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AGRICULTURE AND FORESTRY WORK-RELATED INJURIES AMONG FARMERS ADMITTED TO AN EMERGENCY DEPARTMENT

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Abstract: The objective of the study was to describe the characteristics of agriculture and forestry related injury cases admitted to an Emergency Department (ED), and to asses factors related to injury severity and hospital admission. Retrospective analysis of ED case records in Teaching Hospital No 1 in Lublin, from January 2004 to December 2005 were utilized. Inclusion criteria: patient >14 years old, with agriculture and forestry related injuries. Univariate and bivariate descriptive analyses and multiple logistic regressions were performed. 3791 cases were included, 63.1% males, 53.3% cases younger than 30 years and 47.1% of the patients sustained injuries related to machines or falls. After adjusting for age, sex and the presence of multiple injuries, animal related injuries, followed by machine related injuries and falls, were at higher risk of a more severe injury (OR: 1.77, 1.61 and 1.50, respectively). This groups also showed a higher likelihood of hospital admission (OR: 2.03, 192 and 2.00, respectively). Patients attended to in the ED during night hours (OR: 2.06) were also at a higher risk of hospitalization. It was concluded that animal related injuries, agriculture machine operators, and falls, besides accounting for two thirds of analyzed cases, are the mechanism of injury with a greater risk of a more severe injury and higher likelihood of a hospitalization.

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Key words: agricultural injuries, occupational risk factors, hospital admission, injury severity, mechanism of injury.

INTRODUCTION

The World Health Organization predicts that by the year 2020, injuries will be responsible for more deaths, morbidity and disability than any other diseases. Currently, injuries account for 1 in 7 of potential life-years lost worldwide, but by 2020 they will account for 1 in 5. It is predicted that the majority of this burden will affect the developing countries [13, 18, 22, 35]. According to the most recent statistic, in 2004 there were 28,033 agriculture or forestry related injuries in Poland which resulted in 211 deaths [23]. In agricultural regions, traumatic injuries associated with agricultural production are a serious public health problem, with an increasing contribution to morbidity and disability, most notably among highly exposed population groups such as young people, agriculture machine operators and the elderly [4, 24, 28]. This problem needs to be addressed through comprehensive approaches that include further delineation of the problem, and identification of specific risk factors through analytic research. However, outside North America, western Europe and Australia, information about injury problems and solutions are particularly scant because the injury control efforts from communities and government in developing countries are well below the level of those directed at other health problems [15]. Although agriculture related injuries are receiving increasing attention as a

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public health matter in the Lublin region, few population based investigations in this field have been carried out [12, 28, 31, 32]. Of special interest were the social and physical characteristics of the rural environment.

An agricultural occupational safety and health programme should evaluate injury patterns to identify occupational disease and injury research needs and priorities. Continued development of relevant surveillance systems and implementation of appropriate interventions are the primary challenges for the current decade. Most important, injury control should draw the attention of policymakers and gain support from the government, research institutions, local authorities and communities. This study examines the patterns of agriculture related injuries among farmers in the Lublin region from the perspective of Emergency Department admissions.

MATERIAL AND METHODS

The Emergency Department in teaching Hospital No. 1 in Lublin operates in one of six hospitals which provide medical services to 800,000 people in Lublin and a few neighbouring villages. 41% of the population are rural area residents, whereas the average in Poland is 38.2%. This department accounts for approximately 30% of all agriculture related injuries attended to in EDs in Lublin; the population of their catchments is homogenous from a demographic and socioeconomic standpoint, as well as in type and severity of injuries. In this study, we made a retrospective analysis of the source data of 3,791 adult patients with agriculture and forestry related injuries presented at the ED in Teaching Hospital No 1 in Lublin, from January 2004 to December 2005. In the medical records the following information was identified: record number, date and time of visit, date of birth, sex, postal code, circumstances and mechanism of injury, as well as discharge status and diagnoses. This information was routinely collected by physicians and lower eehelon staff of the ED.

