Tractor safety and related injuries in Iranian farms

Ehsan Houshyar[a,*], Moslem Houshyar[b]

[a] Department of Mechanical Engineering of Biosystems, College of Agriculture, Jahrom University, PO BOX 74135-111, Jahrom, Iran
[b] Department of Mechanical Engineering, College of Engineering, Urmia University of Technology, Urmia, Iran

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ABSTRACT

Background: Several thousand worker injuries and fatalities worldwide per year is the consequence of agricultural activities especially working with farm tractors. The aim of this study was to determine current levels of farm tractors drivers' safety attitudes in Iranian agriculture besides type and severity of tractor-related injuries.
Method: Socio-demographic properties of a sample of 281 tractor drivers and their injuries were investigated using face to face interview. The severity of injuries were also determined. The drivers' attitudes toward safety issues were analyzed by exploratory factor analysis.
Results: The results revealed that drivers aged 30–45 years had higher rates of injuries. Most of injuries were moderate (41%) occurring due mainly to oily surfaces on the tractor or implements, carelessness or fatigue during the work. The low-income group had also higher injuries since the drivers in this group work with no regular work-rest schedule and they usually work with old tractors equipped with unsafe facilities. Those that do comply with safety measures are likely to have fewer exposures to unsafe work practices and consequence injuries. Further education of tractors drivers in various aspects of farm safety besides enforced regulations to adjust safety issues are the possible approaches to prevent tractor-related injuries.

1. Introduction

Farm tractors are the most commonly sources of power on farms. Unlike other agricultural machines that have specific and seasonal use, it is used as a prime mover with all kinds of mounted, semi-mounted and trailed equipment throughout the year. The use of the tractor is not merely confined to farms, but it is also used as the main mode of transportation in rural areas. Tractors are also used for stationary application; taking power from power-take-off (PTO) shafts for threshing operations and water lifting pumps. However, safety problems associated with the use of machinery consistently arise as modern farming technologies advance. Tractors are acknowledged as a primary cause of agricultural work-related fatalities in many industrialized countries (Sanderson et al., 2006; Franklin et al., 2000).

Many researchers have reported that the rate of occupational accidents occurring in agricultural sector is greater than that in industrial sector (Irwin and Poots, 2015; Prasanna Kumar and Dewangan, 2009). According to the 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" (Hagel et al., 2016). One of the most common mechanisms of

death is the tractor turn over, accounting for higher than 50% of tractor deaths (Franklin et al., 2000). Farm men, women and children become caught in the moving parts of machinery (Kepner et al., 1972). Farm safety has been a formalized concern of safety and health professionals since at least 1937, when the National Safety Council organized a separate farm safety program during its National Safety Congress (Burke, 1987). The man who operates modern farm equipment must make many decisions and perform suitable functions to use the machines properly (Ericson, 2010).

Agriculture in Iran is mechanizing very rapidly. Agriculture is one of the most hazardous activities in economic sector of the country, in relation both to injuries at the workplace and occupational diseases. Tractors and hand tractors are being used in various operations like tillage, paddling, plant protection, water pumping, harvesting and threshing. Nonetheless, tractors and farm machines have been associated with more fatal injuries than any other piece of agricultural equipment in the country. It is confirmed that careless driving and driving with tiredness are two main reasons of the public road accidents. In spite of ever improving technology, better training and higher educational levels of farmers, the number of accidents at work is still very high. Although, tractors and farm machines cause a lot of injuries in the country, no study has yet been done to determine the reasons of such fatal injuries. With the correct estimation of drivers' safety

attitudes, suitable safety regulations can be approved and safety problems can be lessened appropriately. Therefore, this study has three main goals to investigate:

1 – The first goal was to investigate into the socio-demographic and injuries characteristics of tractors' drivers. Different questionnaires were used to gather information related to the personal characteristics of operators considering social and economic points of view besides their tractor-related injuries.

2 – The second goal was to assess the severity of injuries. The Abbreviated Injury Scale (AIS) provided by the Association for the Advancement of Automotive Medicine (1990) was used to classify severity of injuries.

3 – The third goal was to evaluate tractors drivers' attitudes toward safety issues. Factor analysis method was applied to find most important factors related to the safety issues that were known by operators.

Findings from this study may provide a primary solution to prevent tractor related accidents and injuries developments in public and rural roads.

2. Material and methods

2.1. Data collection

The survey was conducted as an interview amongst drivers running large, medium and small-size tractor holdings in Fars province (central Iran).

Most of farmers have a tractor in their own farms and do not work with tractors extensively. Thus, all the drivers who have tractors and work for other farmers were the selected respondents of the study. Accordingly, the population of the study was 281 tractor's drivers aged 18–60. Each tractor's operator was visited by one evaluator and all data were recorded in specific questionnaires.

