuries, more retained the physical and emotional scars of the trauma they endured.

In 1990, a Congressional mandate to the National Institute of Occupational Safety and Health (NIOSH) turned national attention to understanding and preventing agricultural injuries and illnesses. Federal funding sponsored the first full-scale examination of farm health and safety. The initial results of these studies illustrated the high rate of injuries to farm children. As a result, in 1997, additional funds were earmarked for research to find ways to reduce injury rates among farm children.[12]

The effect of these efforts on the actual incidence of injuries to children is unclear. Among the growing number of epidemiologic studies of injuries to farm children, nearly all are confined to descriptive record reviews and case studies, with only a few population-based surveillance reports.[13] Even these studies suffer from limited data sources. Layde et al.[14] reported significant differences when comparing population-based vs. non-population-based surveillance data.

In addition, little has been accomplished regarding systematic examination of the functional outcomes following farm injuries.[15] The final essential data element for injury surveillance is the outcome of the event, including resultant disability.[16,17]

The purpose of this review was to summarize the literature on the incidence of injury and the subsequent disability to children on the farm. Our goal was to identify what is known, what areas need further research and what areas are ripe for intervention.

Methods

Search Strategy

Relevant studies from peer-reviewed journals, technical and government reports, and unpublished reports were searched using a systematic approach. Due to the multidisciplinary nature of the research question, the search was conducted across disciplines, and included several different databases and collections of literature. A total of five databases were included in the search: two biomedical (Medline, Embase), one social science (ERIC), one government (NTIS), and one occupational health (NIOSHTIC).

In addition to database searching, other relevant information sources were identified by checking references and consulting with experts in the field. A full description of the databases and search strategy is included in the overview article on information retrieval.[18]

Inclusion Criteria

Studies were included if they were published in the last 20 years (1979–1998) and if they analyzed nonfatal agricultural injury to children or youth (persons aged under 20 years). The review was limited to reports and studies conducted in the United States and Canada. Therefore, some studies were excluded due to geographic setting.[19–25] Articles that did not meet age limitations[20,26–35] or did not report separate analyses for children,[30,36–45] those that reported only fatalities,[34,41,46–49] and studies that were not data-based[45,46,50–58] were also excluded. We found no studies meeting the criteria published from 1979 to 1983.

Outcome Measures

Information in the literature included simple frequency enumeration of injuries and injury rates. Because of varying denominators, no attempt was made to standardize rates across reports.

An injury was defined as any event that required medical attention or resulted in lost time from usual activities. A farm-related injury was defined as any injury that occurred on a farm or ranch and resulted from an event related to agricultural production. The child did not need to reside on or be working on the farm to be included.

Disability resulting from injury was defined as any health condition that prevented usual activities for a prolonged period of time or that resulted in permanent alteration of usual activities. Definitions of temporary and permanent disabilities were adapted from standard worker compensation definitions.[59,60] Temporary disability referred to injury from which the child fully recovered but at a cost of at least 8 days of lost time from usual activities. Permanent disability referred to loss of vision or hearing, loss or loss of use of any part of a limb, or any injury that partially or fully incapacitated the child. Because very few of the reviewed articles included definition of disability, we used length of hospitalization, type and severity of injury, and clinical reports as proxy measures for possible disability and degree of disability.

Results

The incidence and cause of injuries to farm children varied with age of the child. The age range of children in these reports differed among studies, a factor that deserves consideration when findings are compared. Some studies included adults in addition to children[61–68]; few results were given for children alone, which limited our ability to comment on their injuries and outcomes.

Table 1 summarizes the literature on child farm injury published between 1979 and 1998. The study

designs represented include case series (n=9), secondary review of administrative databases (n=11), case–control studies (n=2), cross-sectional surveys (n=6), mixed method (n=1), prospective case series (n=2), and prospective cohort (n=1).

