

## **Dynamics of work accidents incidence by severity, gender and lost workdays in Estonian agricultural sector and sub-sectors in 2008–2017**

A. Enn\* and E. Merisalu

Estonian University of Life Sciences, Institute of Technology, Fr.R. Kreutzwaldi 56, EE51006 Tartu, Estonia

\*Correspondence: [anni.enn@student.emu.ee](mailto:anni.enn@student.emu.ee)

**Abstract.** The risk of dying in a work-related accident is greatest for those employed in agricultural sector. The aim of this study is to analyse the dynamics of work accidents (WA) incidence by severity, gender and lost workdays in Estonian agriculture in 2008–2017. **Method:** The database of accidents in agriculture (2008–2017) was obtained from the Estonian Labour Inspectorate (ELI). Work accidents statistics is based on official reports of employers. **Results:** In total 1,683 non-fatal work accidents (NFA) was registered in the past decade, from which 1,235 (79.3%) were minor and 448 (20.7%) severe. In total 13 fatal work accidents (FA) have occurred, which accounts 0.8% of all the WAs ( $n = 1,696$ ). Although the trends of minor and severe WA cases showed steady increase, the number of FA has remained low. A major part WAs (74%) was registered in farming and horticulture, with prevalence of minor accidents. A severe WA is likely to occur in forestry or very likely in fishery. The proportion of injured male and female was 51.8% and 48.2%, accordingly. In the farming and horticulture sector there were more accidents among women – of all the minor accidents ( $n = 1,235$ ) 52.1% occurred to women. Of all the severe WAs ( $n = 448$ ) 61.2% and all the fatal work accidents happened to male workers. About 2/3 of severe WAs caused sick leave 31–90 days and more. **Conclusion:** The number of WAs in Estonian agricultural sector show steady increase in the past decade. A major part of accidents is minor and mostly occurred in farming and horticulture, and more often with females. Severe and FAs more often occurred in forestry and fishery. Mostly the severe WAs cause long sick leave – a month or more. When to increase work accidents severity level by one step (from minor to severe), the sick leave is increasing significantly.

**Key words:** agriculture, injury, gender, occupational accident, severity, sick leave, work-related.

### **INTRODUCTION**

Agriculture has traditionally been one of the most hazardous occupations for workers (Frank et al., 2004). An estimated 1.3 billion workers are engaged in agricultural production worldwide. This represents half of the total world labour force, and almost 60% of them are in developing countries (International..., 2011). Agricultural injuries are reported from all around the globe (Pickett et al., 1999; Myers et al., 2009; Yiha et al., 2010). The risk of dying in a work-related accident is greatest for those employed in agricultural sector (Thelin, 2002).

About 500 people die per year while working in agriculture, including about 100 in forestry. Moreover, there are about 150,000 reported non-fatal accidents at work in the EU agriculture, forestry and fishing sector incidence rates (IR) are generally higher than in other sectors (Thomson, 2016). For example, in 2015 the average IR of NFAs in EU-28 was 1,513 (NFAs reported in the framework of ESAW are accidents that imply at least four full calendar days of absence, they are serious accidents). If to compare economic sectors with each other, there are three sectors where the IR is higher than in agriculture (IR 1,894) – construction (IR 2,852), transportation and storage (IR 2,461) and administrative and support service activities (IR 2,274), while in all the other sectors remain lower with their IR. Even in the mining and quarrying sector the IR of NFA was 1,257 and in manufacturing sector the IR was 1,869. Moreover, on-farm accidents happen to a very wide range of ages, from the very young to the relatively old (Thomson, 2016). According to Eurostat serious problems actually lay in the ages under 25 (Non-fatal..., 2019) and also ages over 65 (Burholt & Dobbs 2012).

It is important that agricultural workers acknowledge the risks in different sub-sectors and activities. A study in Italy concluded that about 11% of agricultural workers do not consider their occupation dangerous, but in the same time they clearly perceive accident risks that cause serious injuries and long time sick leave, but not those risks that cause illness (Antonucci et al., 2012). A clear correlation was found between the attitudes of people who had received occupational safety and health (OSH) training – they considered their work more dangerous than those who had not been trained. It was also found in this study that some workers were very negatively minded of the hazards of the work environment, especially older workers who had not been trained in occupational safety. This suggests that such a critical socio-cultural attitude is difficult to change because it is an integral part of the attitudes and behavior of these employees (L'abbate et al., 2010). The second type of problem is the employees who have been trained but still do not behave as they have been taught (Stoneman et al., 2014). Changing these attitudes requires experts to be prepared to provide training that will help change attitudes from the grassroots level. However, these trainings should not be in the classical sense of training, which are often static and one-way communication from the teacher to the learner. Rather, training should be like a training program that gives the employee practical experience and develop decision-making skills (Marino et al., 2010; Cecchini et al., 2018). An emerging issue in developed country agriculture is the raising migrant working population and the difficulties in communicating during OSH mandatory training. Even though it is an issue in many European countries and also in USA but Baltic countries do not have so much migrants.

In general, WA statistics focus on non-fatal (NFA) and fatal work accidents (FAs), Eurostat has taken into account sick leave more than 3 working days due to WA. In terms of injury severity WAs are divided into three groups in Estonia: minor, severe and fatal. In other countries WAs are often divided into four or even more groups. FA are often analyzed separately from NFA. According to Estonian' Occupational Health and Safety Act 'an occupational accident which resulted in serious bodily injury to an employee or due to which an employee's life is endangered is classified as a serious occupational accident. These injuries and conditions are determined in 'Severe injury determination guide' (OHSA, 1999).

