

Title: Persistent musculoskeletal pain and productive employment. A systematic review of interventions.

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Abstract

Background: A systematic analysis of the literature was undertaken to determine which characteristics of workplace interventions are most effective in assisting people with persistent musculoskeletal pain (PMP) to remain productively employed.

Methods: Databases of Medline, PsychINFO, CINAHL and Embase were searched using MeSH and other relevant terms. Studies that reported on interventions at, or involving, the workplace were included. Interventions were considered as either focused on the individual or multilevel. Outcome measures assessed included: job loss, productivity, sick leave, pain and cost benefit. A quality assessment was undertaken using GRADE criteria with development of impact statements to synthesise the results.

Results: Eighteen relevant articles (14 studies) were identified for inclusion in the review. No high level evidence for workplace interventions to assist people with PMP were identified. Low numbers of participants and limited studies resulted in downgrading of evidence. However, individually focused interventions will probably reduce job loss and sick leave, but are unlikely to reduce pain. Multilevel focused interventions will probably result in decreased sick leave and provide some cost benefit. The evidence on productivity was limited and of poor quality. Further research is required because sustainable employment for individuals with PMP is important and understanding what works is necessary to ensure effective workplace interventions are developed.

Key words: systematic review; chronic pain; musculoskeletal; employment; productivity; persistent pain

Introduction

Persistent pain imposes a profound personal and societal burden globally. Up to one in three people live with a persistent pain condition ¹⁻⁵, with pain of musculoskeletal origin being the

most common aetiology⁶ and prevalence predicted to rise substantially in coming decades⁷. Notably, the majority of people living with painful musculoskeletal conditions are of working age⁷, and, importantly, this proportion will increase as working age extends. In addition to the physical, emotional and social impacts of persistent musculoskeletal pain (PMP), reduced work participation rates are common and often result in many individuals retiring from work earlier than their counterparts without pain⁸.

Reduced workforce participation has both psychosocial and socioeconomic consequences for the individual^{9,10} as well as socioeconomic consequences for society through lost human capital, reduced taxation revenue, reduced productivity^{4,7} and the multi-system costs of supporting people with PMP. The increasing imperative for individuals to remain employed for longer represents a significant societal challenge, particularly in the context of a rising prevalence of PMP, unless appropriate workplace accommodations can be made to support employees with PMP manage activity impairments and symptoms, and prevent further disability^{11,12}. Determining the most effective aspects of such accommodations is an important step towards achieving a longer, productive working life for those with PMP, thus imparting both individual and societal benefits.

Musculoskeletal conditions include more than 150 different diagnoses¹³. While the pathologies and nature of impacts may vary, a unifying characteristic across the vast majority of conditions is persistent pain. Importantly, pain is the key reason consumers seek medical care and experience disability¹⁴. Recent research has also identified that, despite very different pathologies, individuals with inflammatory arthritis or osteoarthritis did not differ in workplace activity limitations¹⁵. Examining the effectiveness of interventions across painful musculoskeletal conditions is, therefore, appropriate. Moreover, many musculoskeletal conditions may co-exist, so there is less generalizability when the focus is disease-specific, rather than a person-centred, symptom-based approach.

According to macro-ergonomics theory, worker¹⁶ productivity is improved when individuals are well matched to the inherent requirements of their work with better outcomes at an individual and organisational level, often referred to as person-environment fit¹⁷. Workplace interventions to address issues of person-environment fit are complex and challenging to implement and appropriately measure their effectiveness. Interventions can be targeted at a range of levels: individual, environmental, or organisational; focussing on a particular level or taking a multilevel approach¹⁸. Accommodations that address the multidimensional aspects of productivity in workers with PMP may be more effective than those that take a more narrow focus; synchronous to a biopsychosocial approach to managing PMP¹⁹. This review sought to investigate this issue.

To assist people with PMP and their workplaces in maintaining productive employment, clarity around what constitutes effective interventions is needed. This review aims to synthesise the current evidence in order to develop recommendations for the consideration of effective workplace interventions for those who need to accommodate workers with PMP. Analogous to the vast majority of chronic health conditions, PMP that is experienced by the majority of the population is unrelated to a specific work injury⁶, although it is acknowledged that work may be an aggravating factor. Therefore, we aimed to examine the effectiveness of interventions in populations with PMP that was not associated with a compensable workplace injury, thus allowing the generalisability of the findings to the majority of the working population, rather than the subgroup engaged in a compensable system.

