



LUND UNIVERSITY

Interventions to reduce injuries among older workers in agriculture: A Review of evaluated intervention projects

Nilsson, Kerstin

Published in:

Work: A Journal of Prevention, Assessment & Rehabilitation

DOI:

[10.3233/WOR-162407](https://doi.org/10.3233/WOR-162407)

2016

Document Version:

Peer reviewed version (aka post-print)

[Link to publication](#)

Citation for published version (APA):

Nilsson, K. (2016). Interventions to reduce injuries among older workers in agriculture: A Review of evaluated intervention projects. *Work: A Journal of Prevention, Assessment & Rehabilitation*, 55(2), 471-480.
<https://doi.org/10.3233/WOR-162407>

Total number of authors:

1

General rights

Unless other specific re-use rights are stated the following general rights apply:

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Interventions to reduce injuries among older workers in agriculture: A review of evaluated intervention projects

BACKGROUND: The number of older workers is increasing throughout the industrialised world and older workers are known to be more frequent in the injury-prone agricultural sector.

OBJECTIVE: This paper sought to extend knowledge by reviewing evaluated intervention studies intended to decrease risks and work injuries among older workers in agriculture.

METHODS: A systematic literature review regarding: evaluated intervention projects on injury prevention, including participants aged 55 years and older, and working in agriculture.

RESULTS: This review identified evaluated intervention projects regarding: i) intervention in injury prevention; ii) interventions to increase knowledge in health and safety tasks and practice; and iii) interventions to increase the use of safety equipment in work. The evaluations reviewed showed that the interventions were less successful in involving older agricultural workers than their younger counterparts. The evaluations also showed that the outcome of interventions was generally less positive or brought about no significant difference in risk awareness and behaviour change among older agricultural workers.

CONCLUSIONS: Many articles and statistics describe injuries in agriculture. Especially older farm workers are one of the groups with most work injuries and deaths. Despite this, an important finding in this review was shortage of implemented and evaluated intervention studies orientated toward reduce injuries among older workers in agriculture. This review also found that no intervention project in the evaluations studied had a clear positive effect. Many intervention studies have problems with or lack of evaluation in the study design. Based on the results in this review, important future research tasks are to improve the design of interventions, devise implementation methods and formulate appropriate evaluation methods to measure the outcome of the interventions. Intervention programmes also need to involve older workers specific physical and cognitive age aspects in the design to increase their willingness to participate and to be successful to reduce injuries.

Keyword: Risk prevention, accidents, injury, occupational health, age management, farm, health and safety practice, older employees, work risk education, extended working life.

Introduction

Approximately 35 per cent of the global workforce is involved in agriculture, forestry, fishing and hunting [1]. At the same time, the number of older workers is increasing due to the demographic change with more elderly people [2-4]. Agricultural workers are already over-represented in the old age workforce and work more often than those in other occupations until older age [5-8].

Furthermore, there is a high incidence of work-related accidents and demands in agriculture and a number of studies highlight the importance of preventing injuries and promoting the health of older agricultural workers [9-13]. Farming consistently ranks as one of the highest injury risk work sectors [1;5;14-16]. For example, according to ILO estimates, agriculture is among the most dangerous sectors in terms of fatal accidents, injuries and work-related ill health [1]. At least 170 000 agricultural workers worldwide are killed each year and the mortality rates have remained consistently high over the past decade. In addition, there is widespread under-reporting of injuries, occupational diseases and deaths, which means that the true picture of occupational safety and health (OSH) is likely to be worse. Elderly workers also seem to suffer a higher risk of injuries [17;18]. Approximately 38 per cent of the general workforce who die from work-related injuries are 55 years or older [19;20], but roughly 60 per cent of those who die from work-related injuries in agriculture are 55 years or older.

Agricultural workers are at risk from a wide variety of hazards, e.g. machinery, biological, chemical, dust, ergonomic, psychosocial and physical, as well as from long hours of work [1]. Poorly designed tools, difficult terrain and exposure combined with fatigue in older workers increase the risk of injuries. Although technological change has reduced the physical demands of agricultural work in some areas, it has introduced new risks, e.g. associated with the use of sophisticated machinery and the intensive use of chemicals such as pesticides without appropriate safety and health risk control measures, information or training [1].

It is a known fact that functional health decreases in many people as they grow older [21-25]. From 40 years of age, anatomical and physiological systems are declining, as is the interaction

between brain, sensory organs, locomotive organs and circulatory organs [26;27]. The prevalence of chronic pain, problems with hearing and eyesight, and also slower reaction times and work-related exhaustion seem to increase with age [28-30]. This all contributes to older people being at higher risk of injury than middle-aged and young people [18]. Older agricultural workers also seem to take longer to recover and go back to work after an accident [31]. Since functional ageing affects the body and mind of workers in an ageing workforce, many more workplaces will have to be age-adapted [9-13;32-37].

The overall objective of this study was to extend knowledge about how to decrease risks and work injuries among agricultural workers aged 55 years and older through a systematic review of evaluations of previous intervention programmes with this aim.