In general, if an occupational accident occurs, the employer will carry out an investigation which will establish the circumstances of the WA. The employer will

submit a report on the investigation results to the victim and the local office of the Labour Inspectorate. The report shall indicate the measures that have to be implemented by the employer to prevent a similar occupational accidents (Occupational..., 1999).

In a retrospective analysis that was made in Poland 3,791 adult patients with agriculture and forestry related injuries were analysed. 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 and the results were: slight ( $ISS \leq 3$ ) – 77.6%, moderate ( $4 \leq ISS \leq 8$ ) – 16.9% and severe ( $ISS \geq 9$ ) – 5.5% (Nogalski et al., 2007).

The previous studies show that in the agricultural sector there are usually more male workers and they therefore make more WAs (Solomon et al., 2007; Lower & Mitchell, 2017; Scott et al., 2017). But often the problem lies in female to whom a bigger part of accidents have happened compared to the percentage of female employees in this sector. In the study made in two states of USA from 2008 to 2010 women constituted 39.5% in Maine and 47.8% in New Hampshire of all agricultural NFA injuries ( $p = 0.0002$ ). For these two states combined, almost half (43.8%) of those sustaining an agricultural injury were women. This percentage is significantly higher than the overall percentage of women (27.4%) in the agricultural workforce in these two states ( $p < 0.0001$ ) (Scott et al., 2017).

In New South Wales in Australia between January of 2010 and June of 2014 a retrospective epidemiological examination was conducted of linked injury hospitalisation and mortality records. This study identified a total of 6,270 farm-related hospitalised injuries. These injuries involved a higher proportion of males (78.2%) than females (21.8%). Also, a higher proportion of males were injured during work activities compared to females (Lower & Mitchell, 2017).

On the other hand, a survey of NFA was carried out in British agriculture. This survey was restricted only to men for reasons of statistical efficiency, because the prevalence of paid work in agriculture is much higher in men than in women. Their findings cannot necessarily be extrapolated to female agricultural workers, whose occupational activities may differ substantially from those of their male counterparts. One of the most important results was that risks are particularly high in those who undertake forestry (Solomon et al., 2007).

Although NFA happen more with women compared to percentages of female employees, male workers are at higher risk of FAs. In the study in New Zealand in 1985–1994, from 159 cases of FA only 4.4% were female (Horsburgh et al., 2001).

The number of days where a NFA victim is unfit for work provides an indication on the severity of the injury (European..., 2008). According to the EU Labour Force Survey (Thomson 2016) in 2005, the average duration of absence from work (if over 3 days) was 43 days, compared to an all-sector figure of 35 days (32 in 1995), with only a few sectors (for example private household employment 53 days) having higher figures.

The aim of this study is to analyse the trends of WAs incidence by severity and gender in Estonian agriculture and its' sub-sectors (crop and animal production (CAP), forestry and fishery) in 2008–2017.

## METHOD

The database of accidents in agriculture (2008–2017) was obtained from the Estonian Labour Inspectorate (ELI). WA statistics are based on official reports of

employers. Also, ELI investigates all lethal and a few severe WAs. Dynamics and trends of WAs including injury severity, gender and lost workdays are analysed in the present study. Injury severity is assessed by the doctor, who determines the injury severity by the 'Severe injury determination guide'.

An accident at work is defined as 'a discrete occurrence in the course of work which leads to physical or mental harm'. The data include only fatal and non-fatal accidents involving more than 3 calendar days of absence from work. If the accident does not lead to the death of the victim, it is called a 'non-fatal' (or 'serious') accident. A fatal accident at work is defined as an accident which leads to the death of a victim within one year of the accident (Accidents..., 2017).

General statistics has described as total numbers and incidence rate. The incidence rate indicates the relative importance of non-fatal or fatal accidents at work in the working population. Eurostat methodics includes NFA involving more than 3 calendar days of absence from work (Accidents..., 2017).

ELI registered all work accidents, including 0–3 days of absence, until the year 2018. The sample group consisted in 879 male and 817 female workers, in age 17–70 years. The length of work experience was 0–47 years. 62.9% of victims of WAs worked in micro- and small enterprises, 33.4% in medium and 3.7% in other. The results analysis was done using the Statistical Package for Social Sciences (SPSS25.0) and MS Excel software.

## RESULTS

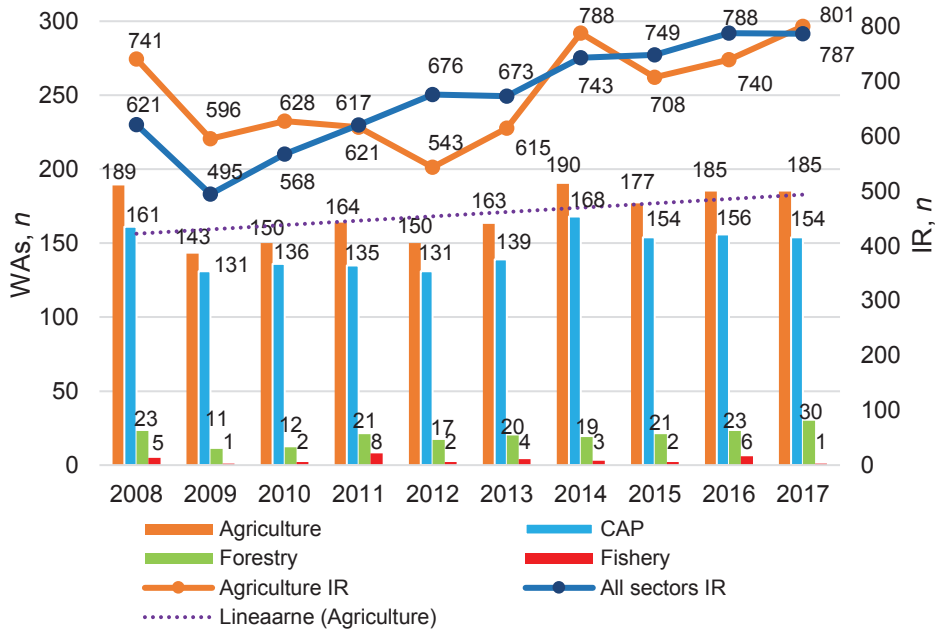
Estonian agricultural sector is divided into three sub-sectors: CAP (including hunting and service activities), forestry and fishery (including aquaculture). Based on the database 2008–2017, we can see, that 1,696 accidents were registered in the Estonian agricultural sector in the last decade. It constitutes 4% of all WAs registered in that period in Estonia ( $n = 42,049$ ).

