



# The healthy older worker: A systematic review of literature on work health and safety Interventions for older workers



**Centre**  
for WHS





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## The Healthy Older Worker: A Systematic Review of Literature on Work Health and Safety Interventions for Older Workers

This paper reports on research undertaken as part of the Centre for Work Health and Safety NSW funded project: The ageing demographic of the Australian workforce: prevention of work health and safety harm.

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## Executive summary

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This literature review is the first of a series of studies with the goal of developing a toolkit resource that will improve the ability of organisations to effectively manage the risk of physical and psychological injury amongst older workers. The systematic literature review examined interventions to improve physical and psychological injury outcomes amongst older workers, with a focus on measures to reduce exposure to work-related musculoskeletal disorders (WMSD) and psychological injury risks.

The search strategy was co-designed with the NSW Centre for Work Health and Safety, and searched relevant databases to find scholarly research articles and reviews specific to interventions for older worker health, safety and wellbeing, published in English after 2000. Grey literature included in the review was sourced from relevant government agencies, institutions, professional associations and targeted internet searches. A total of 32 scholarly outputs and eight grey literature records were included in the final review following an extensive screening and full text review process.

The review found no contemporary scientific articles on interventions for older workers which directly related to the prevention of MSD and psychological injury, although many had relevant content and were, therefore, included in the analysis. While a number of older studies were identified in the literature, some had methodological issues and others only investigating interventions for older workers partially.

Overall, the body of research reviewed was very small, with many records being excluded through the rigorous screening process due to not including content relevant to interventions for older worker work health and safety. Of the records retained, the number of high-quality intervention studies published was low, the quality of the evaluation designs employed was mixed, and Australian content records were limited.

It was also noted that interventions did not address context well, including industry, organisation, and the work tasks, nor were future of work forces and trends that are changing the nature of work and risks faced by older workers a consideration.

Composite interventions comprising both organisational and individual-level approaches appear to have most promise for addressing older worker injuries, although the number of records for composite or integrated interventions was very small. Organisational interventions were also effective in impacting some outcome variables, but many had significant methodological limitations. Examples of outcome variables affected by organisational interventions included improved posture (Taieb-Maimon et al., 2012), improvement in fatigue and musculoskeletal problems (Hesselink, de Leede & Gondswaard 2010), sick days and health perceptions (Piszczek

and Pimputkar 2020). Individual-level interventions tended to have mixed, short-term benefits in areas such as work stress reduction (Palumbo et al., 2012) and improvements in short-term dietary and exercise practices (Cook et al., 2015).

The report sets out a future research agenda that addresses the key shortcomings identified in the current body of research along with a focus on WMSD and psychological injury prevention in the Australian context. Finally, the report considers the implications of the systematic literature review findings for the development of an intervention to assist organisations in promoting healthy and safe work for older employees – the Healthy Older Worker Toolkit. This toolkit will be developed and evaluated in Phase 3 of this project.

# 1. Introduction

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## 1.1 Project background

This literature review is the first of a series of three studies that will inform the development of a toolkit resource aiming to improve the ability of organisations to effectively manage the risk of physical and psychological injury amongst older workers.

The project comprises:

- a) A systematic literature review on interventions to improve physical and psychological injury outcomes amongst older workers, with a focus on measures to reduce exposure to risk for work-related musculoskeletal disorders (WMSD) and psychological injury;
- b) A quantitative questionnaire survey that examines the relationship between a wide range of workplace factors, WMSD risk factors and psychosocial risk (PSR), and injury outcomes amongst older workers;
- c) An intervention study that develops and evaluates a Healthy Older Work (HOW) Toolkit intervention designed to assist organisations in assessing the impact of workforce ageing on WHS systems and processes, and in the design and redesign of work for older workers.

A co-design process with the Centre for Work Health and Safety (CWHS) was an integral part of the research project. The nature of WHS duties in NSW informed our approach. While our focus was on preventative and proactive organisational strategies and interventions that improve organisations' capacity to manage physical and psychological injury risks associated with older workers, the review also included a number of individual-level intervention studies and interventions with composite individual and organisational elements.

### 1.1.1 Defining 'older workers' for this report

There is no accepted definition in the Australian context of the age at which someone would be classified as an 'older worker'. The Australian Bureau of Statistics define older workers as employed people aged between 45-64, while health begins to decline at age 55, according to the Queensland Government's Office of Industrial Relations (2019). We note that various ages and age ranges were used to define older workers in the records reviewed in this report.

## 1.2 Introduction to older worker WMSD and psychological injury

While a growing body of research has focused on identifying and assessing the extent and nature of WHS risks to older workers, research that focuses on Australian older workers' health, safety and wellbeing is very limited. None of this literature deals specifically with intervention for older worker WMSD and PSR prevention. Responding to this knowledge gap, the present review has the primary goal of identifying interventions to promote healthy and safe work for older

workers in the international literature, with a focus on WMSD and psychological injury prevention. This will contribute to the production of a *Healthy Older Worker (HOW) Toolkit* intervention in Phase 3 of the research project.

Ageing of the workforce is an important issue that is seldom addressed in safety management systems and risk management plans. As workers are working into older age, work tasks, systems, and equipment need to adapt in order to continue to prevent injury, consistent with an organisation's WHS duties. Strategies commonly used to deal with the challenge of ageing workforces are problematic. Individual-level controls, such as exercise programs for older workers, focus at the wrong end of the hierarchy of controls and are of questionable efficacy given age-related physical and cognitive changes. By contrast, re-designing work systems and work tasks to fit the capabilities and needs of older workers can reduce injury and boost productivity. To be successful, active consultation with older workers is required to enable tailoring of work tasks to the specific work conditions in question.

The focus of this literature review is on the prevention of older worker injury in two highly prevalent and costly injury areas: WMSD and psychological injury. WMSD and psychological injury have complex aetiologies arising from exposure to physical and psychosocial hazards in the workplace (Robertson, Jayne & Oakman, 2021). International research indicates older workers experience a high prevalence of WMSD (Delioiacono, 2015; Tugman, 2013). WMSD are also the most frequent and costly injury type for Australian businesses. Over half (58%) of all serious workers' compensation claims in Australia in 2015-16 were for WMSDs, estimated as costing more than \$24 billion annually (Oakman, Clune & Stuckey, 2019). The Australian Institute of Health and Welfare (2019) report that in 2014-15, 30% of Australians had at least one WMSD and that this prevalence increases with age. A target to reduce the incidence rate of claims for musculoskeletal injuries and illnesses, and serious mental health conditions, is reported in SafeWork NSW's Work Health and Safety Roadmap for NSW 2022.

Further, WMSDs are responsible for 41% of early retirements of workers aged 45-65 years (Arthritis Australia, 2016). The role of psychological stress in WMSD aetiology is widely acknowledged and workplace stress is considered a psychosocial hazard, increasing the risk of occupational injuries such as WMSDs. For older workers, psychological injury exacerbated by the impact of WMSD may lead to loss of employment and early retirement. In turn, this potentially increases the risk of functional decline, social isolation, and often decreases physical activity which further increases the risk of other comorbid chronic conditions (e.g. cardiovascular disease) and death.

The extant literature highlights the fact that psychosocial risks, such as high demands, role conflict, lack of managerial or co-worker support, stress, bullying and discrimination in the work environment, are detrimental to both health and wellbeing of older workers and can also



increase the probability of early retirement (Beehr et al., 2000; Bentley et al., 2019; Bibby, 2008; Chiu et al., 2001; Nilsson, 2016). Indeed, studies indicate that where the work is intrinsically stressful, such as is the case for police officers (Gershon, Lin & Li, 2002) and nurses (Santos et al., 2003), older workers are more likely to have significant mental health problems. In line with this research, Nilsson (2016) found that a poor work environment and associated stress and mental disorders are associated with early retirement amongst older workers, especially in highly demanding work environments (Johnston & Lee, 2009).

Furthermore, the organisation and scheduling of work is critical to older worker health and wellbeing. Working part-time for example, appears to be a strong predictor of positive health and wellbeing for older Australian (Forbes et al., 2015) and Japanese (Kajitani, 2011) workers.

Research also indicates that older workers may need more rest and recovery time between periods of work and are less able to sustain long work hours and high work-pace (Nilsson, 2016). However, other research evidence suggests that older workers may be more resilient to work demands, including work-family conflict and stress (Mauno, Ruokolainen & Kinnunen, 2013).

The literature offers growing empirical evidence for the role of the organisation in supporting the health and wellbeing of older workers through initiatives focused on this population specifically. These include human resource management (HRM) mature-age practices such as recognition, support and flexible work opportunities. These practices have been found to increase older workers' wellbeing and satisfaction with work (Bentley et al., 2017; Kooij et al., 2010; Raab, 2020). In this regard, a small but growing body of literature has examined the role of HRM on employee wellbeing (Guest, 2011), and in particular, the role of HRM practices on older worker health, wellbeing and retention outcomes (Armstrong-Stassen, 2008; Bentley et al., 2017; Guest, 2017). HRM practices designed to enhance wellbeing and retention of older workers are important to consider as they offer an organisational level approach to improving the work environment and working conditions of older workers. These HRM practices include job design measures and improvements to the work environment. Teo et al. (in press) found that mature-age HRM practices were related to improved wellbeing and partially mediated the relationship between inclusive leadership and psychological wellbeing. This finding was explained through older worker perceptions of feeling recognised and valued. The perception of job design and positive changes to the work environment promoted worker wellbeing and positive engagement in work (Bentley et al., 2017).

One area of HRM practice that has become increasingly prevalent due to the COVID-19 pandemic and its restrictions on work is flexible working. These arrangements have been suggested as an important strategy for the ongoing healthy engagement of older workers in employment (Bentley et al., 2017). Indeed, Vanajan et al. (2020) found perceived access to

flexible working hours and a psychologically safe climate to be associated with improvements in work ability amongst older workers with chronic health conditions.

These and other studies clearly demonstrate that it is the organisation of work and the work environment, rather than the age-related factors per se, that are the more important influences on older workers' wellbeing (EU-OSHA, 2016; Guglielmi et al., 2016; Raab, 2020; Thorsen, Jensen & Bjørner, 2016). This indicates that intervention should focus on prevention of physical and psychological injury through intervention at the organisational and work environment level, rather than individual-level approaches which tend to predominate in the general WHS intervention literature. Organisations that address the injury risk as close to the cause as possible are also considered consistent with the primary duty on NSW PCBUs to prevent sources of harm to physical and psychological health.

### **1.3 Intervention for older worker WMSD and psychological injury**

As highlighted in the previous section, the key focus for intervention and preventive efforts to reduce the risk of WMSD and psychological injury should be on prevention of hazards in the work environment and work system that can cause harm (See Caponecchia, 2019; Leka et al., 2011; Mackay et al., 2004; Robertson, Jayne & Oakman, 2021; Spurgeon, 2003). Indeed, this is in keeping with widely accepted WHS practice and is consistent with the primary duty on NSW PCBUs to prevent sources of harm to physical and psychological health. Furthermore, recent research by Robertson, Jayne & Oakman (2021) noted that the complex and multifactorial aetiology of WMSD and psychological injury require systematic approaches to risk management, although fragmented risk management practice is most evident in Australian workplaces (Robertson, Jayne & Oakman, 2021).

The need to intervene as close to the source of harm as possible and to address the complex nature of WMSD and psychological injury indicates that organisational-level, systematic approaches to intervention should also be applied in the case of older worker injury. According to the European Agency for Health and Safety at Work, risk prevention addressing risks to older workers and the wider workforce should focus on changes in the way work is carried out, reducing physically demanding work, exposure to repetitive work or dangerous substances, using equipment to make work easier and avoiding prolonged risk exposures (EU-OSHA 2016, p.12). However, research by Robertson, Jayne & Oakman (2021) found Australian organisations predominantly used individual-level risk management approaches to address WMSD and psychosocial hazards, such as addressing employee behaviour, rather than identifying and controlling the source of the hazard.

Interventions for managing the risk of WMSD and psychological injury are generally organisational or individual focused, and are many in scope and variety. Organisational

interventions are most commonly primary prevention interventions (e.g. job design, ergonomics), and act closest to the sources of harm. Individual level interventions are most commonly secondary/tertiary in nature (stress management, mindfulness, training, exercise), and focus further from the source of harm, often dealing with the resulting symptoms rather than addressing the causes themselves. As noted above, interventions that act closest to the sources of harm, notably organisational interventions, are most important in prevention of older worker WMSD and psychological injury. However, intervention programs can also be composite, including multiple elements, and may incorporate both organisational and individual-level aspects.

## 1.4 Aims and scope

The aim of this study is to identify, from the international scholarly and grey literature, effective organisational intervention approaches for older worker health, safety and wellbeing. Specifically, the review will examine strategies for older workers in relation to:

- i) interventions for older worker health, safety and wellbeing, including safety management systems interventions;
- ii) effective participatory intervention design and evaluation approaches; and
- iii) job design approaches to the prevention of physical and psychological injury.

The review also aims to incorporate an integrative element, whereby new models for intervention related to WHS for an ageing workforce are developed from the literature.

The search strategy, outlined in the Methods section, was co-designed with the CWHS, and focuses on records that include interventions. Broadly, papers that report on experiments on the relationships between variables, and mention options for future interventions were not included (see Screening, Section 2.2.4).

## 2. Method

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A systematic review of the literature on effective organisational intervention approaches for older worker health, safety and wellbeing was conducted. The scope of the systematic literature review was co-designed with the CWHS using standard research methods for conducting systematic literature reviews.

### 2.1 Co-designed search strategy

The research team developed a preliminary literature search strategy, including potential search terms. The team tabled the proposed strategy, together with a list of potential databases for the scholarly literature search, for discussion at a co-design meeting with the CWHS

representatives. During the same meeting sources of grey literature were discussed and a search strategy for the grey literature agreed upon. The protocol for each category of literature, the scholarly literature and the grey literature, are presented separately in this section.

## 2.2 Scholarly Literature

### 2.2.1 Search terms

Two members of the research team consulted with a university librarian to discuss the proposed search terms and search strategy for the scholarly literature. After further testing of the search terms and following the guidance offered by the university librarian the final search terms were determined (see Table 2.2.1). The search terms were adapted for database nuances.

Table 2.2.1: Search Terms for the scholarly databases

| Aged worker terms (joined with OR)  | AND | Workplace injury terms (joined with OR)  | AND | Outcomes (specific injuries) (joined with OR)   | AND | Organisational interventions (joined with OR)  |
|---|-----|--|-----|---|-----|--|
| older worker<br>ag*ing<br>workforce<br>mature age<br>worker<br>older<br>employee* |     | work-related<br>injur*<br>occupational<br>injur*<br>work injur*<br>workplace<br>injur*<br>workability<br>occupational<br>health and<br>safety injur*<br>workplace<br>health and<br>safety injur*<br>workplace<br>organisation<br>organization<br>occupation* |     | psycho* health<br>psycho* safety<br>psycho* harm<br>psycho* disorder<br>mental health<br>outcomes<br>mental wellbeing<br>musculoskeletal<br>disorder<br>WMSD<br>MSD<br>musculoskeletal<br>injur*<br>pain<br>mental illness<br>workplace stress<br>occupational injur*<br>workplace injur*<br>age discrimination<br>strains and sprains<br>occupational<br>overuse<br>repetitive strain<br>slip fall trip<br>wellbeing<br>well-being<br>healthy work<br>health at work |     | control strateg*<br>risk control*<br>participatory<br>intervention*<br>management<br>system<br>evaluation<br>approach<br>risk prevention<br>injury prevention<br>risk management<br>job design<br>manual handling<br>intervention<br>workplace<br>intervention<br>organisational<br>intervention<br>early intervention<br>intervention<br>strategy<br>healthy<br>workplaces<br>return to work<br>ergonomics<br>job control |

The databases were selected for the scholarly literature to search across the range of research fields relevant to the study – health journals, psychology journal, business journal and a citation database.

Table 2.2.2: Scholarly databases searched

| Area of academic inquiry          | Database                        |
|-----------------------------------|---------------------------------|
| Nursing, Allied Health & Medicine | CINAHL (which includes MEDLINE) |
| Psychology                        | PsychINFO                       |
| Business                          | ProQuest Business               |
| Citation Database                 | Scopus                          |

### 2.2.2 Exclusion and inclusion criteria

To be included, records had to meet the following criteria: published after 2000; published in English. To ensure high quality results, the search focused on records categorised as journal articles, reports, literature reviews, and conference proceedings. Less rigorous and reliable sources, such as newspaper articles, magazine articles, media reports, commentaries, opinion pieces, or editorials were excluded.

### 2.2.3 Search protocol

The searches were conducted in July 2021. The database searches identified 3458 studies for review (Appendix 7.1).

### 2.2.4 Screening

The records returned from the database search were uploaded into Endnote where 172 duplicates were removed. The records were then uploaded to 'Covidence', web-based software that streamlines the organisation of data for systematic reviews. Covidence identified an additional seven duplicates which were removed.