Materials and methods

The method used was a systematic literature review, performed in several steps in accordance with the literature review guidelines in “Cochrane Handbook for Systematic Reviews of Interventions” [38]. First, a list of criteria was drawn up with the objective of increasing the validity and limiting the search to the articles most relevant to the topic under investigation. Since the aim of this study was to analyse evaluated health and safety intervention studies on older workers in agriculture, the criteria were set to achieve this aim. The search was limited to articles published from 2000 onwards because older interventions were considered less relevant in light of the fast technical and organisational changes occurring in agriculture. The definition of older workers as 55 years and older was because that is a general age definition of an older worker in research [4].

The criteria for inclusion of articles in the literature review were:

- i) Evaluated intervention project to reduce risks and prevent injuries
- ii) Participants working in agriculture.
- iii) Including participants aged 55 years and older.

iv) Published in peer-reviewed journals in English in the period 2000-2013 and searchable in electronic databases.

Literature searches were conducted in the following electronic databases: Medline, PubMed, Web of Knowledge, Scopus, Google Scholar, Cochrane Library and Science Direct, in order to locate evaluations of intervention and prevention projects targeting older workers in agriculture. Relevant articles were then identified in seven steps. First, a search for articles was carried out in each of the databases using the following seven different key words in various combinations: Older worker, Intervention, Health prevention, Health promotion, Age management, Farm, Agriculture. This resulted in a total of 2 229 289 articles. However, most articles did not meet the criteria set and had no relevance for this literature review. For example, the key word "Agriculture" led to many articles on crops, buildings and clean water. A number of articles also turned up many times in the application of different key word combinations and while searching various databases. Therefore the articles were sorted in order of relevance and those articles not addressing the topic of this literature review and duplicates were removed (Figure 1).

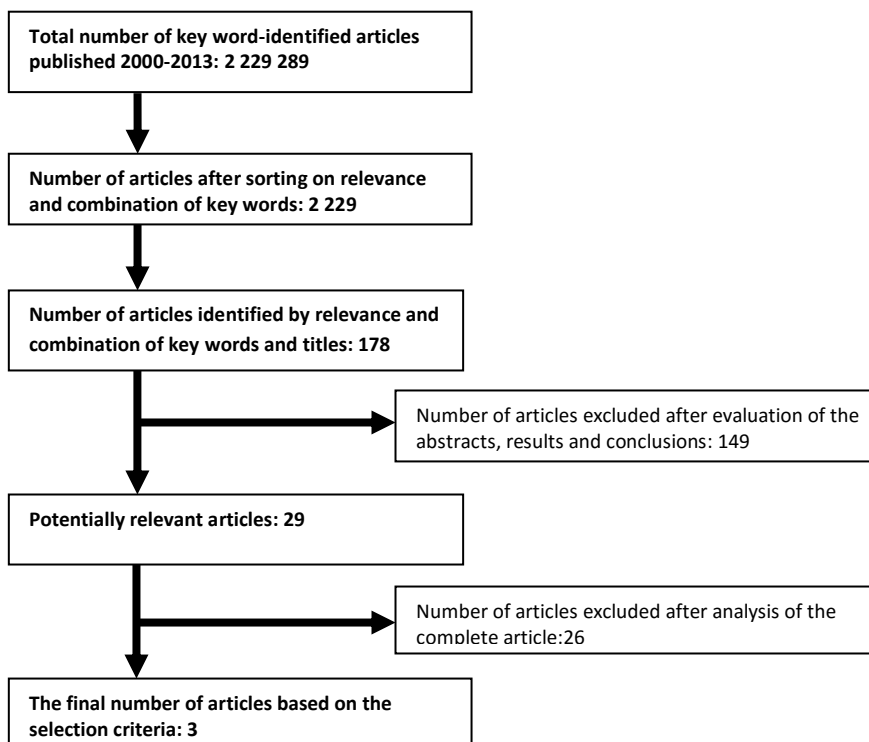


Figure 1. Selection process for relevant articles in the literature.

Results of the search

A total of 2229 references were reviewed in order of relevance to the topic of this literature review. From these, 178 articles were selected by relevance and combination of key words and titles for a more detailed review. In the next step, after reading all the abstracts, summaries and methods, 29 articles were identified as having potential to be included in this review of evaluated intervention projects to reduce injuries among agricultural workers aged 55 years and older. Careful reading and examination of these articles was performed to determine whether they met all four criteria established for inclusion. However, this revealed that only three studies followed the inclusion criteria and could be included in the review and the remaining 26 studies were excluded.

Included studies

Of the three intervention studies that had the aim of reducing injury among older workers in agriculture, and were thus included in this review, two were related to general risk assessment and awareness training, i.e. lectures and workshops to reduce the risk of various types of injuries. These two articles concerned the FarmSafe Programme in New Zealand [39] and the Agricultural Health and Safety Network (AHSN) in Saskatoon, Canada [40]. The third article evaluated the effect of an information campaign to increase the use of roll-bars on tractors in the U.S. [41].

