

# Causes, Nature, and Outcomes of Work-Related Injuries to Adolescents Working at Farm and Non-Farm Jobs in Rural Minnesota

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**Background** *Although there are many studies on working adolescents, information on youth who simultaneously hold jobs on both a farm and in other sectors of the economy is lacking.*

**Methods** *Six high schools in rural Minnesota were evaluated for adolescent work practices and injury incidence. A 20-page self-administered survey was administered to students.*

**Results** *A total of 2,250 students completed the survey, representing 92% of the student body. Students that simultaneously hold both farm and non-farm jobs have a significantly higher proportion of injuries. However, annual injury rates are highest for those working in non-farm only (26.7/100 full-time equivalents, FTEs) or farm only (25.9/100 FTEs) employment when compared with those working simultaneously in farm and non-farm jobs (21.9/100 FTEs).*

**Conclusions** *Many rural students employed simultaneously on farm and non-farm jobs work long hours and are at significant risk of work-related injury. The annual injury rates we estimated are higher than those reported in previous studies. Am. J. Ind. Med. 42:142–149, 2002. © 2002 Wiley-Liss, Inc.*

**KEY WORDS:** *child labor; farm youth; work hours; injury; agriculture; occupation; adolescents; youth*

## INTRODUCTION

Several descriptive studies have been done to evaluate the nature and cause of work-related injuries to adolescents. Studies address work and work-related injuries among youth

employed in either the agricultural or non-agricultural sectors of the economy. A comprehensive review of the epidemiologic literature revealed no studies that evaluated information on youth that simultaneously hold jobs on both a farm and in other sectors of the economy.

Both national and regional data indicate that work-related injuries remain a serious ongoing problem for teens in the United States. The estimated annual incidence of non-fatal injuries among working adolescents in all occupations, including agriculture, ranges from 1.9/100 full-time workers to 16/100 full-time workers [Schober et al., 1988; Brooks et al., 1993; Layne et al., 1994; Brooks and Davis, 1996; Wegman and Davis, 1999]. The estimated incidence of work-related fatalities for adolescents in all occupations ranges between 3.5/100,000 full-time workers and 5.1/100,000 full-time workers [Castillo et al., 1994; Castillo and Malit, 1997].

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Layne et al. [1994] estimated an injury rate of 4.3/100 full-time agricultural workers aged 14–17. Other estimates of farm-related non-fatal injuries range from 1,717/100,000 to 1,827/100,000 child farm residents [Stueland et al., 1996; Rivara, 1997]. The estimated incidence of agricultural fatalities among working youth ranges between 2.3/100,000 child farm residents to 30.9/100,000 child farm residents, depending on the age and sex group [Stallones and Gunderson, 1994; Rivara, 1997].

This study and its companion [Parker et al., 2002] describe the incidence, cause, and severity of work-related adolescent injury in three rural counties in central Minnesota. Prior studies have only examined the independent impact of either farm work- or non-farm work-related injuries. This study demonstrates the combined impact of farm and non-farm work injuries on adolescents in rural communities in central Minnesota, and how injury risk and incidence differs in children involved in both, as compared to children involved in either one (i.e., farm or non-farm work).

## METHODS

The Community Partners for Healthy Farming surveillance program, sponsored by the National Institute for Occupational Safety and Health (NIOSH), was designed to evaluate agriculture-related injury and illness. As part of this program, the Minnesota Department of Health in collaboration with the Community Health Board for Meeker, McLeod, and Sibley counties conducted a cross-sectional survey of adolescent work practices in rural central Minnesota.

A sample of six high schools was selected based on convenience, school size, and the rural nature of the communities. A comprehensive self-administered questionnaire was given to 2,250 adolescents in six high schools from the three counties. Surveys were given to students in grades 9–12. The questionnaire was administered by trained school staff between February and March, 1998. Depending on the school, the students took the survey either as a group at a school-wide assembly, or sometime during a single week within a class in which every student was enrolled. Absentees were followed up to ensure that they were not excluded from the survey.