Issues that resulted in papers being excluded at the screening and subsequent stages, included records that focused on:

- domains other than work (e.g. medical treatment/interventions for clinical populations)
- issues other than interventions for older workers (e.g. experimental work that mentioned possible interventions for consideration in future research, or did not consider an intervention at all)
- returning older people to the workforce (e.g. retirees, the unemployed, people with illness unrelated to workplace injuries)
- finding new work opportunities for older people so that they can participate in employment
- removing discrimination or stigma around hiring older people

Seven members of the research team independently screened the records by Title and Abstract in Covidence, which randomly assigned records to each researcher, until all of the records had been screened by two researchers. Where two researchers voted differently, the files were classed as 'conflicts'. Two members of the research team reviewed the conflicts, and resolved each conflict (inclusion/exclusion). A second round of screening by Title and Abstract was conducted by two members of the research team who agreed on whether or not to include/exclude each record by consensus.

Next, the 53 selected papers were subjected to a full paper review. A number of papers were excluded at the full text analysis stage, for reasons including that they did not report on organisational interventions, were not focused on older workers, or more broadly did not fit the criteria used in the review process. Papers that made theoretical contributions, but did not implement or evaluate interventions were excluded, although these were used to inform our analysis and interpretations. Where records were study protocols, progress on those studies was checked and records reporting on the implementation on the intervention were selected for review for inclusion in this study.

An additional 21 records were identified from references of the scholarly records examined during the full text review. These were subject to the same full paper screening process. Subsequently, 10 additional records were included in the review. This resulted in a total 32 scholarly records.

## **2.3 Grey literature**

The grey literature search strategy involved searching the websites of key organisations, government bodies and other enterprises with an interest in workplace health and safety, older workers, and wellbeing at work. These included: Regulator/WHS Expert bodies in Australia and internationally (e.g. national and state SafeWork/WorkSafe, OSHA), Mental Health and wellbeing focused websites (e.g. Mentally Healthy Workplace Alliance), WHS/OHS Professional bodies (AIHS, NIOSH), Union websites, Professional Organisations (e.g. AHRI, CIPD), Management Associations, and international key bodies (e.g. World Health Organisation (WHO), International Labour Organisation (ILO)). In addition, research team members submitted grey literature for review.

### **2.3.1 Inclusion and exclusion criteria**

The inclusion criteria targeted reports, guidelines, toolkits and case studies that contained information on interventions or strategies designed for older workers. Documents were excluded for reasons including that they did not include interventions or they were not focused on older workers at work.

### 2.3.2 Screening

The grey literature website search identified 24 documents. Each document was allocated to a member of the research team who conducted the first screening. The first screening included scanning through the documents and noting whether the documents met the inclusion criteria, if it was relevant to the study, and if the intervention described was based on sound evidence. The additional 38 documents identified by the research team were screened using the same criteria – two duplicates were removed and 36 did not meet the inclusion criteria.

Next, the 12 grey literature documents selected for inclusion, underwent a second round of screening, together with three records identified through the screening of the references of the scholarly records. The second screening involved reading each identified document in depth and identifying the type of document (guidance material, toolkit, standards, reports, frameworks), the author, the year of publication, the country or state it was written for, the intended audience, and the focus of the intervention(s) described in the document. Documents were excluded for reasons including not focusing on older workers, or for not being informative for workplace interventions. This resulted in a total of eight records from the grey literature included in the systematic literature review.

### 2.4 PRISMA protocol

Using the PRISMA protocol for systematic literature reviews, Figure 2.4.1 shows the process for selecting and screening the scholarly and grey literature.

A total of 32 scholarly records and 8 grey literature records met the inclusion criteria to be included in the systematic literature review.

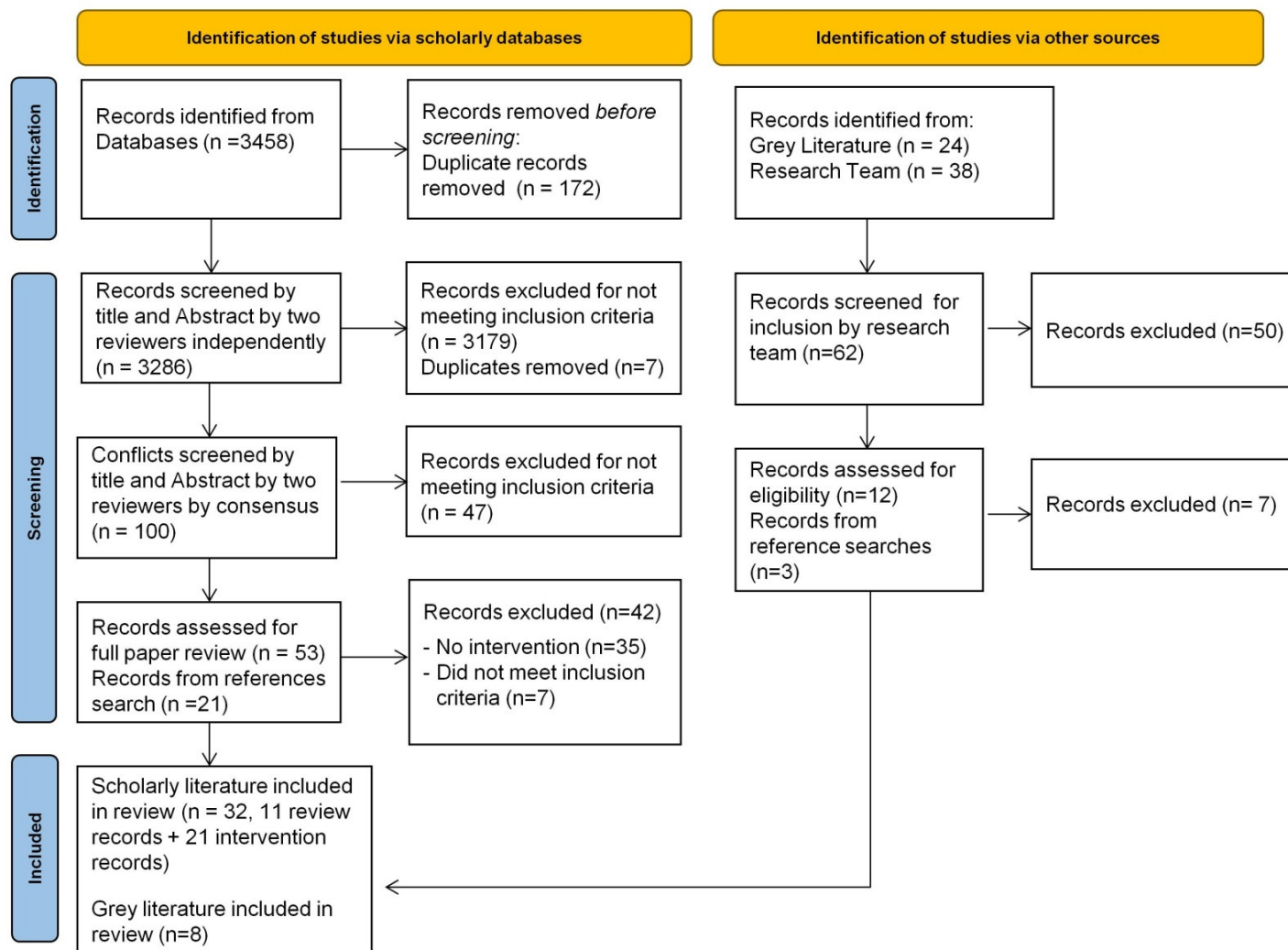


Figure 2.4.1: PRISMA diagram



## 3. Results

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### 3.1 Review Records

The eleven (11) review papers (see Table 3.1.1) are considered separately to the intervention paper records because they can often offer broader conclusions. Review papers consolidate and interpret research relevant to a particular research question(s), and can be helpful in summarising research approaches, major themes in research findings, and future research needs. Broadly, the reviews differed in terms of their focus on particular industries, interventions and outcomes. However, the number, scope and quality of the studies reviewed are very limited and suggest a significant gap in knowledge related to which interventions are most effective in tackling older worker injuries.

#### 3.1.1 Review context

Where stated, the age-range addressed within the review papers fell between 40-65 years. One review article had a focus across all working age ranges but included specific content on older workers (Pieper, Schröer, & Eilerts, 2019). Most reviews focused on older workers generally, rather than focusing on specific industries or occupational groups, with the exceptions being agriculture (Nilsson, 2016) and nursing and midwifery (Denton, Evans, & Xu, 2021).

The reviews were concerned with a range of older worker outcomes, extending beyond worker health, safety and wellbeing, to include related issues of work ability, performance and retention. None focused specifically on WMSD or psychological injury, although several papers included studies focused on either WMSD or employee wellbeing or work stress.

#### 3.1.2 Intervention foci

The intervention foci of the review papers were mostly inclusive of multiple interventions for older worker health, safety, wellbeing and work ability, although some addressed specific intervention categories: workplace physical activity interventions (Merom et al., 2021) and workplace health promotion campaign (Nilsson, 2016). The foci of the remaining review papers were across a wide range of interventions including those related to physical aspects (ergonomic design and equipment, engineering improvements, safety equipment); individual approaches (stress management, exercise, education programs); and organisational improvements (organisational changes to the work environment, administrative changes).

#### 3.1.3 Evidence for intervention effectiveness

Positive findings on intervention effectiveness were reported for composite/multi-component interventions (Pieper et al., 2019), and integrated approaches as systematic solutions for complex problems (Cooklin et al., 2017). These studies typically included both organisational

and individual-level interventions - for example, a combination of exercise, education and ergonomic equipment in reducing musculoskeletal pain (Pieper et al., 2019).

Evidence for the effectiveness of single component interventions for enhancing older worker health, safety, wellbeing or work ability was mixed. Job stress management training and workstation adjustments as single approaches were found to have no effect on WMSD outcomes (Pieper et al., 2019), while another review reported moderate effects of stress management training on stress reduction, although there was no evidence for the sustainability of this approach (Pieper et al., 2019). Workplace health promotion programs failed to improve the work ability, productivity or job retention of older workers (Poscia et al., 2016).

There was limited evidence that individual-level interventions such as health promotion, exercise, web-based programs and training can have positive outcomes for older workers (Merom et al., 2021; Poscia et al., 2016), although almost all the reviews reported methodological weaknesses that limited the value of the research studies. There was some evidence of effectiveness for multi-component interventions including a mix of organisational (e.g. workplace changes) and individual-level interventions (e.g. physical activity) (Pieper et al., 2019).

### **3.1.4 Methodological and quality considerations**

A number of the review papers reported that studies did not always use controls or utilise robust evaluation designs. The following evaluation design approaches were identified within the review papers for the evaluation of interventions for older worker health, safety, wellbeing and work ability:

- randomised-controlled design
- case-controlled design
- modified randomised
- no control
- process evaluation only

The lack of process evaluation for most studies also limited the ability of researchers to understand how effective the implementation process was, and identify barriers and facilitators of the intervention's success (Nielsen & Abildgaard, 2013). Problems with intervention and evaluation quality limited the value of intervention studies reviewed in a number of papers. These limitations include a lack of implemented and evaluated interventions (Nilsson, 2016), inadequate description of interventions implemented thus reducing their reproducibility (Merom et al., 2021), low-quality evaluation methodologies (Merom et al., 2021), small sample sizes (Poscia et al., 2016), and limited implementation and/or evaluation period (Poscia et al., 2016).

In summary, a common theme amongst several of the review papers was the paucity in the body of research on intervention to control risks to older workers, and evaluated interventions in particular (e.g. Crawford et al., 2010; McDermott et al., 2010; Pieper et al., 2019). Indeed, a number of the reviews conclude the need for higher-quality evidence from future intervention research for older workers, as there is currently insufficient evidence to recommend specific interventions (Pieper et al., 2019). Composite interventions that include a range of approaches may be most effective in addressing complex workplace problems such as work-related musculoskeletal disorders (WMSD) and psychological injury, but more, higher-quality, evidence is required.

Table 3.1.1. Review records

| Literature Type                         | Authors                       | Year | Aims  | Main Findings  |
|---|-------------------------------|------|---|--|
| Systematic Review of Systematic Reviews | Pieper, Schroer, and Eilerts. | 2019 | Synthesise the current evidence about health promotion interventions in the workplace for older employees, with a focus on interventions for the prevention of musculoskeletal disorders (MSD), psychological and behavioural disorders, and economic evaluations of interventions. | <ul style="list-style-type: none"> <li>• Impact of intervention:               <ul style="list-style-type: none"> <li>○ Job stress management training and workstation adjustment as single-component interventions had no effect on musculoskeletal outcomes</li> <li>○ Evidence for the positive effect of multi-component workplace programs</li> <li>○ Evidence for workplace interventions reducing absenteeism and associated costs</li> <li>○ Moderate evidence that Cognitive Behaviour Therapy, mindfulness-based stress reduction, and job stress management training can significantly reduce stress, but evidence for sustainability of these effects was insufficient or limited.</li> <li>○ Moderate evidence for workplace interventions (e.g. exercising, training, educational programs, and ergonomic desks/chairs decreasing symptoms and pain for employees experiencing musculoskeletal disorders</li> </ul> </li> <li>• Research design:               <ul style="list-style-type: none"> <li>○ Scientific literature contained insufficient evidence to recommend specific interventions</li> <li>○ More, higher-quality evidence is needed</li> <li>○ Guidance for managing increasing numbers of older employees and work-related chronic conditions cannot be provided from systematic reviews.</li> </ul> </li> </ul> |

| Literature Type              | Authors       | Year | Aims  | Main Findings  |
|------------------------------|---------------|------|---|--|
| Systematic literature review | Poscia et al. | 2016 | Systematically review the literature on workplace health promotion (WHP) interventions specifically targeted to older workers | <ul style="list-style-type: none"> <li>• Impact of intervention: <ul style="list-style-type: none"> <li>○ Current evidence fails to show that WHP programs improve the work ability, productivity or job retention of older workers.</li> <li>○ Insufficient evidence that workplace programs can increase the working capacity of older employees</li> <li>○ Moderate evidence that activity-based workplace interventions can reduce waist circumference, body weight, Body Mass Index (BMI) and other components of metabolic syndrome</li> <li>○ Limited evidence that web-based programs may be useful in changing older workers' behaviour</li> </ul> </li> <li>• Research design: <ul style="list-style-type: none"> <li>○ Most published workplace health promotion (WHP) studies had small samples, and were implemented for a limited period of time</li> <li>○ WHP studies focused on older workers are few and are generally poor quality</li> </ul> </li> </ul> |

| Literature Type              | Authors        | Year | Aims   | Main Findings   |
|------------------------------|----------------|------|--|---|
| Systematic literature review | Nilsson.       | 2016 | Review intervention studies intended to decrease risks and work injuries among older workers in the agricultural industry                        | <ul style="list-style-type: none"> <li>• Impact of intervention: <ul style="list-style-type: none"> <li>○ Interventions were less successful in involving older agricultural workers than younger agricultural workers.</li> <li>○ Intervention outcomes were generally less positive or found no significant difference in risk awareness and behaviour change among older agricultural workers.</li> </ul> </li> <li>• Research design: <ul style="list-style-type: none"> <li>○ Few implemented and evaluated intervention studies that focused on reducing injuries among older workers in agriculture</li> <li>○ None of the interventions included in the literature review had a clear positive effect</li> <li>○ Many intervention studies have problems with, or lack, evaluation in the study design.</li> </ul> </li> </ul>  |
| Systematic literature review | Cooklin et al. | 2017 | Systematically review the effectiveness of integrated workplace interventions that combine health promotion with occupational health and safety. | <ul style="list-style-type: none"> <li>• Impact of intervention: <ul style="list-style-type: none"> <li>○ Interventions that reported being effective for the stated outcomes, usually aimed at improving employee physical or mental health</li> <li>○ Less consistent results were reported from integrated interventions (i.e. those combining occupational safety and injury prevention with health promotion to protect and promote worker health and organisational cost savings).</li> <li>○ Empirical evidence, while still emerging, provides some support for integrated approaches as comprehensive solutions to complex issues</li> </ul> </li> <li>• Research design: <ul style="list-style-type: none"> <li>○ Most studies were of moderate quality</li> <li>○ Most studies reported on precursor outcomes, rather than the “harder” outcomes of mortality or costs.</li> </ul> </li> </ul> |