Reference	Intervention	Aim of the paper	Method and Participants	Activities/Measures	Result/Outcome	Comments
Morgaine et al. [39]	FarmSafe: A national programme to raise awareness of safety issues for farmers and farm workers to reduce farm work-related injuries	To describe the implementation of the first stage of the FarmSafe Program in 2003, presenting findings from the process.	Semi-structured interviews with key members of the 5 agencies responsible for the programme: 6 workshop facilitators 29 farmers and farm workers participated in the first stage workshop. Participants in the intervention 2003: 6 341 farmers and farm workers in 350 workshops	FarmSafe Awareness interactive workshop during five hours to improve attitude to farm safety among farmers, farm workers and their families and to improve safety practice on farms.	The total intervention programme was successful in achieving participation in this first year. However, fewer older workers (55+) participated than the percentage in the population, but more participants in the age group 15-54.	No results about whether the programme improved attitudes and farm safety among farmers, farm workers and their families, and in different age groups
Hagel et al. [49]	Educational interventions by Agricultural Health and Safety Network (AHSN). Including three groups: 1) participated for >8 years; 2) participated for ≤8 years; 3) no participation in AHSN education activities.	To evaluate the effectiveness of an agricultural health and safety programme in reducing the risks of injury.	Self-reported prevalence of: farm safety practice, physical farm hazards, agricultural injuries.	Educational interventions on farm safety issues: tractor safety (roll-over protection, extra rider injuries, run-over protection, jump starting), farm machinery safety (harvesting equipment, machinery guarding, power-take-off devices, all-terrain hazards), Non-machinery hazards (falls, large animals, farm structures and buildings, power lines), burden of farm injury (statistical summaries, Impact of injury on farm families), personal and farm protection (emergency preparedness, farm safety audits/modules, hearing), special populations at risk (children, young workers, older workers)	Educational interventions by the AHSN programme associated with observable differences in farm safety practices, physical farm hazards or farm-related injury outcomes.	One of the educational print interventions included in the AHSN programme was to the risk group 'older workers', but what and how it was performed were not described in the article. The results in different age groups were also not described.
Loring & Myers [41]	Rollover Protective Structure (ROPS) to reduce overturn deaths from tractor overturns.	Evaluate the prevalence of ROPS on farms to decrease tractor overturn fatalities	Data from 1993, 2001, 2004 about ROPS prevalence statistics	Use of ROPS in order to reduce worker deaths on farms from tractor overturns.	Farm operators 65 years and older and with low farm income had lower ROPS prevalence.	The results were described as useful for future ROPS promotion activity to older farmers.

Table 1. Interventions to reduce risks and prevent injuries among older farmers published in international scientific journals

The *FarmSafe Programme in New Zealand* was directed at all farmers and people working with sheep, dairy and beef production on farms [39]. The intervention was carried out by the FarmSafe Consortium, including the Agriculture Industry Training Organisation (AgITO), Telford Rural Polytechnic (Telford), Agriculture NZ (a private training company) and the Injury Prevention Research Unit at the University of Otago. The aim of the study was to present findings from implementation of the intervention. The participants in the intervention were 6341 people working in agriculture in 2003. These participated in 350 workshops that presented e.g. statistics on farm accidents and causes of injuries in agriculture and “farm walks” with risk identification in order to eliminate risks and increase safety on farms. The programme also included a special information package delivered through television and magazine articles with the aim of spreading information about risk and safety in agriculture.

The evaluation article concluded that the intervention was successful in terms of farmer participation. However, it also noted that it was more difficult to reach older farmers and that people aged 55 and older had a much lower participation rate than younger people. Another shortcoming of the study was that it only described workshop participation rates and not the impact of the workshops and information activities on work injury rates among farmers and the participants’ attitude to safety and risk in agriculture. The evaluation was therefore exclusively on the number of participants and not on the effect of the intervention itself and from the text it was impossible to determine whether the intervention actually reduced accidents and injuries in agriculture and to older farm workers.

The *Agricultural Health and Safety Network (AHSN)* in Saskatoon, Canada, arranged 112 intervention efforts [40]. The intervention programme was developed in collaboration between active farmers and the Centre for Agricultural Medicine, University of Saskatchewan. The objective of the article was to evaluate whether the educational interventions by the AHSN programme were

associated with observable differences in farm safety practices, physical farm hazards or farm-related injury outcomes.

The intervention had a pedagogic approach and raised various questions about security on the farm. These included educational interventions on farm safety issues: tractor safety (roll-over protection, extra rider injuries, run-over protection, jump starting), farm machinery safety (harvesting equipment, machinery guards, power take-off devices, all-terrain hazards), non-machinery hazards (falls, large animals, farm structures and buildings, power lines), burden of farm injury (statistical summaries, Impact of injury on farm families), personal and farm protection (emergency preparedness, farm safety audits/modules, hearing) and special populations at risk (children, young workers, older workers).

The subject evaluated in the study was the effect of AHSN activities on risk and injury in agriculture in 50 rural municipalities. The intervention included three groups: one which participated in AHSN for more than 8 years, one which participated in AHSN for 8 years or less and one which did not participate in AHSN. In the evaluation, participants were asked to complete a questionnaire about their farm safety, physical injuries and accidents that occurred on the farm. Adult key informants from 2386 farms responded. To evaluate the intervention results, the three groups were compared.