The 20-page self-administered survey had three sections: general demographic information and knowledge of occupational health; farm work and farm-related injury; and non-farm work and non-farm work-related injury. Students were questioned about the time period between the end of school the preceding year and the date they completed the survey. The survey included questions on risk factors for injury, and defined relevant terms like “farm,” “farm work,” “non-farm work,” and “injury.” An injury was defined as any health problem that caused the individual to seek medical attention from a health care facility or miss four or more hours of school or work. Completed surveys were individually

checked for quality and then scanned into a computerized database.

Injuries were classified as mild, moderate, and severe depending on the duration of restricted activities, school missed, work missed, and presence of any permanent injuries. A severe injury was defined as one that resulted either in permanent injury (including scarring of the face) or, more than 1 month of restricted activities, missed work, or missed school. A moderate injury was defined as one that resulted in 8 days to 1 month of restricted activities, missed work, or missed school. Finally, a mild injury was defined as one that resulted in 1 week or less of restricted activity, missed work, or missed school.

Teens were asked to describe the severity of only their most recent farm or non-farm work-related injuries. They were also given an opportunity to note how many additional times they were injured in each environment during the referent period. Students who reported multiple (>6) injuries were capped at six. The questionnaire asked for the hours of work per week during different time periods (summer, school-time, harvest, etc.) for both farm and non-farm work. For the purpose of data analysis, summer time was defined as the 12 weeks starting at the end of the school year. Harvest school time was defined as the 6 weeks starting in the early fall. Non-harvest school time was defined as the 17 weeks starting at the end of the harvest season. Total school time was 23 weeks. Thus, we divided the entire eight-month (35 weeks) period and estimated the total number of hours each adolescent worked in the 8-month period.

Data were analyzed using the SPSS and SAS software programs [Statistical Package for the Social Sciences, 1990; Statistical Application Systems, 1999–2000]. Descriptive statistics were computed and contingency tables were evaluated using tests of statistical significance at the 0.05 level. Injury incidence was the number of injury events occurring per year using an 8-month referent period (i.e., June 15, 1997 through February 15, 1998).

## RESULTS

A total of 2,250 teenagers were surveyed. Within schools, student participation varied from 79 to almost 100%. Overall, 92% (2,250) of the 2,446 students from the six schools participated in the survey. Out of the 2,250 students who completed surveys, 206 (9.2%) had not worked in the 8 months preceding the date of the questionnaire. A total of 2,044 teens (90.8%) had worked for at least some time in the preceding 8 months. Of these, 273 (13.4%) did only farm work, 1,305 (63.8%) did only non-farm work, and 466 (22.8%) did both farm and non-farm work.

Teens doing only farm work averaged 18.6 hrs per week of work. Those doing only non-farm work averaged 13.8 hrs per week, and those doing both farm and non-farm work averaged 28.6 hrs per week during the referent period.

**TABLE I.** Number of Injuries by Type of Work

Injury status	Work group			Total, n (%)
	Farm work only, n (% <sup>a</sup> )	Non-farm work only, n (%)	Both, farm, and non-farm work, n (%)	
Injured	23 (8.4)	84 (6.4)	46 (9.9)	153 (7.5)
Not Injured	250 (91.6)	1,221 (93.6)	420 (90.1)	1,891 (92.5)
Total	273 (100)	1,305 (100)	466 (100)	2,044 (100)

<sup>a</sup>Percentage of column total.

Students that simultaneously hold both farm/non-farm jobs have a significantly higher proportion of workers injured than students doing only farm or non-farm work ( $\chi^2 = 6.3$ ,  $P < 0.05$ ) (Table I). A Mantel–Haenszel analysis was used in order to assess whether this effect was due to the longer hours of work among students doing both farm and non-farm work. As seen in Table II, this finding was no longer significant when adjusting for hours of work. Annual injury rates<sup>1</sup> are highest for those working in non-farm (26.7/100 full-time equivalents, FTEs) or farm only (25.9/100 FTEs) employment when compared with those working simultaneously in farm and non-farm jobs (21.9/100 FTEs).