The case series study samples ranged from four farm children[69] to 253 farm children.[64] Not all articles limited inclusion to farm children; thus the number of farm children in the study was sometimes less than the full sample.[62–64] Varying ages included in the study may have influenced the cause and type of injury. All case series reports were based on retrospective review of medical records. Therefore, by definition, only injuries requiring medical care were included in the studies. Four of the studies included fatalities in the sample.[63,64,70,71] Case series reports generally focused on a single injury source, such as chemical agents[72,73] and farm machinery.[62,64,71,74] Machinery and animals were the leading sources of injuries in the remaining three articles.[63,69,70] These findings are historically consistent with the general body of farm injury literature.[5,8]

Six of the articles described the etiology of injury.[62–64,70,71,73] Outcome measures of disability were included in only three of those reports.[63,70,71] The proportion of children left with some type of disability after injury ranged from 10%[70] to 41%.[71] Orthopedic complications (including amputation and discrepancies in limb length), neurological disorders, and pulmonary disabilities were most frequently cited, indicating that the resultant disabilities were of a serious nature. The other three case series studies reported no measures of disability but made some reference to outcome. By nature of the sampling technique, all injuries would have been classified as at least temporarily disabling. Three of the articles focused on clinical description and management of the injuries and had very small samples.[69,72,74] Within the clinical reports, no description of functional outcome was reported except by inference of quality of healing[69,72,74] and number of amputations.[69]

Articles were classified as secondary reviews of administrative databases if they used large existing data sets other than medical records for their analysis. Eleven studies met this criterion.[9,11,60,61,65,75–80] Although the sample sizes were quite large, closer examination revealed that in the studies that were not specific to agriculture, the number of agricultural cases was very small. In some articles, it was not possible to report on the subset of child agricultural cases. We were unable to calculate injury rates from most studies due to lack of denominator data. Only one report that was not agriculture-specific calculated a separate injury rate for agricultural claims.[77] In non-agriculture-specific studies, sources of injury for agricultural cases were not reported. The seriousness of farm-related injury was underscored in several articles.[60,75,78,79] Heyer et al.[76] noted that 26% of farm worker claims for children were classified as serious, compared with 16% of all claims filed for children.

Three publications focused exclusively on child agricultural injury.[9,11,80] Farm machinery was the primary cause of injury in each study. Each of these reports included fatal cases. Rivara's articles[9,11] provided the only comparison studies within this systematic review, but the author indicated that even these publications are not strictly comparable.[9] No direct measure of functional outcome was provided in any of these analyses. However, medical treatment for the injury was part of the inclusion criteria.

Only two case–control studies were reported.[81,82] One was a population-based study in Wisconsin designed to identify preventable risk factors for injury.[82] The reported incidence of injury was similar to that found in other agricultural literature. The other was a report of a pilot study focused on supervision issues.[81] One third of the cases were hospitalized; however, the response rate was only 17%, thus limiting conclusions.

The six cross-sectional studies provided the most variance in data collection methods.[83–88] Two studies surveyed students by self-administered questionnaires.[84,85] In North Carolina, the lifetime prevalence of injury among students who did farm work was an astounding 71%. Nine percent missed at least 1 day of usual activities. The mechanism of injury and outcome was not assessed.[85] Hawk et al.[83] presented survey results from a youth disability prevention project. Machinery was the leading mechanism of injury, and nearly all injuries resulted in restricted activity. Length of restricted activity (average 14.4 days) indicated that full recovery may have required months.

Two population-based reports surveyed farm units but provided very limited findings for children. Pickett et al.[87] reported a low rate of child injury, but injuries to the children resulted more often in hospitalization than for other age groups, again indicating the severity of outcome. A national agricultural injury survey conducted by NIOSH[86] noted that 7.7% of all injuries occurred to children aged 10 years to 19 years, and that 67% of children under age 10 years required medical attention for their injuries. Injuries tended to be severe but not permanently disabling, with fractures reported most often.