The results showed that training efforts in the AHSN programme were not associated with observable differences between the three groups in farm safety practices, physical farm hazards or incidence of agriculture-related physical injuries and accidents. A limitation pointed out in the article that could have affected the results was the impossibility of conducting a randomised controlled trial to test the relative effectiveness of AHSN. For example, promotional information material included a national farm safety brochure that was distributed to all farms during the project period.

A shortcoming of the evaluation in terms of the objectives of the present review was that it only described the effect to which the intervention project had contributed in general, and not whether

there was any statistically significant variation between different groups in agriculture, e.g. younger and older farmers.

The American Society of Agricultural and Biological Engineers (ASABE) started an information campaign in the U.S. in 1993 to increase the use of roll-bars, i.e. Rollover Protective Structure (ROPS), on existing tractors and introduce ROPS as standard on new tractors, and thus reduce the mortality rate from tractor overturns [41]. The article evaluated the effect of the information campaign and the introduction of ROPS as standard on tractors through statistical analysis of a survey in which farmers were asked whether their tractors were equipped with roll-bars. The data were compiled by the National Institute of Occupational Safety and Health (NIOSH), which surveyed approximately 15 000 farm operators on the use of ROPS in 1993, 2001 and 2004. The results showed increased use of ROPS on tractors over time, i.e. 37% in 1993, 42% in 2001 and 46% in 2004. The results also showed that it was mostly farmers aged 65 years and older who still had tractors without ROPS, or farmers with lower farm income. The evaluation stated that the increase in ROPS use was not satisfactory to decrease the rate of tractor overturn deaths on farms. It also suggested that incentive programmes should target older agricultural workers and low-income farms to increase ROPS use on tractors. Despite the increased use of ROPS, the authors concluded that the use was not yet comparable to that in Europe. However, the results were described as being useful for future targeted information campaigns and interventions. As regards the objectives of the present review, it should be noted that this evaluation was not about the effect on injury incidence, but only about the use of the technical equipment reported in earlier studies to reduce injuries.

Excluded studies

In the final scrutiny of the 29 articles selected for review, it emerged only after reading the full text that 26 of these did not actually meet the inclusion criteria. The criterion “evaluated” was particularly problematic. Many studies described development of models for interventions or were study protocols of ongoing interventions and did not describe the outcome or results of an intervention,

which was the topic of interest in this review [42-58]. Other reasons for exclusion were that the intervention did not include a description of the participants' age, or excluded older workers [42;54;59-61], or that it did not describe agricultural workers [49-51;53-55;61;66].

Discussion

In order to obtain better knowledge of older workers in agriculture, this paper reviewed published articles presenting evaluations of past interventions intended to decrease risks and work injuries among agricultural workers aged 55 years and older. This is interesting because working on farms and older workers are both correlated with a higher proportion of work-related injuries and death [5-8;14-19;36]. However, the articles that met the strict criteria for this review did not report any marked injury decrease among older agricultural workers following the interventions. There seems to be a situation whereby many articles and statistics over the years and around the world describe injuries in agriculture and among older workers, but few scientific publications evaluate intervention programmes to reduce the problem. It is perhaps easier to measure and research the problem and suggest recommendations than to actually make an intervention and conduct a successful evaluation [68].

An extensive literature search revealed that there were few intervention studies focusing on injury prevention among older workers in agriculture. Application of three strict selection criteria for this review (evaluated intervention projects to prevent injuries; participants aged 55 years and older; and working in agriculture) resulted in only three articles that met the criteria. Earlier review studies have pointed out the great shortage of relevant studies regarding interventions to prevent injuries in agriculture (69-70) and of interventions promoting health and safety for older workers (71-73). Therefore the lack of intervention studies that included both older workers and injury prevention in agriculture was not a surprise. An additional problem in the present review was finding any actual

evaluations showing an outcome and results from the intervention. It is important to rectify these shortages in order to bring about change.

The inclusion criteria in the present study were based on research quality labelling and a possible limitation is that the article had to be published in a scientific journal searchable in an electronic database. There could also be more or less successfully implemented interventions in practice, but not published in scientific journals, and therefore not included in this review. That may have excluded some evaluations of intervention studies. It was also important that the interventions were evaluated and that the outcome was described in the articles. This criterion was set to include evaluations of whether the intervention design was successful or not. A study protocol or a description of an intervention without an evaluation says nothing about the outcome and was thus not relevant for this review. Furthermore, restricting the search to articles published from the year 2000, because older interventions were considered less relevant in light of the fast technical and organisational changes occurring in agriculture, may have excluded some material.

