

The West-Jutland Study on Prevention of Farm Accidents, Phase 1: A Study of Work Specific Factors in 257 Hospital-treated Agricultural Injuries

O. Carstensen, J. Lauritsen, K. Rasmussen

Abstract

The aim of the present study was to obtain detailed knowledge of fatal and nonfatal unintentional injuries and working conditions related to farming for purposes of designing possible preventive interventions. The study is geographically restricted to one county in Denmark with 270,000 inhabitants, 13,835 of whom are engaged in full-time farming on 7,922 farms. Most farms are owned and operated by single families. Production is focused on only one of three types: swine, dairy or crop. The study is based on injuries treated at local hospitals. A total of 257 farm injuries were reported during the period 1 January to 31 December 1992. The results do not indicate any single preventive effort, but some aspects are considered important. The majority of injuries occurred near or in production buildings during work with animals and machinery. Approximately one-third of the injured persons were employed part-time in farming. A three times higher incidence was seen among 15- to 29-year-old farmers than among older farmers. Fractures were seen more often after injuries in which animals were involved. Seventy-four cases (30.7%) reported "unusual" conditions on the day of the incident. When asked directly 73 (30.3%) stated that they had changed routines of work or equipment as a consequence of the injury. Comparisons with other studies indicate the necessity of careful data collection on both etiology and injury statistics.

Keywords. Farm, Agriculture, Accident, Injury, Prevention.

Denmark has for centuries been an agricultural country, with an agricultural structure characterized by single farms most often operated by the farmer himself with the assistance of family members or one employee (DFA, 1993).

Although farm work often carries the connotation of fresh air and robust health, surveys indicate that the farm is a dangerous workplace (Myers, 1990; Purschwitz and Field, 1990). In 1992 the incidence rate of fatal farm accidents in Denmark was 11.7/100,000 person years — three times higher than the working population in general. According to the Danish Work Environment Service (DWES), farming ranks highest in fatal accidents for the years 1990 and 1991, and second highest in 1992 (DWES, 1992).

Article was submitted for publication in November 1994; reviewed and approved for publication in July 1995.

The authors are Ole Carstensen and Kurt Rasmussen, Dept. of Occupational Medicine, Herning Hospital, DK7400 Herning, Denmark; and Jens Lauritsen, Assistant Professor, Institute of Community Health, Dept. of Epidemiology, University of Odense, DK5000 Odense C, Denmark.
Corresponding author: Ole Carstensen, MD, Dept. of Occupational Medicine, Herning Hospital, DK7400, Herning, Denmark. Telephone: +45 9927 2470.

A Swedish survey from 1988 showed an incidence of 60 farm injuries/1,000 person years. All the injuries were treated by general practitioners, the majority were minor injuries (Janson, 1987). American and Canadian prospective field studies based on telephone interviews among dairy and beef/dairy farmers found incidence rates of 166 and 70/1,000 person years respectively (Pratt, 1992; Brison, 1992).

The situation in Denmark was studied approximately 10 years ago. An emergency room based consecutive sampling of farm injuries in 1984 in Ringkoebing County identified 142 farm-related injury victims demanding hospital care, corresponding to an incidence of 15/1,000 full-time engaged farm-workers per year (Nielsen, 1986). All treatment in the emergency room was based on referral from general practitioners. The compulsory notification system of the Danish Work Environment Service registered 2.82 farm related accidents/1,000 workers (DWES, 1992) during the same year. Completeness rate of the notification system has been estimated to only 10% of all notifiable cases (Lauritsen, 1992) for the branch of agriculture. The notification system is based on accidents leading to at least one day of absence. No occupational health care system or safety organization exists at the farm level in Denmark. Consequently there are insufficient systems of surveillance on farm injuries and a complete lack of detailed information on causes and risk factors in accidents associated with farm work.

The aim of the present study was to get detailed knowledge of working conditions related to farm incidents for purposes of possible interventions. The study has three phases: (1) during 1992, severe and fatal farm injuries were referred to five hospitals; (2) continuous weekly work activity and injury registration in 400 farms during one year with ongoing data collection, and, finally; (3) an intervention study based on the information from the two first phases. This report includes results from phase one.

Methods

The study is geographically restricted to West-Jutland, the county of Ringkoebing, which has 270,000 inhabitants, 13,835 of whom are engaged on a full-time basis with farming on 7,922 farms (DBPS, 1993). Of the county's active workforce, 8.8% are employed with farmwork. Farm types are typically small family farms with one to three full-time persons and a fluctuating number of family members working a few hours daily in the production. Most farms focus production on only one of three types: swine, dairy or crop.