| Literature Type                     | Authors                             | Year | Aims  | Main Findings   |
|-------------------------------------|-------------------------------------|------|---|---|
| Systematic Review and Meta-analysis | Merom et al.                        | 2021 | Characterise and evaluate the effects of physical activity and fitness outcomes in workplace interventions that target older employees. | <ul style="list-style-type: none"> <li>• Impact of intervention: <ul style="list-style-type: none"> <li>○ One intervention (a small-scale intervention on muscle strength) demonstrated a significant effect on fitness outcomes, however collectively, there was no definitive evidence on effectiveness as pooled effects remained non-significant.</li> </ul> </li> <li>• Research design: <ul style="list-style-type: none"> <li>○ Most studies with multiple risk factor interventions had poor descriptions of the physical activity component of the intervention which reduced their reproducibility.</li> <li>○ Methodological quality of the studies was generally low.</li> <li>○ Approximately, 40% of interventions were conducted in universities or academic hospitals/clinics, limiting the generalisability of the findings</li> </ul> </li> </ul> |
| Scoping Review                      | Soderbacka, Nyholm, and Fagerstrom. | 2020 | Examine workplace interventions that support older employees' health and work ability, and the effect of these interventions.           | <ul style="list-style-type: none"> <li>• Impact of intervention: <ul style="list-style-type: none"> <li>○ Organisation-level improvements in work environment support older workers' work ability.</li> </ul> </li> <li>• Research design: <ul style="list-style-type: none"> <li>○ Few intervention studies had a focus on older workers, and when they were included the documentation and follow-up was lacking</li> <li>○ The small number of articles related to intervention studies for older workers suggests that a knowledge gap exists</li> </ul> </li> </ul>  |

| Literature Type | Authors                | Year | Aims   | Main Findings  |
|-----------------|------------------------|------|--|--|
| Scoping Review  | Denton, Evans, and Xu. | 2021 | Identify the challenges older workers encounter in the workplace and the organisational strategies required for workforce retention. | <ul style="list-style-type: none"> <li>• Impact of intervention:               <ul style="list-style-type: none"> <li>○ Five challenges were identified for older workers: physical difficulties, tiredness and fatigue, treated differently, lack of respect and lack of opportunities.</li> <li>○ Seven workplace strategies were identified to support older workers: wellness programs, redeployment, flexible hours, support networks, recognition of knowledge/experience, ergonomics, and ongoing education.</li> <li>○ Very little evidence that organisational support strategies were available in the workplace.</li> </ul> </li> </ul> |



| Literature Type   | Authors              | Year | Aims  | Main Findings   |
|-------------------|----------------------|------|---|---|
| Literature Review | Varianou-Mikellidou. | 2019 | Examine the changes that occur in ageing workers as a result of physical and psychological processes and the possible impacts of these at work in relation to occupational health and safety. | <ul style="list-style-type: none"> <li>• Impact of intervention: <ul style="list-style-type: none"> <li>○ Age-related changes help managers and HR to find adaptation measures in the workplace and enhance older workers abilities.</li> <li>○ Research regarding the ageing workforce exists; however, a specifically integrated management perspective for businesses is lacking</li> <li>○ More sustainable work management systems are needed</li> </ul> </li> <li>• Research design: <ul style="list-style-type: none"> <li>○ Research about the effects of the working environment/conditions and the connection of physiological and psychological age-related changes is still mostly lacking.</li> <li>○ There is an obvious lack in studies providing proactive measures.</li> <li>○ Studies identified hazards without giving solutions which may be due to the many articles limited to medical observation of the age-related changes.</li> <li>○ Medicine and WHS are not clearly combined in many studies, and findings from these different scientific sources makes analysis challenging</li> </ul> </li> </ul> |

| Literature Type   | Authors        | Year | Aims   | Main Findings   |
|-------------------|----------------|------|--|---|
| Literature Review | Roper and Yeh. | 2007 | Review obstacles faced by older workers in the workplace and provide ergonomic solutions designed to mitigate and prevent age-related injuries | <ul style="list-style-type: none"> <li>• Impact of intervention:               <ul style="list-style-type: none"> <li>○ Ergonomic improvements were commonly grouped in the literature into three categories: engineering improvements; administrative improvements; safety gear.</li> <li>○ Ergonomic solutions in workplace design are needed to compensate for the diminished physical capacities of older workers</li> <li>○ Ergonomic interventions need to improve the fit between the job and the capabilities of the employee performing it (e.g. engineering improvements).</li> <li>○ Engineering interventions involve rearranging, modifying, redesigning, or replacing tools, workstations, etc</li> <li>○ Administrative interventions require continuous management and employee feedback to ensure that the new practices and policies are effective (e.g. adjusting work schedules)</li> </ul> </li> </ul> |

| Literature Type   | Authors         | Year | Aims   | Main Findings  |
|-------------------|-----------------|------|--|--|
| Literature Review | Crawford et al. | 2010 | Identify the health, safety and health promotion needs of older workers, then, evaluate current research and evidence of successful workplace interventions. | <ul style="list-style-type: none"> <li>• Impact of intervention:               <ul style="list-style-type: none"> <li>○ The '20 health days intervention' was reported to have improved work relationships, health and increased decision-making ability in older workers</li> <li>○ Occupational health interventions can reduce the risk of early retirement from the workplace (e.g. one small study found that supporting fitness and managing change to maintain work ability influenced retirement intentions)</li> <li>○ There is limited research on health promotion but factors identified as important are ensuring participation by older workers in activities, understanding the importance of occupational health in this process, having positive working environments, good relationships with supervisors and co-workers and maintaining health and individual skills.</li> </ul> </li> <li>• Research design:               <ul style="list-style-type: none"> <li>○ Limited research for some findings (e.g. two studies suggest that health promotion enables older workers to increase control over the determinants of their own health, both use the same workplace intervention as evidence).</li> <li>○ Data gaps identified within the review include a lack of longitudinal studies, and few good quality intervention studies.</li> </ul> </li> </ul> |

| Literature Type   | Authors          | Year | Aims   | Main Findings  |
|-------------------|------------------|------|--|--|
| Literature Review | McDermott et al. | 2010 | Review current occupational health (OH) approaches aimed at maintaining the health and workability of older workers. | <ul style="list-style-type: none"> <li>• Impact of intervention:               <ul style="list-style-type: none"> <li>○ An intervention where older workers were screened by OH physicians to identify those at risk of early retirement found that fewer employees in the intervention group retired early than in the control group; however, at two years follow-up, no differences were found between the groups.</li> <li>○ An intervention to improve physical, psychological and social working conditions for older workers found at follow-up, that while participants reported a perceived increase in motivation and job satisfaction; researchers were unable to reliably conclude that physical changes had an impact on workload or job satisfaction.</li> <li>○ Where changes were made to work-stations, participants reported a significant decrease in upper back pain; but, no significant effect was found for persistent bodily pain or eye strain.</li> <li>○ An intervention to improve sleep, health and well-being by changing shift workers' shift rotating system to minimise the perceived effects of changes in sleep patterns found that age did not have a significant main effect and a greater improvement of general health was found among the younger age group.</li> </ul> </li> <li>• Research design:               <ul style="list-style-type: none"> <li>○ An age management intervention showed improvements in the values and attitudes of line managers towards managing older workers, but the effect on older workers was not measured.</li> </ul> </li> </ul> |

## **3.2 Intervention records summary**

This section reviews records from the scholarly literature of articles focusing on intervention studies and evaluations. Records were initially classified in terms of the type of interventions on which they focused. Just 21 articles were included in the final intervention reviews once non-intervention records, records that did not have a focus on older workers, and conceptual/theoretical articles were removed.

### **3.2.1 Outcome measures**

Intervention studies reviewed from the records utilised a wide range of outcome measures related to aspects of older worker health, safety, wellbeing and work ability. A number of the records specifically targeted improvements in WMSD, including some aspects of posture or ergonomics improvement, or work stress/mental health outcomes. However, many records measured other specific health and wellbeing outcomes or general outcomes, including fall prevention, balance, sleep duration, aerobic capacity and diet. Other studies targeted improvements to aspects of work design that would be expected to result in a reduction in exposure to WRMD and psychosocial risk factors. More general health outcome measures included work ability, absenteeism and sick days taken. The evaluation studies used both subjective/perceptual (e.g. self-rated health, work ability) and objective (e.g. absenteeism data, postural observations) outcomes measures.

In conclusion, few of the reviewed studies can be considered WMSD or psychological injury prevention in focus, although many have relevant outcomes, notably work ability, ergonomics and postural improvements, workplace improvements and absenteeism.

### **3.2.2 Evaluation study design**

Of the 21 records examined, approximately one-half (n=11) reported using randomised-controlled trial (RCT) or case-controlled evaluation designs, involving treatment groups which received the intervention and control groups who did not – although in some cases the intervention was provided to controls following the evaluation period. Two studies appear to have used no control group.

### **3.2.3 The interventions**

The interventions reported in this literature can be broadly divided into those which focus on individual-level interventions (n=9) and those which reported organisational level interventions (n=9). Two records reported composite interventions which included both individual and organisational interventions. One record reported a general analysis of outcomes for organisations using some form of intervention for older workers versus those that did not. Figures 3.2.1 and 3.2.2 show the range of individual and organisational-level interventions.

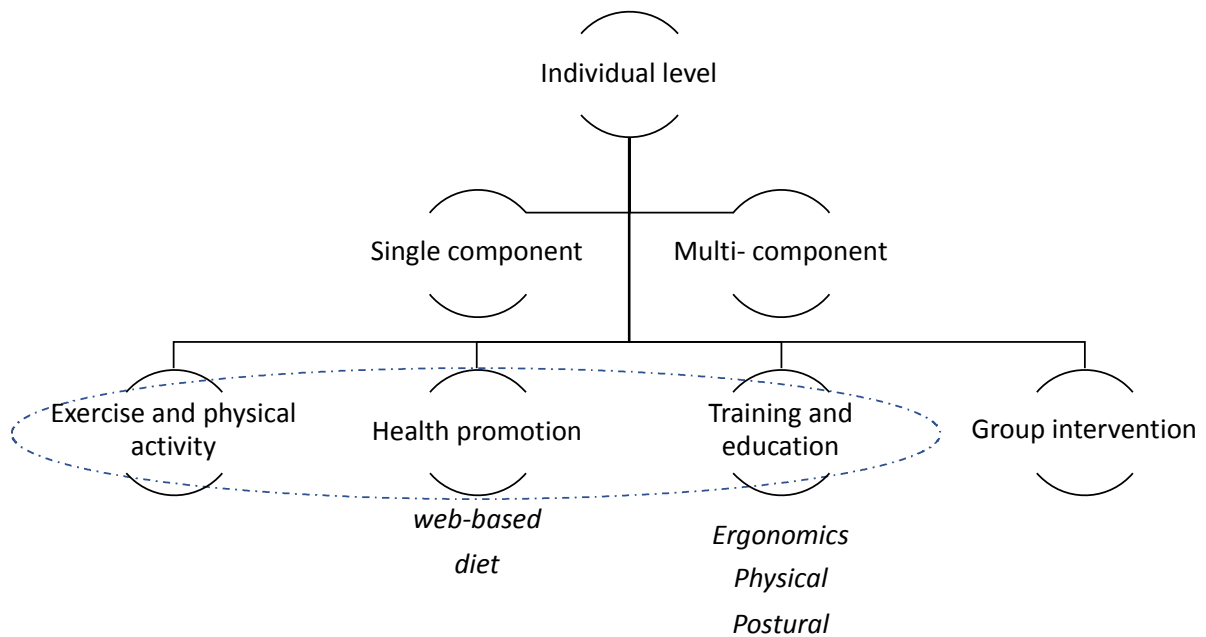


Figure 3.2.1. Individual-level interventions reported in the older worker literature

Individual-level interventions most frequently included some form of physical activity and/or exercise, and these were reported in conjunction with training interventions in two cases. As indicated in Figure 3.2.1, there was some overlap and commonalities between some of the intervention records involving exercise, diet, health promotion and training. Individual-level interventions comprised:

- Physical activity and exercise (5 studies)
- Training and education interventions (2)
- Health promotion (1)
- Group intervention (1)

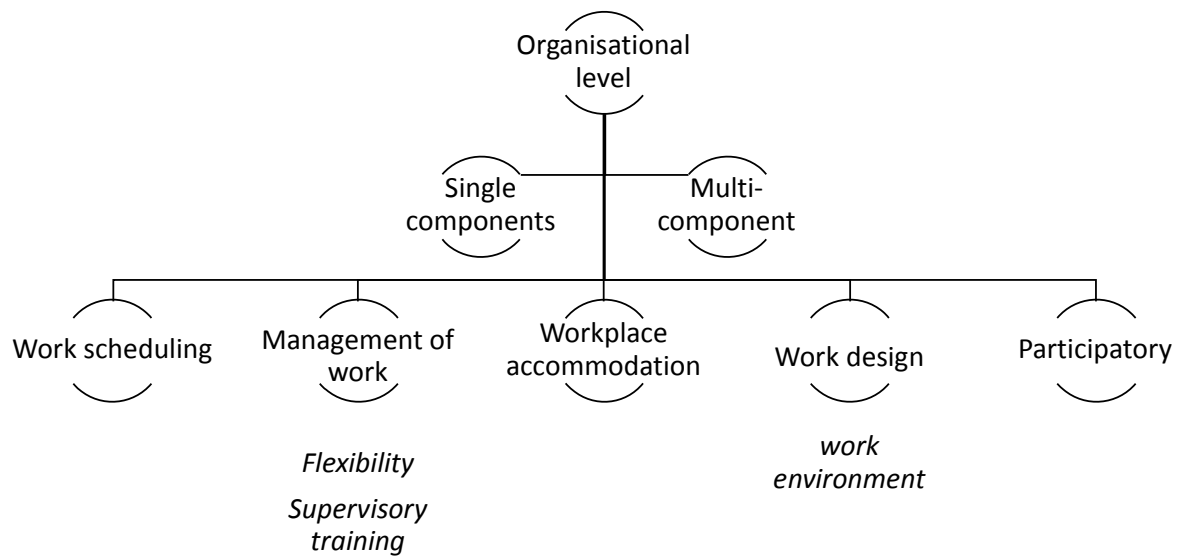


Figure 3.2.2. Organisational-level interventions reported in the older worker literature

As Figure 3.2.2 shows, organisational-level interventions were largely related to the work environment, including the scheduling of work and shift patterns, as well as job design and workplace accommodation measures. As such, they were designed to promote reduced exposure to the risk factors associated with injury and health risks to older workers, rather than acting on the individual to increase fitness to avoid injury, resilience to injury or aid coping. Organisational-level interventions comprised:

- Work scheduling/shift scheduling (3 studies)
- Work design (2)
- Management of work/age management (2)
- Workplace accommodation (1)
- Participatory intervention (1)

A number of interventions were poorly described or had composite organisational and individual level elements, making categorisation difficult. Indeed, within these categories listed above, the interventions were diverse in nature and incorporated a wide range of implementation and evaluation methodologies and approaches, but this was an attempt to best categorise the core element of the interventions. For example, training interventions included

multiple aspects, including postural, ergonomics, and physical exercises, while some were delivered in person and others through web-based approaches.

Broadly, from the categories of interventions outlined above, it can be seen that the intervention literature is balanced fairly equally between those that operate at the individual level and those at the organisational level, with a third category of composite, individual and organisational aspects. The following sections outline findings for each of the more commonly identified interventions, including evidence for intervention effectiveness.

### **3.2.4 Physical activity and exercise**

The most commonly applied intervention category was physical activity and exercise, and this was occasionally used alongside other intervention elements, notably training. The evidence for intervention effectiveness for this category of intervention was mixed and relatively inconclusive as different components of the interventions were more or less effective, while studies did not provide longer-term evaluations. Of the studies focusing on physical activity and exercise interventions, one included a mix of yoga, workout sessions, aerobic exercise, and free fruit (Strijk et al., 2012), and although the program had some positive effects (sports participation and fruit intake), it did not show benefits for aerobic capacity or mental health. Another RCT evaluated intervention involved a Tai Chi wellness program (Palumbo et al., 2012), showing a greater improvement in work stress reduction and some non-significant improvements in general and mental health for the Tai Chi group. An RCT evaluated web-based health promotion (Cook et al., 2015) that involved exercise showed some improvements in short-term dietary and exercise practices of older working adults (50 years and older), with the main improvements amongst women. Finally, a study by Cirila et al. (2005) utilised an ergomotricity training intervention for sedentary office workers aged 40-60 years. The intervention involved six simple exercises during work time. WMSD complaints were improved for 21 of the 56 workers participating in the trial, although the strength and duration of the intervention's effectiveness was not clear from the record.

### **3.2.5 Training**

The evidence for effectiveness of training interventions on older worker health-related outcomes is again mixed, with inconsistencies in study design making it problematic to determine the adequacy of specific solutions to address older worker injury. Moreover, WMSD and psychological injury risk was only a partial focus of some studies.

One study compared an office training group (received ergonomics training and workstation adjustments), a photo-training group (received both office training and self-modelling photos of participants' postures), and a control group (Taieb-Maimon et al., 2012). WMSD risk was evaluated (randomised controlled trials) with both training methods having short-term posture



improvement, but sustained improvement only obtained with the photo-training method. The intervention had greatest benefit to older workers, females, and those suffering most musculoskeletal pain.

A further study by Karazman et al. (2000) examined the effectiveness of an ergonomics and health training program on work interest, work ability and health in older urban transport drivers (50 years average age). The training encompassed physical exercise, skills training and self-experience in groups. Findings of the study suggested improvements in work ability and health and had positive indications for ergonomics and relationships at work.

