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Analysis of occupational accidents with agricultural machinery in the period 2008–2010 in Austria

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ABSTRACT

The number of serious accidents at work, despite improved technology, coordinated prevention measures and better training and higher skill levels of farmers, is still very high in the Austrian agriculture and forestry. The scenarios in which people are injured are manifold. Parametric information of recognized accidents with different machines in agriculture and forestry in Austria in the years 2008–2010 was evaluated descriptively and analytically. This information included data about the accident victim, activity, accident course and cause as well as type of injury and the affected body parts by frequency and contexts. As analytical test method the chi-square test and odds ratio analysis were used. The aim was to determine the information content of parameters, in particular for the accident-causing human–machine interaction, from accident reports to derive prevention measures that meet the demand. The results showed that the information content of accident reports, because of insufficient information about the accident-causing human–machine interaction, does not suffice to derive or develop further sustainable preventive measures. Only through additional injury surveys and evaluations of accident and new machines was it possible to derive prevention measures meeting the demand according to accident course and cause.

1. Introduction

The number of serious accidents at work with some fatalities in agriculture and forestry is still very high in Austria. In the year 2013, 3,805 accidents occurred in the entire agricultural sector, 56 of them were fatal (SVB, 2013). Europe-wide, the number of fatal accidents at work in agriculture, hunting and forestry is higher than in any other sector. Only the number of fatal accidents at work in the construction industry is similarly high. Compared to agriculture, however, the number of fatal accidents in the construction industry decreases steadily (OSHA, 2012).

The accident scenarios in which people are injured are very varied in the agriculture and forestry sector. In spite of ever improving technology, coordinated prevention measures, better training and higher educational levels of farmers, the number of accidents at work is still very high. According to the ESAW statistics, the most common accidents (machine, human and animal accidents) occur by "slipping or stumbling and falling of a person", followed by "loss of control of the machine, means or transport or handling equipment, hand-held tool, object or animal" and "objects breaking, bursting, splitting, slipping, falling and collapsing" in the Austrian agriculture and forestry (SVB, 2013). For accidents with machinery between 2008 and 2010 the "loss of control of the machine, means or transport or handling equipment, hand-held tool or object", the "slipping or stumbling and falling of a person" and the "other movements of the body" were the most common causes. These statistics do not yield the relevant information about the accident-causing human–machine interaction in the technical terminology of agriculture and forestry, which is necessary to evaluate safety-related deficits (Kogler et al., 2014*).

Due to the diversity of the cultivated landscape and the high mechanization of farms (livestock, crop production, mixed farms, forestry and specialty crops) over one production year, different activities need to be performed in the Austrian agriculture. To do so, various machines and equipment are used, such as self-propelled, three-point linked, towed, stationary and hand-held machines. Because of the various machine types and design differences, the operating persons are subjected to diverse injury risks. Despite specific regulative requirements for safety design (Machinery Directive 2006/42/EC, DIN EN ISO 4254-1 and the respective machine type standard), the diverse machinery is subject to very strong signs of wear and tear in practice. In conjunction with careless maintenance and improper handling and operation, this poses a high injury risk for farmers.

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In Austria, the Social Insurance Institution of Farmers (Sozialversicherungsanstalt der Bauern (SVB, 2013) processes accident research, accident prevention, medical treatment as well as rehabilitation and compensation for farm managers, operating farm members (spouse, children, parents, brothers and sisters of farm managers), proprietors of hunting and fishing rights and other persons. The Austrian Workers Compensation Board (AUVA) processes accident prevention, medical treatment as well as rehabilitation and compensation for employed persons, students and children of pre-school age and voluntary organizations and lifesavers. Scientific research (in cooperation with other institutions) on different accident issues is constantly being carried out. The results are incorporated in accident prevention actions through professional journals, leaflets and information events (AUVA, 2012).

Databases (encoded form of accident reports), accident reports of insurance institutions, press releases from newspapers and police and hospital reports form the basis of accident research in Austria. The quality of information varies greatly and accident courses and causes as well as the accident-causing human–machine–environment interaction and the accident-causing machine part are not captured by one database in a professional sector specific way.

Due to the lack of information in the ESAW-compliant accident database, the aim of this study was to analyze the associated accident reports. The information deficits as regards the evaluated accident courses and causes were reduced by conducting additional injury surveys and evaluations of accident and new machines in order to derive and expedite prevention measures.