The highest WA rate 838 per 100,000 employees has shown in the CAP, where 1,465 people got injured, i.e. 86.4% of all activities in agricultural sector. In the forestry sector 197 (11.6%) and in fishery sector 34 (2.0%) employees were injured. The average incidence rate in past ten years was 308 in forestry and 300 per 100,000 employees in fishery.

The total number and incidence rate of WA in the agricultural sector have steadily been increasing over the past decade. Supposedly it is because employers and employees get more aware of the importance of registering the WA. And even if the total number of employees is decreasing, workers report more accidents. This also mean that in the past there has been underreporting of WAs. Compared to the total number of WA in all sectors of the economy, growth is modest. The main reasons of WAs are in Estonian agriculture are loss of control over an animal (usually cattle), falling and slipping, thirdly an attack of an animal.

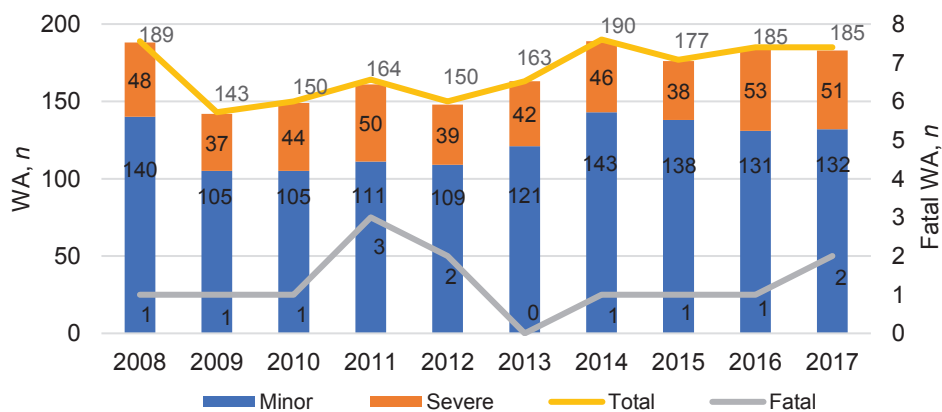
In Fig. 1 we can see the dynamics of incidence rate in increase during the years in both agricultural and all economic sectors. If the incidence rate of occupational accidents in all economic sectors in 2009 was the lowest in the last decade ( $n = 495$ ), then it was increased to the highest level of the decade ( $n = 788$ ) by 2016 and it remained virtually unchanged in 2017 ( $n = 787$ ) (Fig. 1.) The lowest WA rate in the agricultural sector was in 2012 – 543, and the highest in 2017 – 801 accidents per 100,000 employees. In

2008–2017, the average WA rate (per 100,000 employees) in agricultural sector was higher than in all areas of economy in total ( $678 \pm \text{SD } 88.9$  and  $672 \pm \text{SD } 97.4$  accordingly).



**Figure 1.** Dynamics of accidents at work in Estonian agriculture in 2008–2017 (absolute numbers and incidence rate per 100,000 employees).

In the past decade 1,683 NFA accidents have registered, from which 1,235 (79.3%) were minor and 448 (20.7%) severe. There were 13 FA, it counts 0.8% of all the WAs ( $n = 1,696$ ). The dynamics of minor, severe and fatal accidents in the agricultural sector over the past decade is shown in Fig. 2.



**Figure 2.** The dynamics by severity of WAs in agricultural sector in 2008–2017.

Fig. 2 describe the total numbers of WAs (minor, severe, fatal) in Estonian agricultural sector. We can see that there has been an increase in minor and severe WAs in the past decade, whereas the number of fatal accidents has remained low.

