THE WEST JUTLAND STUDY OF FARM ACCIDENTS: A MODEL FOR PREVENTION

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Abstract - This article summarizes the main elements of the West Jutland Study on the Prevention of Farm Accidents, that was presented in four separate papers at the 1996 Occupational Injury Symposium in Sydney, Australia. The objective of the study is to develop and conduct an intervention on the basis of an initial investigation of risk factors, aimed at reducing the number of occupational accidents in a randomly selected, representative sample of Danish farms. The article focuses on the underlying model used in the study, the methods and design employed, and the form and content of the intervention that is currently underway. Results will be presented at a later date. © 1997 Elsevier Science Ltd.

1. Introduction

In Denmark, the risk of serious occupational accidents is greater in farming than in most other occupations. The yearly incidence of fatal work accidents per 100 000 employed is roughly 3 times greater in farming than in other occupations grouped together. In 1992 there were more fatal accidents in agriculture than in any other occupation; in relation to the number of persons employed, the second largest incidence of fatal accidents was to be found in farming. Calculations based on a study conducted in Ringkoebing county in 1992 (Carstensen et al., 1995) reveal that about 1900 farming accidents requiring hospital treatment occur yearly. In the USA, persons occupied in farming have an incidence of injury that is four times greater than other occupations (Elkind, 1993). In Sweden, where only 3-4% of the work force is engaged in farming, 8% of all fatal work related accidents occur in this occupation (Lundquist and Gustafsson, 1992).

Despite such figures, research into work related accidents in farming has been limited. While epidemiological findings regarding the incidence of farm-work accidents exist, very little is to be found in the literature regarding the role of psychosocial factors or the mechanisms through which such accidents occur. The necessity of supplementing epidemio-
logical data with in-depth investigations of causal relations has been underlined in a review of farm accident research (Lundquist and Gustafsson, 1992). Such research is needed to establish a foundation for preventive efforts. Furthermore, previous research has not adequately calculated task specific time at risk, i.e. the amount of time spent on specified tasks on each farm comprising the study sample. This needs to be carried out if adequate estimates of the relative risk of different farming tasks, e.g. machinery, animal or maintenance related work, are to be calculated.

The main aim of this study is to develop and conduct an intervention designed to improve the safety practices of farmers and reduce work related farm accidents. This is done by first carrying out a thorough investigation of accidents and risk factors. Through the study a heuristic model of farm accidents is employed to guide both research efforts and intervention development. Emphasis is put on evaluating the effects of the intervention. Only through adequate evaluation can safety interventions be developed and improved.

The West Jutland study was started in 1992 and consists of three phases:

**Phase 1:** Registration and interview of all farm accidents receiving hospital treatment in Ringkoebing county during one year (Jan.-Dec. 1992).

**Phase 2:** Weekly farm level accident registration and interview study conducted on a representative sample of 399 farms in Ringkoebing county aimed at acquiring information on risk factors (July 1993-June 1994).

**Phase 3:** An evaluated intervention study designed as a randomized trial employing the same sample of farmers as in phase 2 (Nov. 1995-1997).

A report covering phase 1 has been published earlier (Carstensen et al., 1995). The remainder of this article will therefore concentrate on phases 2 and 3.

2. **A model of farm accidents**

For the purposes of the study, a model of farm accidents was constructed (see Fig. 1). Risk situations are assumed to anse as a function of both person and environmental factors.

![Fig. 1. Model of farm accidents.](image-url)
Examples of the former include safety attitudes, perceptions and knowledge. Examples of the latter include farm characteristics such as size and type, whether or not children live on the farm and the safety standard of farm machines.

Given the assumption that farmers have a strong influence on their own working environment, two types of safety relevant behaviour are proposed. Firstly, farmers can, via regular safety checks, maintenance and planning, improve the safety standards of their buildings, machinery and equipment. Secondly, farmers, like everyone else, can behave in a more or less safe fashion while working in a risk situation, e.g. not engage in risk behaviour and use personal protective equipment. We believe that it is important to distinguish between these two types of behaviour, partly because they may be differentially related to accidents, and partly because such a distinction aids the evaluation of interventions, e.g. which type of behaviour are we attempting to change or which type of behaviour have we affected?