Two of the cross-sectional studies reported chronic rather than acute injury.[84,88] Broste et al.[88] collected physical measurement of injury (hearing loss) rather than relying on self-reported data. Hearing loss is different from other injuries in that it is generally caused by cumulative trauma. Even though hearing loss can result in permanent disability, it is missed in the usual injury reports. Broste et al.[88] reported that risk for hearing loss was doubled among high school students who did farm work, with almost three fourths of the students who did farm work exhibiting some level of hearing loss. Millard et al.[84] reported a survey of hand

Table 1. Child injury literature 1984–1998, classified by study design

Author/date	Location and study period	N	Ages	Data source	Injury rate	Injury source	Functional outcome measurement
Case series design (9)							
Hartling, Pickett, Brison (1997)[64]	Ontario, Canada 1984–1993	Fatalities: 52[a] Hospitalized: 1068 Children <19: 253	All	Hospital discharge data and medical records, fatality registries	Hospitalization injury rates: overall = 49.3, males <20 = 56.6 (per 100,000 persons)	Non-tractor agricultural machinery	Inferred by injury type
Neidich (1993)[72]	South Dakota 1984–1989	Children: 14	0–16	Hospital records	Not applicable	Alkali ingestion	Degree of esophogeal involvement
Cogbill, Steenlage, Landercasper, Strutt (1991)[63]	Wisconsin 1977–1989	All ages: 739[a] Age <20: 190[a]	All	Trauma log, hospital charts, outpatient records	Not applicable	Animals: 225 Machinery: 377 Other: 137 (out of 739)	Injury severity score: significant disability 22% (orthopedic/ neurological/ pulmonary)
Brennan, Rhodes, Peterson (1990)[74]	Minnesota 1991–1998	68	1–19	Hospital records	Not applicable	Farm machinery	Injury severity not scored
Swanson, Sachs, Dahlgren, Tinguely (1987)[71]	Minnesota 1974–1985	Children: 87[a]	1–16	Hospital and clinic records	Not applicable	Farm machinery	40.9% long-term disability (not defined)
Edmonson (1987)[73]	Wisconsin 1973–1983	43	<12	Inpatient records	Not applicable	Alkaline products	Clinical judgment
Letts (1986)[69,b]	Canada 1978–1983	Total: 16 Farm: 4	3–14	Hospital cases	Not applicable	Farm machinery: 4 of 17	Number of amputations; quality of graft healing
Cogbill, Busch, Stiers (1985)[70]	Wisconsin 1977–1984	105[a]	0–18	Hospital charts	Not applicable	Animals: 40% Machinery: 46% Other: 14%	Major long-term disability: 1% Minor long-term disability: 9% (Injury Severity Score)
Simpson (1984)[62]	Canada 1980	All ages: 42 Age <18: 12	All	Hospital discharge records	Not applicable	Farm machinery	Inferred by type of injury
Administrative databases (11)							
CDC (1998)[80]	United States 1995–1997	Youth: 104	<20	NEIS Surveillance System	< 15 = NA 15–17 = 1.8 18–19 = 2.7 (per 100 FTE)	Machinery, animals, persons, other	Inferred by injury type
Hartling, Pickett, Guernsey, Alberg, Redekop, Brison (1998)[61]	Canada 1985–1996	All ages: 1324[a] Age < 16: 157	All	Canadian Agric Injury Surveillance Registry, Manitoba Dept. of Labor	Not applicable	Farm machinery	Inferred by injury type and injury code
Miller & Kaufman (1998)[77,b]	Washington State 1988–1991	Claims: 17,800	11–17	Accepted worker comp. files	Overall: 9.0 Agriculture: 11.4 (per 100 workers)	No agriculture-specific information	Not given
Rivara[9] (1997)	United States NEISS 1991–1993 NCHS 1990–1993	Injuries: 89,153 Death/yr.: 104[a]	<20	Nonfatal = NEISS Fatal = NCHS MMC death tapes	1717 per 100,000 resident farm children (nonfatal injuries only)	Machinery: 47% Horseback riding: 8.4% ATV/motor bikes: 8.0% Other: 36.6%	Inferred by injury type

