DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Centers for Disease Control
and Prevention (CDC)

Memorandum

Date: March 26, 2001

From: Roy M. Fleming, Sc.D., Director, Research Grants Program RMF
Office of Extramural Programs, NIOSH, D30

Subject: Final Report Submitted for Entry into NTIS for Grant 1 R01 CC514376-01.

To: William D. Bennett
Data Systems Team, Information Resources Branch, EID, NIOSH, P03/C18

The attached final report has been received from the principal investigator on the subject NIOSH grant. If this document is forwarded to the National Technical Information Service, please let us know when a document number is known so that we can inform anyone who inquires about this final report.

Any publications that are included with this report are highlighted on the list below.

Attachment
cc: Sherri Diana, EID, P03/C13

List of Publications - None

Title: Economic and Psychosocial Impacts of Youth Farm Injury
Investigator: John R. Schmelzer, Ph.D.
Affiliation: Marshfield Medical Research & Education Foundation
City & State: Marshfield, WI
Telephone: (715) 389-3009
Award Number: 1 R01 CC514376-01
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Abstract:
This study was designed to provide increased knowledge of the economic costs and the psychosocial impacts associated with farm-related injuries to youth (i.e., individuals less than 20 years old). It was undertaken because comprehensive literature reviews revealed a paucity of research on both the costs of agricultural injury to youth, particularly for the less seriously injured, and virtually no studies of the psychosocial impacts to youth and their families resulting from a farm-related injury.

Four aims were identified for the study. Specific aims for the economic component included: (1) comparing direct costs of health care utilization for injured youth and non-youth across the injury severity spectrum, and identifying and estimating other potentially relevant factors for their impact on costs, including agent(s) of injury and body injury site(s), and (2) assessing the feasibility of developing methods for estimating indirect costs associated with farm-related injuries. The specific aims for the psychosocial component included: 1) developing and pilot testing survey instruments and interview processes for identifying mid- and long-term psychosocial effects of serious farm injuries to youth, particularly with respect to competence and behavior, school achievement, and social interactions; and 2) determining the psychosocial effects of farm injury to youth on family functioning, including distancing, cohesion, and family interaction patterns.

The study population included individuals who sought care for farm-related injuries at Marshfield Clinic and/or St. Joseph's Hospital in Marshfield, WI between November 1992 and December 1998. A total of 1,066 injury-event-persons were potentially eligible for the study, including 292 youths. The analytic data set included all injured youth (N=236 ambulatory treated and N=56 hospitalized) and 453 adult injured (N=352 ambulatory treated and N=101 hospitalized). All hospitalized injured were included in study analyses. In addition, all ambulatory-treated youth and an approximate 50% random sample of the adult ambulatory-treated were included for analyses. The primary source of case identification was the Emergency Room Surveillance System operating at Marshfield Clinic/St. Joseph's Hospital. A secondary source of case identification was Marshfield Clinic's Urgent Care Department.

Study data were developed from a variety of sources, including abstractions from medical records, electronic Clinic and Hospital administrative and financial data systems, and personal interviews (psychosocial component). Abstraction data were edited to include

only injury-related health services. These data were linked electronically to provider charge data files, and were subsequently aggregated to visit and then injury episode levels. Charges were adjusted to approximate costs using institution-specific cost to charge ratios. All costs were normalized to calendar year 1996, using the appropriate physician and hospital components of the Consumer Price Index.

Multivariate analysis of injury costs indicate that, for those less seriously injured, youth costs tend to be lower than adult costs, and much lower than older adult costs (adults age 65 years and older). Older adult costs were $456 per injury episode compared to $239 for youth, or about 90% higher. For the less seriously injured, machinery, animal, and fall-related injuries contributed to systematically higher costs. Only machinery-related injuries contributed to higher costs for the more seriously injured (i.e., hospitalized). Interaction terms between youth and body part injured and agent of injury did not indicate systemic effects in analyses of either the less or more seriously injured. These results indicate that youth, regardless of the severity of their injuries, tend to have lower costs of treatment than adults and that the effects of injury agents are more pronounced among the less seriously injured.

Pilot psychosocial data for the study were developed from in-home interviews with 15 injured youth and their parent or the injured's parent alone. During the semi-structured, in-home interviews, which lasted about 45 minutes, a trained medical sociologist administered Achenbach's Child and Young Adult Behavior Checklist, respectively, and the Family Assessment Devise (Epstein, et al.). These instruments, which have established psychometric properties in non-farm injury populations, provided preliminary data on the injured's self-concept, school achievement, social interactions, and career aspirations. It also provided data on family functioning, distancing, cohesion, and family interaction patterns.

Publications

No publications to date.

Marshfield Center for Health Services Research
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ECONOMIC AND PSYCHOSOCIAL IMPACTS OF YOUTH FARM INJURIES

Final Report
December 29, 1999

Principal Investigator: John R. Schmelzer, Ph.D.

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Abstract

ECONOMIC AND PSYCHOSOCIAL IMPACTS OF YOUTH FARM INJURIES

Principal Investigator: John R. Schmelzer, Ph.D.

Grant Award: 1 RO1 CCR514376-01

This study was designed to provide increased knowledge of the economic costs and the psychosocial impacts associated with farm-related injuries to youth (i.e., individuals less than 20 years old). It was undertaken because comprehensive literature reviews revealed a paucity of research on both the costs of agricultural injury to youth, particularly for the less seriously injured, and virtually no studies of the psychosocial impacts to youth and their families resulting from a farm-related injury.

Four aims were identified for the study. Specific aims for the economic component included: 1) comparing direct costs of health care utilization for injured youth (individuals less than 20 years old) and non-youth across the injury severity spectrum, and identifying and estimating other potentially relevant factors for their impact on costs, including agent(s) of injury and body injury site(s), and 2) assessing the feasibility of developing methods for estimating indirect costs associated with farm-related injuries. The specific aims for the psychosocial component included: 1) developing and pilot testing survey instruments and interview processes for identifying mid- and long-term psychosocial effects of serious farm injuries to youth, particularly with respect to competence and behavior, school achievement, and social interactions; and 2) determining the psychosocial effects of farm injury to youth on family functioning, including distancing, cohesion, and family interaction patterns.

The study population included individuals who sought care for farm-related injuries at Marshfield Clinic and/or St. Joseph's Hospital in Marshfield, WI between November 1992 and December 1998. A total of 1,066 injury-event-persons were potentially eligible for the study, including 292 youths. The analytic data set included all injured youth (N=236 ambulatory treated and N=56 hospitalized) and 453 adult injured (N=352 ambulatory treated and N=101 hospitalized). All hospitalized injured were included in study analyses. In addition, all ambulatory-treated youth and an approximate 50% random sample of the adult ambulatory-treated were included for analyses. The primary source of case identification was the Emergency Room Surveillance System operating at Marshfield Clinic/St. Joseph's Hospital. A secondary source of case identification was Marshfield Clinic's Urgent Care Department.

Study data were developed from a variety of sources, including abstractions from medical records, electronic Clinic and Hospital administrative and financial data systems, and personal interviews (psychosocial component). Abstraction data were edited to include only injury-related health services. These data were linked electronically to provider charge data files, and were subsequently aggregated to visit and then injury episode levels. Charges were adjusted to approximate costs using institution-specific cost to charge ratios. All costs were normalized to calendar year 1996, using the appropriate physician and hospital components of the Consumer Price Index.