However, as seen in Table III, when rates are calculated based on the number of injuries (rather than the number of workers injured), those in farm only and both farm/non-farm have higher rates.

Also seen in Table III, girls doing only farm work experienced higher injury rates than boys doing only farm work whereas in the other two work groups (i.e., non-farm only and both farm/non-farm), boys experienced higher injury rates as compared to girls.

Overall, a total of 153 (7.5%) teens were injured at least once during the referent period. However, some of these 153 teens reported more than one injury during this period. Tables IV and V classify the 153 injured teens according to work type, grade, and number of injuries sustained in the referent period. We estimated<sup>2</sup> a total of 344 injury events during the referent time period.

Table VI lists the equipment or animals involved in causing injuries. Lifting jobs and knives accounted for most of the injuries to teens working at non-farm jobs. This relates well with the data in Table VII, showing cuts, puncture wounds,

lacerations, strains, and sprains to be the predominant injury types among non-farm workers. Animals and machinery were common causes of farm-related injuries. Among farm workers, bruises and sprains caused by farm animals were the predominant types of injury.

Out of the total 153 adolescents, 96 were mildly injured, 33 were moderately injured, and 24 were severely injured. Table VIII shows injury classification by severity and work group. In the group that included farm and non-farm workers, 19.6% of the injuries were severe as compared to only 13% of the injuries to those doing only farm work and 14.3% in the group doing only non-farm work. This difference in proportion of severe injuries between the three work groups was not significant as measured by the chi-square test ( $P > 0.05$ ).

## DISCUSSION

Due to a dearth of surveillance data, the number of agricultural injuries occurring annually to adolescents in the US is unknown [National Research Council, 1998]. Apart from the data presented here, we know of no studies that compare injury incidence among adolescents working on a farm to the injury incidence among a similar group of adolescents working at non-agricultural jobs. Nor, to our knowledge, are there studies that assess the injury risk to adolescents simultaneously working on and off the farm.

National and regional data indicate that animals, machinery, and falls are common sources of farm-related injuries [Cogbill and Busch, 1985; Layde et al., 1995; Pickett et al., 1995; Derstine, 1996; Stueland et al., 1996]. Tractors and hay processing equipment were the most common type of equipments associated with injury [Hopkins, 1989]. Tractors have been shown to be a leading cause of equipment-related mortality for children working on farms [Karlson and Noren, 1979; Goodman et al., 1985; Brown et al., 1997]. Hours worked per week, presence of disabled safety devices, feeding cows, and use of heavy equipment have been identified as risk factors for agricultural injuries [Stueland et al., 1996; Schulman et al., 1997] As seen in Table VI, these are all issues faced by teens working on farms in central Minnesota and appear to be ongoing causes of work-related morbidity.

<sup>1</sup> The annual injury rate for each work group was calculated as follows: Number of teens injured/injuries in that group X (2000/total hours worked by all the adolescents in that group, in the 8-month period). The 2000 corresponds to the number of hours worked by a full-time employee in 1 year. The total hours were calculated by assuming the summer period to be 12 weeks and school period to be 23 weeks (divided as 6 weeks harvest and 17 weeks non-harvest time). Those who mentioned more than six injuries were assumed to have had only six injuries for the calculation.

<sup>2</sup> For the calculation, we assumed that all teens reporting anything more than five injuries sustained six injuries, and those reporting between three and five injuries sustained four injuries.

**TABLE II.** Mantel–Haenszel Analysis for the Work Groups “Both” vs. “Nonfarm” Stratified by Hours Worked Per Week\* (< 20; ≥ 20)

	Marginal unadjusted	Stratified adjusted
OR	1.6	1.1
95% CI for OR	1.1–2.3	0.7–1.6
$\chi^2_{M-H}$	5.5	0.1
$P \leq$	0.02	0.75

\*The average hours worked per week was calculated by assuming the summer period to be 12 weeks and school period to be 23 weeks (divided as 6 weeks harvest and 17 weeks non-harvest time).