The three intervention studies that met the inclusion criteria appeared to be solid, well-executed and successfully implemented [39-41]. However, the evaluation of the interventions could not show an injury-reducing effect for older agricultural workers. In addition, the intervention evaluations referred to older workers, compared with younger age groups, as being less likely to: participate voluntarily in health and safety intervention programmes; be aware of safety practices in their tasks; and use safety equipment such as ROPS. However, there are some factors to consider in the intervention design. It has been demonstrated that older people learn to remember things in a different way than when they were younger [74;75;76]. There is sometimes a misunderstanding and age discriminating descriptions that older people cannot or is not interested in learning new things [77-79]. Though, this is not an excuse for not implement interventions to this specifically risk exposed group. The interventions must instead be designed to meet the needs of older workers. It takes a longer time for older people to structure and organise new information in a cognitive way, which affects the time they take to learn new things [74;75]. On the other hand, if the new knowledge is

linked to the existing knowledge of older people, they can learn faster than young people. In fact, the actual potential to learn new things in old age is mostly affected by the individual's own belief about their potential to learn and if they want to make a change [76]. The design of interventions needs to include these aspects about older people if they are to be successful. Repeating information, continuing education and pedagogic methods such as "learning by doing" seem to be a better way to teach new things and increase injury awareness among older workers than a one-off or short-term information campaign [6;74-76;80]. Furthermore, the participation among elderly people is lower than among younger workers [39-41], so approaches to attract older workers need to be considered in the intervention design. Addressing a message directly to people in a special target group makes those people feel involved and increases their willingness to participate in interventions [80], in this case older workers in agriculture.

The design of approaches to evaluate interventions is another important question to consider. This is because intervention studies in general can have a problem identifying an effect and also determining whether the effect was an outcome of the preceding intervention or not [68;81]. The three articles reviewed here used three different evaluation designs. Two actually evaluated the effect of the intervention: one assessed the effect in three groups with different levels of exposure to the intervention programme [40], and one examined the effect on the whole study population of changes in the use of risk-reducing equipment over time [41]. The third study evaluated the participation rates in the intervention, and not the effect of the programme on the participants' health and injuries or use of risk-reducing equipment [39]. Exchanges of information between people and in the general media increase the possible effect, but decrease the actual difference in exposure between those considered "exposed" and those considered "not exposed" in the evaluation. One example is an intervention with rice farmers in Thailand to empower them to protect their health and prevent occupational health hazards [65]. In the third year of the intervention, the researchers found that new networks of farmers and student-teachers had started by themselves in the surroundings and were using the intervention's health promotion model for occupational health and

safety. This could also be one reason why AHSN [40] did not find any significant effect on comparing the outcome between groups in its evaluation. People live together in society and the design of an intervention is complicated because people cannot be isolated as in a laboratory experiment. The aim of an intervention is also to spread information to people and propose changes in attitudes and behaviour. Successful information campaigns result in increased communication and informal information spreading in the community. Making a difference, e.g. decreasing health problems, is the main goal of starting an intervention. However, general spread of the information is unhelpful and could be a problem if the evaluation is designed to measure the effect of the intervention in different exposure groups.

The effectiveness of an intervention is measured by an evaluation method. Deciding how and what to measure in the evaluation is important for the validity of the intervention study [54;55;80]. For example, reporting how many participants an intervention includes is not a valid measure of the effectiveness of the intervention if the aim is actually to reduce injuries among older agricultural workers. This lowers the validity of the study because it measures something else, and the effectiveness in reducing injuries among older agricultural workers cannot be stated based on that evaluation. However, measuring the number of participants is a good way to study the interest in making attitude and behavioural changes, as in the FarmSafe Programme in New Zealand [39], but the problem is that such evaluations do not show whether the participants then change their attitude and behaviour and whether the incidence of injury is decreased. The effect of an intervention programme aiming to change attitudes and behaviour is longitudinal, and therefore an evaluation such as that in the article about ROPS implementation in the total study population [41] could be a successful design. However, that study included no information and no control about whether those included in the evaluation actually took part in the intervention or whether the use of ROPS decreases mortality on farms. The organisation funding a research project often wants a result (often a good one) after a shorter period than ten years. The design used in intervention evaluations in all three articles reviewed [39-41] of measuring the effect in different directions seems therefore

to be an interesting suggestion. Evaluation of successful intervention designs could be a topic for a further review study. The problem within an intervention study is often measuring the effect, as the study population and control population need to be similar but cannot be isolated from each other as in a laboratory experiment [42;48]. Designing significant evaluation approaches for intervention projects therefore needs to be further researched, e.g. design of process evaluations, effect evaluations, etc.

This extensive literature search also found very few intervention studies regarding injury prevention to older agricultural workers published in scientific journals. Designing an intervention study and measuring the real outcome is complicated. However, the importance of interventions to reduce the gap between knowledge of a health or injury problem and making a practical and sustainable change through implementation in practice need to be highlighted in the research society and among research funding organisations. It is important to spread knowledge on initiatives undertaken, successfully or not, in order to increase the possibility to reduce work-related injuries in agriculture and to older workers. To achieve this, it is important to carry out more scientific evaluations of interventions and publish the results in readily available form. The results from past intervention programmes can be applied to spread new knowledge, bring about change and reduce injuries among older workers.