Multivariate analysis of injury costs indicate that, for those less seriously injured, youth costs tend to be lower than adult costs, and much lower than older adult costs (adults age 65 years and older). Older adult costs were $456 per injury episode compared to $239 for youth, or about 90% higher. For the less seriously injured, machinery, animal, and fall-related injuries contributed to systematically higher costs. Only machinery-related injuries contributed to higher costs for the more seriously injured (i.e., hospitalized). Interaction terms between youth and body part injured and agent of injury did not indicate systemic effects in analyses of either the less or more seriously injured. These results indicate that youth,

regardless of the severity of their injuries, tend to have lower costs of treatment than adults and that the effects of injury agents are more pronounced among the less seriously injured.

Pilot psychosocial data for the study were developed from in-home interviews with 15 injured youth and their parent or the injured's parent alone. During the semi-structured, in-home interviews, which lasted about 45 minutes, a trained medical sociologist administered *Achenbach's Child and Young Adult Behavior Checklist*, respectively, and the *Family Assessment Devise* (Epstein, et al.). These instruments, which have established psychometric properties in non-farm injury populations, provided preliminary data on the injured's self-concept, school achievement, social interactions, and career aspirations. It also provided data on family functioning, distancing, cohesion, and family interaction patterns.

Psychosocial results indicate that the injured child's behavioral functions, adoptive abilities, and competencies fall within the normative range established by Achenbach's 1991 profile. This suggests that injured respondents did not demonstrate significant behavioral disturbances, and that their farm injury did not prevent them from achieving normal psychosocial modification. Although families reported adequate functioning on the problem solving, communication, behavioral control, and general functioning scales, measures of family roles, affective responsiveness and affective involvement fell outside the healthy range established by cut-off scores of the McMaster group. This suggests families may experience difficulties in establishing patterns of behavior, including provisions of resources, nurturance, and support of personal development. In addition, parents may experience difficulty expressing appropriate affect (e.g., emotions and tenderness).

Significant Findings

Economic Findings

There are a number of significant findings from this study related to the economic cost of injury. First, study results indicate there are statistically significant differences between youths and adults in the direct cost of health care for treating less serious injuries requiring only ambulatory care. In particular, youth and young adults incur lower health care costs than older adults. In this study, the most costly to treat were individuals age 65 years and older, who were about 80% more costly to treat on average and over 90% more costly to treat than youth and young adults. This cost difference reflects true differences in resource consumption required to treat injured individuals. The difference is not attributable to differences in payor mix across age groups.

In multivariate analyses, some agents of injury had statistically significant impacts on the cost of treating the less seriously injured. Specifically, injuries occurring from encounters with machinery, animals, or related to falls were 53%, 39%, and 37% respectively, higher on average than other injuries. These results are highly statistically significant ($p < .01$). Machinery-related injuries also were associated with significantly higher costs for injured persons requiring hospitalization. These results confirm the importance of machinery, in particular, as an important contributing factor to farm injury, and a significant predictor of higher costs.

Another important finding of this study was some inconsistency between bivariate and multivariate results. Generally, the bivariate results were not statistically significant in comparing youth and adult injury costs by injury agent and body part injured for individuals not requiring hospitalization for their injuries. Multivariate regression results indicated machinery, animal, and fall-related injury agents were contributory factors leading to higher average injury costs. These results indicate the importance of employing multivariate statistical techniques in the analysis of injury costs.

Psychosocial Findings

A significant finding from the psychosocial pilot study is that children and young adults who suffered a serious farm-related injury seem to have developed techniques of adapting that allowed them to achieve what other, non-injured children do. It appears their serious injury did not prevent them from normal psychosocial modification. Compared to the published, clinically non-referred, reference group outlined by Achenbach (1991) studied children were generally judged to be competent in school and in interpersonal relationships.

A second significant finding of the psychosocial pilot study was that parents of injured children scored outside the healthy range on three subscales related to family function. These scales included: roles, affective responsiveness, and affective involvement. This indicates families in the study tended to have difficulties establishing patterns of behavior for handling family functions, which include providing nurturance and support and support for personal development, and may have difficulty expressing appropriate affect (e.g., emotions and tenderness).

Usefulness of Findings

Neither the economic nor the psychosocial components of this study were designed with the specific intent of directly preventing work-place disease or injury. Rather, they were designed to expand knowledge about the economic and psychosocial effects of injuries to children living, visiting, and/or working on farms or in other agricultural settings. Accordingly, these research results have value for a broad array of potential users, including policy makers, injury control specialists, and individuals who design and evaluate interventions to reduce injuries.

The results from the economic component are particularly valuable because virtually no cost estimates have been available previously for injured individuals who were treated solely in ambulatory settings. Considering only an estimated ten percent of all agricultural-related injuries require hospitalization, little was known about the direct health care costs of the ninety percent of agricultural injuries that did not result in a hospitalization. The results from this study helped to fill this data void. When combined with epidemiological data on the frequency of less serious (i.e., non-hospitalized) agricultural injuries, this study significantly improves estimates of the direct health care resources required to treat less serious injuries.

The findings from the economic component of this study will also be valuable in a number of ways in the evaluation of interventions designed to reduce the incidence and/or the severity of agricultural-related injuries. First, because we estimated costs, not charges, our results provide a better estimate of true resource consumption. Second, because all health services were standardized to normal charges before adjustment, the study's estimated cost are not influenced by the distribution of payers. This is especially important when estimating resources consumed by individuals who are insured in public programs like Medicaid and Medicare. Third, our results are reported by meaningful age groups, agents of injury, and body part injured, which facilitate their use with epidemiological studies to estimate avoided injury costs and to conduct cost-effectiveness analyses of interventions to reduce injuries.

The usefulness of the psychosocial findings lies mainly in establishing the feasibility of collecting psychosocial-related data using standard instruments with known psychometric properties. Although definitive results must await larger studies, pilot results suggest that injured children adapt and adjust well to their post-injury environment. Their parents, however, seem to experience more difficulties, particularly as they relate to emotional aspects of their parenting responsibilities. These findings, even in pilot studies such as this, may be beneficial for cooperative extension personnel and other adult educators and other health professionals who develop programs and/or counsel adults of children who have been seriously injured.

Scientific Report(s)

To facilitate reporting of study results across its economic and psychosocial dimensions, the scientific report section of this document is organized into two distinct subsections, each with its own background, methods, results, and conclusion sections.

Economic Component

Background

Injury is recognized as the leading cause of premature death in the U.S. (Trunkey 1983), accounting for about one-third of all injuries and one-sixth of all injury deaths among persons age 20-64 years (Baker 1992). It has been well documented that injuries have an enormous impact on society in terms not only of costs but also the devastating effects on the lives of the injured and their family and friends (Rice 1989). Previous studies have established that farmers and other agricultural workers, who in the aggregate account for less than three percent of the U.S. workforce, suffer about 18% of work-related deaths (Council 1991). This means that each year about one out of every 2,000 U.S. farmers dies as a result of an occupational injury. Of even greater concern, however, is the recognition that these fatality rates have remained steady even while fatalities in other occupational settings have declined (Council 1991; Statistics 1991).

There has been demonstrated interest from the research community, particularly in the last 10-15 years, in more closely examining the causes of serious agricultural injuries, including injuries to youth. This interest is both domestic and international in scope. Studies reporting agricultural-related injury and trauma have been conducted in Australia (Wolfenden, McKenzie et al, 1992), Great Britain (Goulding 1988), the European continent (Vanneuville, Corger et al. 1992), Sweden (Sterner, Jansson et al. 1991)

and Ireland (Doyle and Conroy 1989 a, b), for example. These studies are very similar in that they tend to be based on case reports generated from trauma and tertiary care centers, and they do not report any economic-related data.

