REFEREED ARTICLE

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Effectiveness of occupational health service programmes in farmers' safety and security risk management

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ABSTRACT

Occupational health service programmes aim to reduce injury and illness risks. Yet, recent studies indicate that members of the voluntary Farmers' Occupational Health Service programme (FOHS) in Finland have filed more occupational injury and disease claims than non-members. To investigate this unexpected finding further, we conducted a safety risk management survey among farmers (n=591). We used multivariable regression to evaluate the differences in injury incident reporting between FOHS members and non-members while controlling for demographic, risk perception, and management practice variables. We found that FOHS members were significantly younger, had larger farms, and had more livestock than non-members. Similar to recent studies, FOHS members reported 1.5 times more injury incidents compared to non-members. However, when controlling for farm size, dependence on one person, physical strain at work, and injuries to family members, there was no significant difference in injury incidence between FOHS members and non-members. In some models, FOHS had a protective but non-significant effect. While no consistent protective effect was found on injuries, FOHS members reported greater awareness of risks and greater effort in controlling risks. Regular self-monitoring of safety had a protective effect on injury incidents. A crucial challenge in FOHS and similar risk management programmes is how to ensure farmers and managers commit to the practical implementation of the programme.

KEYWORDS: Farm; risk; management; safety; injury; survey

1. Introduction

Occupational health and safety risks are significant in agriculture. About one in fifteen farmers experiences a farm injury each year (Mela, 2013), and about one in ten thousand becomes a victim of an occupational fatality (Eurostat, 2012). Typical sources of injury among farmers include machinery, livestock, hand tools, working surfaces, and human error (Rautiainen et al., 2009; Kaustell et al., 2007; Donham and Thelin, 2006; Thurston and Blundell, 2005; Rautiainen et al., 2004). Suutarinen (2004) found that working capacity, ergonomics, and business management practices are associated with occupational health and safety risks and accidents on farms.

In addition to occupational health and safety risks, farmers manage a broad range of risks from financial and production risks to fire, assets, machinery, environmental and other farm security risks. (Leppälä et al., 2012; Leppälä et al., 2011; Kay et al., 2008; Hardaker, 2006; Hardaker et al., 2004; Wagner, 1999). The security risks may seriously threat the firm activities (EK, 2012, Leppälä et al., 2012). In search of the ideal safety management culture, Reason (1997) suggests using comprehensive safety information systems, which can be used to collect, collate and regularly check the system's safety risk signs. Such safety information systems may include human, technical, organizational and environmental information.

An understanding of theories of risk can provide a mechanism for improving safety risk management. Risk can be defined as 'the effect of uncertainty on objectives'. It includes the probability of occurrence and severity of consequences (ISO 31000; IEC 60300). Formal risk management phases include risk assessment (identification and analysis), control, monitoring, and developing of risk management. Different risks involve different potential losses and costs, and a positive risk could also be seen as business opportunity, like potential profit as a consequence. The best risk management strategy is calculated by the sum of negative and positive risks (ISO 31000; COSO, 2004; Uusitalo et al., 2003).

Farmers in Finland can join the voluntary farmers' occupational health service (FOHS) programme, which aims to manage risks concerning safety, health, and security on the farm. FOHS offers preventive health screenings, farm visits with walk-through safety assessments, information on identified health and safety concerns, and insurance incentives (Kinnunen et al.,

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2009). Similar services are available in Norway. The Certified Safe Farm programme in the USA is also similar, and it has been tested in limited studies. Other western countries have similar programme elements but no comprehensive occupational health service programmes, specifically designed for farmers (Rautiainen, 2011; Lehtola et al., 2008; Rautiainen et al., 2004). FOHS is well established in Finland nationally; it was developed and implemented in the 1970's and 1980's and had 30,148 members in 2011 (Mela, 2012). Major national investments have been made into this programme. It has been a common belief that FOHS has a positive impact on farmers' health behaviour and occupational safety and health risks (Kinnunen et al., 2009). However, recent studies have shown that FOHS members have more workers' compensation claims in comparison to non-members (Karttunen and Rautiainen, 2013; Rautiainen et al., 2009). To investigate this unexpected finding further, we conducted a survey to evaluate differences in injury incident reporting between FOHS members and non-members while controlling for demographic, risk perception, and management practice variables. Our research posed two questions:

- Is FOHS membership associated with greater risk management activity on farms in general?
- Does FOHS membership provide a reduction in injury incidents when controlling for important background variables?

2. Materials and methods

To address question 1, differences in risk management variables among FOHS members and non-members were identified. To address question 2, the association of injury incidence and FOHS membership was evaluated while controlling for potential confounding variables, particularly those where a difference between FOHS members and non-members existed.

