Agricultural exposures and farm-related injuries among adolescents in rural China

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ABSTRACT

This cross-sectional study explored the incidence of farm injuries and the relationship between agricultural exposures and injury among 2053 adolescents aged 13–19 years in Macheng, China. A comprehensive self-administered questionnaire was given to adolescents. The cumulative incidence rate of farm injury was 19.8%. Adolescents who were male, aged 10–15 years, left behind, working more days each month and living on the plains, reported higher rates. Specific agricultural exposures, such as large animals, pesticides and operating farm machinery were associated with higher injury rates. Prevention programmes are needed to reduce farm injuries.

Agricultural hazards in developing countries are very different from those in industrialised countries because a significant amount of manual labour is involved. Although the lack of heavy farm machinery may seem likely to lessen the risk of farm injuries, injury rates among farmers in developing countries are high.[1] In China, with the development of the economy and technology, more machinery is being used in farm work. In addition, large numbers of adult farmers have migrated to cities to find jobs; many leave their children at home, thus increasing the children's exposure to farm work.[2] Examining the risk of farm-related injuries among children is especially pertinent in China because the agricultural enterprises are family owned and operated. In farming families, children have traditionally provided a substantial portion of the labour, especially during school breaks and peak harvest seasons ranging from a few hours after school to full days of work.[3–5] Risk factors related to farm-related injuries among rural adolescents in China have not been studied extensively.[1] Compared with developed countries, there are no programmes to guide prevention of farm-related injury. The purpose of this study was to explore the incidence rate of farm-related injuries, and to describe associations between agricultural exposures and farm-related injuries among rural adolescents in China.

METHODS

Sampling strategy

Macheng is located in central China and is mostly an agricultural economy. A cross-sectional study design using cluster sampling was conducted. A list of schools in rural towns and villages of Macheng was obtained at the first stage. Schools were categorised according to the terrain (mountains, hills and plains) where the schools were located. Six schools from the three areas were randomly selected. Two classes in each grade were selected by a facilitator at the school. Surveys were administrated in the classrooms. All students in selected classes were invited to participate.

Data collection

A comprehensive self-administered questionnaire was given to 2455 adolescents in December 2009. The survey facilitators consulted with the principal of the school to arrange 30–40 min for conducting the survey. The recall period of the survey was the preceding 6 months.

Trained interviewers entered the classrooms, explained the purpose of the survey, and obtained consent from the students. If students agreed to participate in the survey, they stayed in the classroom, and if not, they were allowed to leave. All students completed the questionnaires in the classrooms; questionnaires were then collected by the interviewers.

Quality control

All interviewers were graduate students majoring in maternal and child health. They received training before conducting the study. The researchers visited the field to supervise activities. A sample of the participants was reinterviewed by the field supervisors. All interviewers were involved in retraining exercises over the study period. Field supervisors reviewed completed questionnaires each day and checked them for accuracy and completeness.

Study variables

We obtained demographic characteristics of participating adolescents: grade, parents' and grandparents' education and age, annual family income, and whether parents had left to work in a city.

With respect to farm work, we asked the age at which they began to work on the farm: average number of days of farm work per month; work with livestock; operation of farm machines; pesticides stored in the home; exposure to pesticides (mix or spray pesticides, or helping others to mix or spray pesticides); number of pesticide applications; and terrain.

We asked about any injuries that occurred on the farm while doing farm work or farm chores in the 6 months prior to the interview, and that resulted in at least 4 h of restricted activity or medical treatment.[6]

We identified 'left-behind children' as those whose parents (one or both) had left the community to search for work, where the child is left at the location of household registration and one or both parents are away for more than 6 months a year.[7]

This study was supervised and conducted by Colorado Injury Control and Research Center, Colorado State University and Tongji Injury Control and Research Center, Tongj Medical College. The study protocol was reviewed and approved by the Colorado State University Institutional Review Board, and the Institutional Review Board, School of Public Health, Tongji Medical College, Huazhong University of Science & Technology. Approval was obtained from both institutions before the study was conducted.

Data analysis

All statistical analyses were performed using SAS V.9.1. Descriptive statistics were used to evaluate the incidence rate of farm-related injuries by demographic characteristics and agricultural exposures. The 6-month cumulative incidence rate of injury among adolescents was calculated. Multiple logistic regression was applied to assess the association of agricultural exposures and farm-related injuries. The presence or absence of farm-related injuries was used as the dependent variable; agricultural and environmental exposures were independent variables in the logistic regression model. Age, gender and grade were considered confounding variables.

Table 1 The incidence rate and 95% CI of farm-related injuries among rural adolescents (N=2053), Hubei China, 2009.