The most comprehensive study on youth agricultural injuries, included both fatal and non-fatal injuries, was performed by Rivara (1985). Using data from a number of national data sources, including the National Center for Health Statistics, the National Electronic Injury Surveillance System, the Consumer Product Safety Commission and the Bureau of Census, Rivara was able to generate estimates of the number of deaths and non-fatal traumatic injuries suffered on farms by adolescents and children. Although this is a significant study, which identified the importance of farm machinery in both fatal and non-fatal injuries, no economic costs were estimated.

There have also been a number of state-level studies that document the number and rate of fatal injuries to children occurring on farms. These include studies of fatal farm injuries to youth in Wisconsin and Illinois, respectively (Salmi, Weiss et al., 1989). Although fairly comprehensive in their epidemiological assessments of injury, these studies, like their international counterparts, and Rivara's earlier work do not include estimated costs associated with these injuries.

There are also a series of studies of agricultural-related injury and fatalities that have identified the central role of machinery as an agent of injury (Etherton 1991; Hawk 1991; Kelsey and Jenkins 1991; Dunn and Runyan, 1993; Wilk 1993; Layde, Nordstrom et al., 1995; Pickett, Brison et al., 1995). These studies have a very definite epidemiological focus; they provide estimated rates for both fatal and non-fatal injuries but do not report the economic impact or costs associated with these injuries.

Although the importance of sound epidemiologic studies to identify the incidence and rate of both fatal and non-fatal agricultural injuries, and to identify causative agents is indisputable, complementary economic studies of these injuries offer substantial additional advantages. Weighting injury events by their relative resource intensity (cost) provides opportunities for 1) assessing the injury problem's size, 2) efficiently establishing prevention priority and appropriately allocating prevention resources, 3) evaluating outcomes using cost-benefit and/or costs-effectiveness analyses, and 4) establishing benchmarks against which future studies can compare their results (Miller 1995).

Study Aims

Against this back drop of previous research, the current economic study was designed with the following specific aims:

1) Compare direct costs of health care utilization subsequent to a farm-related injury for youth (individuals less than 20 years old) and non-youth (individuals 20 years of age or older), receiving ambulatory treatment only and hospital treatment, respectively. Identify and estimate other potentially relevant associative factors for their impact on costs, including agent(s) of injury and the body injury site(s).

2) Assess the feasibility of developing a telephone-based survey instrument for use in estimating indirect costs associated with farm-related injuries.

Procedures/Methods: Cost Analyses

Injury cases were identified by the injury surveillance system operated by Marshfield Clinic and St. Joseph's Hospital in Marshfield, WI. This emergency department and clinic-based system, which was in continuous operation between November 1986 and April 1999 was implemented for the expressed purpose of identifying injuries occurring at agricultural work sites. A particular advantage of this surveillance system is that is provides an opportunity to analyze not only injuries requiring hospitalizations, but also less serious injured that can be treated in ambulatory care settings alone. Injured persons seeking health care for their injuries between November 1992 and January 1999 were eligible for inclusion in the study. A total of 1,066 injury-event persons sought care during this period. The injury cases used in this study met the case definition developed for a farm-injury study conducted at Marshfield in 1990-1992 for the Centers for Disease Control. Specifically, cases were unintentional, farm work-related injury resulting from exposure to rapid transfer of mechanic, chemical, electrical, thermal, or radiant energy. An injury is trauma in one person from one incident. Cases had to seek care from a physician in a hospital emergency department or clinic.

Study subjects for analysis included all injured youth (N = 292), all injured adults requiring hospitalization (N = 101), and a random, approximately 50%, sample of injured adults treated only in ambulatory settings (N = 352). A retrospective review of medical records was used to 1) confirm the farm-related nature of the injury, and 2) to identify specific health care services utilized during the injury treatment episode. The process of identifying injury-related health services and linking those data with health services utilization, and subsequently to cost estimates, was facilitated by the integrated electronic medical record shared by Marshfield Clinic and St. Joseph's Hospital.

Using dates of service and evaluations of encounter (visit) content, a health services profile specific to services provided for injury treatment was developed from the medical record review process, and subsequently linked electronically to administrative data bases containing charges for those health services. Health services were weighted by Marshfield Clinic's or St. Joseph's Hospital standard fee schedule, respectively, and aggregated to the encounter level and then the injury episode level. Weighting by standard charges reduces noise-related variation in cost estimates and facilitates the adjustment of charges to approximate costs. Episodal charges were subsequently adjusted to approximate resource cost by applying institution-specific, accounting-based cost to charge ratios for clinic and hospital services, respectively. Finally, because these injury episode costs are specific to the year of injury/service, they were adjusted to approximate a 1996 base year using the physician services component (for clinic services) and the hospital services component (for hospital services) of the Consumer Price Index. Both are sub-indices within the broader CPI published by the Bureau of Labor Statistics. The end result of these methodological steps is an incidence-based estimate of the direct health care costs associated with specific injury events.

This measure of resource utilization includes the cost associated with physician services, laboratory services, emergency department facility costs, radiology services, ambulance services, inpatient and rehabilitative services and closely related services. Drug costs are not included in these estimates, because they are not an integral part of the electronic medical record. In addition, these estimates do not include any indirect costs associated with morbidity and lost productivity. These later costs can be large relative to direct costs for individuals who are seriously injured, but are usually low for individuals who are treated for their injuries in ambulatory settings.

The distributions of injury-episode costs are highly non-linear, both for ambulatory only and hospitalized injured cases, making mean-variance-based statistical tests (e.g., t-test) inappropriate. Two different statistical approaches were used to adjust for this condition. In all univariate and bivariate analyses, non-parametric approaches based on Kruskal-Wallis' multiple comparison test were used to determine statistically significant differences between youth and adult injury costs, and also to determine the effect of agents of injury and injured body part on these costs. Although appropriate under these conditions, a limitation of non-parametric tests is they are less powerful than mean-variance-based tests because they

do not utilize any information about the sample dispersion. Second, in all multi-variate analyses, episodal injury costs (the dependant variable) were transformed to their natural logarithm equivalent for estimation purposes.

Procedures/Methods: Indirect Costs

During the early phases of the study, study investigators assessed the feasibility of collecting data from study subjects and their families, as appropriate, that would support the estimation of indirect costs of injury. In this study, indirect costs are costs incurred in the process of seeking and accessing health care for the injury and its sequelae, and the economic value of productivity losses directly related to the injury. These costs are in addition to the direct cost of health care services. Some examples of these costs include out-of-pocket costs of travel to receive health care services and the value of time in travel and treatment for these services. Other sources of indirect costs include productivity losses resulting from the injury, even if these losses accrue to others (e.g., family or friends) rather than the injured.

Although previous research has established the importance of indirect costs in assessing the total economic burden associated with injury and/or disease, specific study circumstances created significant obstacles to implementing a valid and reliable survey instrument for this purpose. The principal obstacle was the significant time lag between the injury event and the survey opportunity, which at the time the study commenced was a minimum of 12 months and an average of about 36 months. This made the collection of data related to time in travel and treatment and lost productivity highly problematic due to recall bias not only for the most serious injury cases but also for those treated in ambulatory settings for their injuries.