Farm or forestry related injury was defined as any unintentional injury that occurred during activities at work on a farm or ranch, or involved any accident on a farm, ranch or forest environment. To evaluate the severity of body injury, the Abbreviated Injury Scale AIS (1990 revision) was used, and based on this scale an Injury Severity Score (ISS) was calculated [1, 2]. Severity was further categorized in 2 different ways depending on the case. In order to describe factors associated with severity as a dependent variable, 2 categories were created: slight ($ISS \leq 3$) and moderate to severe ($ISS \geq 4$). When used as an adjustment variable in the study of hospital admission, 3 categories were used: slight ($ISS \leq 3$), moderate ($4 \leq ISS \geq 8$) and severe ($ISS \geq 9$). The variable admission was created into 2 categories: patients admitted to the Department of Trauma or Intensive Care Unit in our hospital, and patients discharged home from the ED. With regard to independent variables, time and day of visit were categorized as follows: morning 07:00-15:00, afternoon/evening 15:00-22:00, night 22:00-07:00. Weekday: Monday to 19:00 Friday, weekend – Friday night to Monday 7:00. Cases of multiple injuries were defined as those with more than one diagnosis in at least 2 different anatomical regions. Finally, based on the mechanism of the injury 5 categories of injuries related to agriculture or forestry were created: a) hand tools users, b) machine operators, c) falls, d) animal related injuries, e) other mechanism of injury. Beside a descriptive analysis of the main study population, multivariate logistic regressions methods were used for the construction of models involving factors associated with injury severity and hospital admission. Assessment of performance of the models was conducted using the Hosmer-Lemeshow goodness-of-fit test [11]. This test evaluates the degree of correspondence between the models estimated probabilities of a more severe injury, or of a hospital admission, and the actual severity or hospital admission experienced by patients over groups spanning the entire range of probabilities. Discrimination was assessed using the area under the receiver operating characteristic (ROC) curve [10] to evaluate how well the model distinguished between patients not severely injured or not admitted from those severely damaged or admitted. Statistical analysis was performed using computer software Statistica v. 6.0 [Statsoft, Poland].

RESULTS

As presented in Table 1 between January 2004 and December 2005 at this Department there were treated 31,800 patients with injuries; among them 1,940 needed hospitalization over 24 hours. Among these patients there was a group of 3,791 agriculture or forestry related injuries which formed 11.9% of total ED admissions and 14.2% of all injury related hospital admissions.

Table 2 indicate that 63.1% of the analyzed population were men. The young people aged from 20-29 years which was the age group with the largest contribution to all agriculture or forestry related injuries (41.8%). In all age groups, the percentage of men was higher than that of women (over 66%), except among the elderly, where the percentage was higher among women (57.2%). About two-thirds of analyzed injuries took place on weekdays, and half of them in the afternoon and evening hours. Weekend

Table 1. Structure of injury related admissions to the Emergency Department January 2004–December 2005.

	Total ED admissions	ED one day discharges	Hospital admissions
No. of patients with injuries	31,800	29,860	1,940
No. of agriculture or forestry related injuries (% of all injuries)	3,791 (11.9%)	3,516 (11.8%)	275 (14.2%)

ED – Emergency Department

Table 2. Distribution of main demographic characteristics of agriculture or forestry related injury cases by age group.

Age (years)	14-19	20-29	30-49	≥50	Total
Cases (N)	514	1583	1014	680	3791
Gender (%)					
Males	69.8	66.7	67.7	42.8	63.1
Females	30.2	33.4	32.4	57.2	36.9
Admissions (%)					
Hospital admission	5.1	6.3	7.1	11.5	7.3
ED one day discharge	94.9	93.8	92.9	88.6	92.8
Visit day and time (%)					
Weekday	67.51	66.7	72.1	73.2	69.4
Weekend	32.5	33.4	27.9	26.8	30.6
Morning	22.2	31.5	33.6	40.2	32.4
Afternoon/ evening	52.9	44.5	46.1	49.2	46.9
Night	24.9	23.9	20.3	10.7	20.7

Table 3. Distribution of main injury related characteristics of agriculture or forestry related injury cases by age group.