### **3.2.6 Work scheduling**

Interventions that focused on aspects of work and shift scheduling targeted a range of outcomes associated with health and wellbeing. All rated as at least partially effective in terms of their impact on the outcomes targeted, with particularly strong effects for older workers, while the evaluation methodologies used were of mixed quality. The records focused largely on altering the shift rotations with a view to improve health and absenteeism rates. Harma et al. (2006) examined the impact of changes to a rapid, forward-rotating shift system on sleep duration of both younger (>45 years) and older (45+ years) shift workers, finding older workers in particular to be positively affected, with improvements in sleep, alertness following night shift, and wellbeing in older shift workers. A case-controlled study by Hesselink, de Leede & Gondswaard (2010) examined a number of roster changes on health, injury and absence of all workers in a Dutch steel production site. Changes included more days off after night shifts, backward to forward rotating and slow to fast rotating shifts. Older workers (>50 years) particularly benefited from these new arrangements, including improvement in fatigue and musculoskeletal problems. A German study by Piszczek and Pimputkar (2020) found flexible schedules to benefit older workers (>50 years) in terms of sick days and health perceptions, while only middle-aged workers experienced improvements in work-family conflict. As the intervention impacted workers differently, the authors recommended age-specific policy to address the ageing workforce.

### **3.2.7 Work design**

Work design is the general term used for design and redesign changes to work or tasks that reduces the exposure of workers to physical or psychosocial risk factors. While a number of the intervention records examined included some aspect of work design, these have been classified elsewhere to reflect their key foci (e.g. work scheduling, workplace accommodation), others included work design as part of a composite intervention.

May et al. (2004), in a quasi-experimental longitudinal field study, examined the impact of ergonomics design improvements on municipal workers' workstations on perceptions of ergonomics qualities, musculoskeletal complaints in the form of back pain, and satisfaction with workstations. Findings suggested the experimental groups had superior outcomes to those of controls, although this effect was weaker for older workers (50+ years).

A study by Weichel et al. (2010) examined the impact of task rotation, including improvements to the variety of work, on health and performance outcomes of equipment manufacture workers in the automobile industry. While older workers rotated tasks less, and therefore had less variety in their work, greater rotation was associated with lower absenteeism and improvements to health. However, the study design was relatively weak as it did not incorporate a control group, while the sample of older workers was relatively small, with the oldest worker included being just 56 years of age.

### **3.2.8 Management of work**

The two management of work/age management reviews examined used training and other means to develop the capabilities and skills of managers to manage older workers and maintain a safe and healthy work environment. While this approach appears to have merit as the manager can strongly influence the work experience of older workers, only one of the studies found a beneficial effect. The first, a Swedish study by Skoglund and Skoglund (2005), implemented a one-year training program for managers of council and municipal workers. The interventions were detailed and multi-faceted, involving a mix of policy reviews, interviews, seminars, support and mentorship, with senior and middle managers receiving aspects of the intervention. The program was evaluated using a quasi-experimental design, finding that managers' knowledge about ageing and work ability was improved, and managers developed skills that enabled them to assess the needs of older workers and were able to use knowledge in practice. It is noted that this intervention required a considerable commitment from participants, and might prove impractical for many organisations looking for more low-commitment and fast-track approaches.

A second study involving a management of work initiative was authored by Morelock, McNamara and James (2017), and examined the role of a 'Time and place management' initiative on the work ability of older workers. Set in the health care sector, the management intervention focused on flexible work options and communication between managers and workers on the best practice for the design and implementation of flexible work arrangements. The intervention had only a low effect size, with improvements most evident for those older workers approaching retirement with low work ability. While the study used an RCT design, it suffered from a number of limitations that impact confidence in its findings.

### 3.2.9 Composite interventions

Composite interventions are often favoured as they are more likely to address the complexity associated with work design and workplace problems, and the multi-factorial nature of injury risk. The two records reported on composite interventions each combined organisational and individual-level interventions. De Boer et al. (2004), examined the effectiveness of a program that combined discussions with managers about workplace changes to suit older workers and health promotion component. Utilising an RCT design, the study found that workers in the treatment group were less likely to retire early and took less sick days. Furthermore, after 6-months, older workers had greater work ability and less burnout, although no differences were detected after two-years, putting in question the longer-term effects of this approach.

The second composite report reviewed was a quasi-experimental study by Andersson-Felé (2005), examining the role of a combined training and workplace change intervention on workload, ergonomics troubles, psychosocial troubles and stress. The evaluation found an improvement in each of these outcomes, alongside greater joy and stimulation from work. No differences were observed in sick days or work duration. The authors noted the relatively brief evaluation period of one-year as a limitation of the study.

### 3.2.10 Other

Several articles described their intervention as a health promotion program but these tended to include exercise, training or diet regimes and were coded as such for this review. Cook et al. (2015) examined the effectiveness of a web-based 'Healthy at 50' program focusing on the dietary and exercise program of working adults of 50 years of age and over. Utilising a RCT design, short-term improvements were seen in the group receiving the intervention, with women benefiting the most.

Participative interventions document the process of gaining insights from employees on how to construct meaningful and tailored interventions to improve injury rates and health outcomes associated with work. While participatory interventions are frequently put forward as best practice for organisational intervention (e.g. Eurofound and EU-OSHA, 2014; EU-OSHA, 2018; Leka, Van Wassenhove & Jain, 2015; Nielsen & Christensen, 2021), these approaches are difficult to evaluate as a range of factors specific to the workplace for implementation of the actions that may be recommended for implementation through this process. The review included one record for a participatory intervention (Hengel et al., 2011), involving an intervention mapping processes resulting in the participatory design of a 3-component intervention (workload reduction, rest break tool, empowerment training) for Dutch construction workers. The intervention resulted in improvements in satisfaction with workplace design and better insights into older workers, however there was no robust effectiveness evaluation reported in the article.

A study on workplace accommodations – changes to the workplace to maintain older worker health and work ability – was undertaken by Dettmann and Hasselhorn (2021). However, this study did not involve the implementation of an intervention, rather it used regression analysis to examine which forms of workplace accommodation were most helpful to older workers with health problems. The study concluded that changes in work times, work tasks and the workplace were perceived as most helpful.

Table 3.1.1. Intervention records

| Intervention Category          | Author/s      | Year | Study Design                | Method/intervention   | Main findings  |
|--------------------------------|---------------|------|-----------------------------|---|--|
| Physical activity and exercise | Strijk et al. | 2012 | Randomised Controlled Trial | <ul style="list-style-type: none"> <li>• Participants: <math>N = 730</math> workers from two hospitals in the Netherlands, aged <math>&gt;45</math> years; randomly allocated to intervention group (<math>n = 367</math>) or control (<math>n = 363</math>).</li> <li>• All participants received written information about healthy lifestyles, the intervention group also received the 6-month intervention.</li> <li>• The 6-month Vital@Work intervention includes: (1) a Vitality Exercise Program (VEP) combined with (2) three visits to Personal Vitality Coach. The VEP consisted of a weekly yoga session, a weekly workout session and weekly unsupervised aerobic exercising. Free fruit was provided at the VEP.</li> <li>• Data on the outcome measures were collected at baseline (<math>n = 730</math>) and 6 months after baseline (<math>n = 575</math>) using questionnaires, accelerometers and 2 km walk tests.</li> <li>• Effects were analysed according to the intention-to-treat principle with complete</li> </ul> | <ul style="list-style-type: none"> <li>• The Vital@Work intervention was successful in increasing sports participation and fruit intake, and positively affected need for recovery (NFR) after a day's work, but was not effective in improving VPA, aerobic capacity or mental health.</li> <li>• Both the intervention and control group increased their VPA (vigorous physical activity) from baseline to 6 months later, with no significant differences between groups.</li> <li>• No effects were found on total weekly vigorous physical activity</li> <li>• The intervention group workers improved their fruit intake significantly more when compared to the control group. No significant effects were found on aerobic capacity or mental health</li> <li>• The intervention group significantly decreased their NFR compared to controls.</li> <li>• Only the relationships between the outcomes measures and guided group compliance that appeared to</li> </ul> |

|                                |                  |      |  |  |  |
|--------------------------------|------------------|------|--|--|--|
|                                |                  |      |  | <p>cases (<math>n = 575</math>) and imputed data (<math>n = 730</math>) using linear regression analyses. Additional analyses were performed for high yoga and workout compliance (i.e., &gt;mean number of sessions).</p>   | <p>be significant are presented.</p> <ul style="list-style-type: none"> <li>• A significant relationship was found between sports and high compliance to the guided yoga and workout sessions when compared to the control group.</li> <li>• For fruit intake, effects were stronger in the high compliance group of both the yoga and the workout sessions.</li> </ul>  |
| Physical activity and exercise | Granacher et al. | 2011 | Controlled longitudinal intervention study | <ul style="list-style-type: none"> <li>• Participants were &gt; 50 years (<math>N = 32</math>)</li> <li>• The intervention - 8 weeks of balance and strength training conducted at the worksite during work time. A 6-month intervention was evaluated using a RCT design - (3 times a day for 5 days), followed by 8 weeks of no training ("detraining").</li> <li>• Measurement to monitor physical changes included: total centre of pressure displacements during one-legged standing, gait velocity and stride-to-stride variability, peak isometric / isokinetic torque and rate of torque development of the plantar flexors and jumping height.</li> </ul> | <ul style="list-style-type: none"> <li>• After training, significant improvements in centre of pressure displacements, gait velocity, peak isometric / isokinetic torque, rate of torque development, and jumping height were observed.</li> <li>• During detraining, muscle strength deteriorated, whereas postural control improved.</li> <li>• This falls-prevention training program conducted at the worksite proved to be feasible and effective.</li> </ul> |
| Physical activity and exercise | Formanoy et al.  | 2016 | Cluster-randomized controlled trial        | <ul style="list-style-type: none"> <li>• Participants: <math>N = 312</math>; office workers at one financial service provider business. Cohort of younger and older</li> </ul>   | <ul style="list-style-type: none"> <li>• The mean improvement in need for recovery (NFR) of older (&gt;46.5 years) office workers in SEI group was</li> </ul>  |

|                                |                |      |     |   |  |
|--------------------------------|----------------|------|-----|---|--|
|                                |                |      |     | <p>(&gt;46.5 years) workers.</p> <ul style="list-style-type: none"> <li>• “Be Active &amp; Relax” physical activity and relaxation program aimed to reduce the need to recuperate and unwind from work-induced effort (need for recovery, or NFR).</li> <li>• Intervention involved two delivery modes with controls for each mode: a social environmental intervention (SEI; intervention <math>n = 149</math>, control <math>n = 163</math>) - 4 x group motivational interviewing sessions conducted by team leaders; and a physical environmental intervention (PEI; intervention <math>n = 132</math>, control <math>n = 180</math>) - modification of office and coffee break space to promote daily physical activity and relaxation.</li> </ul> | <p>significantly lower than older office workers who did not receive the SEI.</p> <ul style="list-style-type: none"> <li>• The results for the PEI indicated that the mean improvement in NFR of office workers (regardless of age) who worked fewer hours overtime was significantly higher when they had received the PEI than when they had not received this type of intervention.</li> <li>• For office workers who worked more hours overtime there was no effect of the PEI.</li> </ul> |
| Physical activity and exercise | Palumbo et al. | 2012 | RCT | <ul style="list-style-type: none"> <li>• Participants: <math>N = 14</math> nurses aged &gt;49 years from an academic medical centre</li> <li>• Intervention: Tai Chi classes - attended on-site once a week; practice alone for 10 minutes each day at least 4 days per week for 15 weeks</li> </ul>  | <ul style="list-style-type: none"> <li>• At baseline, compared to the control group, the intervention group showed: <ul style="list-style-type: none"> <li>○ similar health and physical conditions but significantly higher perceived stress and workload limitation scores.</li> <li>○ non-significant improvement in general health and mental health while the control group showed a decline in both</li> <li>○ greater reduction in work</li> </ul> </li> </ul>                          |

|                                |              |      |  |  |   |
|--------------------------------|--------------|------|--|--|---|
|                                |              |      |  |  | <p>stress and general stress than the control group did post exercise.</p> <ul style="list-style-type: none"> <li>○ larger improvement in trunk flexibility than the control group.</li> <li>○ greater reduction in the Work Limitation Scale</li> <li>○ 3% increase in work productivity; no unscheduled time off, while controls showed 49 hours unscheduled time off in intervention period.</li> </ul>  |
| Physical activity and exercise | Cirla et al. | 2005 | <p>Pre-post questionnaire (3 months post) - self assessed improvements</p> <p>Quasi-experimental</p> | <ul style="list-style-type: none"> <li>• Participants: <math>N = 56</math> participants aged 40 - 60 years who sat at a desk for at least 6 hours per day.</li> <li>• Two intervention groups; 1st group (called AE) - employees at a financial agency (<math>n = 34</math>); second group (called ACP) - administrative employees of a motorway company (<math>n = 22</math>).</li> <li>• Both groups undertook a theoretical and practical educational ergomotricity program, and exercises supervised by a physiotherapist.</li> <li>• Difference in schedules for educational program for the groups; AE group: 1h x three subsequent afternoons; ACP group: 3h in same afternoon</li> </ul> | <ul style="list-style-type: none"> <li>• 46% of participants noted musculoskeletal complaints prior to the intervention, and 37% of participants reported an improvement after the intervention</li> <li>• Higher proportion of participants with improved musculoskeletal outcomes in AE group (i.e. training conducted in 1h sessions over three afternoons than ACP group (1 x 3h session).</li> <li>• Three months post-intervention, 82% reported doing the work break exercises at least 3 days a week, and 69% of participants remembered all four exercises.</li> <li>• The best efficacy was for neck complaints - this could be due to the prevalence of</li> </ul> |



|          |                     |      |                      |   |  |
|----------|---------------------|------|----------------------|---|--|
|          |                     |      |                      |   | such impairment in the group, or because three out of the four exercises were for neck pain  |
| Training | Taieb-Maimon et al. | 2012 | Quasi-experimental   | <ul style="list-style-type: none"> <li>• Participants: <math>N = 60</math> workers from a university or a university hospital (administration (<math>n = 42</math>), computer programmers (<math>n = 8</math>), or researchers (<math>n = 10</math>)) in Israel; aged 23-66 years</li> <li>• Participants worked an average of at least 4 h per day, five days a week at an office computer station for at least a year.</li> <li>• A modified randomized experimental design - participants were equally divided into three groups: (1) control group; (2) office training group received personal ergonomic training and workstation adjustments; and (3) a phototraining group that received both office training and self-modeling photos (images of themselves to use to improve their posture).</li> <li>• 6-week intervention - Musculoskeletal risk was evaluated pre and post intervention (baseline, week 2-4, week 5, week 6)</li> </ul> | <ul style="list-style-type: none"> <li>• Both training methods provided effective short-term posture improvement; however, sustained improvement was only attained with the photo-training method.</li> <li>• Both interventions had a greater effect on older workers and on workers suffering more musculoskeletal pain.</li> <li>• The photo-training method had a greater positive effect on women than on men.</li> </ul> |
| Training | Karazman et al.     | 2000 | Quasi experimental - | <ul style="list-style-type: none"> <li>• Participants: <math>N = 122</math> Public urban transport drivers of the</li> </ul>  | <ul style="list-style-type: none"> <li>• Results showed that: <ul style="list-style-type: none"> <li>○ for approximately 40% of</li> </ul> </li> </ul>   |