Study investigators briefly considered an alternative cross-sectional design for the most seriously injured that would have systematically collected data at defined time intervals following the injury date (e.g., 6, 12, 18, 24 months post-injury). This approach would have allowed construction of synthetic time series cost estimates. Two problems were encountered in this approach. First, the number of seriously injured youth was inadequate as a foundation for this approach, although it may have been feasible if all serious farm injuries had been considered. Second, after the abstraction phase of the study had been completed, it became apparent that most of the seriously injured typically concluded formal care for their injuries in less than 12 months. This meant that efforts to collect data on time in travel and treatment, at a minimum, would likely be subject to significant recall bias, and that the focus of any survey effort should be measurement of on-going lost productivity effects.

Since the lost productivity effects of less serious injuries tend to be very time limited, confined at and immediately following the injury date (i.e., within 4-6 weeks), it did not make sense to survey this population. Similarly, the expected yield from the more seriously injured child cases was anticipated to be low. Low expected yield and the need to pilot-test the psychosocial interview process on this population led to a decision to forego surveying this group.

A feasible alternative is to estimate non-productivity-related indirect costs for the less seriously injured using travel distances between the injured residence and the site of care. These distances and times can be estimated from resident and care site zip codes. These data can be combined with data on number of visits to proxy total travel time and distance for each injury episode. Time in treatment, out-of-pocket costs, and the opportunity cost of time will not be observed directly. However, for the less seriously injured, these costs are likely to be similar to those incurred by non-injured children and their parents in seeking care for treatment of common health conditions. A study of indirect costs associated with upper respiratory infections (URI) in children currently underway at Marshfield will provide estimates of time in treatment, out-of-pocket costs, and the opportunity cost of time that may be used to proxy these costs for the less serious injury cases. Lost productivity effects will not be observed, but these effects are generally small for treatment of uncomplicated injuries. Results of the URI study will be available in late Spring 2000.

Results/Discussion

Basic demographic and injury-event data are reported in Table 1. Males are over represented in the data, accounted for about 70% of youth cases and 80% of adult cases. Falls and machinery-related injuries are most common among both youth (30.9% and 27.3%) and adults (28.4% and 31.4%) requiring hospitalization for their injuries. For those needing only ambulatory care, "other" injury agents, a composite category, accounts for more injuries among both youths (34.5%) and adults (31.3%). Falls were the next most frequent injury agent for youths (24.3%), while injuries resulting from animal encounters were next most frequent for adults (31.1%) treated in ambulatory settings. Injuries to the extremities, including hands, were the most frequent injured body part for both youths and adults treated in both ambulatory-only and hospitalized settings, respectively. Injuries to the head and/or neck were more frequent among youth, regardless of treatment site; torso injuries were more prevalent among adults.

Median direct health care costs were $308 for all ambulatory-treated injured and $6,198 for all hospitalized injured in constant 1996 dollars (Table 2). For ambulatory-treated individuals, youth ($302) and adult ($312) median costs were very similar and not statistically significantly different from one another. Larger differences in median costs were apparent, however, between hospitalized youths and adults. Among the most seriously injured, adult median costs ($7,604) were over 75% greater than youth median costs ($4,314). The difference in the median cost for youth and adult hospitalized cases is unlikely to be due to random chance ($p<.001$).

In addition to youth/adult differences, study results indicate a consistent, positive relationship between age group and costs for the most severely injured. Median costs for adults aged 20-39 years were about 40% greater than youth costs, and injured adults aged 40-59 years had median costs nearly 70% greater than youth. Median injury treatment costs for hospitalized adults aged 60 years and older ($13,580) were more than three times larger than youth median costs. Like the dichotomous youth/adult comparison, the underlying relationship between age group and injury costs for the most seriously injured is unlikely to be due to chance (Kruskal-Wallis: $p<.01$).

Median costs for less seriously injured individuals were also positively related to age group, although the pattern of increasing costs with age was not as consistent in comparison to more seriously injured individuals. Median costs for individuals aged 60 years and older were $417, or about 35% greater than the all-age median cost of $308. The positive relationship between age group and health care costs for the less seriously injured was highly statistically significant (Kruskal-Wallis: $p<.02$).

Median costs for youth and adults, arrayed by injury agent and injured body part, are reported in Table 3. Among adults, machinery-related injuries were the most costly, with median costs of $400 and $10,339 respectively for ambulatory and hospitalized cases. For seriously injured youth, machinery-related costs were also high ($5,280), ranking second to "other" injury agents ($5,522). The distribution of median injury costs varied systematically with injury agents. The pattern of higher costs associated with injuries related to machinery and falls is very distinct and stable both across the injury severity continuum and between youths and adults. Statistical analyses indicate these distributions are unlikely to occur as a result of random chance (Kruskal-Wallis $p< .01$, except hospitalized youth: $p< .06$). By contrast, univariate analyses of the distribution of injury costs by body part injured did not indicate statistically reliable cost differences.

Table 1. Demographic and Injury-event Data

Variable	Youth				Adult			
	Ambulatory N = 236		Hospitalized N = 56		Ambulatory N = 352		Hospitalized N = 101	
Sex:								
Male	161	(68.2%)	41	(73.2%)	278	(79.0%)	87	(86.1%)
Female	75	(31.8%)	15	(26.8%)	74	(21.0%)	14	(13.9%)
Age-group:								
0-19 years	236	(100.0%)	56	(100%)	--------		--------	
20-39 years					175	(49.7%)	38	(37.3%)
40-59 years					117	(33.2%)	34	(33.3%)
60+ years					60	(17.0%)	30	(29.4%)
Agent of Injury:								
Machinery	34	(14.5%)	15	(27.3%)	61	(17.4%)	32	(31.4%)
Animal	52	(22.1%)	5	(9.1%)	109	(31.1%)	17	(16.7%)
Fall	57	(24.3%)	17	(30.9%)	58	(16.5%)	29	(28.4%)
Exposure	11	(4.7%)	3	(5.5%)	14	(4.0%)	4	(3.9%)
Other	81	(34.5%)	15	(27.3%)	109	(31.3%)	20	(19.6%)
Injury Site:								
Head and/or Neck	65	(27.5%)	15	(28.8%)	59	(16.9%)	13	(12.9%)
Torso	35	(14.8%)	13	(25.0%)	86	(24.6%)	32	(31.7%)
Extremity	135	(57.2%)	24	(46.2%)	200	(57.1%)	55	(54.5%)
Other	1	(0.4%)			5	(1.4%)	1	(1.0%)

Table 2. Median Direct Costs, for Youth and Adult Injured and Age Groups

Variable	Ambulatory	Hospitalized
All Injured	308	6,198
Youth/Adult:		
Youth	302	4,314
Adult	312	7,604
p-value	NS	.001
Age Group:		
0-19	302	4,314
20-39	285	6,181
40-59	339	7,296
60+	417	13,580
p-value	.02	.01

All costs are reported in constant 1996 dollars.

Table 3. Median Direct Costs for Youth and Adult Injured

Variable	Youth		Adult	
	Ambulatory	Hospitalized	Ambulatory	Hospitalized
Agent of Injury:				
Machinery	306	5,280	400	10,339
Animal	332	2,558	307	8,208
Fall	469	4,448	360	8,063
Exposure	207	4,098	319	1,712
Other	253	5,522	260	5,677
P-value	.01	.06	.01	.01
Injury Site:				
Head and/or Neck	274	3,765	274	6,038
Torso	418	4,448	345	7,395
Extremity	290	5,873	308	9,348
Other				
P-value	.01	NS	NS	NS

All costs are reported constant 1996 dollars.
NS indicates p-value > .10

Results of statistical comparisons of youth to adult injury costs by agent of injury and body part injured are reported in Table 4. For less serious injuries, adult injury costs are systematically higher than youth costs, when controlling for specific agents of injury; however, these patterns are not statistically reliable (Kruskal-Wallis: $p > .10$). Statistically significant cost differences are, however, apparent among the more seriously injured. For these individuals, adults injured by machinery ($10,339 vs. $5,280: $p < .05$), animals ($8,208 vs. $2,558; $p < .10$) and falls ($8,063 vs. $4,448: $p < .02$) are all much larger in absolute value, and statistically different than corresponding youth costs.