Data collection

The questionnaire data variables are listed in Appendix 1 under groups and subgroups addressing the respondent, farm, farm management, and safety management characteristics. Variables were derived and adapted from VTT Technical Centre of Finland's PK-RH–risk management tools for small and medium size enterprises (SME's) (Uusitalo et al., 2003), Confederation of Finnish Industry's YTNK - safety and security programme (EK, 2012; Kerko, 2001) and Insurance Company Tapiola's risk identification guide applied to farms (Tapiola 2002). Risk perceptions and incidents were addressed in 24 areas including personal, property, financial, environmental, and crime risks. The significance of each risk was measured on a 4-point Likert scale. Incidents leading to a loss or close call (Yes/No) in each of the 24 risk areas were included. Further, variables were included to identify risk monitoring and risk control measures on the farm (Appendix 1). The questionnaire is in Finnish and it is published in MTT's project report 126/2008 (Leppälä et al., 2008).

Statistical methods

Most survey questions had categorical responses. Likert scale answers were dichotomized into yes/no or high/low responses. SAS Enterprise Guide 4.3 was used for frequency and logistic regression analyses. The analyses focused on first identifying the differences between FOHS members and non-members, and then looking at differences in injury/close call incidence between FOHS members and non-members while controlling for potential confounding variables. The analyses progressed in stages as presented in figure 1. First, data were prepared for analyses and table analyses were used to identify variables that were associated with each of the two outcomes. At this stage, we used a low threshold for significance (chi square test, $p<0.2$ level). Next, the associations of FOHS membership and significant variables from Phase 1 were tested in univariate logistic regression analyses. Then multivariable models were fitted using the stepwise (forward) procedure one subgroup (same as in Appendix 1) at a time. Statistically significant variables (at $p<0.05$ level) from subgroup analyses were entered into the final stepwise procedure, which identified the variables that predicted being a FOHS member. Next, a similar process was repeated using injury incident as the dependent variable. The flow of the analyses phases is described in figure 1.

3. Results

The data were collected by a farm safety and security survey, which was mailed out to 1499 Finnish farmers in November 2005. During winter 2005 - 2006 we received 591 responses (39% response rate). One reminder letter was mailed out to increase responses. The questionnaire sheet was piloted before posting by one grain and one animal production farmer. The questionnaire included 75 questions and took about 45–60 minutes to fill in. Five responses were rejected due to returning an empty questionnaire. In 21 questionnaires there was no answer to the FOHS membership question and these responses were excluded.

The survey participants were sampled randomly from the farm client register of the insurance company Tapiola[4]. At the time of the survey Tapiola's market share of farm (property) insurances in Finland was 44% (Tapiola 2006). Considering the growth trend in farm size, the survey sample was limited to farms with over 20 hectares of arable land to be more representative of active farms in the future. There were 14,000 farms in this size category at the time of the survey (2005), which was 52% of Tapiola's farm clients (Tapiola, 2005). The most frequent production type in the survey was grain/crop farms (44%). Compared to national data, dairy cattle farms were over-represented in our survey (37% vs. 24% nationally). About 56% of the Finnish farms had over 20 hectares of arable land in 2005 (TIKE, 2010). Farm production in Finland compared to the sampling frame and the survey respondents is presented in table 1.