Factors associated with work-related injuries outside of agriculture have also been evaluated. Parker et al. [1994] noted that performing certain job activities were likely to be associated with higher rates of certain types of injury. For example, it was noted that butchers, baggers, and store clerks had higher rates of being struck by objects and striking against objects; and bussers, carhops, and cooks had higher injury rates due to contact with hot items. Layne et al. [1994] noted that the majority of lacerations in the retail trade resulted from being struck by objects and striking against objects. Cuts and lacerations are most often reported as the major injury type. Although many of these problems persist in rural communities, it appears that many youth are also exposed to more serious hazards such as those related to the construction trades (e.g., nail gun).

Data on the total number of injuries reported in this study were limited by the fact that detailed information was obtained for only one farm and/or one non-farm injury. However, even the lower end of the range of injury rates (Table III) in our study is higher than those reported in other studies [Schober et al., 1988; Brooks et al., 1993; Layne et al., 1994; Brooks and Davis, 1996; Stueland et al., 1996; Rivara, 1997;

Wegman and Davis, 1999]. There are various explanations for these differences: (1) Rural youth may be engaged in more dangerous work than youth in more commonly studied urban populations, (2) Rural youth work long hours, and (3) The students in this population may have over-reported injuries. The large range of incidence estimates points to the need for a carefully designed longitudinal study of injury among working youth in rural communities.

Study data indicate that injury incidence was modestly influenced by hours of work. The student survey evaluated work hours categorically (e.g., 0–4, 5–9) and students were asked to estimate how many hours they worked during a typical week during the summer and a typical week during the school year. Hours of work were then estimated using the mid point of each category. Although asked to state how many hours were spent performing different job-related tasks (e.g., cleaning tables, milking cows, driving tractors), job task data appeared to have been recorded with little accuracy by students and had to be ignored during analysis.

According to Davis [1997], adolescents work long hours in agriculture and frequently work before, during, and after school hours. Our findings suggest that a teen that simultaneously holds two different jobs has an increased incidence of injury. A possible reason for this finding could be due to sleep deprivation and stress among teens that have more than one job. Pilcher and Huffcutt [1996] concluded from their meta-analysis that sleep deprivation strongly impairs human functioning. Moreover, partial sleep deprivation (sleep periods of < 5 hrs in a 24-hour period) may have a more serious effect on performance than total sleep deprivation even for a long time (i.e., total sleep deprivation for more than 45 hrs). Teens doing both farm and non-farm work reported long work hours in addition to their schooling [Carskadoon, 1990; National Research Council, 1998].

Apart from suggesting that children working simultaneously in farm and non-farm jobs experience more injuries,

**TABLE III.** Annual Injury Rates, Based on the Number of Teens Injured (Person Rate) as well as the Number of Injuries (Injury Rate), for Males and Females in Each of the Three Work Groups

Annual incident rate (per 100 FTEs)	Work Group		
	Farm only	Non-farm only	Both, farm and non-farm
Total			
Person rate	25.9	26.7	21.9
Injury rate	63.1	49.8	56.1
Male			
Person rate	24.3	33.4	25.1
Injury rate	58.7	65.1	65.9
Female			
Person rate	38.3	22.6	15.9
Injury rate	95.8	40.5	38.0

**TABLE IV.** Number of Injuries by Grade in Farm and Non-Farm Work-Groups

Grade	Number of injuries											
	Farm work (n = 273)						Non-farm work (n = 1,305)					
	0	1	2	3-5	≥ 6	Total	0	1	2	3-5	≥ 6	Total
9	96	6 <sup>a</sup>	1	3	2	108	305	11 <sup>a</sup>	1	5	1	323
10	73	2	0	1	0	76	301	13 <sup>a</sup>	3	3	0	320
11	48	5 <sup>a</sup>	0	0	1	54	338	15 <sup>a</sup>	1	5	2	361
12	33	1	0	0	1	35	276	18 <sup>a</sup>	4	0	2	300
Total	250	14	1	4	4	273	1,221 <sup>b</sup>	57	9	13	5	1,305 <sup>b</sup>

<sup>a</sup>Includes one adolescent who mentioned he was injured, but did not state how many times.