Comparisons of youth and adult injury costs by injured body part closely mirror the pattern of youth/adult costs across agents of injury. Youth and adult costs for less seriously injured individuals do not vary by body part injured. For the most seriously injured individuals, adult injury costs are higher than youth costs for each primary injury site comparison. These results are also statistically significant, although they are not as robust as the agent of injury results. The generally higher pattern of adult injury costs for the severely injured probably reflects higher relative levels of injury severity.

Results of multivariate regression analyses of both ambulatory-treated and hospitalized agricultural injury cases are reported in Tables 5 and 6, respectively. Model results are largely consistent with the results of the univariate and bivariate analyses. Generally, injury-related direct health care costs for youth are either lower than for other age groups (seriously injured), or were only modestly higher (Table 5, Model 1). They are also consistent with other study results that indicate a positive relationship between injury costs and age group. Controlling for all other covariates, average costs of care for individuals aged 65 years and older are 79% higher than average youth costs for ambulatory-treated injuries, and 56% higher for injuries requiring hospitalization (Tables 5 and 6).

The impact of body part(s) injured and injury agents are also fairly consistent with the study's univariate and bivariate results. Generally, the independent effects of torso and extremity injuries for both hospitalized and ambulatory-treated cases are much less consistent and less robust than those associated with injury agents, which was the pattern observed in the bivariate analyses. In the most fully specified models (Model 3 in both Tables 5 and 6), the marginal impact of injured body part is either statistically insignificant ($p > .10$, Table 5) or marginally statistically significant ($p < .10$, Table 6).

Injury agents, particularly machinery, animal, and fall agents, have much stronger and more consistent marginal impacts than injured body part. This is especially the case for the ambulatory-treated injured (Table 5). For example, results from Model 3 (Table 5) indicate that the independent effects of machinery, animal, and fall-related injuries raise treatment costs 53%, 39%, and 37%, respectively, above the all-case average. For hospitalized injured, injury agent effects are neither as consistent nor as strong as those associated with the less seriously injured. The exception to this general pattern is machinery-related injuries, which, on average, are nearly 86% higher than non-machinery related costs (Table 6).

The strength of the statistical association between costs and agents of injury varies between ambulatory-treated and hospitalized injured. In particular, different costs effects for machinery, animal, and fall-related injuries are apparent for injured individuals receiving only ambulatory care. By contrast, both the number and the statistical reliability of injury agents as explanatory factors diminish when analyzing costs for those more seriously injured. One explanation for this is that the effect of injury agents gets "crowded out" by the increased level of the severity of the injury. Another way of saying this is that only serious injuries (generally speaking) require hospitalization, and it is the severity not the agent of injury that impacts on the hospitalization decision. By contrast, ambulatory-treated injuries are less severe and perhaps more sensitive to the differential effects of injury agents on costs.

Table 4. Comparison of Youth and Adult Injury Costs by Injury Site and Agent

Variable	Ambulatory			Hospitalized		
	Youth	Adult	p-value	Youth	Adult	p-value
Agent of Injury:						
Machinery	306	400	NS	5,280	10,339	.05
Animal	307	332	NS	2,558	8,208	.10
Fall	469	360	NS	4,448	8,063	.02
Exposure	207	319	NS	4,098	1,712	NS
Other	253	260	NS	5,552	5,677	NS
Injury Site:						
Head and/or Neck	274	274	NS	3,765	6,038	.08
Torso	418	345	NS	4,448	7,395	.05
Extremity	290	308	NS	5,873	9,348	.07

All costs reported in constant 1996 dollars.
NS indicates p-value > .10.

Table 5. Regression Models with Interactions, Non-Hospitalized Injured

Variable	Model 1	Model 2	Model 3
Intercept	5.611	5.444	5.539
Age group:			
Ages: 0-19 yrs	0.152*	0.132	-0.062
	0.092	0.092	0.189
Ages:20-34 yrs	Reference	Reference	Reference
Ages: 35-64 yrs	0.227**	0.203**	0.228**
	0.098	0.098	0.099
Ages: 65+ yrs	0.575***	0.547**	0.584***
	0.150	0.149	0.150
Injured body part:			
Torso	0.251**	0.218**	0.006
	0.110	0.110	0.142
Extremity	0.086	0.076	0.085
	0.089	0.089	0.124
Head and Neck	Reference	Reference	Reference
Injury Agent:			
Machinery		0.308***	0.423***
		0.106	0.135
Animal		0.238***	0.332***
		0.091	0.114
Falls		0.403***	0.317**
		0.101	0.138
Exposure		0.045	0.176
		0.186	0.248
Other		Reference	Reference
Youth Interactions:			
Torso			0.566**
			0.226
Extremity			0.307*
			0.177
Machinery			-0.261
			0.218
Animal			-0.209
			0.189
Falls			0.183
			0.201
Exposure			-0.312
			0.376
N	585	585	585
df	5	9	15
MSE	3.301	3.404	2.580
F	4.568	4.842	3.706
R^2 (adjusted)	0.03	0.06	0.07

Dependent variable is natural log of constant 1996 costs.
Statistically different from zero at *.10, ** .05, and *** .01, respectively.

Table 6. Regression Models with Interactions, Hospitalized Injured

Variable	Model 1	Model 2	Model 3
Intercept	8.407	8.432	8.256
Age group:			
Ages: 0-19 yrs	-0.148	-0.233	-0.077
	0.226	0.220	0.512
Ages:20-34 yrs	Reference	Reference	Reference
Ages: 35-64 yrs	0.254	0.132	0.052
	0.221	0.218	0.219
Ages: 65+ yrs	0.622**	0.558*	0.446
	0.296	0.290	0.292
Injured body part:			
Torso	0.312	0.236	0.512*
	0.228	0.227	0.303
Extremity	0.468**	0.315	0.472*
	0.205	0.214	0.280
Head and Neck	Reference	Reference	Reference
Injury Agent:			
Machinery		0.504**	0.619**
		0.221	0.267
Animal		-0.129	0.115
		0.226	0.315
Falls		0.197	0.246
		0.219	0.273
Exposure		-0.771*	-1.407***
		0.397	0.524
Other		Reference	Reference
Youth Interactions:			
Torso			-0.240
			0.492
Extremity			-0.005
			0.473
Machinery			-0.332
			0.436
Animal			-0.898
			0.596
Falls			0.005
			0.469
Exposure			1.436*
			0.834
N	156	156	156
df	5	9	15
MSE	3.345	3.370	2.510
F	3.648	3.968	3.011
R^2 (adjusted)	0.080	0.150	0.160

Dependent variable is natural log of constant 1996 costs.
Statistically different from zero at *.10, ** .05, and *** .01, respectively.