[4] http://www.lahitapiola.fi/www/Maa_ja_metsataloudet/

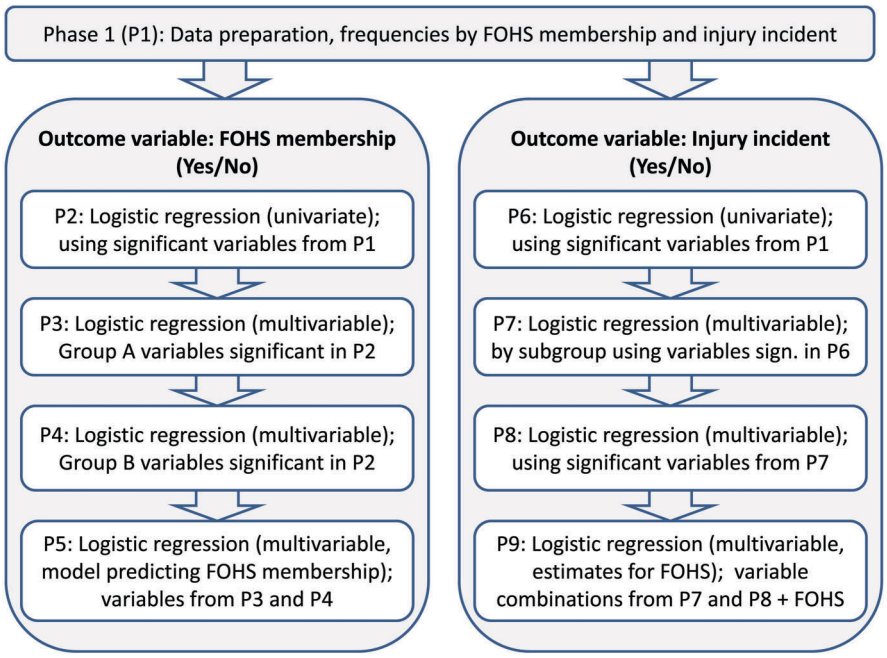

Figure 1: Description of the analysis process

Frequencies

The data included 338 (60%) FOHS members and 227 (40%) non-members (total n=565). Injury incidents or close calls were reported by 157 (28%) respondents. Those variables that had significant associations with the two outcomes of interest (chi square test, $p<0.2$ level) were entered into regression modelling phases. Distributions of these variables by FOHS membership and injury incident are presented in Appendix 1.

Variables associated with FOHS membership

In Phase 2 univariate (unadjusted) odds ratio estimates were calculated for the association of FOHS membership and each variable that was associated with FOHS in initial table analyses. These estimates are presented in Appendix 1 (statistically non-significant variables are indicated as blank). The analysis showed that FOHS members reported more frequently personal protective equipment (PPE) use and monitoring of safety and security issues than did non-members. FOHS members had larger farms and they estimated their profitability as higher than non-members. FOHS members provided more safety orientation for their workers, and they also perceived to have less risks related to the field machinery condition. However, about only 17% of FOHS members reported having safety and security assessment done, which is an essential part of FOSH. Further, the safety and security training (including first aid) was more common (10% vs. 30%) among non-members, while this training is recommended for FOHS members.

Multivariable odds ratio estimates were then calculated in Phase 3 for Group A variables using the stepwise (forward) procedure (Table 2). Several demographic, farm, and management variables from Group A were strongly associated with being a FOHS member including: animal production, forest hectares $\geqslant 80$, having dairy cows, full-time farming, having plans and goals documented, and having safety plans and budgets set yearly. Computer use for farm management and annual planning and budgeting of safety were also clearly more common among FOHS members.

In phase 4 we included these variables as confounders and evaluated Group B variables one variable at a time, controlling for these confounders. Adjusted odds ratio estimates from these analyses are presented in Table 2. In these analyses, FOHS members reported more profitability risk and regional risk incidents than did non-members, but the wide confidence limits should be noted due to low 'yes' responses in these variables.

In Phase 5, all significant variables from the adjusted models by subgroup (table 3) were entered into a

Table 1: Number of farms by type of production in the survey and Finland in 2005

Farm production	Survey respondents	%	Base population for sampling*	%	Farms in Finland	%
Grain/crop	254	44	7.700	55	43.000	62
Dairy cattle	216	37	5.000	36	16.400	24
Beef cattle	51	9			4.400	6
Swine	32	5			3.200	5
Others	29	5	1.300	9	2.000	3
Farms total	586	100	14.000	100	69.000	100

* Farm clients of Tapiola insurance company, categorised into grain/crop, dairy/cattle and other animal farms.

Table 2: Association of FOHS membership and explanatory variables (n: members=338, non-members=227)

	Multivariable estimates			Final model estimates		
Group A	*95% Confidence Limits*			*95% Confidence Limits*		
Respondent	*OR*	*LL*	*UL*	*OR*	*LL*	*UL*
Occupation: full time farmer (vs. part time)	2.1	1.22	3.63	4.55	2.14	9.67
Farm						
Farm size: forest hectares < 80 (vs. ⩾ 80)	0.59	0.37	0.93			
Main production: animals (vs. crops)	2.24	1.24	4.04			
Dairy cows (vs. no dairy cows)	2.45	1.3	4.63	4.78	2.5	9.12
Farm management						
Production plans and goals documentated (vs. not)	3.45	1.77	6.74			
Computer used for farm management (vs. not used)	2.32	1.36	3.96			
Safety management						
Safety plans and budgets set yearly (vs. not)	1.91	1.1	3.34	2.28	1.09	4.77
Self-assessment of farm safety: high (vs. low)	1.55	1.02	2.37			
Security training (fire, first aid) (vs. no training)	0.36	0.18	0.71			
Group B						
Risk perception; perceived risks: high (vs. low)						
Risk of field machinery damage	0.60	0.38	0.95			
Risk perception; actual incident or close call during past 3 years: yes (vs. no)						
Injury incident risk on farm	1.65	1.05	2.61	2.28	1.21	4.31
Mental wellness risk	2.80	1.41	5.57	4.87	1.68	14.19
Profitability risk	2.66	1.09	6.48			
Measures to monitor and control risks on farm: yes (vs. no)						
Using lockings in farm facilities	0.45	0.26	0.77	0.40	0.19	0.82
Farm safety and security assessment done	2.63	1.18	5.84			
Regular monitoring of work process flow	1.57	1.04	2.38			