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|  |  |  | pre post questionnaires | <p>Munich Transportation Authority with seniority and over 45 years of age; average age of 50 years</p> <ul style="list-style-type: none"> <li>• Intervention: <ul style="list-style-type: none"> <li>○ Programme comprising of 20 paid health days over one year (1 x 8h day every two weeks) to undertake group training in elements of physical exercise, professional skills training, and self-experience in groups (stress management, diet counselling, psychological training and physical training) facilitated by professional trainers.</li> <li>○ Inclusion of a placebo year (one year prior to intervention) to assess whether health, well-being and interest is affected by programme more than by daily life.</li> </ul> </li> <li>• Effects evaluated using pre- (after placebo year) and post comparison of work ability, work interest, and health via Work Ability Index (WAI) and Effect Typology (ET) (to evaluate whether the effect of the intervention on somatic and psychic health is short, medium, or long term).</li> </ul> | <p>the workers, a health promotion programme or rehabilitation programme would reduce morbidity and mortality rates.</p> <ul style="list-style-type: none"> <li>○ participants who displayed the best long-term changes in health behaviours showed an increase in WAI scores (suggesting long-term improvement of health and work ability) and decreased thoughts on early retirement. WAI scores remained unchanged in the other groups.</li> <li>○ 60% of participants experienced improved psychological and mental changes pre- and post-intervention.</li> <li>○ participants who displayed the “evolution effect” had an increase in WAI scores (suggesting long-term improvement of health and work ability) and decreased thoughts on early retirement. WAI scores remained unchanged in the other groups.</li> </ul> |
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| Group intervention | Maatouk et al. | 2018 | Two-armed<br>Randomised<br>Controlled Trial | <ul style="list-style-type: none"> <li>• Participants: <math>N = 115</math> nurses aged <math>&gt; 45</math> from 4 trial sites</li> <li>• Intervention: <ul style="list-style-type: none"> <li>○ Small-group intervention (~10 employees per group) of 1 x 2h sessions per week for 7 weeks led by one to two trainers (psychologist and or/ doctor trained in group psychotherapy).</li> <li>○ Intervention group (IG) received booster session after six-week break, Waitlist control (WLC) group received same booster two weeks after IG booster session.</li> <li>○ Sessions explored topics of ageing in care professions, coping with stress, mindfulness, and goal setting theory.</li> </ul> </li> <li>• Validated self-report questionnaires – pre and post intervention</li> <li>• Primary outcome measures: well-being and mental health-related quality of life; Secondary measures: irritation, depression, workability and job control.</li> </ul> | <ul style="list-style-type: none"> <li>• Results suggest that intervention reduced work-related mental strain and improved mental health-related quality of life (specifically, a small significant effect in favour of the IG). However, no effect on wellbeing was observed.</li> <li>• No difference between the IG and WLC was observed for wellbeing or work-related measures including work ability and job control.</li> <li>• Positive effects observed for overall irritation, emotional irritation, and cognitive irritation. However, effect sizes were small (<math>d = 0.24</math> to <math>d = 0.31</math>).</li> </ul> |
| Health promotion   | Cook et al.    | 2015 | Randomised<br>Controlled Trial              | <ul style="list-style-type: none"> <li>• Participants: <math>N = 278</math> workers aged 50 to 68 in multiple US offices of a large global information technology company. Participants recruited online</li> </ul>  | <ul style="list-style-type: none"> <li>• Study suggests that the HealthyPast50 program encouraged healthier eating and exercise among participants.</li> <li>• Specifically, results from the</li> </ul>  |

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|                 |                  |      |  | <ul style="list-style-type: none"> <li>• Intervention: “HealthyPast50” Web-based multimedia program with information and guidance on healthy aging, diet, physical activity, stress management, and tobacco use. Also included a central module with assessments across major health topics and recommendations of material to revisit in HealthyPast50 based on their assessment results.</li> <li>• Randomly assignment of participants to the Web-based “HealthyPast50” program (<math>n = 138</math>) or to a wait-list control condition (<math>n = 240</math>).</li> <li>• Self-report measures of diet, physical activity, stress, and tobacco use were collected online before and 3 months after the program group was given access to the program. Usage data included number of log-ins and number of pages accessed.</li> </ul> | <p>study indicated that the program group compared to the control group showed:</p> <ul style="list-style-type: none"> <li>- significantly greater improvement on diet behavioural change self-efficacy and planning healthy eating</li> <li>- significant improvement on mild exercise.</li> <li>- no significant difference for strenuous exercise, sweat, exercise self-efficacy, exercise planning, overcoming barriers to exercise, and on symptoms of distress and coping with stress.</li> </ul> <ul style="list-style-type: none"> <li>• Findings indicate that the program was more effective for women than men.</li> </ul> |
| Work scheduling | Hesselink et al. | 2010 | Case-control group pre- and post-test design | <ul style="list-style-type: none"> <li>• Participants: <math>N = 6163</math>; Shift work employees in a large steel producer working in the five-shift system (<math>n = 4600</math>), and all daytime workers in technical and maintenance jobs (<math>n = 1450</math>) as a control group.</li> <li>• In this study, older workers were defined as <math>&gt;50</math> years of</li> </ul>  | <ul style="list-style-type: none"> <li>• There was a decrease in absence figures (particularly on midterm sickness absence) after the roster change.</li> <li>• Improvements in health indicators were present (e.g., fatigue, musculoskeletal complaints, relationship work and health and workload) in the year after implementation</li> </ul>   |

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|                 |                       |      |                     | <p>age.</p> <ul style="list-style-type: none"> <li>• Intervention was a shift roster change in a large steel producer in the Netherlands.</li> <li>• The changes in the roster were: 1) from backward rotating to forward rotating; 2) from rather slow (three) to fast rotating (two consecutive shifts); 3) the number of days off after the night shifts was changed from two to three.</li> <li>• Company data covering 1 year prior and 1 year after the implementation of the new roster for all employees in the five-shift system and all daytime workers (1450 workers) in technical and maintenance jobs.</li> <li>• Data from three employee databases were analysed: occupational accidents; health data; sickness absence.</li> <li>• The five health variables used as dependent variables were: fatigue, musculoskeletal complaints, flu complaints, health and work relationship, and workload.</li> </ul> | <p>of the new roster.</p> <ul style="list-style-type: none"> <li>• Older workers benefited more from the roster changes than younger workers &lt;50 years of age.</li> <li>• Older workers in the five-shift group reported significantly less musculoskeletal problems and work effects on their health in the year after roster implementation.</li> <li>• The results were significantly more positive for the shift workers compared with the control group.</li> </ul> |
| Work scheduling | Piszczeck & Pimputkar | 2020 | Longitudinal survey | <ul style="list-style-type: none"> <li>• Participants: <math>N = 2820</math>; data from a federally collected and maintained data set in Germany of younger and older workers in 870 establishments with a total of 3623 observations over three-waves</li> </ul>  | <ul style="list-style-type: none"> <li>• Flexible schedules have age-specific effects for some outcomes and age-neutral effects for others.</li> <li>• Specifically, those over 52 years of age had fewer sick day usage, and higher</li> </ul>   |

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|                 |              |      |  | <p>(2013, 2015, 2017). Data comprised of linked employer and employee surveys with a focus on human resource management practices, individual employee attitudes and behaviours, and establishment performance was analysed.</p> <ul style="list-style-type: none"> <li>Hypothesis testing examined the relationship between flexible work hours and sick days; flexible work hours and general subjective health; and flexible work hours and work-to-family conflict.</li> </ul>  | <p>perceptions of subjective health.</p> <ul style="list-style-type: none"> <li>No significant link was observed for work-to-family conflict for employees over 50 years of age; however, those aged 30-50 had lower perceptions of work-to-family conflict.</li> <li>Higher levels of affective commitment were observed for employees over the age of 33, but this dropped off after an employee reached 62 years of age.</li> <li>The effect on work engagement was most pronounced for those aged between 30-47; and was not significant past 58 years of age.</li> </ul> |
| Work scheduling | Harma et al. | 2006 | Quasi-experimental (with control group) intervention study | <ul style="list-style-type: none"> <li>Participants: <math>N = 140</math>; Younger (25-44 years of age) and older (45-61 years of age) male technicians of an aircraft technical maintenance unit.</li> <li>Intervention: <ul style="list-style-type: none"> <li>A forward rotating shift system, avoiding consecutive night shifts and with more free time between the individual shifts</li> <li>Intervention was administered to a sample of 24 (25-44 years old <math>n = 10</math>; 45-61 years old <math>n = 14</math>),</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>Results showed that the change from a slower backward rotating shift system (shift changes every 3 shifts) to a quickly forward rotating shift schedule improved the perceived effects of the new shift schedule on sleep and alertness, general well-being and social and family life.</li> <li>The benefits of the rapidly forward rotating shifts system were more positive among the older shift workers (those over 45 years of age), especially the</li> </ul>   |

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|                    |                     |      |   | <p>with the control group <math>n = 116</math> participants (25-44 years old <math>n = 64</math>, 45-61 years old <math>n = 49</math>).</p> <ul style="list-style-type: none"> <li>• Questionnaires taken pre (18 months prior), during, and 6 months post intervention (commencement of the new shift system); sleep diaries, activity monitors, field measurements, and subjective sleepiness was measured to determine intervention effectiveness.</li> </ul>  | <p>improvement in sleepiness.</p> <ul style="list-style-type: none"> <li>• The level of alertness on night shifts (measured by the sleepiness-psychomotor vigilance test) was significantly higher for those in the intervention group, including those over 45, with a significant four-way interaction evident linking group, time, shift and age.</li> </ul>   |
| Management of work | Skoglund & Skoglund | 2005 | Qualitative evaluation of a management development training program | <ul style="list-style-type: none"> <li>• Participants: <math>N = 6257</math> aging (45 to 64 years old) employees in Finnish municipalities.</li> <li>• Intervention: <ul style="list-style-type: none"> <li>○ Two (repeated) government funded systematic Age Management programs for the public sector aimed to build capability in senior and middle managers, more effectively cater for older workers, support changes in work organisation, and break negative trends of high rates of sickness absences and early retirements before 65 years of age.</li> <li>○ Intervention consisted of 1) interviews with managers and employees to</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• The qualitative data suggested the basic principles of age management were generally well received by staff; and the intervention generated a dialogue and through this effected the attitudes in a positive way</li> <li>• The paper has a significant limitation in that no empirical data analysis was provided; however, the paper cites an external report (not published nor available) which concludes the intervention was effective.</li> </ul> |

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|                    |                 |      |                             | <p>understand values and attitudes; 2) a one-day seminar for senior managers; on the theme of “Evidence Based Management in the Perspective of an Aging Workforce”; 3) two-day seminars for middle managers on “Age Management in Theory and Practice”; 4) open 3h lectures for all employees at workplace committed to the initiative, and 5) professional support and mentorship provided to middle managers</p>   |  |
| Management of work | Morelock et al. | 2017 | Randomised Controlled Trial | <ul style="list-style-type: none"> <li>• Participants: <i>N</i> = 437; Health care workers aged 50+ working at a system of hospitals run by a single medical provider; who responded to at least one follow-up time point in the study.</li> <li>• Intervention: “Time and place management” (TPM) intervention which encourages flexible work options, and structure and encouragement for managers and employees to communicate for best implementation of these options.</li> <li>• Treatment group received access to structured 30 min</li> </ul> | <ul style="list-style-type: none"> <li>• The intervention resulted in a low effect size and only showed potential for extending the retirement age of older workers nearing retirement who were already struggling with low workability.</li> <li>• For those workers in the sample who had high starting workability, outcome workability was high even at the oldest ages included (into the mid to late 60s). However, for those with low baseline workability in the control group, outcome workability was lower for the oldest workers in the sample.</li> </ul> |



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|             |                |      |   | learning module and follow-up materials (posters and videos) for employees and managers to better understand and implement TPM processes.  |  |
| Work Design | Weichel et al. | 2010 | Cross-sectional (single time points self-report and objective data) | <ul style="list-style-type: none"> <li>• Participants: <i>N</i> = 248 blue collar workers from an equipment manufacturer in the automotive industry (in Germany) working on assembly line. Only 7.4% of assembly line older than 50 years old.</li> <li>• Analysis of job rotation as an intervention in the automotive industry through various measures: <ul style="list-style-type: none"> <li>- Questionnaire assessing different aspects of job performance and health i.e., coping styles, job ability, irritation, and musculoskeletal complaints.</li> <li>- Company internal objective data i.e., absenteeism, work-related impairments, and job rotation. <ul style="list-style-type: none"> <li>○ Observation of job rotation with a representative sample over two months.</li> <li>○ Correlation analysis of job rotation and job performance health, and group comparison with consideration age of</li> </ul> </li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Older and impaired employees worked on fewer workstations and therefore undertook less job rotation than younger employees, with number of rotations declining with increasing age</li> <li>• Employees working on a greater number of workstations reported lower scores for resignation, and higher scores for proactive problem solving, inner balance and distancing. This suggests that employees who undertook job rotation more had better subjective coping styles and a high work ability (self-rated); with lower scores for emotional and cognitive strain, and lower musculoskeletal complaints.</li> <li>• A limitation of the study is that employees older than 50 years are rarely found on the assembly line – however, the specific number of employees over 45 years was not listed in the paper.</li> </ul> |

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|                    |                       |      |   | impairment, with a focus on age group < 35 years, 36-45 years, and > 45 years.  |  |
| Work Design        | May et al.            | 2004 | Quasi-experimental, two phases (control group and intervention group) | <ul style="list-style-type: none"> <li>• Participants: <math>N = 87</math> municipal employees</li> <li>• Office workstation ergonomics intervention program with an intervention (<math>n = 61</math>) and control (<math>n = 26</math>) group.</li> <li>• Workers in intervention group received one of four types of workstation and office settings interventions: seating enhancement (<math>n = 33</math>), keyboard-related improvement (<math>n = 21</math>), computer relocations (<math>n = 11</math>), and computer screen modifications (<math>n = 14</math>).</li> <li>• Validated measures included: workstation ergonomic characteristics, persistent pain, eyestrain, workstation satisfaction, workstation ergonomic change, age, job tenure, and positive affectivity.</li> </ul> | <ul style="list-style-type: none"> <li>• Results indicated that workstation improvements were associated with enhanced perceptions of the workstation's ergonomic qualities, less upper back pain, and greater workstation satisfaction.</li> <li>• There was no significant effect for the interaction between workstation ergonomic improvement and age.</li> <li>• Perceptions of improved workstation ergonomics increased more for younger than older employees, with the latter category reporting scores not dissimilar to the control group.</li> <li>• Authors suggest that weak impact of workstation improvements for older workers may be to them valuing other job facets, such as security and fringe benefits, more so than their workstation; or, a "threshold of attitude change" weakens the perceived benefit.</li> </ul> |
| Work accommodation | Dettmann & Hasselhorn | 2021 | Cross-sectional study   | <ul style="list-style-type: none"> <li>• Participants: <math>N = 207</math>; Older (either 53 or 69 years of age) employees who reported poor health randomly selected from the German social insurance</li> </ul>  | <ul style="list-style-type: none"> <li>• Changes in working times (OR = 6.59) , work tasks (OR = 3.50)and in the workplace (OR = 2.57) were perceived as the most helpful interventions.</li> </ul>  |

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|               |               |      |   | <p>system.</p> <ul style="list-style-type: none"> <li>• Analysis of cross-sectional data from the third wave (in 2018) of a cohort study researching the relationships of work, age, health and retirement.</li> <li>• Measures included: <ul style="list-style-type: none"> <li>○ Health was assessed by the single item from the Short Form Health Survey (SF-12)</li> <li>○ Workplace accommodations - Participant could choose from seven options: 1) changes in the work tasks (e.g., different or less tasks), 2) changes in the workplace, 3) changes in working time, 4) working from home, 5) talks, 6) training or further qualifications and 7) other changes.</li> </ul> </li> <li>• Where at least one accommodation was reported, participants were asked how helpful it had been - dichotomised into helpful and not helpful</li> </ul> | <ul style="list-style-type: none"> <li>• The results suggest that workplace accommodations can be helpful in older employees with health impairments and that this is not by chance, but that the perceived effectiveness has determinants and can be influenced.</li> <li>• The positive impact of workplace accommodation on maintaining health and work ability in older employees is not by chance; but is rather facilitated by a system of effective company, supervisor and collegial support, and workplace equality.</li> </ul> |
| Participatory | Hengel et al. | 2011 | Participatory design using intervention mapping to co-develop an intervention | <ul style="list-style-type: none"> <li>• Participants: construction workers aged 45 years or older; five companies involved in the intervention design study.</li> <li>• Development of a health promotion intervention for</li> </ul>   | <ul style="list-style-type: none"> <li>• The Intervention Mapping approach led to the design of an intervention with three components: 1) two individual visits of a physical therapist to lower the physical workload, 2) a rest break tool to improve</li> </ul>   |

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|         |                |      |                       | <p>construction workers using an Intervention Mapping approach.</p> <ul style="list-style-type: none"> <li>• Intervention design involved: <ul style="list-style-type: none"> <li>○ 1) a needs assessment involving discussions with older construction workers (<math>n = 23</math>) and human resource managers (<math>n = 5</math>);</li> <li>○ 2) preparing matrices of change objectives with older construction workers (<math>n = 26</math>) and human resource managers (<math>n = 5</math>);</li> <li>○ 3) selecting theory informed intervention methods and practical strategies with researchers (<math>n = 7</math>) and potential providers of intervention (<math>n = 7</math>), producing program components and materials with a project group (<math>n = 6</math>)</li> <li>○ 4) planning for program adoption, implementation, and sustainability, and</li> <li>○ 5) planning for evaluation.</li> </ul> </li> </ul> | <p>the balance between work and recovery, and 3) two empowerment training sessions to increase the range of influence at the worksite (physical activity, workplace changes, job design).</p> <ul style="list-style-type: none"> <li>• Involvement of all stakeholders was useful in the development of the worksite intervention - workers had a positive attitude and high commitment to the program; and supervisors played a key role during the intervention.</li> <li>• The participatory approach of the intervention led to new insights regarding older workers who mentioned age discrimination as one of the most important obstacles for a successful implementation.</li> <li>• By including construction workers of all ages, the older workers felt more comfortable with the worksite prevention program.</li> <li>• Intervention mapping is a time-consuming process, to be more efficient in future research, qualitative data (e.g., in-depth interviews and focus groups) could be combined with quantitative data.</li> </ul> |
| General | Midtsundstad & | 2016 | Cross-sectional study | <ul style="list-style-type: none"> <li>• Participants: <math>N = 713</math> survey data from Norwegian companies with &gt;10 employees</li> </ul>   | <ul style="list-style-type: none"> <li>• In 2004/2005, disability rates for companies offering preventative interventions</li> </ul>   |