A logical extension of the binary variable modeling approaches used in Models 1 and 2 (Tables 5 and 6) is the specification of interaction terms which allow estimation of different cost gradients for interaction variables. This approach was used in Model 3 in both Tables 5 and 6 to estimate cost gradients between youths and adults for injured body parts and agents of injury. Although some interaction terms are statistically significant, they tend to be small relative to average costs. For ambulatory-treated injured, there are small positive youth effects for torso and extremity injuries, but no agent of injury effects (Table 5). For hospitalized injured, only injuries resulting from exposure affected costs, and then only marginally so (Table 6). Only small, marginal increases in model explanatory power were achieved with the addition of these terms.

Conclusions

The results of this study are mixed with regard to direct health care costs of injury treatment for youths and adults incurring farm injuries. Univariate and bivariate results indicate youth/adult differences in costs for injured requiring hospitalization, but no differences in costs for those requiring ambulatory treatment only. More disaggregated age group results were similar to the dichotomous youth/adult results for hospitalized injuries; youth costs were systematically lower than adult costs for all adult age groups. This general pattern was also reflected in results of bivariate analyses comparing youth and adult costs by agent of injury and body part injured; cost differences between youths and adults, when identified, were with the most seriously injured and tended to be only modestly statistically significant.

Generally, results from multivariate regression analyses counter the bivariate results. Specifically, multivariate results indicate that there are underlying age group and agent of injury effects for injuries treated in ambulatory settings, but no age group and only modest injury agent effects for injuries requiring hospitalization. The reasons for these results are not clear. However, it seems plausible that the increased level of severity for all hospitalized injured may "crowd out" the effects of injury agents on costs. More research in this area would be beneficial in sorting out these findings.

Machinery, animal, and fall-related injuries are associated with significantly higher average direct health care costs for ambulatory-treated injuries. Machinery-related injuries also increased costs for injuries requiring hospitalization. This suggests, as previous studies have noted, that efforts to reduce machinery-related exposures and subsequent injury are likely to yield the largest economic benefits to society. The results of this study provide an important (economic) component, that when combined with estimates of the frequency and distribution of farm-related injuries, provide a basis for determining the potential societal costs of farm-related injuries, and the potential future payoff for successful interventions designed to reduce those injuries.

The results of this study also confirm the need to conduct multivariate analyses of injury costs. The capability to simultaneously control for the impacts of covariates and explanatory variables in estimating differential injury costs reduces the likelihood of misinterpreting bivariate relationships.
A limitation of this study is the lack of a severity measure for modeling purposes. Future studies should incorporate such measures to control for some of the unexplained variation in treatment costs for both hospitalized and ambulatory-treated injured.

Psychosocial Component

A substantial body of research related to spinal cord injuries and traumatic brain injuries in children have documented that psychosocial effects on both the child and their family are momentous and potentially long-term (e.g., see Christoffel et al., 1996; Stancin et al., 1998). Unfortunately, the psychosocial effects of childhood farm injuries, in contrast to spinal cord and traumatic brain injuries in children (Stancin, et al., 1998), have not been thoroughly investigated. An in-depth review of the existing literature examining the psychosocial effects of childhood farm injuries quickly reveals a paucity of relevant studies. Indeed, an extensive and systematic search of bibliographic sources such as MEDLINE and PSYCH-INFO did *not* find one research publication specific to the population and area of interest.

Study Aims

Given the paucity of previous research on this topic, and the expressed interest by NIOSH in this research area, study investigators established the following aims for the psychosocial component of the study:

1) Develop and pilot test survey instruments and interview processes for identifying mid- and long-term psychosocial effects of serious farm injuries to youth on victims' competence and behavior, school achievement, and social interactions;
2) Determine the psychosocial effects of farm injury to youth on family functioning, including distancing, cohesion, and family interaction patterns.

These aims were developed to fill an important void in the literature on childhood farm injuries, using established standardized behavioral measures and injury-specific survey techniques that produce both valid and reliable results, and provide the potential for comparing the effects of farm injuries to youth to injuries to youth occurring in other settings.

Methods

The study population for this research were individuals less than 20 years of age who suffered a serious agricultural injury (i.e., patients who required an inpatient hospital admission for at least one day) and who were subsequently treated at either Marshfield Clinic and/or St. Joseph's Hospital in Marshfield, Wisconsin between November 1992 and December 1998. The primary source of case identification was an Emergency Room surveillance system established in November 1986. The secondary source of case identification was the ambulatory care surveillance through Marshfield Clinic's Urgent Care department. Special foci of these surveillance systems are the unique capability to ascertain injuries occurring at agricultural worksites as well as those involving agricultural machinery.

A case was defined as any unintentional, farm-work-related injury resulting from the exposure to rapid transfer of mechanical, chemical, electrical, thermal, or radiant energy. Injuries that involved farm machinery or farm animals, which took place on highways or other public roads, were eligible for inclusion in this study, as were injuries sustained to bystanders if they were injured due to the proximity to agricultural work. Recreational injuries, including almost all injuries from horses, family pets, and injuries occurring inside or outside the home were excluded.

Study participants must have been less than 20 years old at the time of the injury and been admitted to a hospital for their injury(ies) for at least one day. Personal interviews, conducted at the injured's residence, were the source of pilot data for this study. Following previously established interview procedures for children, youth less that 12 years of age were not interviewed. Instead, their parents served as a proxy and provided data on their child's behalf. Parents are typically among the most important sources of data about children's competencies and problems. Further, they are generally the most informed about their child's behavior across time and situations (Achenbach, 1991). If the injured child was $\geq$ 12 years of age at the time of the interview, then s/he was eligible to be interviewed for the study. A parent of each seriously injured child (despite its age) was eligible to participate in the study. For purposes of this study, we only report data provided by the parent/guardian related to seriously injured child. The principal reason for this is that seven of the 15 cases were too young to be interviewed. A second reason is the parent's perspective has been shown to be a reliable proxy for the child's in previous studies.

Procedures

A review of medical records by trained abstractors during 1998 and 1999 provided data on age, gender, hospitalization, medical status, injury severity, and costs associated with the injury. This review yielded 55 individuals who met the eligibility requirements. Two of the 55 injured youth lived more than four hours away from Marshfield, Wisconsin and were considered to be too distant for in-home interviews,

leaving a total of 53 eligible participants. The vast majority of these 53 participants resided in a four county area (Wood, Marathon, Clark, and Taylor) that lies in the heart of the Marshfield Clinic's patient catchment area.

The 53 subjects and/or their parents were initially mailed a letter signed by the principal investigator that outlined the general idea of the study and requested their participation into the study. Approximately one week after the letters were mailed, all subjects and their parents were contacted by phone to solicit their participation into the study. Fifteen of the 53 gave their verbal consent to participate in the study and were scheduled an in-home interview. After the appointment was scheduled, but before any data was collected, subjects who were currently 18 years of age or older, had to complete a written IRB release form. For those subjects that were still under the age of 18 at the time of the interview, such written permission was obtained from their appropriate parent or guardian prior to interview. In all cases, both parties (i.e., the injured child and his/her parent/guardian) were interviewed separately, but during the same interview visit. Only one of the parents (typically the mother) was interviewed. Each interview took approximately 45 minutes to complete. All participants were visited in their home by a trained sociologist who conducted a semi-structured interview.

In short, complete data was collected from a parent to all 15 seriously injured children. Written consent was obtained before the interviews. Interviews were begun after written consent was obtained. The 15 responders were compared to the 38 nonresponders for several available variables (age of patient, gender of patient, agent of injury, body part injured, costs and charges in '96 dollars) using the Kuskal-Wallis test and the Mann-Whitney two-sample test, depending on the variable tested. Based on these tests, there were no significant differences between participants and non-responders.