A total of five similar evaluator (education, age and sex) were contributed to the data collection. The data for a period of 10 years, i.e., from the year 2006 to 2016 were collected. 10 years was chosen since there were not determined information from tractors' drivers for longer period of time. Two questionnaire were used at this step: all the personal information (age, experience, income, etc.) was collected from the first questionnaire. The questions related to the type, time and place of injuries and medical treatments were included in the second questionnaire. The questionnaires for gathering drivers' socio-demographic and injuries characteristics were included 11 open questions.

During the 2 h meetings, it was observed that some drivers show reluctance in providing information about the agricultural accidents probably to avoid any legal complications. Thus, all the questionnaires were filled anonymously.

The validity and reliability of the questionnaires as the survey instruments were determined. A panel of 23 experts in the agriculture and industrial safety participated to check the validity of the questionnaires. The reliability of the questionnaires was assessed using Cronbach's alpha coefficient which reached 0.78–0.79 after several revisions of the questionnaires showing that the developed questionnaires are highly reliable. Nunnaly (1978) stated that 0.70 or higher to be an acceptable reliability coefficient.

The questionnaires for factor analysis included 21 questions related to safety issues (see questions in Table 2). The questions were included in the questionnaire according to ideas of 23 experts in the agriculture and industrial safety. The experts have believed that they included important safety issues in the questionnaire considering regulations by Health and Safety Executive (HSE). Using local experts were essential since it was important to ask questions in such way that drivers understand them well. In addition no similar study were found in literature review focusing on the investigation into drivers' attitudes by

application of factor analysis.

The drivers were asked to indicate their agreement on each question with a statement on a five-point Likert scale (Likert, 1961) in which one, two, three, four and five were considered as "very low" "low", "medium", "high" and "very high" agreements, respectively. This method was chosen since the objective was the assessment of drivers' attitudes toward safety issues using factor analysis (see Section 2.3).

2.2. Injury type and severity

Since most tractor-related injuries were on farms (88%) and few on rural roads (12%), the classification were based on the types and severity of injuries, not place of accidents. All the tractor-related injuries were further categorized into various types of injuries, i.e. caught/pinched/cut, collision, rollover, run over and fall/slip/other. The details of the victim, i.e. age, driving experience, education, participating in driving classes and net income were analyzed to study the distribution of injuries across various groups. The information related to type of injury was collected through face-to-face interviews because no accessible medical reports especially for previous years were available. Then, to describe the severity of injuries, the Abbreviated Injury Scale (AIS) provided by the Association for the Advancement of Automotive Medicine (1990) was used. The scales are: 1 minor, 2 moderate, 3 serious, 4 severe, 5 critical and 6 unsurvivable. The injuries that resulted in permanent disability were considered as severe injuries, while serious injuries are those that necessitated major hospitalization. The moderate injuries required professional treatment. The minor injuries mostly involved bruise or contusion, crushing, sprain or strain and burn. If these types of minor injuries needs "professional treatment", it was considered as moderate injury in our analysis. Since non-fetal tractor-related injuries were under consideration, we had no critical and unsurvivable injuries.

2.3. Factor analysis

Exploratory factor analysis (EFA) was used to identify factors underlying tractors drivers' perceptions of safety issues. EFA was conducted using SPSS 21. It was considered that at least two variables with a loading score of 0.4 should be in an extracted factor. Furthermore, the factors should have an eigenvalue of 1 or greater to be able to explain the observed variance (Floyd and Widaman, 1995).

We used a varimax rotation method as an orthogonal rotation option. Varimax rotates the axes to find the minimum number of variables that have high loading on a factor. For every variable in each factor, a factor loading score was calculated that indicates the correlations amongst each of the variables included in each factor. Generally, a factor loading score of 0.30–0.40 is considered significant (Samanic et al., 2005). However, the loading factor of each variable (question) was greater than 0.5 in this study. In other words, we have no dropped questions from the study.

3. Results and discussion

3.1. Drivers' socio-demographic and injuries characteristics

The result revealed 586 nonfatal tractor injuries during last 10 years (Table 1). The majority of injuries occurred in adults aged 30–45 years (66%) with adults aged 18–30 years accounting for 16% of injuries and those 45–60 years accounting for 18%. The proportion of injuries to drivers in adults aged 30–45 years was twice of that of other age groups. Driving experience below 10 years and above 20 years had similar impacts on the reduction of injuries while drivers experienced 10–20 years accounting for 36% of injuries. Driving experience with tractors is important since this machine is both demanding to operate and inconspicuous, especially at night. The proportion of injuries to drivers displayed that level of education had no impacts on the magnitude of