Hypothetically, stress may affect both types of behaviour; by reducing the quality and amount of maintenance activity, and/or by increasing risk taking behaviour and/or reducing cognitive functioning (attention, concentration) in risk situations. Stress acts as a moderator of person and environmental influences upon accidents by affecting safety behaviour and may thus explain why previous research has failed to find an association between safety attitudes and farm accidents (Murphy, 1981). Stress, like risk situations, is a function of both person characteristics and environmental demands (Lazarus and Folkman, 1984).

Thus, the occurrence or non-occurrence of accidents is the result of interactions between many factors. This picture is complicated still further by the fact that an individual's accident history will influence attitudes and behaviour. For example, long term risk taking that does not result in accidents will reinforce the tendency to take risks. This could be represented in Fig. 1 by an arrow going from outcome (accidents) back to the person variables, thus giving the model a time or feedback dimension.

The study combines both quantitative and qualitative methods. The former involves statistical analyses of questionnaire and observational data, the latter involves in-depth interviews with accident victims and qualitative analyses of accident sequences. This approach allows for method triangulation as a means of assessing the validity of results. For example, if the questionnaire study reveals stress to be a risk factor, then accident sequence analyses based on interviews should also implicate stress as a contributory factor in a large proportion of accidents. Furthermore, these interviews should be able to tell us something of the mechanisms through which stress is exerting an effect.

2.1. Sample

A random sample of 794 farms, comprising 10% of all members of the Danish Farmers Association in Ringkøbing county, were asked to participate. Of these, 133 were subsequently excluded because of retirement. Of the remainder, 399 (60.3%) farmers (principle farm operators) agreed to participate in the 1-year accident registration phase of the study (phase 2). 1610 persons were registered as living or working on these farms. Non-participants differed from participants by being older and running smaller farms.

In addition, an extra group of 60 farms, likewise randomly selected, participated in six months of accident registration. This extra group was established for use as an additional control group in the intervention phase of the study.

The region's farms are typically small family units with one to three persons occupied on a
full-time basis and a fluctuating number of family members working a few hours daily. Most farms focus production on swine, dairy, crop or a mixture of these.

2.2. Design

The general design of the project is shown in Table 1. Accident registration consisted of farmers reporting weekly during one year via a small questionnaire on the occurrence or non-occurrence of accidents. Accidents were broadly defined as unexpected events causing a break in work. Near accidents were included. All reported accidents were followed up with a telephone interview requesting details of the accident and its consequences. Subsequently, accidents that were not related to farm work and injuries that were not related to accidents were sorted out. In addition, details of work tasks and hours spent on them were collected, so as to allow task specific estimations of time at risk.

Eight months after completion of accident registration, questionnaires on psychosocial variables were sent out. Questionnaires were mailed to all persons over 18 years of age on the farms. This questionnaire was constructed on the basis of a literature review and a pilot interview study. The 17 page questionnaire contains scales and items (some taken from existing research and some constructed specifically for the present study) on demographics, work characteristics, safety perceptions, behaviours and attitudes, safety locus of control, type A behaviour pattern, stress perceptions and symptoms. Scale validation is to be carried out using item bias analysis.

For the intervention study, the initial group of farms was divided on a random basis into an intervention group (group A) and a control group (group B). In order to gauge the effects of participation in the study (Hawthorn effect), a second control group (group C) was established in the same manner as the initial sample. This group underwent six months of accident registration and received the questionnaire on psychosocial variables at the beginning of this period. Details of the intervention are outlined below.

Following intervention (which is currently underway), a new six month period of accident registration is to be conducted. Following this, the same questionnaire on psychosocial variables will be administered once more.