logistic regression stepwise (forward) procedure. In the final model being a FOHS member was associated with having dairy cows, being full-time farmer, having safety plan and budget set yearly, having experienced mental wellness incidents, experiencing farm injury incidents and having less locking (doors etc.) on the farm. Overall, FOHS members and non-members differed in many respects. The odds ratio estimates were notably different for many variables in crude and adjusted models indicating that a complex set of characteristics is involved predicting whether farmers join the voluntary FOHS programme. In general FOHS members reported risk incidents more frequently than non-members (Table 2).

Variables associated with injury incidents

Variables that were associated with the injury incident (chi square test $p<0.2$ level) in Phase 1 were entered into regression modelling phases. The frequencies of significant variables are presented in Appendix 1. The Phase 6 analysis identified numerous risk factors for injury incidents. First, farmers that had an injury incident rated perceived risks higher than farmers without injury incident. Second, farmers that had an injury incident reported more other risk incidents including physical strain, mental wellness, liquidity, production machinery damage, fire, crime, building damage, natural disaster and water or energy supply risk incidents. Safety management variables including safety budgeting and planning yearly, security training and self-assessment of farm safety showed no significant relation with injury incident, but regular monitoring of safety and environmental risks had a protective association with injury incidents.

In phase 7, multivariable analyses were performed one subgroup at a time. All significant variables are presented in Appendix 1, and adjusted models are presented in Table 3. In the adjusted model, farms with larger field size (⩾40 hectares) were approximately four times more likely to have injury incidents than smaller farms. Farmers with injury incidents perceived injury incident risks, dependence on one person and dependence on few suppliers as significant risks on their farm. Farmers reporting physical strain incidents were almost 3 times more likely to have injury incidents. Dependence on one person, increased investment planning, quality management, and computer use for farm management were also risk factors for injury incidents.

In Phase 8, significant variables from Phase 7 were entered into a stepwise (forward) procedure (Table 3). Risk factors for injury incidents in the final model included dependence on few suppliers, water or energy supply incident, dependence on one person, family member's risk incident and physical strain incident. Regular monitoring of farm safety and security was the only protective factor (OR: 0.41; 95% CI: 0.23–0.73). FOHS membership was evaluated in the final adjusted model. It was not associated with injury incidents when adjusted for the variables in the final model (OR: 1.29; 95% CI: 0.78 - 2.10). No significant multicollinearity was observed in the final models.

FOHS membership and injury incidents on the farm

Phase 6 analysis showed that FOHS members had 1.5 times greater likelihood of injury incidents than did non-members. While controlling for Group A variables in

Table 3: Risk factors for injury

	Multivariable estimates			Final model estimates		
Group A	*95% Confidence Limits*			*95% Confidence Limits*		
Respondent	*OR*	*LL*	*UL*	*OR*	*LL*	*UL*
FOHS membership (vs. not membership)	1.49	1.00	2.22	1.29	0.78	2.10
Farm						
Farm size: field hectares < 40 (vs. ⩾ 40)	0.26	0.09	0.80			
Beef cattle (vs. no beef cattle)	0.24	0.06	0.90			
Farm Management						
Quality management training (vs. no training)	1.46	1.00	2.12			
Computer used for farm management (vs. not used)	1.76	1.01	3.06			
Group B						
Risk perception; perceived risks: high (vs. low)						
Injury risk	1.61	1.07	2.42			
Dependence on one person	1.68	1.04	2.71			
Dependence on few suppliers	1.90	1.01	3.55	2.55	1.30	5.01
Risk perception; actual incident or close call during past 3 years: yes (vs. no)						
Physical strain risk	2.75	1.63	4.62	2.64	1.50	4.63
Risk on farm family members	5.31	2.49	11.30	6.13	2.78	13.52
Dependence on one person	2.52	1.28	4.98	2.71	1.30	5.66
Water or energy supply risk	2.31	1.35	3.94	2.24	1.27	3.95
Measures to monitor and control risks on farm: yes (vs. no)						
Regular monitoring of safety and security	0.43	0.25	0.74	0.41	0.23	0.73

Note: Injury incident n = 157 and not injury incident n = 410

Phase 9, the odds of injury reduced to 0.90, but the association was not statistically significant. Several other models were tested and the odds ratio estimates varied from 0.7 to 1.7, depending on the combination of control variables in the multivariable models. Overall, with our sample size and available background variables, FOHS membership does not have a robust protective effect, nor is it associated with an increase in reporting of injury incidents.