**Table 1.** Work accidents by severity – minor (M), severe (S) and fatal (F) in agriculture and it's sub-sectors

Year	Crop and animal production				Forestry				Fishery				Agriculture all together			
	M	S	F	Total	M	S	F	Total	M	S	F	Total	M	S	F	Total
2008	123	37	1	161	14	9	0	23	3	2	0	5	140	48	1	189
2009	96	34	1	131	8	3	0	11	1	0	0	1	105	37	1	143
2010	93	42	1	136	10	2	0	12	2	0	0	2	105	44	1	150
2011	94	38	3	135	13	8	0	21	4	4	0	8	111	50	3	164
2012	98	33	0	131	11	4	2	17	0	2	0	2	109	39	2	150
2013	103	36	0	139	15	5	0	20	3	1	0	4	121	42	0	163
2014	133	34	1	168	10	9	0	19	0	3	0	3	143	46	1	190
2015	124	30	0	154	12	8	1	21	2	0	0	2	138	38	1	177
2016	110	46	0	156	18	4	1	23	3	3	0	6	131	53	1	185
2017	114	38	2	154	18	12	0	30	0	1	0	1	132	51	2	185
Total	1,088	368	9	1,465	129	64	4	197	18	16	0	34	1,235	448	13	1,696

Table 1 show that the most part of WAs (minor, severe and fatal) take place in the CAP – 1,465 (86.4%) employees have incurred into the accidents in this sub-sector. In forestry 197 (11.6%) and in fishery 34 (2.0%) employees have incurred into the accidents. The reason why CAP takes such a big part is due to the biggest part of employees who are working in this sub-sector. There are 69.9% of all the agricultural employees working in CAP, 25.7% in forestry and 4.4% in fishery sub-sector. But even if there are so much CAP workers, the portion they take from WAs is still too big. Therefore, we have to say, that CAP is the most dangerous sub-sector of agriculture in Estonia.

Of all the WAs ( $n = 1,696$ ) the biggest part of minor accidents ( $n = 1,088$ ; 88.1%) has taken place in CAP, 10.4% ( $n = 129$ ) in forestry and 1.5% ( $n = 18$ ) in fishery. Among the severe WAs, the distribution is as follows – 82.1% occurred in CAP, 14.3% in forestry and 13.6% in fishery. From all the FAs 69.2% ( $n = 13$ ) have occurred in CAP and 30.8% in forestry.

Excluding for a moment all the FAs the ratio of the distribution of severity – minor WAs vs severe WAs, will be as follows – CAP 3:1 (74.3% and 25.1%), forestry 2:1 (65.5% and 32.5%) and in fishery almost 1:1 (52.9% and 47.1%). Compared to all economic sectors, where 79.0% of WAs were minor and 20.5% were severe, we can verify that in agriculture severe WAs occur more often. A particularly high probability (about 50%) for serious WA has detected in the fishery sector, however, no FAs have registered in this sub-sector.

The proportion of men and women who have been affected by WAs in the total sample was 51.8% M vs 48.2% F. In the CAP sub-sector there were more accidents among women (54.2% F vs 45.8% M) ( $p = 0.0001$ ). According to Estonian Statistics female employees make 36.2% of all the employees in the CAP labour market (vs 63.8% M), which means that women make large poportion of WAs. In Estonia a big part of agriculture makes animal production and in this area, there are a lot of female workers, with whom WAs happen. In forestry sub-sector men make more WAs – 89.3% M vs



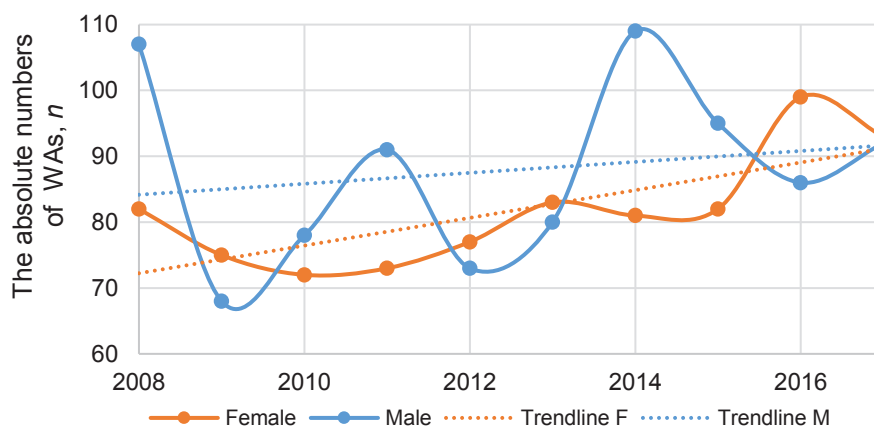
10.7% F ( $p = 0.0001$ ). In fishery sector 94.1% of WAs have reported by the male employees. If in the CAP there were more female employees with whom WA happend but lower employment percentage compared to male workers, then in forestry and fishery it is vice versa. In forestry 12.5% and in fishery 13.6% of employees were female, accordingly.

In the forestry sub-sector 176 men and 21 women were injured in the past decade. The dynamics of WA incidence rate among the men showed steady increase in the observation period – there were injured 10 men in 2009 and 27 in 2017. In fishery 32 men and 2 women were injured. According to the ELI statistics there are 63.7% of WAs that happened to male employees in all economic sectors in Estonia. In the EU countries the number is 68.7% – therefore the incidence among men in forestry and fishery is enormously higher than in Estonia in general or also other EU countries.

When to compare minor, severe and fatal WAs among female and male employees, the results show that minor WAs happened more often to female workers. More than half (52.1%) of all the minor accidents ( $n = 1,235$ ) were registered among women. Inversely, about two thirds (61.2%) of all the severe WAs ( $n = 448$ ) and all (100%) the FAs ( $n = 13$ ) have happened to male workers.

The dynamics of WAs in agricultural sector show three sharp increases of absolute numbers among the men in 2008, 2011 and 2014, and a sharp grow of female part in 2016, with overlapping F and M trendlines in 2017 (Fig. 3).

In Fig. 3 we can see that in some years female workers have reported more WAs than male with the highest number of cases ( $n = 99$ ), and *vice versa*. At the same time WAs numbers are fluctuating quite rapidly among the men, showing the highest score ( $n = 109$ ) in 2014.