The county is served by two central and three smaller local hospitals. Each of these has around the clock emergency room service, which requires referral from the family physician. The family physician refers only the more severe cases, and treats all minor injuries himself. During 1 January 1992 to 31 December 1992 the staff of these five emergency rooms were asked to register all farm-related injury victims. Our definition of a farm injury is an incident that took place during farm work or farm-related work. For each of the five hospitals, the project had a primary contact physician who had the responsibility of ensuring a high degree of precision and low level of dropout, i.e., to catch all relevant contacts, even the doubtful ones. It was done by reading all the emergency department records. The primary medical registration forms in the emergency rooms were all stamped with an easily identifiable label in red color: "Farm accident? _Yes _No". The injuries marked "yes" on the medical form are hereafter referred to as a "farm contact". Only medical diagnosis, date and place of treatment, and name of persons injured were transferred once a month to the project secretary at the Department of Occupational Medicine

in Herning. A telephone interview with the injured person was subsequently performed two to four months after the time of accident. Interviewers were two MDs, one a qualified specialist in occupational medicine (KR) and the other a trainee (OC). The interview was performed using a structured questionnaire with 22 questions supplemented by qualitative injury data. The questionnaire was not piloted, but was read and evaluated by a group of 20 farmers.

During and after the interview the information was coded into approximately 70 variables.

Injury Framework

Formulation of questions and variables was based on the injury framework seen in figure 1. This framework, originally developed in Finland, proposes that information regarding the injury can be meaningfully detailed into the following aspects: conditions prior to injury, contact situation and consequences of the accident (Touominen, 1982). Each of the aspects can be associated with (influenced by) facilitating and prohibitive factors.

Material

For the period 1 January to 31 December 1992, three hundred visits to emergency rooms qualified as "farm contacts". Based on emergency room and/or interview data, 43 injuries were classified as nonoccupational contacts, mostly in relation to traffic, play or other leisure activity, leaving 253 injuries conforming to the stricter "farm injury" definition: (1) farmers or nonfarmers injured during farmwork, or (2) bystanders injured by farmwork (children playing in a barn were not included). These 253 injuries seen at the hospitals were supplemented with four fatal farm injuries. Data on the fatal injuries were obtained from death certificates and the coroner's inquest. All 1992 death certificates for unexpected deaths from the county (number 219) were evaluated for possible relationships with farm work.

Of the 257 injured persons, 16 refused participation in the interview, comprising 241 index cases. Rate of participation was 93.7%. The 16 nonparticipants were randomly distributed when looking informally at age, sex, injury date and diagnosis of the injury from the emergency room files. Official population statistics (statewide farm surveys carried out annually) include only full-time employed persons (DBPS, 1993); therefore estimates of incidence measures include only this subgroup. All other analyses were based on the 241 cases with interview information. The study has been accepted by the Regional Ethics Committee and the registry authorities in

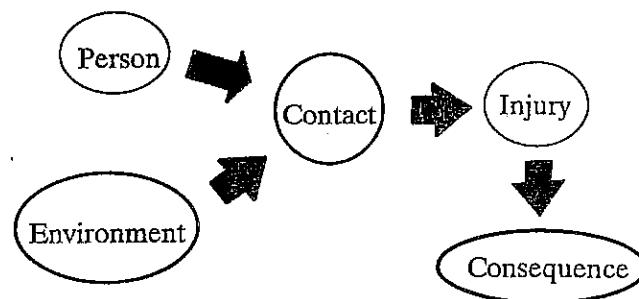


Figure 1—Accident framework. Main elements of data collection, each is associated with facilitative and prohibitive factors (Touominen, 1982).

Denmark. Data analysis was made using standard epidemiological and statistical packages (SPSS/PC, EPI-Info, StatXact) and procedures.

Results

Results will be described according to the injury framework shown in figure 1.