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Layne, Castillo, Stout, Cutlip (1994)[75,b]	United States July–December 1992	Injuries: 37,405 Age-related: 2502	14–17	NEISS data (91 U.S. hospital emergency depts.)	4.3/100 FTE	Farm machinery: 20%	Not reported
Belville, Pollack, Godbold, Landrigan (1993)[60,b]	New York State 1980–1987	9656 Farm: 7%	14–17	Worker comp. claims	Overall = 46.2 per 10,000 working adolescents (no age-specific rate)	Various vocations	43.5% of adolescents with WC claims had permanent disability
Heyer, Franklin, Rivara, Parker, Haug (1992)[76,b]	Washington State 1986–1989	Total claims: 16,481 Farm: 7%	< 18	Worker comp. claims	Not applicable	Not reported	Disability by time loss and Z-code; 26% classified as "serious"
Demers, Rosenstock (1991)[65]	Washington State 1982–1986	All ages: 29,451 Age < 18: 5%[a]	All	Worker comp. claims	Not applicable	Not reported	Inferred by injury type
Parker, Clay, Mandel, Gunderson, Salkowicz (1991)[78,b]	Minnesota 1986–1987	Total: 1607 Farm injuries: 45 Total: 23,823	12–17	MN Dept. of Labor and worker comp. claims	14.0/1000 FTE (all occupations)	Not reported	"Unable to determine disability"
Schober, Handke, Halperin, Moll, Thun (1988)[79,b]	24 U.S. States 1980–1983	Farm worker claims: 1243	< 18	Worker comp. (SDS) files	Males: 12.6/100 FTE Females: 6.6/100 FTE (Ages 16–17, all vocations)	Various	Not reported
Rivara (1985)[11]	United States 1978–1983	Deaths: 286[a] Injuries: 117,525	0–19	NCHS death tapes, NEISS, CPSC data base, 1980 Census	Males: 1740 Females: 343 Overall: 1551 (per 100,000 population in each age/gender group)	Farm equipment	Severity indicated by body part; 1:10 admitted to hospital
Case control studies (2)							
Sebille, Donham, Roberts (1997)[81]	Iowa 1993	Cases: 22 Controls: no #	0–9 yrs.	Mailed survey	Not applicable	Machine, falls, animals	Type of medical care sought; 1/3 hospitalized
Stueland, Lee, Nordstrom, Layde, Wittman (1996)[82]	Wisconsin 1990–1992	Cases: 60 Controls: 102	< 18	Cases: MESA medical records; Controls: Lists from USDA/ dairy milk producers, farm vehicle registration, subscribers to AgriView	Males: 23.47 Females: 12.66 Overall: 18.27 (per 1000 farm resident persons)	Disabled safety devices, livestock	Contusions, lacerations, fractures
Cross-sectional surveys (6)							
Myers (1998)[86]	United States	Farms: 11,630	Not given	Self-administered questionnaire	9% aged 0–19 injured	Not specified	10% loss time and types of injuries
Millard, Shannon, Carvette, Tanaka, Halperin (1996)[84]	Maine 1994	Responses: 648 Rakers: 364	13–19	Self-administered questionnaire	Not applicable	Metal hand rakes	51% hand pain (R.R. = 3.7) 4% pain >1 month

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Author/date	Location and study period	N	Ages	Data source	Injury rate	Injury source	Functional outcome measurement
Cohen, Runyan, Dunn, Schulman (1996)[85,b]	North Carolina	Respondents: 323 Farm workers: 112	14–17	Self-administered guestionnaire	71% injured doing farm work (lifetime prevalence)	Not specified	Inferred by number who sought medical treatment
Pickett, Brison, Neizgoda, Chipman (1995)[87]	Canada 1991	Ontario farms: 2000	All	Population-based mail survey	Children < 19: 2.0 (per 100 persons per year)	Machinery, lifting, animals, falls, other	Not reported for children
Hawk, Gay, Donham (1991)[83]	Iowa (year not reported)	Families: 169 Children: 344	Families with children < 19	Survey of 169 families	Not applicable	Machinery: 36%	93% = restricted activity (range 1–60 days; avg. 14.4)
Broste, Hansen, Strand, Stueland (1989)[88]	Wisconsin 1985–1988	Voc-agriculture students: 872	12–19	Audiometric testing and survey	Not applicable	Not applicable	Hearing loss: 71%–74% (work farm) 36%–46% (no farm work)
Mixed method: record reviews and interview (1)							
McDermott, Lee (1990)[67]	South Carolina 1986, 1987	Med. records: 776 Interviews: 116	All	Medical records, interview	Interviews: 7.8% of injured were children	Not given for children	Not reported
Prospective case series (2)							
Waller (1992)[66]	Vermont 1988–1989	Farm injuries: 147[a]	All	Hospital records, follow-up phone surveys	Not applicable	All farming and woodlot aspects (machinery, tools, animals)	# days of disability
Stueland, Layde, Lee (1991)[89]	Wisconsin 1986–1988	Children: 246	< 19	Medical records, survey	Not applicable	Machinery: 45 Animals: 47 Other: 154	Not reported
Prospective cohort (1)							
Lee, Gerberich, Gilson, Carr, Shutske, Renier (1996)[68]	5 states 1990	Farm households: 3939 Children injured: 4	All	Phone surveys	Age < 10: 110.3 Age 10–19: 79.5 (per 100,000 persons on farms with tractors)	Tractors	Not reported for children