Measurement

Competence and Behavioral Functioning. The *Child Behavior Checklist* (CBCL; Achenbach, 1991) was administered to assess the child behavioral functioning of respondents who were 18 years of age or younger at the time of the interview. For those injured children who were 18 years of age or older at the time of the interview, The *Young Adult Behavior Checklist* (YABC) (Achenbach, 1997) was administered to assess their behavioral functioning and adaptive behaviors relevant to young adults. Both measures included 113 items and were standardized parent-report measures that yielded three scales. The first scale, Total Behavior Problems, was composed of all behavior items on the checklist. The second scale, Internalizing Scale, evaluated inhibited or overcontrolled behavior. The third scale, Externalizing Scale, rated antisocial or undercontrolled behavior. Moreover, the CBCL and the YABC yielded scores on a multiplicity of more explicit behavior symptoms, including, somatic complaints, social problems, and depression or anxiety (Achenbach, 1991; Light et al., 1998; Stancin et al., 1998). The CBCL and the YABC have well-known, strong psychometric properties, including gender-specific and age-specific norms, and have been used comprehensively in research and in clinical practice as a reliable and valid assessment of child and young-adult behavioral abnormality (Achenbach, 1991; 1997; Stancin et al., 1998). As recommended by Achenbach, *T* scores were employed for the analysis of the combined scores from the CBCL and YABC (Achenbach, 1991; 1997). *T* scores of 63 or higher on the CBCL and YABC scales were believed to reveal clinically significant psychopathologic conditions, while scores 60 to 63 are in the borderline clinical range (Achenbach, 1991; 1997).

The CBCL also has the capacity to evaluate children's (4 to 18 years old) competence with respect to participation in various activities, school related functioning, and peer interaction. Achenbach developed three scales designated as *Activities, Social,* and *School* on the basis of their content. The present study reports only the total competence score, which is the sum of raw scale scores from the Activities, Social, and School scales (Achenbach, 1991). Once again, the total competence scores were converted to *T* scores. *T* scores below 37 are regarded as noticeably in the clinical range, while *T* scores in the 37 to 40 are in the borderline clinical range (Achenbach, 1991).

Family Functioning. The *Family Assessment Device* (FAD) (Epstein, Baldwin, & Bishop, 1983) was administered to the parent of each injured child to assess the current functioning status of the family. The FAD contains 53 items discriminating into seven scales. Six of these corresponded to the dimensions of the McMaster Model of Family Functioning, specifically Problem Solving, Communication, Roles, Affective Responsiveness, Affective Involvement, Behavior Control, and General Functioning. The seventh scale, a 12-item general family functioning scale, characterizes general family functioning. Each of the 53 items were scored on a four-point scale, where 1 = "strongly agree", 2 = "agree", 3 = "disagree", and 4 = "strongly disagree". Thus, higher scores indicated the presence of more family problems. Previous studies have confirmed the validity of the FAD in discriminating families with members having psychiatric or neurologic diagnoses from control families (Miller et al., 1985; Stancin et al., 1998).

Sociodemographic Variables. Parents provided important sociodemographic information about the seriously injured child and objective contextual information related to the injury. Sociodemographic variables included the gender and race/ethnicity of the injured child, age of the child both at the time of the injury and interview, composition of family members living in the household at the time of the injury, household income both at the time of the injury and interview, and whether or not the parents resided on a farm both at the time of the injury and at the time of the interview. Objective contextual information included agent of the injury (injured by machinery, in a fall, exposure to chemical, or other agent), whether or not the family had health insurance at the time of the injury. If a parent indicated that they did in fact have health insurance, then they were queried about level of adequacy in covering medical costs (0 = *adequate* to 3 = *inadequate*). In addition to this self-report information, supplementary information was obtained from the medical records, including body part injured (face, torso, extremities), number of days spent in the hospital, number of hospital visits, and costs associated with the injury episodes.

Results

Demographic data for study participants are reported in Table 1. These data were collected during interviews with the injured's parent, who was more likely to be a mother (13). The most common occupation of the injured's father was farming (10). The occupational status of mothers was wide-ranging, with the most common being working on the family farm (4) followed by homemaking (3) (results not shown).

All of the injured children were English speaking, White, and from the United States. Twelve of the injured children were male. Ages ranged from 6 to 20 years (mean = 13.0, SD = 4.57) at the time of the interview, and from 1 to 18 years (mean = 9.27, SD = 5.39). All 15 injured children had their mother, while 14 had their father living in the household at the time of the injury. In addition, the injured children had, on average, one brother and as many as 3 sisters (mean = 1.47, SD = 0.99) living in the household at the time of the injury. Seven of the 15 parents indicated a change in household composition since the time of the injury. The median household income at both the time of injury and at the time of the interview was $30,000 to $39,999. At the time of the interview, all three of the respondents who were > 18 years of age, were working full-time on the family farm (results not shown).

Table 2 summarizes the objective contextual information for the seriously injured children. Seven of the children were injured by farm machinery, while five were injured in a fall. The body part injured was uniformly distributed, with five injuries each to the face, torso, and extremities. Eleven of the parents had health insurance at the time of the injury. The mean Inadequacy of Health Insurance score (possible range, 0 to 3) was 1.23 (SD = 0.73). The mean number of days spent in the hospital was 4.73 days (SD = 3.37). Seriously injured children respondents made, on average, 3.93 visits to the hospital (SD = 2.74). Average charges (in 1996 dollars) related to the injury episodes were $9,230 (SD = $9,746), while average costs (in 1996 dollars) were $6,500 (SD = $6,869) per episode.

Table 3 presents means and standard deviations for each of the seven FAD scores for respondents in the sample, and the clinical cut-off scores for family dysfunction (Miller et al., 1985). Families reported

Table 1. Demographic Data for Seriously Injured Children (N=15)

	N	Mean	Standard Deviation
Gender			
Male	12		
Female	3		
Race/Ethnicity			
White	15		
Age at Injury (range:1-18)	15	9.27	5.39
Age at Interview (range: 6-20)	15	13.00	4.57
Mother in household at injury	15		
Father in household at injury	14		
Number of brothers in household at injury (range: 0-2)	13	1.00	0.58
Number of sisters in household at injury (range: 0-3)	15	1.47	0.99
Change in household composition since injury	7		
Household income at injury			
<$10,000	2		
$10,000-19,999	2		
$20,000 – 29,999	3		
$30,000-39,999	3		
$40,000 and more	4		
Missing	1		
Median	$30,000-39,999		
Household Income Now			
<$10,000	2		
$10,000-19,999	1		
$20,000-29,999	3		
$30,000-39,999	3		
$40,000 or more	6		
Median	$30,000-39,999		

Table 2. Objective Contextual Information for Seriously Injured Children (N=15)

	N	Mean	Standard Deviation
Agent of injury			
Machinery	7		
Fall	5		
Exposure to Chemicals	1		
Other	1		
Health Insurance at Injury (%yes)	11		
Inadequacy of health insurance (range: 0-3)	13	1.23	0.73
Body Part Injured			
Face (%)	5		
Torso (%)	5		
Extremities (%)	5		
Number of Hospital Days (range: 1-14)	15	4.73	3.37
Number of Hospital Visits (range: 1-12)	15	3.93	2.74
Costs associated with injury episodes in 1996 dollars (range: $2,187 - $30,081)	15	$6,500	$6,869
Charges associated with injury episodes in 1996 dollars (range: $3,102 - $42,681)	15	$9,230	$9,746

adequate functioning on the Problem Solving scale, Communication scale, Behavior Control Scale, and the General Functioning scale. In comparison with the cut-off scores of the McMaster group (Miller et al., 1985), three of the means (Roles, Affective Responsiveness, and Affective Involvement) from the study sample fell outside the healthy range.