Persons (table 1)

The median age of injury victims was 42 years, range 2 to 81 years; 207 were males and 34 were females. Ownership: 131 (54.4%) were owners, 44 (18.3%) were employees and 40 (16.6%) were relatives. Of the 131 owners, 103 (78%) worked full-time as farmers. Approximately 65% (our data suggest the range 60 to 70%, but we cannot distinguish some groups) of all injured were working full-time in agriculture. Overall injury rate for the estimated full-time working persons (N = 146), 11.34 (95% C.I.: 8.9 to 12.4)/1,000 person years. The same rate stratified by age groups: 15 to 29 years 29.0 (95% C.I.: 21.7 to 40.1); 30 to 49 years 9.6 (95% C.I.: 7.1 to 12.6); 50 to 69 years 8.6 (95% C.I.: 6.3 to 11.3); 70+ years 1.6 (95% C.I.: 0.2 to 5.6).

Environment (table 2)

Any particular farm consists of a variety of different work environments, approximately 75% of all injuries occurred in the immediate vicinity of the production buildings or inside these buildings, the rest occurred in the field. Most injuries occurred inside buildings (61%). Only 16 (19%) animal-related injuries occurred outside, but these were more serious than the indoor injuries. The dominant finding regarding particular environments is the dairy/beef stable comprising 77 (32%) of all injuries; 13 of these occurred while operating stable machinery.

There is a seasonal pattern in the injury rate. Two-thirds of the 149 (62%) injuries occurred in summer and fall. This pattern covers both animal and machinery related injuries. In the spring, machinery related injuries occurred at twice the rate of animal related events. During other seasons, there was roughly a one-to-one relationship between the number of animal versus machinery injuries.

Contact

Contact between injured persons and environment was classified as entrapment "caught in" 27%, "hit" by an object 44%, and falls 17.4%. Only 2.9% of the injured were bystanders to farmwork. Of the 15 children under 15 years of age, 10 were injured during farmwork, the remainder were bystanders to farmwork. Call for assistance was graded as significant to the reduction of injury sequelae by 22 (9%) of the injured (18.6% of those who actually called for assistance).

Table 1. Aspects of accident framework — persons

Age Group	N = 241	(%)
0-14	15	6.2
15-29	59	24.5
30-44	59	24.5
45-59	75	31.1
60-69	26	10.8
70+	7	2.9
Total	241	100.0

Table 2. Aspects of accident framework — environment

	N = 241	(%)
Place of accident		
Beef/dairy stable	77	32.0
Farm field	53	22.0
Barn	42	17.5
Near vicinity of farm buildings	40	16.6
Pigpen	21	8.7
Other (garden, etc.)	8	3.3
Total	241	100.0
	N.	(%)
Animal involved		
Dairy cows	36	41.9
Young cattle	21	24.4
Pig/hog	18	20.9
Horses	6	7.0
Beef cattle	2	2.3
Other	3	3.5
Total	86	100.0
Machinery involved		
	114	47.3
<i>Type of machinery</i>		
Tractors (incl 2 PTO injuries)	22	19.3
Indoor machinery	19	16.7
Harvesting equipment	16	14.1
Wagons	14	12.3
Equipment for soil preparation	11	9.6
Irrigation equipment	9	7.9
Other and hand held tools	23	20.1
Total	114	100.0
<i>Work task to be completed</i>		
Soil preparation	8	7.0
Harvesting	15	13.2
Transportation	28	24.6
Other (e.g., machinery repair)	63	55.3
Total	114	100.0
Carrying-handling goods	13	5.4
Other (e.g., chemicals)	28	11.6
Total	241	100.0

Injury (table 3)

Types of injury are shown in table 3. The distortions occurred when the farmer jumped to uneven and unstable ground. Two tractor roll-over injuries occurred leading to minor cerebral injuries (roll-over protection is compulsory on tractors in Denmark). A few injuries were the result of defective brakes and narrow space. Cattle-related injuries are generally more serious with many fractures and contusions. This difference is highly significant ($P < 0.001$). Two separate injuries led to multiple lesions after a bull gored the victim.

Table 3. Aspects of accident framework—
injury by ICD8 diagnosis

ICD8 diagnosis	Animals		Machinery		Other	
	N	(%)	N	(%)	N	(%)
Fracture (800.00-829.99)	36	41.8	26	22.7	13	31.7
Luxation (830.00-839.99)	1	1.2	0	0.0	0	0.0
Distortion (840.00-849.99)	11	12.8	15	13.2	8	19.5
Cranial trauma (850.00-854.99)	1	1.2	5	4.4	3	7.3
Internal injury (859.00-869.99)	1	1.2	1	0.9	0	0.0
Amputation (885.00-888.99)						
(895.00-898.99)	0	0.0	8	7.0	0	0.0
Wounds (870.00-884.99)						
(890.00-894.99)	11	12.8	32	28.1	7	17.2
Lesion of muscle and tendons (905.00-909.99)	0	0.0	3	2.6	2	4.9
Contusion (920.00-929.99)	24	27.8	22	19.3	4	9.7
Other	1	1.2	2	1.8	4	9.7
Total	86	100.0	114	100.0	41	100.0

ICD-8 diagnosis as defined by WHO, 1982.