Conclusions

The most important findings in this review are the marked lack of injury decrease among older agricultural workers brought about by the interventions evaluated in the literature and the shortage of scientific publications on the subject. An important issue for a sustainable society is reducing injuries among one of the most vulnerable work groups, older workers, in one of the most dangerous work places, agriculture. Based on the results of this review, methods to achieve this need to be identified, refined and widely circulated. The evaluations reviewed were generally successful, but did not demonstrate any significant recognised or confirmed injury-reducing effect among older

agricultural workers who participated in an intervention. Instead, the evaluations found that older farmers were less likely than their younger counterparts to participate voluntarily in health and safety intervention programmes; to apply new safety practices in their tasks after the intervention; or to use safety equipment such as tractor roll-bars after receiving safety information. Reducing work-related injuries among older agricultural workers seems to be a great challenge and suitable intervention and evaluation methods need to be formulated.

Acknowledgements

The study was supported by The Royal Swedish Academy of Agriculture and Forestry (KSLA) and SLO-foundation

References

- [1] ILO. Good Practices in Labour Inspection. The Rural Sector with Special Attention to Agriculture. Geneva: International Labour Offices; 2011.
- [2] OECD. Population Pyramids in 2000 and 2050. OECD Statistics Portal: Demography and Population; 2007.
- [3] Head L. Baker PM.A. Bagwell B. Moon NW. Barriers to evidence based practice in accommodations for an aging workforce. *Work*, 2006;27:391–396.
- [4] Nilsson K. To work or not to work in an extended working life? Factors in working and retirement decisions. *Acta Universitatis Agriculturae Sueciae*; 2013.
- [5] Statistic Sweden Jordbruksföretag och företagare 2007. [Agricultural Enterprises and Entrepreneurs 2007] Rapport JO 34 SM 0801; 2007. (in Swedish)
- [6] Hernandez-Peck M.C. Older Farmers: Factors Affecting Their Health and Safety. Centre for Studies in Aging School of Social Work and Human Services, Eastern Washington University; 2008.
- [7] Villosio C. et al Working Conditions of an Ageing Workforce. European Foundation for the Improvement of Living and Working Condition; 2008.

- [8] Thelin A. Holmberg S. Farmers and retirement: a longitudinal cohort study. *Journal of Agromedicine*, 2010;15(1):38-46.
- [9] Mitchell L. Hawranik P. Strain L. Age-related Physiological Changes: Considerations for Older Farmers' Performance of Agricultural Tasks. Winnipeg, Centre of Aging, University of Manitoba, Canada; 2002.
- [10] Mayers JR Layne LA. Marsh SM. Injuries and fatalities to U.S. farmers and farm workers 55 years and older. *American Journal of Industrial Medicine*, 2009;52:185-194
- [11] Lilley R. Day L. Koehncke N. Dosman J. Hagel L. William P. The relationship between fatigue-related factors and work-related injuries in the Saskatchewan farm injury cohort study. *American Journal of Industrial Medicine*, 2012;55:367-375.
- [12] Walters JK. Olson R. Karr J. Zoller E. Cain D. Douglas JP. Elevated occupational transport fatalities among older workers in Oregon: An empirical investigation. *Accident Analysis and Prevention*, 2013;53:28-38.
- [13] Purschwitz MA. Field WE. Fatal farm injuries to older workers. *Work*, 1991; 2(1):47-53
- [14] Lundqvist P. Ökad säkerhet inom jordbruket – interventioner och andra strategier. [Increased Safety in Agriculture - Interventions and Other Strategies] Rapport 2012:15. Swedish Work Environment Authority; 2012. (in Swedish)
- [15] Rautiainen R, Lehtola MM, Day LM, Schonstein E, Suutarinen J, Salminen S, Verbeek JH. Interventions for Preventing Injuries in the Agricultural Industry (Review). *The Cochrane Library*, 2009, Issue 3.
- [16] Nordic Council of Ministers. Fatal occupational accidents in the Nordic countries 2003 – 2008, Tema Nord 2011:501. Copenhagen; 2011.
- [17] Farrow A. Reynolds F. Health and safety of the older worker. *Occupational Medicine*, 2012;62:4-11.
- [18] Collin McLaughlin A. Sprufera JF. Aging farmers are at risk for injuries and fatalities: how human-factors research and application can help. *North Carolina Medical Journal*, 2011;72(6): 481-483.