Age (years)	14-19	20-29	30-49	≥50	Total
Hand tool users	17.9	30.1	41.2	33.1	31.9
Machine operators	27.6	38.0	29.0	4.6	28.2
Falls	44.55	23.9	9.5	2.2	18.9
Animal related injuries	8.8	7.0	17.3	47.8	17.3
Other mechanism	1.2	1.2	3.1	12.4	3.7
Injury severity (%)					
Slight	81.5	77.5	79.9	71.3	77.6
Moderate	14.2	17.3	15.0	21.0	16.9
Severe	4.3	5.2	5.1	7.7	5.5
Injuries (%)					
Isolated injuries	94.2	92.4	92.4	92.1	92.6
Multiple injuries	5.8	7.6	7.6	7.9	7.4
Head	4.3	5.5	5.4	6.3	5.5
Face/neck	0.6	0.7	0.7	1.2	0.8
Thorax/abdomen	0.0	0.3	0.8	2.7	0.8
Spine	4.9	10.2	16.4	8.4	10.8
Lower limbs	8.2	10.0	7.3	13.8	9.7
Upper limbs	7.4	7.6	8.4	7.7	7.8
External injuries	74.7	65.7	61.1	60.0	64.6

injuries had a higher contribution in the population below 29 years, while nighttime injuries were slightly more frequent in the 14-19 year age group, and were the lowest among those older than 50 years. Only 7.3% of all agriculture or forestry related injuries were finally admitted to the hospital, with the proportion of admissions rising with age.

Table 4. Distribution by severity and admissions for selected demographic variables. Bivariate analysis.

Factor	No. of patients	Hospital admission (%)	Injury severity		
			Slight (%)	Moderate (%)	Severe (%)
Gender					
Male	2,391	8.0	76.8	17.8	5.4
Female	1,400	6.1	78.9	15.4	5.7
Age (years)					
14-19	514	5.1	81.5	14.2	4.3
20-29	1,583	7.1	77.5	17.3	5.2
30-49	1,014	7.1	79.9	15.0	5.1
≥ 50	680	11.5	71.3	21.0	7.7
Visit day and time					
Weekday	2,631	7.1	78.5	16.3	5.2
Weekend	1,160	7.6	75.5	18.4	6.1
Morning	1,227	6.3	78.8	16.5	4.7
Afternoon/ evening	1,778	6.8	77.8	16.6	5.6
Night	768	9.8	75.1	18.3	6.6
Hospital admission (%)		-	2.5	23.7	24.5

Table 3 indicates that falls and machine operators together accounted for the largest share of agriculture or forestry related injuries (47.1%), followed by hand tools users (31.9%) and animal related injuries (17.3%). About one out of every 5 cases had an injury of moderate or high severity. The relative contribution of these 2 severity categories was higher among the elderly (28.7%). External injuries (superficial wounds and crashing) accounted for more than half of all injuries, followed by injuries to the spine, injuries to the head, lower and upper limbs. This relative distribution varied substantially by age group, with a much larger contribution of external injuries among youths, spine injuries in the middle-aged population, and lower limbs in the elderly.

As shown in Tables 4 and 5, bivariate comparisons indicate that males and the elderly, as well as animal related injury, suffered more often from injuries of moderate to high severity. Injuries resulting from weekend and nighttime accidents were also of high severity, while injuries to the head, the thorax and the abdomen, and to both extremities, were also of higher severity. Admissions proportions followed an overall pattern of distribution among each of the variables, rather similar to that described for severity, except for face and neck injuries, for which, despite of majority of cases being of minor severity, about 21% of cases were finally admitted to hospital.