Intervention effect evaluation is carried out by comparing pre and post intervention accident frequencies and questionnaire responses, as well as by comparing the intervention group with the control groups on both these measures. Furthermore, the first element of the intervention consists of a safety check of each farm in the intervention group. This is repeated after the second period of accident registration, providing a third means of effect evaluation, e.g. pre versus post intervention safety standards. Groups B and C will also receive safety

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<tr>
<th>Group</th>
<th>Accident registration</th>
<th>Questionnaire</th>
<th>Intervention</th>
<th>Accident registration + interviews</th>
<th>Questionnaire</th>
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<tbody>
<tr>
<td>A</td>
<td>1 year</td>
<td></td>
<td>Safety check + course</td>
<td>6 months</td>
<td>+ safety check</td>
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<tr>
<td>B</td>
<td>1 year</td>
<td></td>
<td>Control</td>
<td>b months</td>
<td>+ safety check</td>
</tr>
<tr>
<td>C</td>
<td>† + 6 months accident registration</td>
<td></td>
<td>Control</td>
<td>6 months</td>
<td>+ safety check</td>
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checks after the second period of accident registration, thus allowing comparisons on this measure between the intervention and control groups.

The qualitative part of the study takes place during the second accident registration period, where reported accidents will be followed up with in-depth interviews, aimed at gaining detailed information about the circumstances and sequencing of events leading up to the accident. This information is to be used to conduct analyses of each accident, with a focus on the processes involved and the points at which alternative behaviour could have prevented the incidents. It is hoped that this approach will supplement the quantitative data to give a better understanding of what is happening (as opposed to what is involved). An analysis approach based on the work of Leplat and Rasmussen (1984) will be applied. This approach focuses on human error from a cognitive perspective and on breaking accident sequences up to identify and examine the conditions, events (including decisions and behaviours) and their interrelations that contribute to the incident.

3. Intervention

The intervention, which is designed on the basis of results from phases I and 2 and the model of farm accidents, involves two main elements (see Table 2 for a brief outline):

Firstly, an agricultural safety engineer conducts a half-day safety walk-through of each farm in the intervention group along with the farmer. The farmer receives immediate verbal feedback about problems, risks and hazards, and advice about what he can do to rectify these. During this safety check, both hardware (i.e. buildings, machinery, equipment and tools) and reported behaviour involved in specific working routines are looked at. Upon conclusion of the safety check, the farmer receives a brief written report containing recommendations for immediate and long term actions that can improve the safety standard of his farm. For the purpose of effect evaluation (and to allow assessment of relationships between psychosocial variables such as safety attitudes and objective measures of safety standards), a more thorough

<table>
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<th>Table 2</th>
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<td><strong>Summary of intervention</strong></td>
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<td><strong>l. Farm safety check</strong></td>
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<td><strong>Duration:</strong> - day</td>
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<td>Safety engineer and farmer inspect farm, focussing on all major work routines, e.g. milking, feeding, harvesting, pesticide handling, repair work.</td>
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<td>Standardised checklist used to score: (a) safety condition of hardware (b) reported safety behaviour during each routine</td>
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<tr>
<td>Feedback: verbal and written with an emphasis on what needs improving and how to do so.</td>
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scoring of hardware and safety behaviours is made. For each working time (e.g. milking), both the hardware and reported behaviours involved are evaluated on a six point scale.

Secondly, as soon as possible after the safety check (usually a couple of weeks), the farmer, along with all others engaged in farm work on the farm over 18 years of age, attends a one day safety course conducted by medical doctors and psychologists. These courses are typically attended by 10-15 persons at a time and are held at locations that are as close as possible to the participant's farms. The courses contain five main elements:

1. Information about risk factors (feedback from the accident registration phase), with an emphasis on concrete examples of preventable, often serious accidents is presented. Participants are encouraged to respond to this information, e.g. how typical are these accidents, how do they fit with the farmers own perceptions of risks and hazards?

2. Focus group interviews, moderated by two psychologists, where the farmers themselves are the active participants. Farmers speak about their own accident or near accident experiences, why they occurred and what could have been done to prevent them. Reasons and motives for unsafe behaviour and obstacles to safe behaviour are discussed. Farmers also talk about what they actively do to improve safety. Here, the farmers act as their own experts in that ideas and successful solutions are disseminated throughout the group.

   Relevant themes, derived from the previous phases of the study, e.g. the influence of stress on work practices and safe behaviour, are introduced. The discussions may thus be broadened to include often chronic conditions that may underlie safety practices and accident occurrence, and not least. how these might be dealt with. For example, in the case of stress, the question arises as to how this might be coped with in a way that prevents it from increasing accident risk. One possibility here is to plan farm activities so that the most hazardous jobs are carried out at times when stress, time pressure and manpower shortages are least likely. These group discussions take the previous element a step further by increasing the participants' personal involvement and commitment to solution finding. An important role for the moderators in this respect is to cherish social processes such as group pressure.