[a]Study included fatal cases.
[b]Not agriculture-specific.

pain among students who raked blueberries. Persistent hand pain lasting longer than 1 month may be indicative of cumulative trauma disorder.

In the only report focusing on minorities that included children, McDermott et al.[67] used a mixed design of record reviews and interviews to describe injuries. Interview data revealed nine injuries to children. No descriptions of these injuries were included. However, it is important to note that 7.8% of the total injuries in the survey were attributed to these young workers.

Only three prospective studies were found.[66,68,89] Two hospital-based case series reports focused on the sources and types of injuries. Only one[66] reported disability outcomes. However, disability outcomes were not reported for children included in the study. Stueland et al.[89] focused on the etiology of injury. No long-term outcome data were collected in the survey portion of the study. In the sole population-based cohort study,[68] only four injuries to children were reported. The only child-specific rates calculated were relative risks for injury. The narrow focus of the study (tractors) may have led to this unusually low injury rate.

Methodologic Issues

The methodologic quality of studies varied depending on several factors, including study design and the databases used. Study designs ranged from simple case series reports including only 14 children[72] to secondary analysis of multiple national administrative databases.[9,11,61,75] All case series reports[62–64,69–74] were based on retrospective review of medical records, which limited the type and quality of data. These reports, by nature of their databases, reflected only the most serious injuries. Six reports relied on worker compensation claims.[60,65,76–79] The authors of these reports noted that injuries to farm children were severely underrepresented in these databases. The National Electronic Injury Surveillance System (NEISS) was used as a database in four studies,[9,11,75,80] although that system is known to underrepresent rural hospitals, where farm children would be most likely to be treated for all but the most severe injuries.[9] The heavy reliance on self-reported data[66,81,83–86,89] compromises the validity of study results. Many studies used a compilation of data sources, which may or may not have employed comparable sampling and analysis strategies.[9,11,61,64,78]

One of the major obstacles for reviewing and comparing literature, especially in the arena of agricultural injury, is the problem of comparable definitions.[13] The definition of injury was not consistent across studies. Only two studies[9,11] used the same definition of injury. Only three articles[60,63,86] defined disability, and these definitions varied across studies. The distinction between temporary and permanent disability was defined in only one report,[60] although several articles reported outcomes in these terms.

Discussion

Obstacles continue to thwart our efforts to categorize the literature on injuries to farm children. The descriptive state of much of the literature precludes a definitive portrayal of the magnitude and severity of injuries among farm children. Generally, only descriptive statistics are reported for injury; in many reports agricultural injuries are subsumed within the general results, effectively barring a realistic portrayal of injuries to farm children.

The current literature lacks data on the number of children engaged in farm work. Accurate estimates of the incidence of injuries cannot be calculated until these data are available. Only 12 of the 32 studies reported injury rates and, when these were reported, rates were calculated in varied ways. Consequently, comparisons cannot be made. Rivara[9,11] noted this problem in both his 1985 and 1997 reports on injuries to farm children. There is a continued need for exposure data so that rates can be estimated based on actual time children are exposed to farm hazards. While other industries that employ children and youth are required to keep records of hours worked, the nature of agricultural work prevents good estimates of exposure.