4. Discussion

Minimising health and safety risks is important in agriculture due to the high risk of injury and illness in this industry (Eurostat, 2012). In Finland, the farmers' occupational health service programme (FOHS) aims to reduce the risks of injury and illness among farmers. This programme is voluntary and has about 40% participation rate (Kinnunen et al., 2009). Contrary to the programme's objectives, recent studies have shown that FOHS members have more compensated injury claims compared to non-members (Rautiainen et al., 2009, Karttunen and Rautiainen, 2013). However, it is likely that member and non-member populations differ in many respects due to self-selection into the voluntary programme. Only a limited number of background variables have been available to control for these differences in previous studies. In this study we examined the differences in member and non-member populations using a unique dataset with variables not available in previous reported studies.

Our first question was to identify differences in risk management activity between farmer's occupational health service (FOHS) members and non-members. The results indicate that FOHS members were more likely to be full-time farmers and livestock farmers. They had bigger farms and better profitability. FOHS members reported more documentation and goal setting, quality management training and computer use in farm management. They were also more active in safety planning and use of personal protective equipment (PPE). Generally, FOHS members reported greater awareness of risks and greater effort in controlling risks. However, compared to non-members they had less emphasis on fire risks, economic risks, investment planning and handling of mental wellness risk.

It is common that injury incidents have many causes, and a number of unsafe acts can be indirectly related to accidents (Reason, 1997). Many demographic and farm production characteristics have been identified as risk factors for injury (Rautiainen et al., 2009). In this study, we identified several injury risk factors including animal (vs. crop) production, larger farm size (field and herd size), dependence on one person on the farm, physical work strain, perceived fire risk, and infrastructural problems on the farm. Regular monitoring of safety and security risks was likely to reduce the risk of injury.

Our second question explored whether FOHS membership is a protective factor for injury incidents when controlling for important background variables. Our data indicated that FOHS members reported more injury incidents compared to non-members. Despite the fact that FOHS members receive information and assistance on health and safety issues, they reported 1.5 times more injury incidents compared to non-members. However, members also had more personal and farm characteristics that expose them to injury. When controlling for these confounding variables FOHS was no longer a significant variable explaining injury incidents on farms. Variables like field size, physical strain and dependence on one person on farm were stronger explanatory variables for injury incidents

than FOHS membership. This indicates that differences between FOHS members and non-members, rather than FOHS itself, explain the higher incidence of injuries among FOHS members. Depending on the combination of variables used in the models, the effect of FOHS varied widely, from 0.7 to 1.7. In most models there was no significant difference in injury reporting between FOHS members and non-members. None of the models showed that FOHS had a statistically significant protective effect while few models showed a significant risk factor effect.

The results indicate that FOHS members participate more frequently in quality management training and are more active in risk management in general. However, members did not report high participation in farm safety assessments and safety and security training, which could be essential parts of FOHS. They also perceived their farm safer than non-members, but still they have more injuries and other risk incidents. Main part of the farmers in general (both FOHS members and non-members) are not doing safety and security self-monitoring very regularly or systematically, which was reported as a protective factor for injury incidents. This might be an area where the delivery of FOHS should be improved.

Occupational health and safety management contributes to production and quality. As the farm unit size and complexity in management increase, there is a growing need for improved knowledge management systems, which need to incorporate safety issues. The development of a holistic management system is a challenge for farm managers. FOHS membership provides tools and services for identifying and managing safety and security risks, which may contribute to a holistic management approach on farms. FOHS may contribute to risk management more broadly than just health and safety; the results indicated that members reported greater awareness of risks and greater effort in controlling risks. Yet, a crucial challenge in FOHS and similar programmes is how to ensure farmers and managers commit to the practical implementation of the programmes.

Limitations

The wide variation in odds ratio estimates indicates that strong biases may exist in injury incident reporting. Major sources of bias include self-selection into the voluntary FOHS programme. Those with new and existing health conditions may be more likely to join FOHS. Awareness of injury risks and risk management may be heightened among FOHS members due to education, and therefore members may report risks and incidents more readily. Participation vs. non-participation in a voluntary survey may result in biases. Self-reporting in surveys may involve recall and other biases.