2. Material and methods

As the database of the descriptive and analytical accident analysis, the anonymous accident reports about recognized occupational accidents of the Social Insurance Institution of Farmers (SVB) and the Austrian Workers Compensation Board (AUVA) of the years 2008–2010 were used because they include the most accurately documented information about accident circumstances. Accidents at work are documented in accident reports more frequently and with a much higher information content than in press reports in Austria (AUVA, 2012). The data basis for the analysis were 1,927 reports about accidents with various machines and equipment in agriculture and forestry. Accident analyses are based worldwide on different databases (databases, accident, police, newspaper and hospital reports as well as local and injury surveys). In this study, accident reports were chosen because of the higher information content than in press, police and hospital reports (AUVA, 2012). A recognized occupational accident (according to ESAW methodology) is defined as a clearly defined event occurring during the work process and leading to physical or psychological damage that causes a minimum of three days' absence from work (Eurostat, 2012).

The 1,927 machine accidents were analyzed with the narrative text analysis method (Mayring, 2008) according to the identified variables (kind of machine, position of the person in the farm business, accident, task, accident course and cause, type of injury and affected body part) of the relevant text passages or tags. The variable "task" refers to the work process performed at the time of the accident. The variable "accident course" represents the exact events that led to the accident. The accident cause is defined by the exact specific reason that caused the accident. In addition, safety deficits, which are not listed in the Austrian accident reports, were derived from the available information about accident course and cause. The accident factors were classified into human, machine, environment, and the combination of these. The variable "others" includes sub variables that did not fit into any of the other categories due to low frequencies and differences.

According to Bunn et al. (2008), the narrative text analysis, which was also selected for the analysis of fatal tractor accidents in Kentucky, was chosen for the analysis of press reports. The filtered relevant text passages or keywords were entered into a spreadsheet program. The accident reports were largely completed by hand and did not contain coded information, so that the analysis was done manually and not computer-based. After entering the details of the accident reports, the categorization was carried out after existing literature (CAIR, 2012).

For the injury survey, machine-specific semi-structured questionnaires were created. The inquired contexts to clarify the lack of information about accident-causing man–machine–environment interaction were "machine, human and environmental accident factors", "aggravating and weakening factors of injury severity", "accident course", "proposals of construction changes and the integration of additional safety technologies into the machine and the operation". For the injury survey, a total of 201 (100%, 201/201) victims were interviewed according to machine category and circumstances of the accident. Additionally, existing accident machines and equipment on the farms (100%, 163/163) were evaluated as to their compliance with applicable directives and standards (same as for the evaluation of new machines) to identify any safety-related weaknesses and shortcomings as well as types and states of accident-causing machine parts.

The evaluation of new machinery (100%, 259/259) was carried out because a certain number of the accident machines corresponded to older models and safety weaknesses may even be present in new models. An evaluation questionnaire included the accident-relevant machine parts identified and divided according to accident scenarios, machine size, category, brand and type in relation to the applicable safety requirements of Machinery Directive 2006/42/EC, DIN EN ISO 4254-1 and the respective machine type standard. The information derived from the completed injury survey and machine evaluations was entered into the spreadsheet program Microsoft Excel, categorized and described in Word®.

The statistics program SAS 9.2® was used for the descriptive and analytical evaluation of the parameters of the accident reports. The chi-square test was used as the statistical method for testing significant correlations (contingencies) of qualitative (discrete) features. This statistical method had previously been used by Javadi and Rostami (2007), Linderoos et al. (2008) and Tsioras et al. (2012) for the analysis of machinery accidents in agriculture and forestry. The results were presented in cross tables.

As another method for statistical analysis, an Odds Ratio analysis, which represents a measure of the relationships of two features, was applied. Because of its very good interpretability, it is a preferred method in medical and accident statistics. Since its significance applies to only two features, it is used in combination with logistic regression to handle multivariate problems. It provides a sound mathematical foundation that helps to find the optimum dimension of attributes (variables), to explain an excellent and desired feature through other characteristics that need to be examined and to be able to neglect redundant ones (keyword: backward selection) (Weiß and Razany, 2008). In the model the variable injury severity was compared with personal-, accident-place- (workplace) accident-course and cause- as well as the affected body-part-specific parameters simultaneously and then gradually irrelevant parameters were removed. Only the significant statistical results of the Odds Ratio and the Chi-square test were described closer in the following sections.

The classification of the injury type according to severity (light and severe) was performed after Kanz et al., 2002. Light injuries included wounds and superficial injuries, dislocations, sprains and fractures, while severe injuries included burns, scalds, frostbites, poisoning, infections and amputations, injuries caused by