Consequence (table 4)

After initial treatment at the emergency room 32 cases (13.5%) were hospitalized. Fifty (21.1%) received no further treatment, while 187 cases (78.9%) received some form of treatment afterwards and were seen by general practitioners, hospital outpatient clinics, and others. There were 841 contacts in total (median 2, range 1 to 72). At the time of interview, approximately three months after the injury, 84 (35.4%) still had some complaint of disability and/or persistent pain.

Table 4. Aspects of accident framework—consequences

	Animals		Machinery		Other	
	N = 86	(%)	N = 114	(%)	N = 41	(%)
Death	1	1.2	2	1.8	1	2.4
Length of temporary disability						
0 d	13	15.1	17	14.9	10	24.4
1-7 d	14	16.3	23	20.2	3	7.3
8-20 d	10	11.6	19	16.7	6	14.6
> 20 d	48	55.8	53	46.5	21	51.2
Length of sick leave						
0 d	21	24.4	32	28.1	12	29.3
1-7 d	12	14.0	19	16.7	3	7.3
8-20 d	9	10.5	14	12.3	6	14.6
> 20 d	43	50.0	47	41.2	19	46.3
Length of the need for additional help on the farm						
0 d	38	44.1	53	46.5	19	46.3
1-7 d	7	8.1	8	7.0	1	2.4
8-20 d	6	7.0	14	12.3	6	14.6
> 20 d	34	39.5	37	32.5	14	34.2

No significant differences were found in the distribution of work disability, sick leave or need for additional assistance between the groups working with animals and machinery (Chi square analysis). Seventeen persons (7.9%) reported continued psychological symptoms two to three months after the injury. Symptoms were sleep disturbances, nightmare, and recurrent recollection of the accident. These symptoms point at post traumatic stress disorder, but we do not have sufficient health examination data to confirm the diagnosis as defined in ICD-10 (WHO, 1992).

Four events resulted in fatal injury: (1) A 2 1/2-year-old boy was thrown off and trapped by a feeding cart which turned over on bumpy ground. (2) A 62-year-old male was found dead in a field with cattle, one of them a young bull. The cause of death was multiple fractures and inner chest lesions of the lung and heart. (3) A 74-year-old male, who was found dead under a harrow (a three-winged cultivator). He had removed a key bolt from the harrow. (4) A 73-year-old male, who fell from the upper level of the barn through a hole in the floor. Case 2, 3, and 4 were working alone and were found dead. Case 1, 3, and 4 had cause of death stated as brain injury.

Indicators for prevention

Seventy-four cases (30.7%) reported "unusual" conditions on the day of the event. "Particular haste" (24; 32.4%) and "unfamiliarity with equipment/untrained personnel" (17; 23.5%) were mentioned. Only 5.4% reported defective equipment. Half of the injured persons (45.2%) indicated how the accident could have been prevented. They pointed at suitable working procedures, use of safety equipment, and better safety devices. When asked directly, 73 (30.3%) stated that they had changed something as a result of the injury. The majority of these, 48 (65.8%), had changed "routines of work"; the remainder indicated different changes, e.g., "new tools/new materials" (4; 6%) and "enhanced personal protection/changes to buildings" (5; 6.8%).

Discussion

Our study indicated that farm-related injuries occurred to people of all ages. A statistically significant (three times) higher incidence was seen among 15- to 29-year-old workers than among older farmers. Fractures were seen more often after injuries in which animals were involved. Some indicators of preventability have been identified.

The aim of the present study was to develop baseline data regarding the etiology and consequences of injuries taking place in agriculture in the study region. It was our understanding before the study that some major groups of injuries could be described through hospital data, which in turn could be collected with relatively limited effort (five hospitals for one county with approximately 8,000 farms). Finally, it was our expectation that the results could provide a basis for the planning of targeted interventions.