- [19] Swedish Work Environment Authority. Korta arbetsskadefakta, Jordbruk [Brief Statistics on Work-related Injuries in Agriculture]. Nr 2/2009. (in Swedish).
- [20] Swedish Work Environment Authority. Arbetsskador 2013 [Occupational Accidents and Work-related Diseases] Arbetsmiljöstatistik Rapport 2014:1. Stockholm: Swedish Work Environment Authority; 2014. (in Swedish).
- [21] Moyers PA. Coleman SD. Adaptation of the older worker to occupational challenges. *Work*, 2004;22:71–78.
- [22] Holliday R. Ageing and the decline in health. *HEALTH*, 2010;2(6):615-619.
- [23] Koolhaas W. van der Klink JJ. Groothoff JW. Brouwner S. Towards a sustainable healthy working life: association between chronological age, functional age and work outcomes. *European Journal of Public Health*, 2012;22(3):424-429.
- [24] Laslett P. *A Fresh Map of Life: The Emergence of the Third Age*. Cambridge Massachusetts, Harvard University Press; 1991.
- [25] Seitsamo J. Klockars M. Aging and changes in health. *Scandinavian Journal of Work, Environment & Health*, 1997;23 suppl.(1):27-35.
- [26] Kampfea CM. Wadsworthb JS. Mamboleoa GI. Schonbrunc SL. Aging, disability, and employment. *Work*, 2008;31:337–344.
- [27] Kilbom Å. Torgén M. Fysisk förmåga och hälsa bland äldre i yrkeslivet. [Physical ability and health among older workers]. In Aronsson G. Kilbom Å. (eds.) *Arbete efter 45. Historiska, psykologiska och fysiologiska perspektiv på äldre i arbetslivet*: 103-132. Stockholm: Swedish National Institute of Working life; 1996. (in Swedish)
- [28] Hunter J. Demographic variables and chronic pain. *Clin Journal Pain*, 2001;17:14-19.
- [29] Ahola K. Sirén I. Kivimäki M. Ripatti S. Aromaa A. Lönnqvist J. Work-related exhaustion and telomere length: A population-based study. *PLoS One*, 2012;7 (7), Article e40186.
- [30] Hallsten L. Arbete och psykologiska åldersförändringar. [Work and mental age changes.] In Aronsson G. Kilbom Å. (eds.) *Arbete efter 45. Historiska, psykologiska och fysiologiska perspektiv på*

äldre i arbetslivet: 133-172. Stockholm, Swedish National Institute of Working life; 1996. (In Swedish.)

- [31] Nilsson K. Pinzke S. Lundqvist P. Occupational injuries to senior farmers in Sweden. *Journal of Agricultural Safety & Health*, 2010; 16(1): 19-29.
- [32] Ilmarinen J. Promotion of work ability during aging. Kumashiro M. (ed.) *Aging and Work*. London, Taylor & Francis; 2003.
- [33] Pinzke S. Nilsson K. Lundqvist P. Farm tractors on Swedish public roads – age-related perspectives on police reported incidents and injuries. *Work*, 2014;49:39–49 39
- [34] Ilmarinen J. *Toward a longer working life: Aging and quality of working life in the European Union*. Helsinki, Finnish Institute of Occupational Health; 2006.
- [35] Choi SD. Safety and ergonomic considerations for an aging workforce in the US construction industry. *Work*, 2009;33:307–315.
- [36] Nilsson, K. Why work beyond 65? Discourse on the decision to continue working or retire early. *Nordic Journal of Working Life Studies*, 2012;2(3):7-28.28.
- [37] Nilsson K. Hydbom AR. Rylander L. Factors influencing the decision to extend working life or Retire. *Scand J Work Environ Health*, 2011;37(6):473-480.
- [38] Higgins JPT. Green S. (editors). *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011. Available from www.cochrane-handbook.org.
- [39] Morgaine K. Langley JD. McGee RO. The FarmSafe Programme in New Zealand: Process evaluation of year one (2003). *Safety Science*, 2006;44:359-371.
- [40] Hagel LM. Pickett W. Pahwa P. Day L. Brison RJ. Marlenga B. Crowe T. Snodgrass P. Ulmer K. Dosman JA. Prevention of agricultural injuries: an evaluation of an education-based intervention. *Injury Prevention*, 2008;14:290-295.
- [41] Loring KA. Myers JR. Tracking the prevalence of rollover protective structures on U.S. farm tractors: 1993, 2001, and 2004. *Journal of Safety Research*, 2008;39:509-517.

- [42] Lolley R. et al. The relationship between fatigue-related factors and work-related injuries in the Saskatchewan farm injury cohort study. *Am J Ind Med*, 2012;55:367-375.
- [43] Frank AL. Issues of agricultural safety and health. *Annu Rev Public Health*, 2004;25:225-245.
- [44] Amshoff SK. et al. Health, Work and Safety of Farmers Age 50 and Older. *Geri Nurs*, 2005;26(5):304-308.
- [45] Walters JK. et al. Elevated occupational transportation fatalities among older workers in Oregon: An empirical investigation. *Acc Analys Prev*, 2013;53:28-38.
- [46] Fragar L et al. Partnerships to promote mental health of NSW farmers: The New South Wales farmers blueprint for mental health. *Aust J Rural Health*, 2008;16:170-175.
- [47] Polain JD. et al. Rapid change, climate adversity and next 'big dry': Older farmers' mental health. *Aust J Rural Health*, 2011;19:239-243.
- [48] Knauth P. et al. How to improve the work ability of elderly workers. The European research project RESPECT. *Int Cong Series*, 2005;1280:11-16.
- [49] Noonan RK. et al. Closing the Gap: A research agenda to accelerate the adoption and effective use of proven older adult fall prevention strategies. *J Safe Research*, 2011;42:427-430.
- [50] Edwards NC. Preventing falls among seniors: The way forward. *J Safe Research*, 2011;42:537-541.
- [51] Shephard R.J. Worksite health promotion and the older worker. *Int J Ind Ergon*, 2000;25:465-475.
- [52] Pèrés K. et al. Health and aging in elderly farmers: the AMI cohort. *BMC Pub Health*, 2012;12(558):1-9.
- [53] Strijk JE. et al. The Vital@Work Study. The systematic development of a lifestyle intervention to improve older workers' vitality and the design of a randomised controlled trail evaluating this intervention. *BMC Pub Health*, 2009;9(408):1-5.
- [54] Oude Hegel KM. et al. A worksite prevention program for construction workers: design of a randomized controlled trial. *BMC Pub Health*, 2010;10(336):1-8.
- [55] Koolhaas W. et al. Enhancing a sustainable healthy working life: design of a clustered randomized controlled trail. *BMC Pub Health*, 2010;10(461):1-9.
- [56] Richter JS. Et al. Initiation of farm safety programs in the Arkansas Delta: A case study of participatory method. *National Rural Health Association*, 2007;(Winter):89-91.