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|           | Nielsen        |      |                             | <p>and at least one employee &gt; 60 years old; linked with work, sickness absence and disability data of Norwegian employees aged 50-61 years old in 2001 and 2005 (<math>N = 30771</math>).</p> <ul style="list-style-type: none"> <li>• Measurement of total effect of working in a company offering some type of workplace intervention, and individual probability of receiving a disability pension during period of 2001-03 vs 2005-07 for workers aged 50-61 years old in companies with and without interventions.</li> </ul>   | <p>declined in comparison to companies that did not offer such interventions.</p> <ul style="list-style-type: none"> <li>• Interventions targeting individuals aged 50-61 with health problems and reduced work ability reduced individual disability risk.</li> <li>• Observed trends: disability risk was higher among women, the less educated, those living alone, part-time workers and older workers; prior sick leave increased disability risk; and employees in retail and teaching had higher risks than other industries.</li> </ul>          |
| Composite | De Boer et al. | 2004 | Randomised Controlled Trial | <ul style="list-style-type: none"> <li>• Participants: <math>N = 116</math> employees of large company &gt;50 years of age who stated that they would be able to work up to retirement.</li> <li>• Intervention: <ul style="list-style-type: none"> <li>○ 6-month occupational health program executed by the worker's own occupational physician.</li> <li>○ Intervention group (<math>n = 61</math>) had at least three consultations, including an assessment interview, construction of a detailed action plan, consultation of the employee's supervisor/manager</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Fewer older workers (11%) in the intervention group retired early than in the control group (28%).</li> <li>• The total average number of sick leave days in two years was 82.3 for the intervention group and 107.8 for the control group.</li> <li>• Six months after baseline, older workers in the intervention group had better work ability, less burnout, and better quality of life than employees in the control group.</li> <li>• Two years after randomisation no differences between the</li> </ul> |

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|           |                 |      |   | <p>regarding changes in the workplace &amp; individual health items, and medical referrals where necessary.</p> <ul style="list-style-type: none"> <li>○ Control group (<math>n = 55</math>) received care as usual from occupational physician but were not invited for consultation.</li> <li>○ Job position and number of sick leave days after two years were collected from the company's computer. Pre post questionnaire (baseline, 6 months, 2 years)</li> <li>○ self-assessments for validated scales (Work Ability Index, the Utrecht Burn Out Scale, and the Nottingham Health Profile measuring quality of life).</li> </ul> | two groups were found.  |
| Composite | Andersson-Felé. | 2005 | <p>Quasi-experimental - 3 groups</p> <p>pre post questionnaires</p> | <ul style="list-style-type: none"> <li>● Participants: <math>N = 81</math> healthcare staff from three different wards (<math>n= 39</math> rehabilitation, <math>n=28</math> gynaecological, and <math>n=14</math> medical outpatient)</li> <li>● Intervention - training about life course, work and work ability. During the training, making changes in the workplace was encouraged. The work environment intervention was followed up through a combination of surveys of attitudes and financial human resource</li> </ul>   | <ul style="list-style-type: none"> <li>● The study could not reliably conclude that the intervention had an impact on staff workload and job satisfaction. However, at all three workplaces, staff perceived an increased work motivation and job satisfaction post intervention.</li> <li>● Experience of workload, ergonomic troubles, psychosocial troubles and work stress had decreased at the same time as the experience of stimulation and</li> </ul> |

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|  |  |  |  | <p>evaluations</p> <ul style="list-style-type: none"> <li>• Pre-Post questionnaire, Time management &amp; HR costs data analysed - Data were analysed from an individual and organisational perspective</li> </ul> | <p>of joy at work had increased.</p> <ul style="list-style-type: none"> <li>• Very limited number of suggestions for changes in routines and work organisation provided in action plans made as part of the training.</li> <li>• It was not possible to see any reduction in the HR costs or change in the working time and sick leave.</li> </ul> |
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### 3.3 Grey Literature

The eight pieces of grey literature comprised guidance material, reports, conference proceedings and a book chapter. The small number of reports identified is concerning given the widely accepted importance of safely engaging people in work for longer as the population ages and talent shortages hit many countries and industry sectors globally. This said, many reports were excluded as they did not centrally address WHS for older workers.

Guidance material was the most common category of output within the grey literature, with five reports reviewed falling into this general category. Three of these outputs were published by health and safety regulators: Government of Alberta, Canada; WorkSafe WA; and IOSH, UK. This guidance material is relatively old, however, with the most recent being published in 2016. In fact, of the eight grey literature records, only two were published post-2010, meaning no contemporary guidance appears to be available that relates specifically to the WHS of older employees. Indeed, the nature of work and work tasks have evolved in recent years and advice from government needs to be reflective of these changes. Much of the guidance on older workers is included as a minor consideration as part of wider WHS guidance (e.g. European Agency for Safety and Health at Work, 2007, on emerging psychosocial risks to workplace health and safety), although these reports were excluded from the present analysis as they lacked sufficient information and did not report on interventions for older worker WHS.

Perhaps the strongest guidance record was provided by the European Union (2016), entitled: *The ageing workforce: implications for occupational safety and health*. This document highlights the need for good quality working conditions, appropriate work-life balance, employment security, and lifelong learning. These concepts are considered the basis for "sustainable work". The guide argues that creating sustainable work requires an understanding of the aged-related issues affecting hazard exposure and work ability. Key interventions suggested included: improved risk prevention for all workers, with specific measures for older workers when necessary (depending on type of work and the individual); work ability evaluation as part of risk assessment; health surveillance monitoring; ergonomic focus in making adjustments; flexible work arrangements; skills training, and developing the roles of older workers (e.g. to encompass mentoring of younger workers). The record also recommends effective interdisciplinary rehabilitation post injury, including for chronic WMSD, and specific gender related strategies in relation to sustainable work (e.g. considering industries in which women constitute most of the workforce (e.g. cleaning, healthcare) and support for life stages (e.g. supporting women during menopause), and when caring for family (e.g. elder care). The guide emphasises the importance of an effective OHS system, including skills and resources for regulators to deal with issues of the older workforce.



The Government of Alberta Guide (2016) provides guidance as to creating a healthy work environment for older workers but does not include evidence from interventions. The review emphasises the duty of accommodation within Canadian law, which in the case of older workers, is interpreted as accommodating through modifications and design to fit an ageing workforce. Along with general advice about the design of workplaces, procedures and jobs, all of which benefit the wider workforce along with older workers, the guide includes specific advice around the needs and capabilities of older workers for aspects of work such as standing times, shift work scheduling and duration, and the physical environmental factors such as vision, lighting and noise. The guide also refers to the need to raise awareness about older workers and need for training for supervisors to ensure they know how to manage older workers effectively.

The Safe Work WA (2010) guidance has a similar approach to the Canadian guide, focusing on control measures and raising awareness about older workers' health and safety. It does not review interventions. Taking a risk management approach, the guidance outlines hazards associated with ageing workers and controls that can be used to address these hazards. The review notes that strains and sprains (WMSD) are the most common injury type for older workers, and details the potential changes in physical performance and capabilities that may increase injury risk, including psychological injury. Recommendations for creating a healthy and safety work environment for older workers focus on organisational-level interventions, including aspects of job design, reducing work demands, scheduling of work, flexibility and autonomy, improvements to the physical work environment and reducing postural demands.

The IOSH review and guide (Crawford et al., 2009) perhaps has greatest value amongst the grey literature in an evidentiary sense as it incorporates a systematic review of the health, safety and health promotion needs of older workers. However, it should be noted that the body of work upon which the review drew was very limited and of low quality, and that the review is quite dated. Of interest to the present review, the IOSH review notes the lack of high-quality evidence in the literature and notes that more is needed to understand the high proportion of WMSD and stress and anxiety among older workers (Crawford et al., 2009). The authors also note that there is very little research on the mental health of older workers, nor evidence for what interventions are effective in reducing injury risk for older workers (Crawford et al., 2009). The control measures recommended in the guide include job design/redesign to reduce demands, where they are high, and consideration of ergonomics principles in shift scheduling.

The Proceedings from an Association of Occupational and Environmental Clinics and Society of Occupational and Environmental Health (AOEC & CSOEH, 2009) conference on Healthy Ageing for a Sustainable Workforce comprised a number of short papers related to older worker WHS, with a focus on construction and healthcare industries. The papers call for research that

evaluates the effectiveness of policies (social and organisational), practices, and interventions that are effective in promoting health and safety in older workers. Research is needed to determine the effectiveness of interventions such as job design, workplace accommodations and training on older worker health and safety. A European Union report entitled, *Healthy Work in an Ageing Europe: Strategies and Instruments for Prolonging Working Life* (Morschhäuser & Sochert, 2006) focused on stress management and fitness for older drivers in Munich, but the intervention appeared to be limited to individual fitness and mental techniques and anti-irritation training. Some improvements to health, wellbeing and absenteeism were observed, although few details are provided.

Overall, the small body of grey literature had limited value to the review as they were few in number and there is little evidence of the effective strategies for managing risks to older worker work health and safety. Pleasingly, most advice provided in government and authoritative guidance related to improvements in the organisation and design of work, and in fitting the task to the older worker, rather than vice versa. Some integrated approaches were also recommended.

Table 3.3.1 Grey literature Records

| Type   | Title  | Year | Author/Funding Source                         | State/Country | Intervention Focus   | Comments |
|--------|--|------|---|---------------|--|----------|
| Report | Expert forecast on emerging psychosocial risks related to occupational safety and health | 2007 | European Agency for Safety and Health at Work | Europe        | <p>The most important options generally available to companies regarding the management of ageing workforces included:</p> <ul style="list-style-type: none"> <li>o age-appropriate job design and preventative occupational health measures which will enable workers to remain in their jobs up to retirement age;</li> <li>o ergonomic workplace design;</li> <li>o fostering healthy work processes;</li> <li>o job enrichment by changing types, contents, and methods of work, and mixing tasks;</li> <li>o reducing time pressure;</li> <li>o introducing flexible working-time models;</li> <li>o ensuring ongoing updating of the knowledge base by implementing lifelong learning in companies;</li> <li>o qualification processes at the workplace ensure the maintenance of older employees' performance;</li> <li>o Avoiding lopsided specialisation and, by</li> </ul> |          |

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|        |   |      |                          |        | <p>contrast, systematically promoting the development of a range of competences and flexibility by ensuring that people carry out a variety of tasks and are subject to changing work demands throughout their company careers;</p> <ul style="list-style-type: none"> <li>○ Supporting the intergenerational transfer of know-how in companies and systematically using the complementary, age-specific skills of younger and older workers by setting up mixed-age teams (p.71).</li> </ul> <ul style="list-style-type: none"> <li>• Detailed recommendations depend on the circumstances in the enterprise; and</li> <li>• Risk assessment should be the first step in developing age-appropriate OSH management. (p71)</li> </ul> |   |
| Report | Healthy Work in an Ageing Europe. Strategies and Instruments for Prolonging Working Life. | 2006 | Morschhäuser and Sochert | Europe | <ul style="list-style-type: none"> <li>• Intervention: Stress management and fitness training for older drivers in Munich, Germany <ul style="list-style-type: none"> <li>○ Each year, 96 older drivers participated in a programme involving 20 health days at intervals of 12 days in a “health park” of the Munich adult education centre during working hours on full</li> </ul> </li> </ul>  | <ul style="list-style-type: none"> <li>• Argues that company reality has not kept up with best practice: “Of the three corporate strategies to deal with older employees – career design, work design, externalisation – the latter is currently still in the limelight...” (p.20)</li> </ul> |

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|  |  |  |  |  | <p>pay.</p> <ul style="list-style-type: none"> <li>○ These included stamina training, mental techniques to reduce timetable stress; “Anti-irritation” training and relaxation techniques.</li> <li>○ Result was a “a clear improvement in the health and well-being of the participants as well as a reduction in absenteeism and rates of driving incapacity” (but no more detail on this).</li> <li>○ Source: <i>Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, 2004</i> (p.48)</li> <li>● Intervention: shift changes in Austria <ul style="list-style-type: none"> <li>○ Geotextile producer changed shift rosters to increase recovery periods from three to four days between the shift blocks; night shifts from eight to six per month; and increase the number of weekends employees are free. “This shift rhythm greatly helps older workers in particular.”</li> <li>○ After four years, results were “ a tremendous improvement in the quality of life,” “a reduction in stress, a higher subjective level of health, an improvement in regeneration due to a better</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>● Recommends an age structure analysis and a forecast of the future age structure. (p.29)</li> <li>● Provides a checklist for companies to assess how they are going with respect to healthy older workers.</li> <li>● Suggests holding a workshop where older workers and executives discuss difficulties re healthy ageing and develop solutions. (p.45)</li> <li>● Outlines hazards related to aging and a series of systematic controls.</li> </ul> |
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|        |   |      |                 |                | <p>quality of sleep and family-friendly working hours, resulting in a rise in staff satisfaction.”</p> <ul style="list-style-type: none"> <li>○ Source: <i>www.arbeitundalter.at</i></li> </ul>   |  |
| Report | The ageing workforce: implications for occupational safety and health | 2016 | Crawford et al. | European Union | <ul style="list-style-type: none"> <li>• The report notes that occupational diseases and effects of demanding work develop from cumulative exposure, so extending the number of years worked may extend exposure to hazards.</li> <li>• Work ability can decrease with age, so ability plus hazard exposure must be considered.</li> <li>• Highlights the need for good quality working conditions, appropriate work-life balance, employment security, and lifelong learning. These concepts are the basis of "sustainable work".</li> <li>• Creating sustainable work requires an understanding of the age-related issues affecting hazard exposure and work ability.</li> <li>• Key interventions: <ul style="list-style-type: none"> <li>○ improved risk prevention for all workers, with specific measures for older workers when necessary (depending on type of work and the individual).</li> <li>○ Comprehensive approach</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Reviews age-related changes in workers.</li> <li>• Points out that age is not the only factor affecting the safety of older workers. <ul style="list-style-type: none"> <li>○ Weyman et al. (2013) concluded that chronological age is unlikely to be the best predictor of work preferences or ability, and that focusing on older workers may lead to good practice relevant to employees of all ages being overlooked. "Work should be made easier for all, with specific measures for individuals if needed" (p.10).</li> </ul> </li> </ul> |

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|  |  |  |  |  | <p>including OHS, HR and health promotion</p> <ul style="list-style-type: none"> <li>○ Work ability evaluation as part of risk assessment</li> <li>○ Health surveillance monitoring</li> <li>○ Ergonomic focus on making adjustments</li> <li>○ Flexible work arrangements may benefit older workers</li> <li>○ Skills training and developing the roles of older workers (e.g., to encompass mentoring of younger workers)</li> <li>○ Effective, interdisciplinary rehabilitation post injury, including for chronic MSDs</li> <li>○ Specific gender-related strategies in relation to sustainable work (e.g., considering industries in which women constitute most of workforce, such as cleaning and healthcare, and support for life stages e.g., supporting women during menopause, and when caring for family (e.g., elder care).</li> <li>○ Sector or job specific approaches, which could benefit all who work in jobs or industries</li> <li>○ An effective OHS system is required, including skills and resources for regulators to</li> </ul> |  |
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|              |  |      |                       |       | <p>deal with issues of the older workforce</p> <ul style="list-style-type: none"> <li>○ Access to occupational health services is important, and particularly difficult for smaller businesses</li> <li>○ Advocates an integrated policy approach; sustainable work needs maintenance of health of older workers, plus good working conditions (which includes OHS systems), but also consideration of wider socio-political issues (income distribution, tax regimes, pensions)</li> </ul>   |   |
| Book Chapter | Health and Safety Needs of Older Workers - Chapter 8 | 2004 | Institute of Medicine | of US | <ul style="list-style-type: none"> <li>• Reports on positive outcomes from comprehensive interventions, including job redesign and organisational change, in relation to MSDs among hospital workers, sign language interpreters and office workers.</li> <li>• Reviews evidence on ergonomic interventions for older workers in relation to carpal tunnel syndrome, and ergonomic modifications that have been associated with more rapid return to work.</li> <li>• Reviews evidence for application of ergonomic principles to reduce physical as well as psychosocial stressors.</li> </ul> | <ul style="list-style-type: none"> <li>• Indicates that there are knowledge gaps in socioeconomic and demographic factors than might increase risks for older workers (e.g., minority or immigration status, low literacy, low education level, lack of fluency in English) and regarding factors that may lead older workers to have to keep working (e.g., income insecurity, low-income levels, gaps in health insurance coverage, barriers to access to other public and private benefit</li> </ul> |