5. Conclusion

While FOHS members were more aware of safety risks, they were 1.5 times more likely to self-report injury incidents. When controlling for confounding factors, there was no significant difference between members and non-members. Overall, the results from this survey support the need for improvements in the FOHS programme. As one option, holistic or broader risk management approaches could be utilized to addresses occupational health and safety risks along with management of production, asset, product quality, and environmental risks, among others. FOHS membership appears to increase awareness of safety and security risks in general. However, awareness is not sufficient without a good safety culture and safety management in practice. A crucial challenge in FOHS and similar risk management programmes is how to ensure farmers and managers commit to the practical implementation of the programmes.

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Appendix 1: Univariate association of FOHS membership and injury incidents: basic variables.

Group A	FOHS membership			Injury incident		
Respondent	% Yes	% No	OR	%Yes	%No	OR
Respondent sex: female (vs. male)	**15.7***	**9.7***	**1.74***	15.9	12.5	
Respondent age: < 50 (vs. ⩾ 50)	55.8	56.9		**60.9**	**54.3**	**1.31**
Education: agriculture school (vs. no agr. school)	***52.4****	***42.5****	**1.49***	**54.1**	**46.2**	**1.37**
Occupation: full time farmer (vs. part time)	**88.2***	**62.1***	**4.55***	79.1	77.0	
Farm						
Farm size: field hectares < 40 (vs. ⩾ 40)	**48.5***	**58.04***	**0.68***	**43.59***	**55.83***	**0.61***
Farm size: forest hectares < 80 (vs. ⩾ 80)	**63.4***	**74.2***	**0.6***	**63.2**	**69.6**	**0.75**
Animal herd size: Dairy cattle < 30 (vs. ⩾ 30)	**35.3**	**48.9**	**0.57**	**30.8**	**40.9**	**0.64**
Main production: animals (vs. crops)	**67.4***	**33.9***	**4.02***	57.3	52.7	
Dairy cows (vs. no dairy cows)	**51.2***	**17.6***	**4.9***	41.4	36.4	
Full-time farm workforce: 1 person (vs. >1)	**39.7***	**62.6***	**0.39***	49.6	46.6	
Part time farm workforce: 1 person (vs. >1)	**70.0***	**53.9***	**2.0***	**75.7**	**59.0**	**2.17**
Location: Southern Finland (vs. Middle, North)	**29.8***	**45.6***	**0.51***	34.9	36.6	
Beef cattle (vs. no beef cattle)	**22.2**	**17.5**	**2.02**	**19.8**	**20.5**	**1.91**
Farm management						
Quality management training (vs. no training)	**53.3***	**30.8***	**2.56***	**52.23***	**41.08***	**1.57***
Strategy documented (vs. not)	14.01	15.07		16.7	13.6	
Profitability: good (vs. weak profitability)	**56.8***	**38.7***	**2.01***	49.4	49.8	
Production plans and goals documentated (vs. not)	**41.3***	**19.9***	**2.82***	33.1	32.3	
Computer used for farm management (vs. not used)	**87.2***	**75.3***	**2.23***	**88.46***	**79.9***	**1.93***
Safety management						
Security training (fire, first aid) (vs. no training)	**10.3***	**30.0***	**0.27***	9.55	11.49	
Safety plans and budgets set yearly (vs. not)	**27.5***	**13.9***	**2.33***	25.2	20.6	
Self-assessment of farm safety: high (vs. low)	**69.6***	**60.8***	**1.48***	63.7	66.8	
Rescue plan made for farm (vs. not)	6.3	4.0		5.9	5.1	
FOHS membership (vs. not)	100	0		**66.88***	**57.11***	**1.52***

Note: Percentages indicate the proportion of FOHS members or injury incident (Yes) and non members or non injury incident (No) having this characteristic
Note: FOHS members n = 338 and non-members n = 227
Note: Injury incident n = 157 and not injury incident n = 410
Note: statistical value (P<0,2) have percents and OR bolded
Note: significant variables with statistical value p < 0,05 have *

Appendix 2: Univariate association of FOHS membership and injury incidents: explanatory variables of risk perceptions