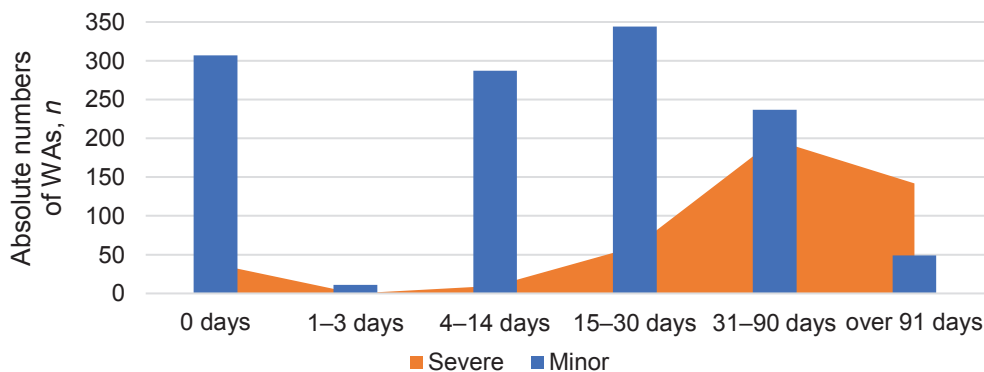
**Figure 3.** The dynamics and trendlines of WAs among female and male workers in the agricultural sector in 2008–2017.

From total of 179 FAs occurred in Estonia in 2008–2017 only 13 were registered in the agricultural sector, *i.e.* 7.3% of all FAs. Comparing this result with the EU – FAs accounted for 14.3% of the EU-28 in the agricultural sector, the share of FAs in Estonian agriculture is almost two times lower. Albeit, it can be confirmed that the prevalence of FAs in agriculture is twice as high as in all economic sectors in Estonia. When FAs

consists in 0.4% of total WAs in entire Estonian economic sector, in agricultural sector it was 0.8% – in the CAP 0.6% and in forestry 2.0%. It means that in forestry there is in average 5 times higher FA risk than in a whole economic sector in Estonia. To compare this number with EU-28, we can see that in 2015 FAs accounted for 0.2% or less of workplace accidents in most activities, but agricultural sector accounted 0.3%, being on the second place (after mining and quarrying with 0.7% of FAs).

Usually, when a WA has happened, the injured employee take sick leave, although our results show that 20.4% of all the WAs recorded in Estonian agriculture, the injured employee doesn't miss any working days ( $n = 345$ ). Only 0.6% of victims have lost one to three working days. The reason is most likely wrong understanding related to the sickness benefits in Estonia. In case of injury arising from WA, the sickness benefit is paid at the rate of 100% from the 2<sup>nd</sup> day of release from work by the Health Insurance Fund in Estonia. But due to many WAs victims believe they are being funded like with the regular sick leave, they are trying to continue working after WA. The regular sick leave is as followed: in the first three days after sickness an employee does not receive benefit for health damage, in the fourth to eighth day, the benefit is paid by an employer; and from the ninth day and onwards the Health Insurance Fund pays it. The benefit is paid at the rate of 70% of the daily income.

In the Fig. 4 we can see that the biggest sick leave group is 31 to 90 days of absence with 25.6% of all the lost workdays, In this group 54.5% ( $n = 237$ ) were minor and 45.5% ( $n = 198$ ) were severe WAs. The second group is 15 to 30 days with 23.8%, from which major part – 85.1% minor and 14.9% severe WAs. The mean of all the sick leaves is 35.5 days when counted all sick leaves and 36.0 when counted sick leaves over 3 days. In Estonian agriculture all together the employees were 60,228 days absent from work due to WAs.

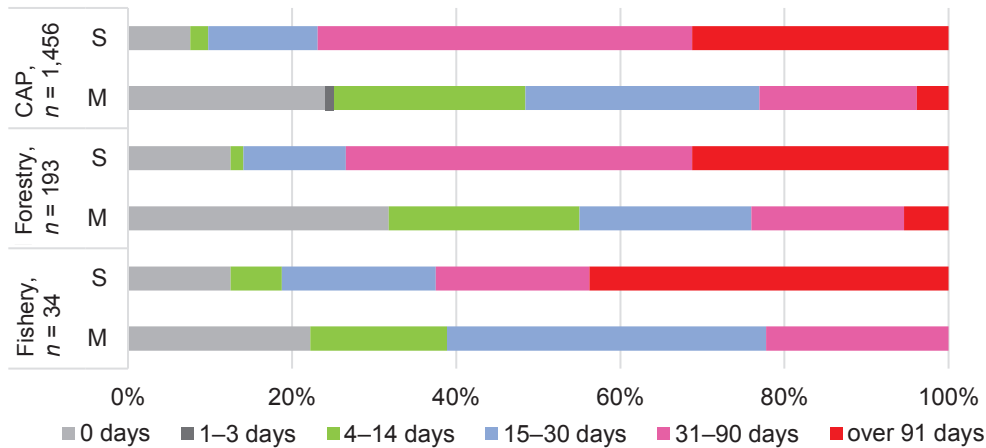


**Figure 4.** The absolute numbers of agricultural workers lost workdays by severity in Estonian agriculture.

Analysing sick leave by agricultural sub-sectors and severity of injury, we can see, that about 2/3 of severe WAs take more than one month and longer sick leave in all the sub-sectors. In the CAP, where in total 1,456 NFAs were registered in the past decade, the biggest sick leave group for severe WAs was 31 to 90 days of absence with 40%, the second group was 91 and more days with 31%. In the forestry, from the total of 193 NFAs, the percentages for more than 30 days and over 90 days of work absence for