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|                        |  |      |   |    | <ul style="list-style-type: none"> <li>• Notes that interventions should be participative, include management commitment and the development of integrated programs that address equipment design, work procedures and organisational characteristics.</li> <li>• Advocates training and retraining interventions, as well as design interventions, to improve productivity and safety of older workers.</li> <li>• Notes little research on training for older workers, and that what exists has not been participatory.</li> <li>• Notes that there are indirect pathways to improving health of older workers, for example, ensuring adequate remuneration, which can make it easier to look after one's health needs.</li> </ul> | programs).  |
| Conference proceedings | Healthy Aging for a Sustainable Workforce: a conference report | 2009 | Association of Occupational and Environmental Clinics and Society of Occupational and Environmental Health (US) | US | <ul style="list-style-type: none"> <li>• Stakeholders in healthcare recommended the following formal policies and programmes (rather than informal solutions): <ul style="list-style-type: none"> <li>○ On-site Elder Care Flexible hours;</li> <li>○ Variability in preferences of staff for shift length;</li> <li>○ Group determination of schedule;</li> <li>○ Accommodations for older</li> </ul> </li> </ul>   | <ul style="list-style-type: none"> <li>• Advocates for evaluation research to determine the aspects of policies, programs, and intervention techniques that are effective in addressing the health and safety of aging workers</li> <li>• Evaluation research should be conducted to determine the</li> </ul> |

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|       |   |      |             |           | <p>workers responsible for elder care, just as accommodations are made for workers with young children;</p> <ul style="list-style-type: none"> <li>○ Designing out hazards rather than training to avoid hazards;</li> <li>○ Transportation for community-based workers;</li> <li>○ Programs to reduce trips and falls;</li> <li>○ Set expectations at practice could place aging workers at increased risk of unexpected hazards/events;</li> <li>○ Severity of injury, increased recovery period/MD behaviour on Return to Work (RTW) of older workers (P27).</li> </ul>       | <p>degree to which public policies intended to enable workers to remain at work safely and productively have met these objectives specifically with regard to older workers.</p>  |
| Guide | Understanding the safety and health needs of your workplace: Older workers and safety | 2010 | Worksafe WA | Australia | <ul style="list-style-type: none"> <li>● Highlights some controls that could be used including: <ul style="list-style-type: none"> <li>○ Matching the task to the person;</li> <li>○ Work organisation, including enabling sufficient individual control over work;</li> <li>○ Allowing flexibility in taking rest breaks;</li> <li>○ Scheduling of work to reduce the risks, (noting that older workers are more negatively impacted by night shifts).;</li> <li>○ Reviewing work intensity;</li> <li>○ Allowing time to adapt to changing requirements;</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>● Outlines hazards related to aging including: <ul style="list-style-type: none"> <li>○ potential increased exposure to sprains and strains, muscular stress incidents, musculoskeletal disorders, low back pain, vibration, heat, slips, trips, falls and noise. In some cases, more severe injuries and disability</li> <li>○ development of occupational disease</li> </ul> </li> </ul> |

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|       |  |      |                       |        | <ul style="list-style-type: none"> <li>○ Reducing physical demands;</li> <li>○ Improving the physical working environment, including lighting, noise, eliminating slip, trip and fall hazards;</li> <li>○ Reducing postural demands;</li> <li>○ Providing training and information;</li> <li>○ Supporting flexible employment conditions</li> </ul> | <ul style="list-style-type: none"> <li>○ high stress situations (depending on the job and the individual)</li> <li>○ physical issues such as: <ul style="list-style-type: none"> <li>- a decrease or changes in physical /performance capacity such as physical functional capacity,</li> <li>- postural changes, mobility,</li> <li>- visual deficits/ acuity and colour discrimination,</li> <li>- hearing</li> <li>- cognitive changes</li> <li>- tolerance for heat/cold</li> <li>- development of sleeping disorders and/or fatigue</li> <li>- ill health and disease-related issues e.g., cardiovascular disease and diabetes.</li> </ul> </li> </ul> |
| Guide | A Guide to Managing an Aging Workforce | 2016 | Government of Alberta | Canada | <ul style="list-style-type: none"> <li>• Argues that “...in almost all cases, training, changes and adaptation within the work environment can improve safety and performance and offset effects of physical and mental changes related to aging.” (p.17)</li> <li>• Highlights the “duty to accommodate” in Canadian</li> </ul>                    |   |

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|  |  |  |  |  | <p>law (p. 22) ie. making reasonable modifications , which applies to older workers.</p> <ul style="list-style-type: none"> <li>• Advocates direct and honest communication with older workers about their needs. (p 23)</li> <li>• Advocates designing and rearranging workplaces, work procedures and equipment to improve workers' health and safety (p 24). This is not specific to older workers, but work redesign can be used to meet older workers' needs.</li> <li>• Provides guidance for reducing the amount of standing work employees do, as well as ways to minimise sedentariness (p25), relevant to older workers, and workers in general.</li> <li>• Employers should provide proper tools (for all workers) including for lifting tasks. (pp. 26-27)</li> <li>• Employers should consider older workers' eyesight and hearing, avoiding contrasts in light, reducing glare, positioning lighting properly and using appropriate font size and style, and reducing excess noise. (pp. 27-28)</li> <li>• Shift work has health effects on all workers, but especially</li> </ul> |  |
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|                     |   |      |                 |    | <p>older workers. The publication recommends changes around shorter shifts, “using shift rotations that are the least disruptive to sleep “and keeping night shifts to a minimum” (p. 29).</p> <ul style="list-style-type: none"> <li>• Training design, raising awareness about older workers and ensuring younger supervisors have the skills to manage older workers appropriately are also mentioned. (p 31)</li> </ul>   |  |
| Review and guidance | The health, safety and health promotion needs of older workers: an evidence-based review and guidance | 2009 | Crawford et al. | UK | <ul style="list-style-type: none"> <li>• Systematic review of the health, safety and health promotion needs of older workers, and a short guidance document.</li> <li>• Suggests that older workers are more susceptible to fatal injury, and take longer to recover from injuries, however to date (2009) no intervention studies have been reported that evaluate strategies to reduce the risks for older workers with regard to either fatal injuries or serious non-fatal injuries.</li> <li>• The only significant workplace intervention for occupational health identified was De Boer et al. 2004. (See our discussion on p.52 for commentary).</li> <li>• The Shephard (1995) review</li> </ul> | <ul style="list-style-type: none"> <li>• 179 publications identified, reduced to 60 papers after screening.</li> <li>• Few of the intervention studies were deemed to be high quality.</li> <li>• Authors note that there are still many research gaps, including: <ul style="list-style-type: none"> <li>○ a lack of longitudinal research</li> <li>○ no further analysis on fatal accidents or understanding of the high prevalence of MSDs, stress, and anxiety in older workers</li> <li>○ a lack of investigation into what interventions are going to be effective.</li> </ul> </li> </ul> |

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|  |  |  |  |  | <p>of worksite health promotions indicates that physical health interventions can have a short-term impact.</p> <ul style="list-style-type: none"> <li>• Worksite fitness did not improve mental health.</li> </ul> | <ul style="list-style-type: none"> <li>○ occupationally relevant measurements of work capacity for both physical and mental work.” (p.6)</li> <li>• Very little research on the mental wellbeing of older workers.</li> <li>• The authors call for prioritising workplace interventions for the over 50s based on this data.</li> <li>• The control measures suggested included: <ul style="list-style-type: none"> <li>○ Physical demands - conduct objective assessment of job requirements and redesign work job demands are too great (for all workers).</li> <li>○ If shift work is necessary, shifts are designed using good ergonomic criteria, as well as recommendations from Costa &amp; Sartori (2007), such as reducing/ eliminating night shifts for older workers and increasing rest times.</li> </ul> </li> </ul> <p><i>Costa G and Sartori S. Ageing, working hours</i></p> |
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|  |  |  |  |  |  | <i>and work ability.<br/>Ergonomics 2007; 50<br/>(11): 1914-1930.</i> |
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## 4. Discussion

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### 4.1 Summary of findings: the primacy of organisational and composite approaches to intervention

This review of interventions to improve older worker health, safety and wellbeing at work examined a comprehensive range of literature, including literature reviews, primary research records, and grey literature.

The review found support for the effectiveness of organisational interventions, with the evidence for effectiveness of individual-level interventions being mixed. However, it should be noted that the quality of the intervention and evaluation designs were inconsistent, providing poor evidence for any one strategy to promote older worker health, safety and wellbeing. Indeed, mixed degrees of evidence were found for the various strategies in the intervention records, which is to be expected when reviewing such a diverse array of interventions.

The primary recommendations from the guidance material reviewed in the grey literature was to focus on fitting the work and work environment to older workers. This advice for implementing organisational intervention was generally around aspects of job design, workplace accommodations for older workers, and work organisation, including shift scheduling and flexible work options. While the intervention records provided support for organisational intervention, study designs and evaluation methodologies were often of low quality and the majority did not provide longitudinal evidence to support the effectiveness of these approaches. While this is a major limitation in the body of work reviewed, it should be noted that this approach is supported by research on the wider workforce and reflects the legislative requirements in most jurisdictions to provide a safe place of work and to manage hazards that can impact worker health, safety and wellbeing. Primary controls and elimination of hazards are also mandated at the top of the hierarchy of controls in WHS legislation in Australia and elsewhere, suggesting prevention should first focus on organisational approaches, notably work design. Clearly, it is fundamental that high quality, longitudinal research on primary organisational interventions examines which measures from the wide array of approaches designed to eliminate or manage risks to older workers are most effective, and in what combination.

While organisational intervention is desirable as it addresses the risks closest to the source of harm, individual-level interventions were examined in approximately one-half of the intervention records reviewed. These studies tended to use higher quality evaluation designs (i.e. randomised control trials), but on the whole failed to find longer-term support for the effectiveness of interventions to influence health, safety and work ability outcomes. The review records provided very limited evidence that individual-level interventions such as health promotion, exercise, web-based programs and training can have positive outcomes for older



workers (Merom et al., 2021; Poscia et al., 2016), while the intervention records offered evidence of only short-term improvements for the most common approaches, including exercise and physical activity and training (Cook et al., 2015). Indeed, in some cases, no significant effect was observed for older workers for specific interventions, including workstation ergonomic enhancements (May et al., 2004), and the opportunity for flexible work (Piszczek & Pimputkar, 2020) – though this was countered in the Morelock, McNamara and James (2017) study (albeit with a low effect size).

The most promising approaches reviewed in the literature in terms of effectiveness in relation to health, safety and work ability outcomes, as evidenced from both the review records and the intervention records, were composite interventions. These integrated approaches can be considered systematic solutions for complex problems (Cooklin et al., 2017). Typically, composite interventions involved both organisational and individual-level elements, and multiple components were often applied in concert. While these approaches make identification of the more effective elements of a composite intervention difficult if not impossible to determine, they reflect the complexity of occupational injury prevention and support a systems approach to intervention. Indeed, the studies reviewed focused on promoting older worker health and safety through changes to both work environment (fitting the work to the person) and improvements to the employee's ability to maintain wellbeing and performance and longevity in work. At the same time, however, virtually no study was able to track the impact of any one intervention on enabling an employee's likelihood to remain engaged in the workforce for a longer time. Future studies need to look specifically at the outcome of 'engaged longevity' (remaining in the workforce, healthily, and for longer) of older workers, so as to meet the growing and pernicious demographic challenges.

Few of the interventions reviewed addressed WMSD or psychological injury/psychosocial risks specifically, although a number of studies included relevant variables as outcomes, including strains/sprains, ergonomics improvements, and mental health and stress. What evidence there is for intervention to manage the risk of WMSD and psychological injury supports composite interventions. As noted earlier, these studies typically included both organisational and individual-level interventions - for example, a combination of exercise, education and ergonomic equipment in reducing musculoskeletal pain (Pieper et al., 2019). When considered alongside the wider range of studies identified in this review, these records add to the body of evidence for supporting composite interventions in the prevention of WMSD and psychological injury.

Finally, only one output considered in the review (from the grey literature) came from an Australian source (WorkSafe WA, 2010), indicating a major gap in our understanding of what works for older worker health, safety and wellbeing in an Australian context.

## 4.2 The role of context

Many of the records reviewed in the different categories of this report did not address the issue of context in any depth, with an assumption of homogeneity in the design and implementation of interventions. While the organisational or industry context was mentioned in 19 of the 21 intervention studies reviewed, there was a lack of elaboration on why the intervention design was related to the specific context of its application. For example, while a number of intervention records dealt with high-risk industry sectors for older workers, including construction (Hengel et al., 2011), agriculture (Nilsson, 2016) and health (Andersson-Frele, 2005; Maatouk et al., 2016; Palumbo et al., 2012; Strijk et al., 2011), this context did not appear to form a key part of the rationale for the choice of intervention, nor for the interpretation and implications of findings. Furthermore, different work contexts such as knowledge workers and skilled workers, white and blue collar, flexible workers and office-based workers were not well addressed, yet older workers in each context will respond differently to any given intervention, and interventions may be more or less effective in different contexts or settings.

Finally, because of the age of the records reviewed, nothing was learned about the context of COVID-19 and the pandemic's restrictions on work. Indeed, impacts of the current COVID-19 context include increased mental health concerns for socially isolated workers, sedentary work, changes to physical activity, flexible working, longer hours working on computers, increased screen time, and so on. In addition, the federally-funded Centre for Population (December 2020) notes that the impact of COVID-19 will be that Australia's population will be smaller and older than previously projections because of a lack of migration; and this will have long term effects for the longevity of the workforce. Clearly, future research needs to be designed to meet the WHS needs of older workers and contemporary organisational workplaces. Moreover, future research should address these wider issues of context to understand what approach works best in different settings and when designing interventions for older workers.

### **4.3 Future of work forces and trends**

Many of the intervention studies covered in this review were undertaken in the 2000-2016 period, meaning most were not cognisant of the more recent, and substantial, demographic and technological shifts that have reshaped the older worker landscape. With so few recent, replicated (or expanded) studies looking at interventions on older workers, we have a significant gap in knowledge. Indeed, technology was largely ignored in the interventions, despite the promise for adopting technological measures to reduce excessive physical and psychological demands on older workers (Anders, 2015; Horton et al., 2018). Undoubtedly, greater understanding of contemporary issues and challenges that older workers face will benefit from research that focuses on identifying and understanding potential hazards related to psychological health and MSD in this new work environment. Such research would provide greater insight into how to better integrate older workers in this new work environment now and into the future in a way that prevents psychological injuries and MSD. Nevertheless, due to

the recent, rapid, fundamental changes that the world of work has undergone, it will take time for the evidence base to provide a clear understanding of how this new world of work that relies so heavily on technological advances affects older workers. The way we work is evolving at a very rapid pace, therefore, a framework for preventing psychological injury and MSD among older workers that relies on the modest literature available could already be outdated. Hence, there is a need to take the current rapidly evolving work environment into account when devising intervention strategies for older workers. Since, the scientific literature has not caught up with recent changes in the world of work, any intervention strategies put forward will have to rely on a very strong theoretical framework to guide their development.

Given these omissions, future research should examine, in particular, the role of technological advancements, including automation, robotics/co-bots, and assistive technologies to enhance work and health outcomes (longevity) for older workers. Similarly, the role of new ways of working, notably flexible work arrangements (Bentley et al., 2017) should also be considered given the indications of their increasing application in the post-Covid-19 world of work.

#### **4.4 Participatory interventions**

Just one study in the intervention records reported a participatory intervention (see Hengel et al., 2018); moreover, the study only reported on the co-design of an intervention and not its implementation. This is a concern given the importance placed on participatory approaches to organisational interventions, in particular, involving end-users, employees, managers and others in intervention and implementation design (Eurofound and EU-OSHA, 2014; EU-OSHA, 2018; Leka, Van Wassenhove & Jain, 2015; Mental Health Commission of Canada, 2014; Nielsen & Christensen, 2021). Indeed, participatory approaches are often favoured for intervention to prevent WMSD (Oakman, Macdonald and Wells 2014) and psychosocial risks (Leka, Van Wassenhove & Jain, 2015; Neilsen et al., 2010). This is because it provides important subject matter expertise and ownership of interventions and provides necessary organisational or workplace context to ensure a good fit. Typically, a steering group will develop action plans for the implementation of the intervention and may also play a role in the evaluation of the process. Future research is also needed to explore participatory interventions in Australian organisations that might help shift stigma that inhibits longevity for older workers, irrespective of their physical health and mental resilience. Indeed, the need for the work design and work environment to be improved in a coordinated fashion would appear essential to creating healthier older workers.

#### **4.5 Culture, Climate and Leadership**

Two of the included interventions studies noted that workplace culture, climate and leadership were key enablers of healthy and active aging for employees (see Skoglund & Skoglund, 2005 and Hengel et al., 2011). In both studies, the authors noted that effective leadership, at both the

senior and line level, as well as an inclusive workplace climate, was key to facilitating dialogue between older workers and other cohorts about workplace health. The role of leadership and climate in advancing a psychosocially safe environment within organisation is well established, but the two papers implied that management considerations can have much broader implications for setting an agenda around stigma and aging, WMSD prevention and physical activity at work, as well as mental health considerations. Future research may seek to develop a more nuanced understanding regarding how workplace culture, climate and leadership can shape (or reshape) foundational values about the role of older workers; and track the direct and indirect effect of management support on health, engagement, longevity and wellbeing outcomes for older workers.