Tables 6 and 7 indicate the results of the multivariate logistic regression models for factors associated with severity and hospital admissions, respectively. Males (OR 1.27), patients older then 50 years (OR 2.00) multiple injuries

Table 5. Distribution by severity and hospitalization for selected injury related variables. Bivariate analysis.

Factor	No. of patients	Hospital admission (%)	Injury severity		
			Slight (%)	Moderate (%)	Severe (%)
Mechanism of injury (%)					
Hand tool users	1211	4.4	80.8	13.1	6.2
Machine operators	1068	7.7	78.2	17.4	4.4
Falls	718	7.1	76.5	18.5	5.0
Animal related injuries	655	12.8	71.3	22.0	6.7
Other mechanism	139	4.3	80.6	15.1	4.3
Injuries					
Isolated injuries	3509	7.1	81.3	15.5	3.1
Multiple injuries	282	9.6	31.6	34.8	33.7
Head	207	7.7	0.0	46.7	53.1
Face/neck	29	20.7	86.2	13.8	0.0
Thorax/abdomen	31	29.0	64.5	32.3	3.2
Spine	410	3.4	95.1	1.7	3.2
Lower limbs	368	32.1	23.1	58.4	18.5
Upper limbs	295	18.6	28.1	66.4	5.4
External injuries	2451	2.3	95.4	4.6	0.0

Table 6. Factors associated with injury severity (ISS ≥ 4). Multivariate logistic regression model (n=3791).

Factor	Cases	OR adjusted	95% CI	
14-19	514	1		
20-29	1583	1.33	1.02	1.74
30-49	1014	1.18	0.88	1.59
≥ 50	680	2.00	1.43	2.78
Females	1400	1		
Males	2391	1.27	1.06	1.51
Isolated injury	3509	1		
Multiple injury	282	10.41	7.93	13.67
Hand tool users	1211	1		
Machine operators	1068	1.50	1.20	1.89
Falls	718	1.61	1.25	2.08
Animal related injuries	655	1.77	1.37	2.27
Other mechanism	139	1.06	0.66	1.71

p-value goodness of fit 0.64.12. Area under ROC curve 0.6627.

(OR 10.41) machine operators (OR 1.50), falls ((OR 1.61), and animal related injuries (OR 1.77) showed a higher and statistically significant adjusted risk of suffering more severe injuries. In the case of risk of hospital admission, after adjusting for injury severity, males (OR 1.39), patients older than 50 years (OR 2.48), machine operators (OR 2.00), falls (OR 1.92) and animal related injuries (OR 2.03)

Table 7. Factors associated with admission to hospital. Multivariate logistic regression model (n=3791).

Factor	Cases	OR adjusted	95% CI	
14-19 years	514	1		
20-29 years	1583	1.18	0.72	1.91
30-49	1014	1.15	0.90	2.54
≥ 50	680	2.48	1.39	4.42
Females	1400	1		
Males	2391	1.39	1.02	1.88
Hand tool users	1211	1		
Machine operators	1068	2.00	1.34	2.99
Falls	718	1.92	1.22	3.03
Animal related injuries	655	2.03	1.51	5.51
Other mechanism	139	1.00	0.39	2.56
Isolated injury	3509	1		
Multiple injury	282	0.42	0.26	0.68
Slight	2941	1		
Moderate	642	12.72	9.36	17.27
Severe	208	24.42	15.15	39.36
Night attention – No	3005	1		
Night attention – Yes	786	2.06	1.50	2.83

p-value goodness of fit 0.2246. Area under ROC curve 0.8507.

had a higher and statistically significant independent risk of hospital admission. Individuals seen during night hours had also a higher independent risk of being admitted to the hospital (OR 2.06).

DISCUSSION

Injury control has recently gained attention and enormous support with the contribution of funds for injury control in developed countries. During last decade of the 20th century, workers in the US agriculture industry received particular attention because of the high risk of fatal injuries and suspected risk for serious non-fatal injuries [16, 19]. Such activities resulted in a significant decrease of morbidity and mortality among farmers.