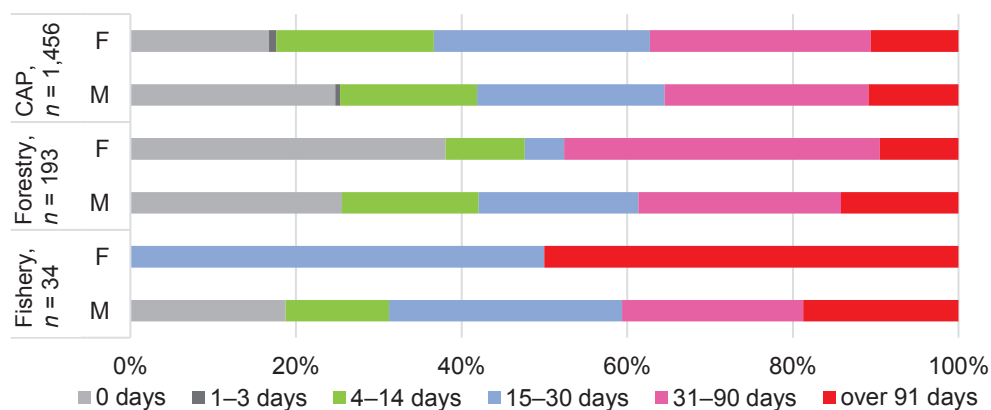
severe WAs were quite similar to CAP. In the fishery, from the 34 of NFA cases, sick leave for severe WAs showed the similar picture. In all the sub-sectors, sick leave for minor WAs took most often 4 to 30 days.



**Figure 5.** The shares of duration of lost workdays by severity (S – severe WAs, M – minor WAs) in the agricultural sub-sectors.

In the Fig. 5 it is shown that in the fishing sector there are much more severe WAs that cause an employee to take more than 90 days of sick leave – over 40% of all the severe WAs, while in the other two sectors the rate is lower. If to consider all the minor WAs, about 40% of sick leaves are less than two weeks of absence in fishery while in the other sectors it is about 50% or more.

We conducted a Poisson regression analysis which showed that when WA severity level is increasing by one step (from minor to severe), the days of sick leave are increasing 2.3 times. This formula does not work in cases of lost work days in accidents with lethal outcome, because no sick leave days are registered when fatal accident occurs, in spite sick leave can take days, months or even a year before death.



**Figure 6.** The shares of lost workdays by gender (F – female, M – male) in the agricultural sub-sectors in the past decade.

When to compare sick leave due to WA by gender, we can see that in general women make more minor WAs and they take longer sick leave, especially in fishery (Fig. 6). Men make more severe accidents, but often without taking sick leave. In Estonian agriculture sector all the FAs happened to male employees.

In the CAP sector there are more male employees who have never taken any sick leave days, when to compare with female employees. But in every other sick leave duration periods female employees outweigh male. In forestry there are much more female workers that have not reported sick leave compared to male. Approximately 40% of forestry and fishery male workers have taken sick leave that is longer than one month.

## DISCUSSION

The risk of dying in a WA is greatest for those employed in agricultural sector. According to the EU Labour Force Survey, about 150,000 non-fatal and about 500 fatal WAs have reported in agriculture. Moreover, in the EU agricultural sector the WA incidence rates are generally higher than in other economic sectors (Thomson, 2016).

Similarly to EU statistics the prevalence of WAs in Estonian agricultural sector, in the past decade, is higher than in all economic sectors in total and in Estonia it shows a steady upward trend – there has been an increase in both minor and severe WAs. We can stress here, that severe WAs most often occur in agriculture, compared to all economic sectors in Estonia. In the fishery sector a probability for a serious accidents is particularly high, although the number of fatal accidents here has remained low. Due to the fact that in Estonia WAs by severity are divided into three groups (minor, severe and fatal) and the fact that all WAs are counted, not just the ones with 4 or more sick leave days, the comparison of WAs by severity and by the countries is not always correct.

From the Eurostat database we can compare the total numbers and the incidence rates of NFA and FA in EU countries agricultural sector and also in all economic sectors. In NFAs a particularly large increase in incidence rate was for agricultural sector comparing the years 2010 and 2016 (incidence rate in 2010 was 1,293 and in 2016 was 2,011). In Estonia there was a slight decrease in NFAs according to Eurostat in the same period of time (from 1,716 to 1,594), just like Ireland (from 1,160 to 1,035) and Sweden (from 693 to 549). These numbers show that Estonian NFAs incidence rate (IR 1,716) that was much higher than the EU average (IR 1,293) in 2010, has fallen and it was much lower in 2016 (IR 1,594). But if to compare Estonian WA statistics with many other countries, our incidence rates are still high (Non-fatal..., 2017).

Large increase in NFA was in Belgium (from 583 to 1,786), Spain (from 1,903 to 4,283), Latvia (from 85 to 314), Netherland (from 119 to 418), Portugal (from 961 to 1,819) and Finland (from 896 to 3,599) (Non-fatal..., 2017).