#### **4.6 The role of Human Resource Management policies, systems and practices**

The records reviewed for this report did not include any studies where the effectiveness of human resources management (HRM) policies and practices were examined. However, much of the literature relevant to HRM was excluded from our review due to not featuring interventions. These included articles about the engagement, recruitment and retention of older workers, age-discrimination (Bentley et al., 2019), retirement and extending working life, work ability, flexible work arrangements (Bentley et al., 2017), diversity management and a range of other issues. Very few of these studies dealt with WHS, although several were concerned with the role of HRM systems and practices in older worker wellbeing (Bentley et al., 2017; 2019), often associated with employee retention. Given the empirical evidence for the role of HRM policy, systems and practices in the retention and wellbeing of older workers, HRM researchers should be encouraged to move beyond empirical studies examining structural relationships between study variables and to collaborate with WHS researchers in intervention studies that apply this promising research to the prevention of older worker injuries.

#### **4.7 A research agenda**

The paucity in the quality and scope of documented evidence for what works in preventing older worker injuries identified in this review suggests the need for a future research agenda that combines gold standard intervention, implementation and evaluation methodologies with appropriate intervention designs. Furthermore, future research will need to have a specific focus on interventions that are effective in preventing the two most common and costly injury types: WMSD and psychological injury. The future research agenda set out in Figure 4.7.1 below responds to some of the shortcomings in the extant literature with a call for robust organisational intervention research that considers both context and the changing workplace landscape.

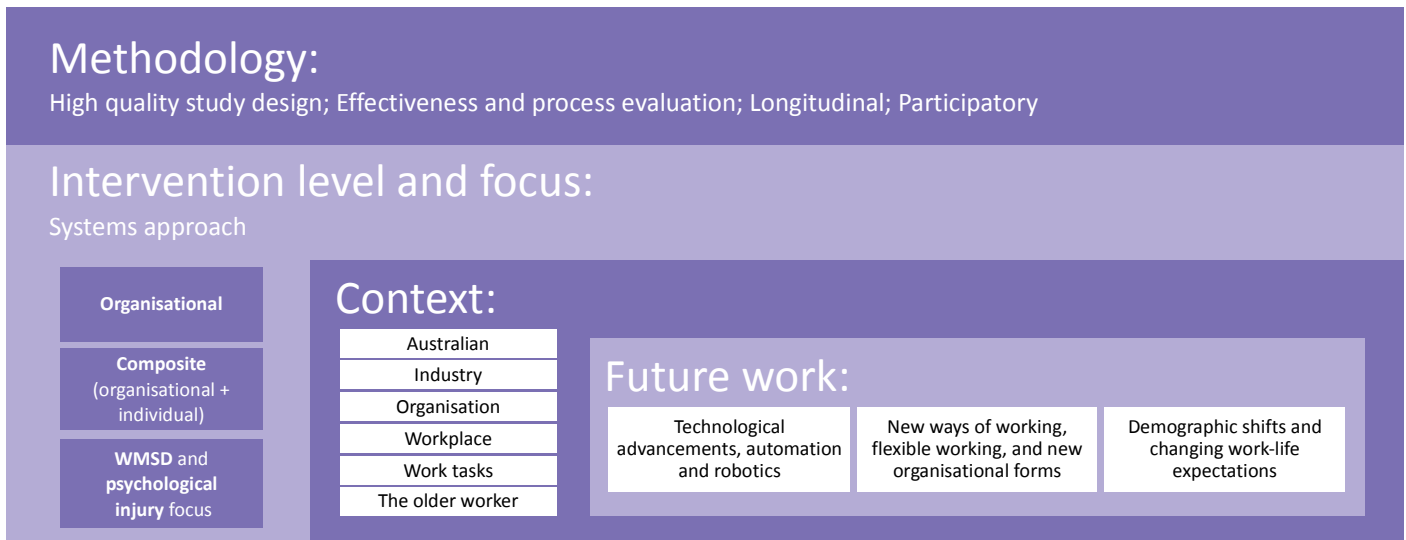


Figure 4.7.1 A future research agenda for older worker WHS intervention

### 4.7.1 Methodology

As shown in figure 4.7.1 it is essential that intervention design and evaluation methodologies follow best practice, incorporating **gold standard evaluation designs**, notably RCT and case-controlled evaluations, and a participatory process. As noted above, the quality of the evaluation designs for organisational interventions, in particular, was of mixed standard, while just one study reviewed used a participatory process. The literature on organisational intervention clearly recommends a **participatory approach** to intervention design and implementation action planning as fundamental in this field (Eurofound and EU-OSHA, 2014; EU-OSHA, 2018; Leka, Van Wassenhove & Jain, 2015; Neilsen et al., 2010; Mental Health Commission of Canada, 2014), with steering groups or similar teams of employees from all levels of the organisation participating in activities such as intervention design, or contextual modification of the intervention, and implementation and action planning. **Process evaluation** is also fundamental to understanding the role potential hindering and facilitating factors at national, industry and organisational levels, and should assess both social and organisational context, intervention development, implementation activities, participatory approaches, and so on (see Neilsen & Randell, 2013).

### 4.7.2 Intervention level and focus

This report argues that a future work agenda should have a dual focus: **organisational intervention** and **composite intervention**. As discussed above, the primary recommendations from the guidance material reviewed in the grey literature was to focus on organisational interventions that fitted the work and work environment to older workers through job design, workplace accommodations for older workers, and work organisation initiatives. The intervention records reviewed also provided support for organisational intervention, including aspects of work design, workplace alterations and culture, climate and leadership, albeit noting the issue identified with evaluation methodology quality. Other promising organisational

approaches, yet to be tested in intervention studies beyond flexibility programs, include the application of HRM practices to support older workers. It needs to be emphasised that organisational interventions best respond to legislative requirements in most jurisdictions to provide a safe place of work and to manage hazards that can impact worker health, safety and wellbeing.

It is also important to highlight the promise that composite approaches hold for acting across the work system, influencing both the design of work and work organisation, and the capacity of the older worker to maintain safe engagement in (healthy) work for longer. Thus, composite interventions, incorporating organisational and individual-level elements, were found to be effective in managing aspects of WMSD and psychological injury, and should therefore be examined through well-controlled intervention studies.

#### 4.7.3 Context

As discussed above, the role of context was not well elaborated in most of the intervention records reviewed. Yet, we argue that context is a fundamental consideration in the design and implementation of interventions designed to reduce WMSD and psychological injury in older workers. Indeed, older workers working in different work contexts such as knowledge workers and skilled workers, white and blue collar, flexible workers and office-based workers may experience and respond differently to any given intervention, and **interventions may be more or less effective in different contexts or settings**. It should also be noted that the **Australian and NSW State context** was absent from most studies in this review. The future research agenda should, therefore, target intervention within the Australian and NSW context, as well as considering context and contextual influences across the whole work system, including sector, organisation, workplace, work tasks performance and the workers impacted. As noted earlier, process evaluation can be useful in understanding the role of societal, cultural and organisational context in intervention effectiveness.

#### 4.7.4 Future work

Many future of work forces and mega trends are impacting how, where, when and with who we work. New ways of working and flexible working (also referred to as telework, telecommuting, working from home, agile working, and so on) have accelerated in prevalence due to the COVID-19 restrictions, while research evidence has found that older workers have a strong preference for flexible work arrangements in supporting their continued participation in employment (Bentley et al., 2017). The virtual workplace relies heavily on ever-improving technology for workers to stay connected with co-workers and perform their work duties.

While new ways of working are currently front of mind for governments and industry, other advanced technology applications are also transforming the workplace and will have implications for how older workers will engage with work in the future, including automation

and robotics/co-bot systems and assistive technologies which have potential to enhance the work and health outcomes (longevity) for older workers and eliminate the more hazardous elements of work for older workers. Demographic shifts impacting society and the workplace include an ageing population and workforce, acute workforce shortages in certain countries, states and sectors, and preferences to remain in employment past traditional retirement age for older workers.

Greater understanding of contemporary issues and challenges that older workers face will profit from research that focuses on identifying and understanding potential hazards related to psychological health and MSD in this new work environment. Such research would provide greater insight into how to better integrate older workers in this new work environment now and into the future in a way that prevents psychological injuries and MSD. Due to the recent rapid and significant changes that the world of work has undergone, it will take time for the evidence base to provide a clear understanding of how this new world of work affects older workers.

A framework for preventing psychological injury and MSD among older workers that relies on the little literature available could already be outdated. Hence the need to take the current rapidly evolving work environment into account when devising intervention strategies for older workers. As the scientific literature has not caught up with recent changes in the world of work, any intervention strategies put forward will have to rely on a very strong theoretical framework to guide its development.

Finally, it should be noted that a limitation of our literature review was that it did not examine interventions not originally intended for older workers but that could have applied/re-purposed for an older worker context.

#### 4.8 Implications for HOW Toolkit

Many of the intervention design implications from the above discussion and research agenda will be addressed through the HOW Toolkit, to be designed and evaluated in Phase 3 of this project. The intervention design will follow a **participatory approach**, involving a steering group from each of five diverse study organisations who will co-design and **contextualise the intervention to fit their unique workplace situation**. The organisational intervention itself will address two key areas: the WHS Management System – including the impact of the ageing workforce on these systems – and the design of work tasks undertaken by older workers. This **composite approach** will also be open to individual-level components where the steering groups require this. The intervention design and resulting HOW Toolkit will also take account of the changing nature of work and **future of work forces that impact the work and work tasks of older workers**. The qualitative evaluation of the HOW *Toolkit* within the five diverse organisations will follow proven **effectiveness and process evaluation models** and will include

participation from the Steering Groups utilised in the design stage, along with the project researchers who will facilitate the evaluation. The evaluation will determine the efficacy of the on-line toolkit to guide effective analysis of the impact of workforce ageing on organisational WHS systems and processes and the design and/or redesign of older workers jobs to provide healthy, safe and sustainable work. Process evaluation will involve interviews with WHS personnel implementing the intervention and written feedback from participants to help understand barriers and facilitating factors for effective implementation. While the evaluation will not have a longitudinal element due to the time constraints of the project, it is recommended that this is considered in a follow-up study that will determine the longer-term effectiveness of the HOW Toolkit.

## 5. Conclusion

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This systematic literature review is the first of a series of three studies that together have the goal of developing a toolkit resource that will improve the ability of organisations to effectively manage the risk of physical and psychological injury amongst older workers. The systematic literature review examined interventions to improve physical and psychological injury outcomes amongst older workers, with a focus on measures to reduce exposure to work-related WMSD and psychological injury. The large majority of the records from the review of academic and grey literature were not directly focused on WMSD and psychological injury, although many had content of relevance or used related outcome measures to evaluate intervention effectiveness, therefore having value for our findings. Overall, the body of research reviewed was considered weak in regard to the low number of high-quality intervention studies published, the quality of the evaluation designs employed, including a lack of participatory approaches and short timeframe evaluations, and the lack of Australian content. Composite interventions comprising both organisational and individual-level approaches appear to have most promise for addressing older worker injuries, although the evidence for this is based on a very small body of research. Organisational interventions are well-supported in the wider intervention literature and found some support amongst the records reviewed, albeit with methodological limitations. Individual-level interventions had mixed, short-term benefits in many records. The discussion noted the weak treatment of context for intervention along with lack of regard for the changing nature of work and future of work forces that are shaping the WHS risks faced by older workers. These concerns should be addressed through a future research agenda, as set out in the report, along with a greater focus on what works in the Australian context and with regard to sector, organisation, workplace, work tasks and worker contexts.



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## 7. Appendix

### 7.1 Records return for each database search

| Database          | Matches | Search Terms   |
|-------------------|---------|--|
| SCOPUS            | 2712    | ( ALL ( "older worker" OR "ageing workforce" OR "aging workforce" OR "mature age worker" OR "older employee*" ) AND ALL ( "work-related injur*" OR "occupational injur*" OR "work injur*" OR "workplace injur*" OR "workability" OR "occupational health and safety injur*" OR "workplace health and safety injur*" OR workplace OR organisation OR organization OR occupation* ) AND ALL ( "psycho* health" OR "psycho* safety" OR "psycho* harm" OR "psycho* disorder" OR "mental health outcomes" OR "mental wellbeing" OR "musculoskeletal disorder" OR "WMSD" OR "MSD" OR "musculoskeletal injur*" OR pain OR "mental illness" OR "workplace stress" OR "occupational injur*" OR "workplace injur*" OR "age discrimination" OR "strains and sprains" OR "occupational overuse" OR "repetitive strain" OR "slip fall trip" OR wellbeing OR well-being OR "healthy work" OR "health at work" ) AND ALL ( "control strateg*" OR "risk control*" OR "participatory intervention*" OR "management system" OR "evaluation approach" OR "risk prevention" OR "injury prevention" OR "risk management" OR "job design" OR "manual handling intervention" OR "workplace intervention" OR "organisational intervention" OR "early intervention" OR "intervention strategy" OR "healthy workplaces" OR "return to work" OR ergonomics OR "job control" ) ) AND PUBYEAR > 1999 AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "re" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) |
| PsychInfo         | 20      | ("older worker" OR "ageing workforce" OR "aging workforce" OR "mature age worker" OR "older employee*") AND ("work-related injur*" OR "occupational injur*" OR "work injur*" OR "workplace injur*" OR "workability" OR "occupational health and safety injur*" OR "workplace health and safety injur*" OR workplace OR organisation OR organization OR occupation*) AND ("psycho* health" OR "psycho* safety" OR "psycho* harm" OR "psycho* disorder" OR "mental health outcomes" OR "mental wellbeing" OR "musculoskeletal disorder" OR "WMSD" OR "MSD" OR "musculoskeletal injur*" OR pain OR "mental illness" OR "workplace stress" OR "occupational injur*" OR "workplace injur*" OR "age discrimination" OR "strains and sprains" OR "occupational overuse" OR "repetitive strain" OR "slip fall trip" OR wellbeing OR well-being OR "healthy work" OR "health at work") AND ("control strateg*" OR "risk control*" OR "participatory intervention*" OR "management system" OR "evaluation approach" OR "risk prevention" OR "injury prevention" OR "risk management" OR "job design" OR "manual handling intervention" OR "workplace intervention" OR "organisational intervention" OR "early intervention" OR "intervention strategy" OR "healthy workplaces" OR "return to work" OR ergonomics OR "job control")   |
| ProQuest Business | 709     | ("older worker" OR "ageing workforce" OR "aging workforce" OR "mature age worker" OR "older employee*") AND ("work-related injur*" OR "occupational injur*" OR "work injur*" OR "workplace injur*" OR "workability" OR "occupational health and safety injur*" OR "workplace health and safety injur*" OR workplace OR organisation OR organization OR occupation*) AND ("psycho* health" OR "psycho* safety" OR "psycho* harm" OR "psycho* disorder" OR "mental health outcomes" OR "mental wellbeing" OR "musculoskeletal disorder" OR "WMSD" OR "MSD" OR "musculoskeletal injur*" OR pain OR "mental illness" OR "workplace stress" OR "occupational injur*" OR "workplace injur*" OR "age discrimination" OR "strains and sprains" OR "occupational overuse" OR "repetitive strain" OR "slip fall trip" OR wellbeing OR well-being OR "healthy work" OR "health at work") AND ("control strateg*" OR "risk control*" OR "participatory intervention*" OR "management system" OR "evaluation approach" OR "risk prevention" OR "injury prevention" OR "risk   |

|        |    |  |
|--------|----|--|
|        |    | management" OR "job design" OR "manual handling intervention" OR "workplace intervention" OR "organisational intervention" OR "early intervention" OR "intervention strategy" OR "healthy workplaces" OR "return to work" OR ergonomics OR "job control")  |
| CINAHL | 17 | TX ( "older worker" OR "ageing workforce" OR "aging workforce" OR "mature age worker" OR "older employee*" ) AND TX ( "work-related injur*" OR "occupational injur*" OR "work injur*" OR "workplace injur*" OR "workability" OR "occupational health and safety injur*" OR "workplace health and safety injur*" OR workplace OR organisation OR organization OR occupation* ) AND TX ( "psycho* health" OR "psycho* safety" OR "psycho* harm" OR "psycho* disorder" OR "mental health outcomes" OR "mental wellbeing" OR "musculoskeletal disorder" OR "WMSD" OR "MSD" OR "musculoskeletal injur*" OR pain OR "mental illness" OR "workplace stress" OR "occupational injur*" OR "workplace injur*" OR "age discrimination" OR "strains and sprains" OR "occupational overuse" OR "repetitive strain" OR "slip fall trip" OR wellbeing OR well-being OR "healthy work" OR "health at work" ) AND TX ( "control strateg*" OR "risk control*" OR "participatory intervention*" OR "management system" OR "evaluation approach" OR "risk prevention" OR "injury prevention" OR "risk management" OR "job design" OR "manual handling intervention" OR "workplace intervention" OR "organisational intervention" OR "early intervention" OR "intervention strategy" OR "healthy workplaces" OR "return to work" OR ergonomics OR "job control" ) |

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