<sup>b</sup>Includes one adolescent whose grade is unknown.

these data also suggest that the injuries are likely to be more severe than injuries to other working children. This finding is likely to be due to the fact that teens doing both farm and non-farm work tend to work long hours. While we were not able to corroborate self-reported injury severity, previous work [Parker et al., 1994] demonstrated that apart from disfigurement, teens accurately reported the nature and outcome of their injuries when compared with physician reports.

The agricultural industry in the United States is exempted from certain laws and regulations applicable to other industries. The most notable one is that for child labor. The Federal child labor laws for agriculture differ from those for non-agricultural employment. If a teen works on his or her parent's farm, it is legal for him or her to do hazardous work. This is not the case in non-agricultural work where children working in their parents' establishments are not allowed to perform hazardous tasks [National Research Council, 1998]. The Fair Labor Standards Act of 1938 establishes child labor requirements in agriculture. However, these requirements are not binding on children working on their parents' farms

[National Research Council, 1998]. For other children doing farm jobs, the Act specifies 16 as the minimum age of employment in any hazardous agricultural occupation, or for any agricultural occupation (i.e., even if not declared hazardous) performed during school hours. Outside of school hours, the minimum age for employment in any non-hazardous agricultural occupation is 14. However, the Act lowers the age to 12 for children employed with written parental consent or on farms where the child's parent or guardian is also employed. Minors below 12 years of age may be employed for non-hazardous jobs on farms not covered by Federal minimum wage requirements, if they have parental consent [US Department of Labor, 1984].

According to the Minnesota Statute, minors employed in agricultural operations, with the permission of their parents or guardians, are exempt from the minimum age and maximum hours restrictions placed on other occupations. This means that minors are permitted to work more than 40 hrs per week and more than 8 hrs in any 24-hr period [Minnesota Statutes, 2000].

**TABLE V.** Number of Farm and Non-Farm Injuries, by Grade, Among 466 Children Doing Both Farm and Non-Farm Work

Grade	Number of injuries											
	Farm injuries						Non-farm injuries					
	0	1	2	3-5	≥ 6	Total	0	1	2	3-5	≥ 6	Total
9	107	5	0	2	3	117	112	2	1	2	0	117
10	110	2	0	0	1	113	106	4	0	2	1	113
11	116	6 <sup>a</sup>	0	0	0	122	116	4	0	2	0	122
12	103	4	0	6	1	114	111	0	1	2	0	114
Total	436	17	0	8	5	466	445	10	2	8	1	466

<sup>a</sup>Includes one adolescent who mentioned he was injured, but did not state how many times.

**TABLE VI.** Equipment/Animals Involved in Causing Injuries

Equipment/animal	Both farm and non-farm work (n = 46) <sup>a</sup>			
	Farm work only (n = 23)	Non-farm work only (n = 84)	Farm injuries (n = 30)	Non-farm injuries (n = 21)
Tractor	1		2	
Bobcat (skid steer loader)	1		1	
Hay baler			2	
Waste-handling equipment			1	
Auger			1	
Four wheeler (all-terrain vehicle)	4		2	
Pesticides, chemicals			1	
Hay elevator	1			
Livestock trailer			1	
Cow/steer/cattle	7		7	
Horse	2		1	
Hammer/nail/crowbar	1	2	3	2
Nailgun/stapler		2		1
Lawnmower			2	1
Slip and fall		2	1	1
Knife, slicer, grinder		18		3
Grill, broiler, stove		4		1
Case cutter, box knife		5		
Ladder		1		1
Cleaning supplies		5		3
Harmful chemicals		2		
Lifting equipment	1	18	1	2
Unknown/other <sup>b</sup>	5	25	4	6
Total	23	84	30	21

<sup>a</sup>Five youth reported farm and non-farm injuries.