In Estonia, FA in agriculture accounted for more than one tenth of all FAs (14.3% in past ten years). In 2015, in EU-28, the incidence of FAs in agriculture was 5.7 per 100,000 persons employed – it is the fourth in line in the most dangerous sectors in the EU. In the period 2010–2016 the FA rate increased from 4.6 to 6.1 in agricultural sector, whereas a decrease of both NFA as FA took place in most activities in the observed period. According to Eurostat the incidence rate of FAs in Estonia in the period 2010–2016 has remained the same – 5.6. The numbers have decreased in Germany (from 2.7 to 2.3), Bulgaria (from 11.4 to 2.3), Italy (from 11 to 8.6), Slovakia (from 4.2 to 3.5),

Sweden (from 8.3 to 6.4) and United Kingdom (from 10.9 to 8.2). The incidence rate has largely increased in Denmark (from 8.2 to 15.8), Spain (from 2.3 to 7), France (from 0.4 to 14.4), Latvia (from 15.2 to 32.9) and Norway (from 8.1 to 24.3). Note that for some EU Member States some of these changes may be linked to changes in coverage of specific activities linked to the end of derogations or voluntary data collection. From these numbers we can allege, that as well as NFAs, also FAs incidence rates in Estonia are often smaller than in many other EU countries but it could be deceptive because in the last 20 to 30 years Estonian agricultural sector has dried up but the incidence rates seem to grow over time not decrease. There could be many reasons for that, for example the lack of knowledges, low risk perception and low safety culture in general in this sector. The under reporting of WA is apparent due to self-employed farmers have no duty to report WA and even their injuries are not compensated, because lack of Insurance Act on WA and occupational diseases in Estonia (Enn, 2018; Fatal..., 2019).

In the agricultural sector there are usually more male workers and based on research articles male workers therefore make more WAs (Solomon et al., 2007; Lower & Mitchell, 2017; Scott et al., 2017). And it is like that in Estonia. But in some countries (Denmark, Ireland, Estonia) female workers are making a bigger part of accidents if comparing the percentages of male and female employees (Non-fatal ..., 2017). In absolute numbers there are more male employees with whom WAs happened but in the CAP sector WA numbers show increase among female workers, taking almost half of all WAs in Estonian agriculture. The same trend is in characteristics among male workers in forestry and fishery (Enn, 2018).

Comparing minor, severe and fatal WAs among female and male employees the results show that minor WAs happened more often to female workers. Inversely about two thirds of all the severe WAs and all the FAs have happened to male workers. The Poisson regression analysis showed 2.3 times higher sick leave when WA severity level was increased from minor to severe (Enn, 2018).

The number of days where a NFA victim is unfit for work provides an indication on the severity of the injury. In 2005, the average duration of absence from work in agricultural sector in EU (if over 3 days) was 43 days, compared to an all-sector figure of 35 days (Thomson, 2016). In Estonian agriculture the average sick leave in the past decade was 36 when sick leaves over 3 days were counted. This shows that an average Estonian farmer is absent from work less time than the farmers in EU. The average number is lower due to the fact that fifth of all the workers in WAs did not take any sick leave days (Enn, 2018). At the same time in all of the economy sectors in Estonia an average 20–22 sick leave days have counted in the years 2011–2017 (ELI, 2018). The reason is most likely wrong understanding related to the sickness benefits in Estonia.

## CONCLUSIONS

Based on the results we can allege that CAP accounted for a large part of accidents at work in the agricultural sector, and the most cases are minor. Severe WAs are likely occur in forestry or very likely in fishery sub-sector. The results show that in Estonia comparing agricultural sector with all the economic sectors, the risk of getting FA is much higher in the agricultural sector. But on the other hand when comparing FA rates in Estonian agricultural sector and EU-28 statistics, the rate of fatal cases in Estonia are significantly lower.

The main approaches to prevent agricultural accidents are improvement of awareness on risks and prevention strategies in agriculture. Among this machine operator manuals and safety warning systems could be improved, so that they don't contain excessive information and are readable for operators (Tebeaux, 2010). The insurance system covering work injuries and illnesses need fast implementation in Estonia. Through engineering improvements, education and training we could better prevent WAs in agriculture.

AKNOWLEDGEMENTS. This study has taken place due to permission of Estonian Labour Inspectorate to use the database on WA statistics in the period 2008–2017 for the research purpose.