The report of injury sources was consistent across studies and was also consistent with the historical evidence of farm injury. Machinery and animals were most commonly cited as primary sources of injury in the injuries to farm children reports. With the exception of one small case series report,[69] publications that were not specific to agriculture did not report sources of agricultural injury.

The problem of incomplete data in hospital and other medical records hampers the ability to present evidence of disability. Judging from the severity of injuries presented in the literature (fractures, lacerations) and the high percentage requiring hospitalization, nearly all would be considered at least temporarily disabling. Many would lead to permanent disability. Worker compensation legislation and current Bureau of Labor Statistics policies exclude most children working in agriculture. Unless these policies are revised to more accurately reflect the rate, outcomes, and costs of injuries to farm children, the literature will continue to present an incomplete portrait of the epidemiology of injuries to farm children.

The inadequacy of national databases in examining these injuries remained essentially unchanged over the last decade. The incidence and severity of injury are calculated in only two comparison studies.[9,11] The NEISS database showed that younger children were likely to have more severe injuries, and older children were likely to have higher rates of injury. While lacer-

ations and puncture wounds were the most commonly reported injuries, severity and outcomes were not documented. Overall, 10% required hospitalization, a reasonable proxy for serious injuries. However, the database has no mechanism for recording post-discharge outcome. Even the continued national surveillance study of agricultural injury[86] provides scant data on outcome, limiting its report to lost time and temporary and permanent disability.

Recommendations for Future Research

Despite increasing knowledge about the epidemiology of childhood farm-related injury, the outcomes of injury remain unknown. Research and prevention efforts of the past decade demonstrate the decline of fatal injuries, yet the concomitant rise in the number of children who survive farm injuries poses the question of their quality of life. While years of potential life lost can be calculated for fatal injuries, there is no documentation of the years of potential productive life lost for survivors. Current and future research needs to incorporate outcomes of these nonfatal events.

Persons with disabilities are at high risk for the development of secondary conditions. Lack of adequate rehabilitation is cited as a contributing factor to the development of these conditions.[90] For rural residents, barriers to the care required after hospitalization are distance to services, transportation, and time required to access care.[91,92] Hispanics and other minorities suffer a disproportionate share of disability among the rural population and have the most limited resources for accessing care.[93] No studies provided insight into these rehabilitation issues that may affect injured farm children. Realization of the need for rehabilitation services for injured farm children was raised over a decade ago.[94] A concerted effort must be made to access the use of rehabilitation services by the farm population. Intervention strategies to deliver care to injured farm children should be designed.

The private and public financial burdens of rehabilitation after serious injury need to be examined for farm children. Serious injuries such as neurologic trauma and amputation require lifelong medical intervention. Many farm families are without insurance, adding to the financial and emotional burden of caring for an injured child.[95] The economic impact of temporary and permanent disability should be included in data collection when possible. Intervention studies that focus on cost reduction and rural accessibility to care should be undertaken.

Stallones[13] reviewed the U.S. literature regarding the epidemiology of childhood agricultural injury and found only descriptive studies that stopped short of examining the postevent phase of injury. The current state of the literature on injuries to farm children continues to exclude functional outcome. Longitudinal studies should be undertaken to follow injured farm children post discharge. This research should include standardized functional outcome measures, days lost from usual activity, pyschosocial evaluation and cost analysis. Data on the ability to work should be included for older children.

Conclusions

The efforts of the U.S. government to establish programs of research and intervention to reduce the prevalence of farm injury should be applauded and supported. Efforts must now be made to standardize measurements in the literature. When planning research programs, investigators should collect data regarding not only the epidemiology and prevalence of injury but the short-term and long-term consequences of the event. Children who would have died from their injuries a decade ago are now living. Examination of the quality of life of these survivors needs to be undertaken. Intervention research aimed at maximizing recovery and improving the quality of life for farm children who are injured must be considered. Three research projects funded by the 1997 National Childhood Agricultural Injury Prevention Initiative are examining farm children's health outcomes and the economic and psychological impacts of farm injury.[12] We anticipate publications in the near future from these and other studies that will extend our knowledge about the incidence of injuries to farm children and the outcomes of these events. Such information can assist in building appropriate intervention services for disabled farm children.

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