This study contributes to the knowledge of the main risk groups of agriculture or forestry related injuries among the rural population of Lublin and nearby villages, and particularly to the identification of factors associated with injury severity and risk of hospital admission. The study is based on an information source that represents a more complete coverage of the population involved than findings based on hospital discharge data. Emergency department data are of great value, especially when the majority of the analyzed population require only outpatient department attendance, while hospitalized patients are not representative for the entire population; similar observations are also reported by other researchers [7, 20, 29, 33]. The availability of emergency

department data for agriculture and forestry related injuries, occurring within the rural area surrounding Lublin, has allowed the identification of the incidence and severity of such injuries, as well as their distribution by different mechanism of injury categories. Knowledge of severity and body region of injuries resulting from ED data is a key element in identifying and evaluating preventive actions. Previous studies of work related injuries among farmers have described patterns of farmers injuries and have evaluated a variety of potential risk factors. In general, the risk factors have been defined into 2 categories: physical characteristics of the countryside and personal characteristics of the farmers. With respect to characteristics of the rural areas, the patterns of injury have been fairly consistently reported among the studies, with agricultural machines, falls, and animal related injuries being the 3 major external causes of injury [19, 25, 27, 33]. With respect to the personal characteristics of the farmers, males were found to be at higher risk of injury than females, regardless of the hours spend in farm activities. Although the results of several studies indicate that younger farmers have the highest risk of non-fatal injuries and older farmers tend to account for the greatest proportion of agricultural fatalities [4, 8, 9, 26]. Our results show that males, machine operators and falls as mechanisms of injury, as well as animal related injury, have a higher risk of suffering a more severe injury, even after adjusting for potentially confounding variables such as sex, age, and type and location of injury, similar that which has been shown in other studies [6, 26, 27, 33]. Many studies indicate that animal related injuries are an important risk factor for the farming population. Although all activities connected with breeding animals may be potentially dangerous, it mostly refers to people whose occupation is connected with animals [20]. The largest group are farmers, but it also includes veterinary surgeons, butchers, and other agriculture related occupations [3, 30]. Researches carried out by American authors reveal that animals are one of the main causes of injuries in the farming industry, and every year in the USA animal related injuries cause about 40 deaths. Most serious injuries are caused by large animals such as horses, cows or pigs [5, 6, 14, 21]. Our previous work confirms a considerably higher percentage of injuries requiring hospitalization only in cases of attacks by horses and cows. Pig attacks, in contrast to American studies, did not cause more serious injuries than other animal species in the Lublin region population [20]. Hospital admission risk, after adjusting for injury severity, was lower for multiple injury cases, indicating that ISS measurements seem to adequately capture the influence of severity of the likelihood of admission, when considered jointly with other independent variables; similar conclusions also appear in the other publications [17]. On the other hand, the observation that patterns of day and nighttime ED attendance may influence the likelihood of admission, even after taking into account differences in age, gender, and injury severity, deserves further attention and in-depth analysis.

The basic limitation of this work is the fact that the analyzed group of patients was treated at one medical centre, and also the lack of information on agriculture related injuries among children. Our study shows that the information collected by emergency departments add a new value for evaluation of the magnitude and pattern distribution of agriculture related injuries, its severity and hospitalization necessity. This study should be considered as an attempt to pinpoint the subgroups on whom fall the burden of agricultural and forestry injuries in a rural area, rather then an effort to explain the differences among such groups. This would certainly require information on whole range of other important factors not routinely collected in ED reports, for example, the presence of other acute or chronic diseases at the time of the injury.

CONCLUSIONS

1. Most agriculture or forestry related injuries are of a minor degree, requiring only outpatient department admission.
2. The results obtained have allowed the identification of 3 groups of mechanism of injury: falls in the young population, young machine operators and elderly injured as a result of animal attack, important in terms of their risk of a severe injury and resulting hospitalization.
3. Focusing on these subgroups, local injury prevention programmes should be designed that should contribute to an important reduction in the rates of agriculture or forestry related injury.

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