## REFERENCES

- Accidents at work (ESAW, 2008 onwards)(hsw\_acc\_work). 2017.  
[https://ec.europa.eu/eurostat/cache/metadata/en/hsw\\_acc\\_work\\_esms.htm](https://ec.europa.eu/eurostat/cache/metadata/en/hsw_acc_work_esms.htm)
- Antonucci, A., Siciliano, E., Ladiana, D., Boscolo, P. & Di Sivo, M. 2012. Perception of occupational risk by rural workers in an area of central Italy. *Journal of Biological Regulators and Homeostatic Agents* **26**(3), 439–445.
- Burholt, V. & Dobbs, C. 2012. Research on rural ageing: Where have we got to and where are we going in Europe? *Journal of Rural Studies* **28**, 432–446.
- Cecchini, M., Bedini, R., Mosetti, D., Marino, S. & Stasi, S. 2018. Safety Knowledge and Changing Behavior in Agricultural Workers: an Assessment Model Applied in Central Italy. *Safety and Health at Work* **9**(2), 164–171. <https://doi.org/10.1016/j.shaw.2017.07.009>
- Enn, A. 2018. *Prevalence and dynamics of work accidents in Estonian agriculture*. Master Thesis, EULS, Tartu. 107 pp.
- Estonian Labour Inspectorate (ELI). Work environment in 2017. 2018. Annual report of Estonian Labour Inspectorate.  
[https://www.ti.ee/fileadmin/user\\_upload/failid/dokumendid/Meedia\\_ja\\_statistika/Toeoke\\_skkonna\\_uelevaated/2015/Tookeskkond\\_2017\\_veebi.pdf](https://www.ti.ee/fileadmin/user_upload/failid/dokumendid/Meedia_ja_statistika/Toeoke_skkonna_uelevaated/2015/Tookeskkond_2017_veebi.pdf)
- European Commission. 2008. *Causes and Circumstances of Accidents at Work in the EU*. Directorate-General for Employment, Social Affairs and Equal Opportunities, F4 unit.
- Fatal Accidents at work by NACE Rev. 2 activity. 2019. Eurostat.  
[https://ec.europa.eu/eurostat/data/database?node\\_code=hsw\\_n2\\_01](https://ec.europa.eu/eurostat/data/database?node_code=hsw_n2_01)
- Frank, A.L., McKnight, R., Kirkhorn, S.R. & Gunderson, P. 2004. Issues of agricultural safety and health. *Annu Rev. Public. Health.* **25**, 225–245.
- Horsburgh, S., Feyer, A.M. & Langley, J.D. 2001. Fatal workrelated injuries in agricultural production and services to agriculture sectors of New Zealand, 1985–94. *Occupational and Environmental Medicine* **58**(8), 489–495.
- International Labor Organization. Safety and health in agriculture [Internet]. International Labor Organization. Geneva; 2011 p. 1–350. Available from: [http://www.ilo.org/wcmsp5/groups/public/—ed\\_dialogue/—sector/documents/normativeinstrument/wcms\\_161135.pdf](http://www.ilo.org/wcmsp5/groups/public/—ed_dialogue/—sector/documents/normativeinstrument/wcms_161135.pdf).
- L'abbate, N., Lorusso, A. & Lasalvia, M. 2010. Production cycles and risk agents in the agri-food sector. *Giornale Italiano di Medicina de Lavoro ed Ergonomia* **32**(4), 408–412.
- Lower, T. & Mitchell, R. 2017. Farm injury hospitalisations in New South Wales (2010 to 2014). *Australian and New Zealand Journal of Public Health* **41**(4), 388–93.
- Marino, S., Donisi, M. & Testasecca, M. 2010. OHSMS based on ergonomics and BBS. In: *Advances in human factors, ergonomics, and safety in manufacturing and service industries*. Ed. Karwowski, W., Salvendy, G. Boca Raton: CRC Press. 1250 pp.

- Myers, J.R., Layne, L.A. & Marsh, S.M. 2009. Injuries and Fatalities to U.S. Farmers and Farm Workers 55 Years and Older. *Am J. Ind. Med.* **52**(3), 185–94.
- Nogalski, A., Lübek, T., Sompor, J. & Karski, J. 2007. Agriculture and forestry work-related injuries among farmers admitted to an Emergency Department. *Ann. Agric. Environ. Med.* **14**, 253–258.
- Non-fatal accidents at work by NACE Rev. 2 activity and age [hsw\_n2\_03]. 2019. Eurostat. [https://ec.europa.eu/eurostat/data/database?node\\_code=hsw\\_n2\\_03](https://ec.europa.eu/eurostat/data/database?node_code=hsw_n2_03)
- Non-fatal accidents at work by NACE Rev. 2 activity and sex. 2017 [hsw\_n2\_01]. Eurostat. [https://ec.europa.eu/eurostat/data/database?node\\_code=hsw\\_n2\\_01](https://ec.europa.eu/eurostat/data/database?node_code=hsw_n2_01)
- Occupational Health and Safety Act. Estonian Legislative Council: passed RT I 1999, 60, 616; last 12.04.2017 RT I, 28.04.2017, 1; 08.05.2017, *Chpt. 5*, 22–24; *Chpt. 51*, 242–245.
- Pickett, W., Hartling, L., Brison, R.J. & Guernsey, J.R. 1999. Canadian Agricultural Injury Surveillance Program. Fatal work-related farm injuries in Canada, 1991–1995. *Can. Med. Assoc. J.* **160**(13), 1843–8.
- Scott, E., Bell, E., Hirabayashi, L., Krupa, N. & Jenkins, P. 2017. Trends in Nonfatal Agricultural Injury in Maine and New Hampshire: Results from a Low-Cost Passive Surveillance System. *Journal of Agromedicine* **22**(2), 109–117.
- Solomon, C., Poole, J., Palmer, K.T. & Coggon, D. 2007. Non-fatal occupational injuries in British agriculture. *Occupational and Environmental Medicine* **64**(3), 150–154.
- Stoneman, Z., Jinnah, H.A. & Rains, G.C. 2014. Changing a dangerous rural cultural tradition: a randomized control study of youth as extra riders on tractors. *Journal of Rural Health* **30**(4), 388–396.
- Tebeaux, E. 2010. Improving Tractor Safety Warnings: Readability Is Missing. *Journal of Agricultural Safety and Health* **16**(3), 181–205.
- Thelin, A. 2002. Fatalities in Farming and Forestry: An Examination of the Registry Information Used in the Swedish National Statistics, 1988–1997. *Journal of Agricultural Safety and Health* **8**(3), 289–95.
- Thomson, K. 2016. Health and Safety in EU Agriculture. Presentation – 160th EAAE Seminar ‘Rural Jobs and the CAP’, Warsaw, Poland, pp. 1–14.
- Yiha, O. & Kumie, A. 2010. Assessment of occupational injuries in Tendaho Agricultural Development S.C, Afar Regional State. *Ethiop. J. Heal. Dev.* **24**(3), 167–74.