Group B **Perceived risk on farm: yes (vs. no)**	FOHS membership			Injury incident		
	% Yes	% No	OR	%Yes	%No	OR
Injury incident risk on farm	41.4	42.7		**52.9***	**37.78***	**1.85***
Physical strain risk on farm	**52.0**	**45.5**	**1.3**	52.9	48.1	
Mental wellness risk	**46.5***	**36.5***	**1.51***	45.9	41.3	
Risk to farm visitors	3.2	4.8		6.08	2.94	
Risk to farm family members	14.2	15.3		14.7	14.9	
Risk of losing production data	**16.6**	**11.6**	**1.52**	**19.35***	**12.66***	**1.66***
Profitability risk	46.3	50.9		53.2	47.6	
Liquidity risk on farm	**32.9**	**26.4**	**1.37**	32.2	29.5	
Building damage risk	**24.2**	**29.7**	**0.75**	28	25.9	
Risk of field machinery damage	**22.9***	**32.7***	**0.61***	**31.21**	**25.19**	**1.35**
Risk of production machinery damage	22.1	26.1		26.6	22.5	
Rescue situation risk	**29.5**	**23.7**	**1.34**	**32.48**	**25.0**	**1.44**
Crime or vandalism risk	**20.8**	**27.1**	**0.71**	**31.58***	**20.0***	**1.85***
Fire risk on farm	29.3	30.8		**34.39**	**28.46**	**1.32**
Local/regional crises risk	43.1	41.0		46.2	40.3	
Risk to product safety	5.1	4.3		**6.41**	**3.85**	**1.71**
Environmental risk on farm	8.7	6.2		6.7	8.1	
Dependence on one person	69.7	72.6		**80.89***	**67.77***	**2.01***
Farm employee safety risk	**29.2**	**23.3**	**1.35**	**31.37**	**25.26**	**1.35**
Electrical risk	**16.6**	**22.8**	**0.67**	**23.57**	**17.26**	**1.48**
Natural disaster risk	32.6	28.4		28.7	30.9	
Product sale risk	**13.8***	**23.4***	**0.53***	20.9	16.3	
Water or energy supply risk	26.0	25.2		26.8	25	
Dependence on few suppliers	9.6	9.9		**16.03***	**7.51***	**2.35***

Note: Percentages indicate the proportion of FOHS members or injury incident (Yes) and non members or non injury incident (No) having this characteristic
Note: FOHS members n = 338 and non-members n = 227
Note: Injury incident n = 157 and not injury incident n = 410
Note: statistical value (P<0,2) have percents and OR bolded
Note: significant variables with statistical value p < 0,05 have *

Appendix 3: Univariate association of FOHS membership and injury incidents: actual risk incidents

Group B **Perceived risk actual incident on farm: yes (vs. no)**	FOHS membership			Injury incident		
	% Yes	% No	OR	%Yes	%No	OR
Injury incident risk on farm actual incident	**31.1***	**22.9***	**1.52***	100	0	
Physical strain risk actual incident	**19.2**	**13.7**	**1.5**	**35.03***	**10.27***	**4.71***
Mental wellness risk actual incident	**15.7***	**7.5***	**2.3***	**27.39***	**6.6***	**5.34***
Risk to farm visitors actual incident	3.0	1.8		**8.28**	**0.24**	**36.8***
Risk to farm family members actual incident	7.1	9.2		**22.29***	**2.93***	**9.49***
Risk of losing production data actual incident	2.2	3.6		**7.64**	**1.22**	**6.69***
Profitability risk actual incident	**8.3**	**3.5**	**2.47***	**12.1***	**4.4***	**2.99***
Liquidity risk on farm actual incident	**10.4***	**5.7***	**1.9***	**17.2***	**5.13***	**3.84***
Building damage risk actual incident	11.5	9.3		**17.2***	**8.07***	**2.37***
Risk of field machinery damage actual incident	20.1	24.2		**35.03***	**16.63***	**2.7***
Risk of production machinery damage actual incident	**17.2***	**7.5***	**2.56***	**24.84***	**8.8***	**3.42***
Rescue situation risk actual incident	**6.8**	**2.2**	**3.24***	**12.74***	**1.96***	**7.42***
Crime or vandalism risk actual incident	**6.5**	**3.5**	**1.91**	**12.1***	**2.69***	**4.98***
Fire risk on farm actual incident	***9.8***	***3.5***	**2.96***	**15.92***	**3.91***	**4.65***
Local/regional crises risk actual incident	**7.7**	**1.3**	**6.22***	**12.74**	**2.2**	**6.49***
Risk to product safety actual incident	**3.6**	**0**	**1.7**	**5.73**	**0.73**	**8.23***
Environmental risk on farm actual incident	**3.9**	**0.9**	**4.5***	**7.01**	**0.98**	**7.63***
Dependence on one person actual incident	**12.1***	**6.6***	**1.95***	**22.93***	**5.13***	**5.5***
Farm employee safety risk actual incident	**4.4**	**0.9**	**5.22***	**7.01**	**1.47**	**5.06***
Electrical risk actual incident	***6.8***	***3.1***	**2.29***	**10.83**	**3.18**	**3.7***
Natural disaster risk actual incident	8.4	8.3		**14.01***	**6.11***	**2.5***
Product sale risk actual incident	4.7	2.2	**2.21**	**9.55**	**1.47**	**7.1***
Water or energy supply risk actual incident	**18.9***	**9.7***	**2.18***	**28.66***	**10.27***	**3.51***
Dependence on few suppliers actual incident	**3.0**	**0.4**	**6.86**	**6.37**	**0.24**	**27.76***