- [57] Myres JR. et al. Injuries and fatalities to U.S. farmers and farm workers 55 years and older. *Am J Ind Med*, 2009;52:185-192.
- [58] Zhang S. et al. A comparative study of health-promoting lifestyles in agricultural and non-agricultural workers in Japan. *Environ Health Prev Med*, 2011;16:80-89.
- [59] Doham KJ. et al. Injury and illness costs in the certified safe farm study. *J Rural Health*, 2007;23(4):348-354.
- [60] Stave C. et al. An intervention method for occupational safety in farming – evaluation of the effect and process. *App Ergo*, 2007(38):357-368.
- [61] Härmä M. et al. A controlled intervention study on the effects of a very rapidly forward rotating shift system on sleep-wakefulness and well-being among young and elderly shift workers. *Int J Psychophysiology*, 2006;59:70-79.
- [62] Sorensen JA. Et al. Results from inspections of farm-installed rollover protective structure. *J Agromed*, 2011;16:19-29.
- [63] Gates DM. et al. A pilot study to prevent hearing loss in farmers. *Pub Health Nurs*, 2007;24(6):547-553.
- [64] McCallum DM. What we know about the effectiveness of farm safety day programs and what we need to know. *J Rural Health*, 2013;29:20-29.
- [65] Burantreveth S. et al. Model development for health promotion and control of agricultural occupational health hazards and accidents in Pathumthani, Thailand. *Indust Health*, 2005;43:669-676.
- [66] Houghes SL. et al. Comparison of two health-promotion programs for older workers. *Am J Pub Health*, 2011;101(5):883-890.
- [67] Strijk JE. et al. A worksite vitality intervention to improve older workers' lifestyle and vitality-related outcomes: results of a randomised controlled trial. *J Epi Com Health*, 2012;66:1071-1078.
- [68] Glanz K. Rimer BK. Viswanath K. (Editors) *Health Behavior and Health Education. Theory, Research, and Practice. Fourth Edition.* San Francisco: Jossey-Bass Publishers; 2008.
- [69] DeRoo LA. Rautianen RH. A systematic review of farm safety interventions. *Am J Prev Med*, 2000;18(4S):51-61.
- [70] Lehtola MM. Rautianen RH Day LM Schonstein E. Suutarinen J. Saliminen S. Verbeek JH. *Scand J Work Environ Health*, 2008;34(5):327-336.
- [71] Crawford JO. Graveling HA. Cowie HA. Dixon K. The health safety and health promotion needs of older workers. *Occupational Medicine*, 2010;60:184-192.
- [72] McDermott HJ. Kazi A. Munir F. Haslam C. Developing occupational health services for active age management. *Occupational Medicine*, 2010;60:193-204.
- [73] Farrow A. Reynolds F. Health and safety of older workers. *Occupational Medicine*, 2012;62:4-11.

- [74] Salthouse T. Aging and measures of processing speed. *Biological Psychology*, 2000;54:35-54.
- [75] Mather M. Aging and cognition. *Cognitive Science*, 2010;1:346-362.
- [76] Hallsten L. Solem PE. Ålder och arbetsprestation. [Age and work capacity.] In Aronsson G. Kilbom Å. (eds.) *Arbete efter 45. Historiska, psykologiska och fysiologiska perspektiv på äldre i arbetslivet: 173-184.* Stockholm, Swedish National Institute of Working life; 1996. (in Swedish.)
- [77] Bengtsson E. Nilsson K. 2004. Äldre medarbetare. [Older worker.] Malmö, Swedish National Institute of Working life. (in Swedish.)
- [78] Nilsson K. 2011. Attitudes of managers and older employees to each other and the effects on the decision to extended working life. In Ennals R. Salomon RH. (eds.) *Older Workers in a Sustainable Society. Labor, Education & Society: 147-156.* Frankfurt, Peter Lang Verlag.
- [79] Thorsen S, Rugulies R, Lønggaard K, Borg V, Thielen K, Bjorner JB. The association between psychosocial work environment, attitudes towards older workers (ageism) and planned retirement. *International Archives of Occupational and Environmental Health*. 2012;85(4):437-445.
- [80] Aust B, Rugulies R, Finken A, Jensen C. When workplace interventions lead to negative effects: learning from failures. *Scand J Public Health*. 2010;38(3):106-19.
- [81] Naidoo J. Wills J. *Health Promotion. Foundations for Practice. Second Edition.* New York: Baillière Tindall; 2000