   3. A farmer who has lost the use of his arm due to a farm accident talks graphically about the experience and its consequences. This direct confrontation with the seriousness of accident consequences aims at building upon increased knowledge and motivation by intensifying the emotional salience of farm accidents.

   4. Personal protective equipment is demonstrated.

   5. Group discussions are again conducted, based on the written reports which the farmers have received following the safety check of their farms. Discussion centres on the extent to which each farmer intends to follow the report's recommendations and also on whether the farmer has other ideas/plans for improving safety on his farm. Each farmer, along with the other members of his household, writes a plan of action. listing changes that he commits himself to make. Farmers are informed that the second safety check will in part be used to document the extent to which they have carried out their plans of action.

   Taken together, the various elements of the intervention are an attempt at a broad psychological modification of cognitions, motives, emotions and behaviour. Since many work practices are ingrained habits, focussing attention on, say, cognitions or motivation alone is unlikely to be successful. It is difficult to change cognitions to an extent that will affect behaviour without attaching some emotional significance to them, or to change behaviour without creating a motivation to do so. Increasing motivation to work safely has limited benefit unless feedback and advice present the farmer with knowledge of what to change and how to do so.
Thus, the first element of the safety course focuses primarily on cognitions (knowledge, perceptions). The second element motivates solution searching and application. Since hearing that a solution has worked for another farmer is likely to increase one's tendency to adopt it. Talking about one's own accidents, or about the shared problems of farmers that influence accident occurrence, increases the emotional intensity of the social processes involved and furthers a feeling of a common purpose. This in turn increases group pressure in the desired direction of improved safety. The third element makes accidents even more emotionally salient, prior to the fourth element, which establishes actions that each farmer commits himself to, thus affecting both behaviour and motivation. These action plans are first and foremost grounded in feedback from the safety checks of each farm. The fifth element improves knowledge about what protective equipment is available and dispels myths about the cost and impracticality of such equipment.

4. Discussion

Accidents involve complicated interactions between characteristics of the individual and his environment. Many processes occurring simultaneously and with differing temporal patterns coincide at the time of impact to determine the nature and consequences of an accident. Studying these complex relations presents the researcher with many challenges. When dealing with farm accidents, the difficulties involved are even greater. This is because farms are geographically scattered over large areas, farmers most often work alone, and farm-work involves many, varied tasks that are, in many cases, seasonally determined. These practical difficulties also apply to preventive efforts, e.g. behaviour modification techniques, which have been successfully applied in other work settings (e.g. Fox et al., 1987; Sulzer-Azaroff et al., 1990), are impractical given the conditions outlined above.

The project presented here represents an attempt to deal with these difficulties, but it should also be noted that certain research advantages are also attached to studying farm-work as opposed to other types of occupational accidents.

Firstly, the random selection of a study sample for the purpose of investigating accidents can easily be achieved with farmers. This is not always the case with other occupational groups.

Secondly, when an intervention study involves an industrial plant, construction sites, hospital or office setting, it will usually be very difficult if not impossible to randomly allocate subjects to intervention and control groups. Indeed, when such settings are used and a controlled study is attempted, the term 'comparison group' rather than control group is often used, because a true control group cannot be established. Such comparison groups are typically 'similar' departments within the same organisation, other wards in the same hospital or the same type of ward from a different hospital. These comparison groups or their working conditions will always differ in important ways from the intervention group. This problem is avoided in the present study.

Finally, since farmers typically work alone, the effects of individual differences will presumably be magnified, in that the social, organisational regulation of behaviour occurring in other industrial settings will to a large extent be absent. Indeed, this may be one reason for the excessive numbers of accidents found in agriculture. This may increase our chances of finding associations between psychological factors and accidents or safety behaviour. While findings can not be generalised to non-agricultural settings, they could, as well as providing
data on farm accidents, be very useful in developing our theoretical understanding of psychosocial processes in accident causation.

References


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