Variables	Adolescents (n)	Injured (n)	Incidence rate (95% CI)	
Gender*				
Male	1225	262	21.4	(19.1 to 23.7)
Female	828	145	17.5	(14.9 to 20.1)
Age*				
13~15 years	1052	227	21.6	(19.1 to 24.1)
16~19 years	1001	180	18.0	(15.6 to 20.4)
Grade**				
7th	448	114	25.4	(21.4 to 29.5)
8th	353	76	21.5	(17.2 to 25.8)
9th	244	52	21.3	(16.2 to 26.4)
10th	482	77	16.0	(12.7 to 19.2)
11th	399	64	16.0	(12.4 to 19.6)
12th	127	24	18.9	(12.1 to 25.7)
Whether parents were at home				
No parents at home	505	92	18.2	(14.9 to 21.6)
Father at home	89	24	27.0	(17.7 to 36.2)
Mother at home	518	128	19.8	(16.7 to 22.9)
Both parents at home	531	115	17.8	(14.9 to 20.8)
Age when began to work on farm (years)				
<12	931	221	23.7	(21.0 to 26.6)
≥12	106	23	21.7	(14.3 to 30.8)
Unknown	1021	163	16.0	(13.8 to 18.4)
Days per month working on farm chores**				
0–2	673	105	15.6	(12.9 to 18.3)
2–7	440	97	22.0	(18.2 to 25.9)
8–14	567	118	20.8	(17.5 to 24.2)
≥15	373	87	23.3	(19.0 to 27.6)
Number of pesticide applications**				
0	1373	237	17.3	(15.3 to 19.3)
1~4	370	91	24.6	(20.2 to 29.0)
5~9	156	39	25.0	(18.2 to 31.8)
≥10	154	40	26.0	(19.0 to 32.9)
Terrain**				
Plains	900	204	22.7	(19.9 to 25.4)
Hills	601	90	15.0	(12.1 to 17.8)
Mountains	552	113	20.5	(17.1 to 23.8)
Total	2053	407	19.8	(18.1 to 21.6)

*p Value <0.05; **p value <0.01 from χ^2 significance test.

RESULTS

Of the 2455 eligible students, 2053 provided complete responses to the questionnaire. The incidence of farm-related injury was 19.8% (95% CI 19.1% to 24.1%) (table 1). Male adolescents reported a significantly higher rate than females (table 1). Adolescents aged 10–15 years reported a higher rate than those aged 16–19 years (table 1). Left-behind adolescents reported higher incidence of farm-related injuries, especially adolescents who lived solely with their fathers (table 1). Adolescents working more days each month reported more injuries as did those who applied pesticides and who began farm work before the age of 12 years (table 1). The adolescents living on the plains reported higher incidence than those living in the mountains and hills.

Table 2 reports the OR and 95% CIs of farm-related injuries from the multivariable logistic regression models after controlling for age, sex and grade. Agricultural exposures significantly associated with farm work injuries were working with large animals (OR=1.55, 95% CI 1.21 to 1.99, p<0.01), exposure to pesticides (OR=1.18, 95% CI 1.03 to 1.36, p<0.05), and operating farm machinery (OR=1.37, 95% CI 1.13 to 1.66, p<0.01). Adolescents who worked with cattle had a significantly higher risk of injuries than those who worked only with hand tools (table 2). Adolescents who spent 15 or more days per month at farm work had higher odds of injury (table 2). Living on the plains was associated with a higher risk of farm-related injuries compared with living in hilly regions.

DISCUSSION

Age, gender and grade level were significantly associated with farm-related injuries consistent with previous epidemiologic

Table 2 The association between agricultural exposures and farm-related injuries, adjusted for age, gender and grades among rural adolescents by multiple logistic regression analysis (n=2053), Hubei China, 2009

Independent variable	OR	(95% CI)
Farm machine on the farm (Yes : No)	1.39	(1.01 to 1.92)*
Large animals on the farm (Yes : No)	1.55	(1.21 to 1.99)**
Pesticide exposure (≥1:0)	1.18	(1.03 to 1.36)*
Farm work tools		
Worked only with hand tools	1.00	
Worked with farm machinery	1.16	(0.79 to 1.71)
Worked with cattle	1.83	(1.08 to 3.12)*
Operated farm machinery before (often/sometimes : never)	1.37	(1.13 to 1.66)**
Days per month worked on farm chores		
0–2 days	1.00	
2–7 days	1.17	(0.85 to 1.61)
8–14 days	1.10	(0.79 to 1.53)
≥15 days	1.81	(1.31 to 2.50)**
Parents		
Both parents at home	1.00	
Mother at home	1.08	(0.79 to 1.48)
Father at home	1.30	(0.65 to 2.63)
No parents at home	1.27	(1.00 to 1.69)
Terrain		
Hills	1.00	
Plains	1.71	(1.30 to 2.25)**
Mountains	1.10	(0.85 to 1.43)

*p Value <0.05; **p value <0.01.

studies of farm-related injuries among youth.[7–12] The differences in farm-related injuries between boys and girls may be related to differences in exposure in farm work tasks, work patterns and work environments.[13 14] In China, boys often are assigned heavy farm work, such as moving heavy objects, driving farm machinery, and working with cattle. Girls more often work on light farm chores and raising fowl. More detailed data on exposure to hazards for adolescents are needed to determine what factors result in the disparate injuries between boys and girls.