An uncertainty in the material is the total number of contacts. Analysis of seasonal distribution of the data indicates inaccuracies in the emergency room procedures at the end of the study period (only 25% of the monthly average reported in the last month). The figures presented are therefore considered to estimate the minimum number of injuries fitting our definition.

The finding that there was a statistically significant higher incidence among 15- to 29-year-old workers is different from other studies where no difference

between age groups has been found (Janson, 1987). The findings need further confirmation in studies with precise denominator information. Finding the true denominator (a total number of persons occupied in Danish agriculture) is problematic, because of the many part-time employed, family-members and children working in agriculture.

The study does not point at any single preventive effort, but the following aspects are considered important for the planning of prevention methodologies: The majority of injuries took place near or in production buildings. Two large groups of activities associated with injuries are working with animals and machinery. Two indicators, each representing one-third of the material, point at items relevant to the "preventability potential": one is the question of "unusual" situations, the other actual change of work procedures as a consequence of the injury. The data does not allow any conclusion as to the actual preventability or expected success in preventive programs, but we do find the mentioned one-third indicative of an awareness among injured persons working in agriculture.

A striking feature of reported incident measures is the great variation in the available literature: 60/1,000 farm workers (Janson, 1987), 166/1,000 (Pratt, 1992), 70/1,000 (Brison, 1992), 15/1,000 (Nielsen, 1986), 3/1,000 (DWES, 1992), and our study 11.3/1,000 just to mention a few. The variability is based to a great extent on the different sources of outcome (interview, primary health care, hospitals) and "time at risk" (number full-time working, total number working, etc.). These differences emphasize the need for strict control of injury reporting in situations where the point of interest is to prevent the occurrence of events. Therefore, our study is now continuing with phase 2, which directly includes the estimation of occurrence of events at the farm level with simultaneous assessment of "time at risk".

ACKNOWLEDGMENTS. The authors gratefully acknowledge the emergency room staff of the five local hospitals in the county of Ringkoebing, Denmark. This study was supported by a grant from the Public Health Research Fund of the counties of Ribe and Ringkoebing, Denmark.

References

- Brison, R. J. and C. W. L. Pickett. 1992. Non-fatal injuries on 117 eastern Ontario beef and dairy farms: A one-year study. *Am. J. Ind. Med.* 21:623-636.
- DBPS. 1993. *Agricultural Statistics* (Statistical notations, 1993:5). Copenhagen, Denmark: Danish Bureau of Population Statistics.
- DFA. 1993. Key figures in agriculture. Copenhagen, Denmark: Danish Farmers Association.
- DWES. 1992. *Occupational Accident Statistics*. (Similar statistics for the years 1982-1991). Copenhagen, Denmark: Danish Work Environment Service.
- Janson, B. R. 1987. The yield of systems for continuous and periodic injury surveillance in emergency care with emphasis on farmwork-related accidents. *Scand. J. Soc. Med.* 15:247-252.
- Lauritsen, J. 1992. Occupational accidents (in Danish). In *Occupational Health and Safety for Danish Employees*, Vol. 2, Chapter 6, eds. M. Nord-Larsen, E. Ørhede, J. Nielsen, H. Burr. Copenhagen, Denmark: Institute of Social Science, Institute of Occupational Health.
- . 1987. Injuries and Contacts to the Health Care System in a Random Sample of the General Population (in Danish). OU-ISH. ISBN: 87-89021-11-8. Ph.D. thesis, Odense University, Odense, Denmark.
- Myers, J. R. 1990. National surveillance of occupational fatalities in agriculture. *Am. J. Ind. Med.* 18(2):163-168.

- Nielsen, C. T. and E. Malte. 1986. Agricultural injuries (in Danish). *Ugeskrift for Læger* 148(27):1705-1707.
- Pratt, D. S., L. H. Marvel, D. Darrow et al. 1992. The dangers of dairy farming: The injury experience of 600 workers followed for two years. *Am. J. Ind. Med.* 21:637-650.
- Purschwitz, M. A. and W. E. Field. 1990. Scope and magnitude of injuries in the agricultural workplace. *Am. J. Ind. Med.* 18(2):179-192.
- Touominen, R. and J. Saari. 1982. A model for analysis of accidents and its application. *J. Occup. Accid.* 4:265-274.
- WHO. 1992. *International Statistical Classification of Diseases and Health Related Problems*. Geneva, Switzerland: World Health Organization.
- . 1982. *International Statistical Classification of Diseases*. Geneva, Switzerland: World Health Organization.