Note: Percentages indicate the proportion of FOHS members or injury incident (Yes) and non members or non injury incident (No) having this characteristic
Note: FOHS members n = 338 and non-members n = 227
Note: Injury incident n = 157 and not injury incident n = 410
Note: statistical value (P<0,2) have percents and OR bolded
Note: significant variables with statistical value p < 0,05 have *

Appendix 4: Univariate association of FOHS membership and injury incidents: risk controlling variables

Group B	FOHS membership			Injury incident		
	% Yes	% No	OR	%Yes	%No	OR
Contracting (written, checked)	**76.8**	**70.7**	**1.37**	75.5	73.9	
Investment planning	38.6	35.2		**42.21**	**35.26**	**1.34**
Asset registering	**12.4**	**7.7**	**1.7**	8.2	11.5	
Using lockings in farm facilities	**17.0***	**26.2***	**0.58***	22.7	19.9	
Updating insurances	81.9	83.3		83	82.3	
Using operators manuals	82.5	80.8		82.9	81.4	
Fire prevention updated	69.2	72.3		68.7	71.1	
Using data back up and computer virus protection	**75.1***	**66.5***	**1.52***	**76.47**	**69.77**	**1.41**
Rescue plan for farm	7.8	7.4		**4.9**	**8.74**	**0.54**
Farm safety and security assessment done	**16.7***	**4.4***	**4.4***	12.2	11.5	
Using of necessary personal protection equiments on farm	**81.4***	**73.5***	**1.58***	78.6	78.1	
Safety guiding of farm visitors	**51.7***	**34.1***	**2.1***	43.0	45.5	
Safety orientation and training for farm workers	**53.2***	**33.8***	**2.2***	48.7	44.3	
Using bookkeeping services	66.7	65.1		68.5	65.1	
Injury incidents and close calls documented	10.4	7.4		11.6	8.3	
Using of safety signs in farm machinery and equipments	17.8	15.9		15.9	17.5	
Relief worker arrangements on the farm	24.2	20.7		25.2	21.9	

Note: Percentages indicate the proportion of FOHS members or injury incident (Yes) and non members or non injury incident (No) having this characteristic
Note: FOHS members n = 338 and non-members n = 227
Note: Injury incident n = 157 and not injury incident n = 410
Note: statistical value (P<0,2) have percents and OR bolded
Note: significant variables with statistical value p < 0,05 have *

Appendix 5: Univariate association of FOHS membership and injury incidents: regular monitoring in farm management

Group B	FOHS membership			Injury incident		
	% Yes	% No	OR	%Yes	%No	OR
Regular monitoring of production costs	**66.3**	**58.3**	**1.39**	65.8	62.2	
Regular monitoring of production machinery and equipment condition	**76.2**	**70.7**	**1.33**	72.7	74.3	
Regular monitoring of changes in work environment	33.2	28.7		34.5	30.2	
Regular monitoring of production quality	**85.1***	**68.9***	**2.59***	82.2	77.3	
Regular monitoring of safety and security	**28.0***	**19.9***	**1.57***	**15.56***	**28.08***	**0.51***
Regular monitoring of environmental quality	**39.9***	**30.7***	**1.5***	**30.92***	**38.5***	**0.72***
Regular monitoring of legislation	37.4	38.3		36.4	38.4	
Regular monitoring of plans and objectives	**39.9**	**32.4**	**1.39**	36.8	36.9	
Regular monitoring of market prices	62.4	64.7		66.2	62.3	
Regular monitoring of work process flow	**61.4***	**51.4***	**1.51***	59.9	56.3	
Regular monitoring of work load	**38.4***	**24.3***	**1.94***	32.7	32.9	
Regular monitoring of sales and revenues	**70.7**	**63.2**	**1.4**	71.7	66.2	

Note: Percentages indicate the proportion of FOHS members or injury incident (Yes) and non members or non injury incident (No) having this characteristic
Note: FOHS members n = 338 and non-members n = 227
Note: Injury incident n = 157 and not injury incident n = 410
Note: statistical value (P<0,2) have percents and OR bolded
Note: significant variables with statistical value p < 0,05 have *