Children aged 10–15 years had higher farm-related injuries than adolescents aged 16–19 years, similar to farm children in Ontario.[15] This finding demonstrated that younger teens may be especially at risk for injury when exposed to farm hazards.[13] The North American Guidelines for Children's Agricultural Tasks (NAGCAT) was developed to define age-appropriate tasks for children aged 7–16 years engaged in farm work in order to reduce farm-related injuries.[16 17] The efficacy of age restrictions needs to be established, and development of age-appropriate guidelines is needed for agricultural exposures in China.[7]

In this study, farm-related injuries were caused predominantly by farm hand tools, however, exposure to farm machinery, large farm animals and pesticides were also significantly associated with farm-related injuries, consistent with results in developed countries.[3 17–23] Laws restricting the age at which adolescents can operate tractors have been effective in preventing injuries in the USA.[24] The tractor design in China is different, often lacking safety equipment; further study in China is needed regarding farm tractor safety. Adolescents may not know how to handle and behave around large animals.[20] Pesticide exposures have been associated with higher odds of injury among farm children.[13 25] Preventing injury associated with pesticides among rural Chinese middle and high school students is a pressing issue.

There are several limitations to this study. First, this was a cross-sectional study, and so inferences about causality cannot be made. Second, in this cross-sectional epidemiological survey, data were self-reported by students within a 6-month recall period without external validation, therefore, recall or reporting bias may be present. Third, because of the timing of survey administration, information about agricultural exposure and farm-related injuries represented only summer and fall months; the findings reported do not represent other months, such as winter, when students were less likely to work on a farm. Finally, our findings cannot be generalised to adolescents in other countries. However, this study does expand our knowledge of agricultural exposure and farm-related injuries in a developing country.

In summary, this study indicated that rural adolescents in China are subject to numerous agricultural hazards. Our findings could have significant implications for injury prevention programmes targeting rural adolescents in middle and high schools in China: (1) interventions should be developed to increase awareness of the hazards of operating farm machinery, handling large animals and pesticide exposures; (2) government and schools can develop guidelines for age-appropriate children's agricultural tasks and to develop health education for adolescents about agricultural safety. Restrictions on operating farm tractors and heavy work on farms among younger adolescents may protect them from farm-related injuries; (3) there is need to design safety training programmes for parents to reduce the risk of adolescent injuries.[16 26–29] Previous studies found a reduction of farm injury among adolescents in North American when parents assign work tasks to children according to the North American Guidelines for Children's Agricultural Tasks (NAGCAT).[26–28] However, there are no comparable guidelines on agricultural hazards in rural China and the NAGCAT guidelines have not been tested in China. It is possible that if parents have enough knowledge and follow age-appropriate assignments of work tasks for children involved in agricultural work, the incidence rate of farm-related injuries may decline.

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Competing interests None.

Ethics approval Colorado State University and Tongji Medical College.

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Data sharing statement I hereby declare that there are no original data from this study shared by other research articles.

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US traffic deaths: seven steps forward, one large step back

For 7 years, road fatalities in the USA have declined but last year they increased by over 2000. Injuries also increased by 5%. Ironically, the reversal of the trend is attributed to more driving as a result of better weather and an improved economy. As well, a more sinister explanation has been put forward: that people are also driving more dangerously. And there were similar increases in pedestrian and bicyclist deaths. A further irony is that cars are far safer but the main causes remain unchanged: Drivers not wearing seatbelts, drunk driving, inexperienced teen drivers, unsafe trucks and motorcyclists not wearing helmets.

Crash fatalities under LaHood

According to one observer, 'More Americans died of crash injuries in the four years that Secretary LaHood served than died in the Afghanistan, Iraq, and Vietnam wars combined.' The *Washington Post* carried an article on Secretary LaHood's departure noting 'a couple million reasons it might not be so bad.' *Editor's comment*: Louis V Lombardo, who runs Care for Crash Victims, brought this item, and many others, to my attention. I encourage you to visit his website (http://www.careforcrashvictims.com).

Drug overdose deaths continue to climb

For the 11th straight year, US figures show an increase in deaths from addictive painkillers. For 2010, the CDC reported 38 329 drug overdose deaths. Prescribed medicines were involved in nearly 60%, far overshadowing fatalities from illicit narcotics. The main culprits were opioids including OxyContin and Vicodin. The Associated Press