<sup>b</sup>Includes injuries in hospital work (being kicked by a patient, back strain while lifting a patient), babysitting (finger injury while lifting a baby, slamming door on fingers), finger cuts by open can lids, and lung infections due to shoveling barley and forage.

**TABLE VII.** Types of Injuries<sup>a</sup>

Injury type	Both farm and non-farm work			
	Farm work only (23 injuries)	Non-farm work only (84 injuries)	Farm injuries (30)	Non-farm injuries (21)
Bruise or contusion	12	14	10	4
Cut, puncture, or laceration	6	30	11	8
Burn (chemical or heat)		7	1	1
Strain or sprain	6	24	15	7
Broken bone	2	7	4	1
Foreign object in eye injury			1	
Chemical exposure (allergy)		2	1	2
Other <sup>b</sup> /unknown	3	4	2	1

<sup>a</sup>One individual may have sustained more than one type of injury.

<sup>b</sup>Includes dislocated knee, slipped disc, lung infection, ear infection, electrocution, and hernia.

**TABLE VIII.** Severity of Injury by Work Group

Injury severity	Work group			
	Farm work only n (% <sup>a</sup> )	Non-farm work only n (%)	Both farm and non-farm work n (%)	Total n (%)
Mild	11 (47.8)	55 (65.5)	30 (65.2)	96 (62.7)
Moderate	9 (39.1)	17 (20.2)	7 (15.2)	33 (21.6)
Severe	3 (13.0)	12 (14.3)	9 (19.6)	24 (15.7)
Total	23 (100)	84 (100)	46 (100)	153 (100)

<sup>a</sup>Percentage of column total.

As a final note, we attempted to more carefully examine possible injury risk factors using Poisson regression [Wassell, 1998]. However, data were insufficient to support a robust analysis. Problems encountered included no valid baseline to which to compare the rate of work-related injury, categorical data on work hours, and inadequate reporting of time spent working at specific job tasks. The ideal baseline would have been the injury incidence among teens doing no work at all or the incidence of injury for teens performing different types of job activities.

## CONCLUSIONS

It is apparent from these data that many rural students work long hours and are at significant risk of work-related injury. Although these data did not permit a precise estimate of the injury incidence, the lower estimate of injury is high compared with most other studies. Students in rural communities report being exposed to a variety of farm hazards that are known to place them at risk of serious injury. Fatality surveillance data for Minnesota have consistently shown some of these hazards to place workers, including young workers at risk of fatal injury.

Finally, future studies should more clearly define work hours and their possible impact on social outcomes and injury in rural communities. Also, there needs to be data on the injury incidence among teens doing no work at all, to serve as a baseline for comparison, so that a Poisson regression analysis may be done. Such analysis would help us to better understand the effect of various risk factors on injury incidence. It would also confirm or refute our finding that the difference in proportion of injuries among the three work groups is in fact due to the confounding effect of number of hours worked.