Table 3. McMaster Family Assessment Device Scores for the Sample and Cut-off Values

Dimension	Mean	Standard Deviation	McMaster cut-off values
Problem Solving	1.93	0.37	2.20
Communication	2.11	0.42	2.20
Roles	2.72	1.51	2.30
Affective Responsiveness	2.22	1.18	2.20
Affective Involvement	2.22	1.10	2.10
Behavior Control	1.57	0.47	1.90
General Functioning	1.58	0.41	2.00

Mean scores associated with the injured children's behavioral functions, adaptive abilities, and competence are shown in Table 4. In comparison with the cut-off scores of the group outlined in Achenbach's 1991 profile, all means from the sample fell within the normative range, which suggests that the respondents did not demonstrate significant behavioral disturbances. Although the behavioral scales were in the normative range, it should be pointed out that parents to seriously injured children who were $\leq$ 18 years of age reported, on average, 1.8 somatic complaints, 2.0 anxious/depressed complaints, 2.17 attention problems, 3.5 delinquent behaviors, and 1.58 aggressive behaviors (results not shown). Further, four of the12 *T* value scores for the Total Competence scale were in the abnormal range (results not shown).

Table 4. Mean Scores (SD) on the Child Behavior Checklist (CBCL) and Young Adult and Behavior Checklist (YABCL)

Scale	N	Mean	SD
CBCL Total Problem T score (range: 40-68)	12	48.92	7.44
CBCL Externalizing T score (range: 40-64)	12	51.50	7.81
CBCL Internalizing T score (range: 37-66)	12	48.25	8.34
CBCL Total Competence T score (range: 36-53)	12	42.83	6.45
YABCL Total Problem T score (range: 39-46)	3	43.67	4.04
YABCL Externalizing T score (range: 49-59)	3	55.00	5.29
YABCL Internalizing T score (range: 35-69)	3	52.00	17.00

A Mann-Whitney *U* test was constructed to explore the extent to which family functioning differed according to the injured body part of the child (facial versus non-facial [torso and extremities]) and agent of injury (machinery versus non-machinery [fall, exposure to chemicals, and other]). With regards to the injured body part of the child, the results of the test were significant for the affective responsiveness subscale ($z = -2.79, p = .005$) and the general functioning subscale ($z = -2.11, p = .034$). For the affective responsiveness subscale, the non-facial injuries had an average rank of 10.25, while the facial injuries had an average rank of 3.50. With reference to the general functioning subscale, the non-facial injuries had an average rank of 9.70, while the facial injuries had an average rank of 4.60.

With regard to the agent of the injury, the results of the test were significant for the affective responsiveness subscale ($z = -2.17, p = .030$), affective involvement subscale ($z = -1.99, p = .047$), and the general functioning subscale ($z = -3.06, p = .002$). For the affective responsiveness subscale, injured by machinery had an average rank of 10.64, while injured by non-machinery had an average rank of 5.69. For the affective involvement subscale, injured by machinery had an average rank of 10.43, while injured by non-machinery had an average rank of 5.88. For the general functioning subscale, injured by machinery had an average rank of 11.71, while injured by non-machinery had an average rank of 4.75.

In summary, these results indicate that parents had poorer family functioning on these subscales if their child suffered non-facial injuries or were injured by machinery.

Discussion

To our knowledge, this pilot study is the first to report on the early psychosocial effects of serious childhood farm injuries to youth by employing standardized psychological measures. The family is known to play a critical function in the adjustment and rehabilitation of an injured child and normally assumes the burden of care once the child is discharged from the hospital (Stancin et al., 1998). The overload imposed on parents of serious farm related injuries is by no means inconsequential. The serious injury to the child takes on an especially imperative role for farm families in Central Wisconsin. A vast majority of these family-owned and operated farms are small to medium sized dairy farms where the children and adolescents tend to provide a significant labor services.

Similar to the subjects of a study of pediatric orthopedic traumatic fractures with and without accompanying brain injuries (Stancin et al., 1998) and from subjects of a study of child pedestrian injuries (Christoffel et al., 1996), the children in the present study did not experience significant rates of psychopathological behavior problems. Although they were within the normal range, a reasonable number of somatic complaints, anxious/depressed complaints, attention problems, delinquent behavioral and aggressive behavioral problems were reported for study children. Compared to the published, clinically nonreferred, reference group outlined by Achenbach (1991), the children in our sample were judged to be competent in school and in interpersonal relationships. Notwithstanding, one-third of the children were rated beyond the normal ranges of competence.

In summary, children and young adults seemingly have developed techniques of adapting to achieve what other children achieve. Apparently, their serious farm-related injury did not prevent them from normal psychosocial modification (cf. Moore et al., 1996).

Perhaps the most intriguing finding was the fact that parents scored outside the healthy range with regards to three subscales (roles, affective responsiveness, and affective involvement) of a family functioning measure. Our data suggests that in terms of roles, the families in our sample tended to have difficulties establishing patterns of behavior for handling a set of family functions which include, for example, provision of resources, providing nurturance and support, and supporting personal development. With regards to affective responsiveness, our data suggests that respondents have difficulty expressing appropriate affect (e.g., emotions and tenderness). In terms of affective involvement, our data suggested that family members had impediments in placing healthy balances (i.e., neither too little nor too much) value in and being interested in other family member's activities and concerns.

Limitations to this study include the very small sample of children who were seriously injured and the dependence on the parental report for a large amount of the data. A low overall participation rate of eligible patients also restricts the generalizability of the study findings. In a larger and more geographically diverse sample, future research should examine in greater specificity the extent to which these serious injuries influence the behavioral functioning of children. Moreover, future research should examine in greater detail the way in which family functioning is influenced by farm injuries, especially by part of body injured and the agent of the injury.

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Project Abstracts

Schmelzer JR, Weier AW, Stueland DT: Economic Costs Related to Agricultural Injuries: A Comparison of Youth and Adult Costs. Proceeding of the American Public Health Association's 127th Annual Meeting, Chicago, Illinois, November 7-11,1999

Schmelzer JR, Weier AW, Stueland DT: Estimating Indirect Costs for Farm-Related Injuries: Methodological Approaches. Book of Abstracts. Fourth International Symposium: Rural Health and Safety in a Changing World, Saskatoon, Saskatchewan, Canada, October 18-22,1998

Schmelzer JR, Weier AW, Stueland DT: An Economic Analysis of Youth and Non-Youth Costs of Farm-related Injuries in the Upper Midwest Region of the US. Book of Abstracts. Fourth International Symposium: Rural Health and Safety in a Changing World, Saskatoon, Saskatchewan, Canada, October 18-22,1998

Project Presentations

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Future Publications

Two future manuscripts related to this study are planned. One will focus on the economic aspects of this study, emphasizing the study's results for refining estimates of injury-related costs particularly when combined with epidemiological data on farm injuries. This manuscript will be targeted at rural health and injury-oriented journals.

The other manuscript will focus on the psychosocial results of the study. There are virtually no studies in this area, and our pilot results may not only be informative but may also spur some additional research interest. Sociological and injury-oriented journal will be targeted for publication.