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## REFERENCES

- Brooks DR, Davis LK. 1996. Work-related injuries to Massachusetts teens, 1987–1990. *Am J Ind Med* 29:153–160.
- Brooks DR, Davis LK, Gallagher SS. 1993. Work-related injuries among Massachusetts children: A study based on emergency department data. *Am J Ind Med* 24:313–324.
- Brown M, Parker D, Seeland E, Boyle D, Wahl G. 1997. Five years of work-related injuries and fatalities in Minnesota. Agriculture: a high-risk industry. *Minn Med* 80(8):29–31.
- Carskadoon MA. 1990. Patterns of sleep and sleepiness in adolescents. *Pediatrician* 17:5–12.
- Castillo DN, Malit BD. 1997. Occupational injury deaths of 16- and 17-year-olds in the United States: Trends and comparisons with older workers. *Inj Prev* 3:277–281.
- Castillo DN, Landen DD, Layne LA. 1994. Occupational injury deaths of 16- and 17-year-olds in the United States. *Am J Public Health* 84:646–649.
- Cogbill TH, Busch HM, Jr. 1985. The spectrum of agricultural trauma. *J Emerg Med* 3(3):205–210.
- Davis S. 1997. Child labor in agriculture. Educational resource information clearinghouse digest. Clearinghouse on rural education and small schools. Charleston, WV: Appalachian Educational Laboratory.
- Derstine B. 1996. Job-related fatalities involving youths, 1992–1995. Bureau of Labor Statistics, Compensation and Working Conditions 1(3):40–42. (<http://www.bls.gov/opub/cwc/cwchome.htm>)
- Goodman RA, Smith JD, Sikes RK, Rogers DL, Mickey JL. 1985. Fatalities associated with farm tractor injuries: An epidemiologic study. *Public Health Rep* 100(3):329–333.
- Hopkins RS. 1989. Farm equipment injuries in a rural county, 1980 through 1985: The emergency department as a source of data for prevention. *Ann Emerg Med* 18(7):758–762.
- Karlson T, Noren J. 1979. Farm tractor fatalities: The failure of voluntary safety standards. *Am J Public Health* 69(2):146–149.
- Layde PM, Nordstrom DL, Stueland D, Brand L, Olson KA. 1995. Machine-related occupational injuries in farm residents. *Ann Epidemiol* 5(6):419–426.

- Layne LA, Castillo DN, Stout N, Cutlip P. 1994. Adolescent occupational injuries requiring hospital emergency department treatment: A nationally representative sample. *Am J Public Health* 84:657–660.
- Minnesota Statutes. 2000. Chapter 181A.07 Subdivision 1. Minnesota Office of the Revisor of Statutes. <http://www.revisor.leg.state.mn.us/stats/181A/>.
- National Research Council, Institute of Medicine. 1998. *Protecting youth at work: Health, safety, and development of working children and adolescents in the United States*. Washington, DC: National Academy Press.
- Parker DL, Carl WR, French LR, Martin FB. 1994. Characteristics of adolescent work injuries reported to the Minnesota Department of Labor and Industry. *Am J Public Health* 84(4):606–611.
- Parker DL, Merchant D, Munshi K. 2002. Adolescent work patterns and work-related injury incidence in rural Minnesota. *Am J Ind Med* 42:134–141 (this issue).
- Pickett W, Brison RJ, Hoey JR. 1995. Fatal and hospitalized agricultural machinery injuries to children in Ontario, Canada. *Inj Prev* 1:97–102.
- Pilcher JJ, Huffcutt AI. 1996. Effects of sleep deprivation on performance: A meta-analysis. *Sleep* 19(4):318–326.
- Rivara FP. 1997. Fatal and non-fatal farm injuries to children and adolescents in the United States, 1990–1993. *Inj Prev* 3:190–194.
- Schober SE, Handke JL, Halperin WE, Moll MB, Thun MJ. 1988. Work-related injuries in minors. *Am J Ind Med* 14:585–595.
- Schulman MD, Evensen CT, Runyan CW, Cohen LR, Dunn KA. 1997. Farm work is dangerous for teens: Agricultural hazards and injuries among North Carolina teens. *J Rural Health* 13(4):295–305.
- Stallones L, Gunderson P. 1994. Epidemiological perspectives on childhood agricultural injuries within the United States. *J Agromed* 1:3–18.
- Statistical Application Systems (SAS). 1999–2000. Version 8.1. Cary, NC, USA: SAS Institute, Inc.
- Statistical Package for the Social Sciences (SPSS). 1990. Version 6.1. Chicago: SPSS, Inc.
- Stueland DT, Lee BC, Nordstrom DL, Layde PM, Wittman LM. 1996. A population based case-control study of agricultural injuries in children. *Inj Prev* 2:192–196.
- US Department of Labor. 1984. *Child labor requirements in agriculture under the Fair Labor Standards Act*. (Child Labor Bulletin No. 102). WH Publication 1295.
- Wassell JT. 1998. Probability models of occupational injury. *Hum Ecol Risk Assess* 4(6):1275–1283.
- Wegman DH, Davis LK. 1999. Protecting youth at work. *Am J Ind Med* 36(5):579–583.