The review has been framed using a macroergonomics framework²⁰, considering interventions from the level of the individual worker to the influence of policy at the societal level, to ensure a comprehensive analysis of all relevant factors has been undertaken, with a view to facilitate translation into occupational health and clinical practices. Macroergonomics, based on sociotechnical systems theory, can be defined as a systematic approach which considers the organisational and sociotechnical context of work activities and processes with their subsequent impact on an individual's health, well being and ultimately productivity^{21 22}.

This is consistent with the intent of the International Classification Framework (ICF), which conceptualises functioning and disability as outcomes of interactions between individuals and contextual factors (environment and personal) ²³.

The sociotechnical context is particularly relevant to the current review as the regulatory environment in which employers operate has substantial influence over the policies and procedures that are available to manage and support workers with persistent pain conditions. Policies regarding public disability support and insurance systems vary considerably across countries. Cause-based systems, are those such as the Australian system, where the context and underlying cause for the illness or injury will determine access to workplace support; if the cause of PMP is determined to be 'work-related' the employer is obliged to provide the worker with supports to assist with return-to-work ²⁴. Those with non work-related PMP, are not covered by specific support systems²⁵ and as such face challenges in ensuring they are provided with appropriate accommodations. In contrast, non cause-based systems, such as the Swedish and Dutch systems, provide support for disability regardless of the cause ²⁶. An alternative system operates in some countries which have cause-based systems, but also provide generous provisions from social security systems for workplace supports for workers with chronic conditions such as PMP.

The objective of the current study is to analyse what are the most effective interventions for those with persistent musculoskeletal pain to remain productively employed.

Methods

Search Strategy

To identify relevant studies of interventions to assist people with PMP to remain productively employed, an electronic literature search of the following databases was undertaken:

Medline, PsychINFO, CINAHL and Embase. The search was limited to English language, between January 2000 – March 2014 to capture articles relating to the contemporary work

environment. Bibliographies of included papers were searched, and a cited reference search was undertaken using Web of Science. Grey literature was accessed through internet searching, but not included as it did not meet the review criteria. An expert in the field was also contacted for advice regarding other potentially relevant studies not already identified using the above methods.

Selection of studies

Inclusion criteria

Inclusion and exclusion criteria covered participants and the interventions. Studies reporting on workers with pain of musculoskeletal origin of at least three months duration were included in the review. Workers on sick leave (less than 1 year) but with an ongoing relationship with their workplace through an employment agreement were also included. We also included studies where PMP was not a specific inclusion criterion for the study, but where subgroups of participants with PMP could be separately analysed. Studies were included from countries with disability support schemes that provide support for individuals regardless of cause. For countries with a cause-based support system, studies were excluded if the PMP condition was considered a workplace injury or illness and study participants were receiving support through a cause-based workers' compensation system, such as the support schemes available through the Australian, Canadian, the USA or UK cause-based systems²⁶. Here, the intent was to capture studies that described programs available to people experiencing PMP without a direct occupational causation.

In relation to the intervention, studies were included if they involved interventions that comprised at least advice about changes in work processes to improve productivity and/or were part of a multifaceted intervention. Interventions were required to be connected to the workplace, or a component of the intervention needed to be at the workplace. Studies with interventions that included additional components not connected to the work environment, such as treatment by practitioners, were not excluded²⁷. Interventions could be aimed at

modifying the physical work environment, work routine, work hours and/or individual coping mechanisms provided they were workplace-based or involved the workplace.

Only randomized control trials (RCTs) and cohort studies with pre and post intervention measures were included in the review. Two reviewers (NK and JO) independently assessed studies for inclusion. The retrieved studies were first selected by title and abstract for potential inclusion. In cases of disagreement between reviewers the full text of studies was accessed and consensus reached. All studies selected for potential inclusion had full text assessment. Full texts of all studies were analysed for inclusion or exclusion by the two reviewers, and where consensus was not reached, a third reviewer was consulted (TK).

Outcome measures

Five outcome areas were examined in this review: productivity, sick leave, pain, job loss and cost benefit.

Data management

Extraction of data

Data from the relevant studies were extracted using a customised form. Characteristics of studies were extracted and summarised including: study design, country where intervention was implemented and the type of public disability support schemes available, participant details, type of intervention, outcome measures and results. Interventions were classified as having an individual, workplace or multilevel focus.

Assessment of risk of bias

Individual studies were assessed for risk of bias using a domain based evaluation as recommended by the *Cochrane Handbook*²⁸. Non-RCT studies were assessed using the Cochrane Bias Methods Group criteria²⁹. Two reviewers (JO, TK) independently assessed the studies, with any differences resolved by consensus. If consensus was not reached, a third reviewer (AMB) was included to arbitrate. For the RCTs, six areas of bias were

assessed: selection, performance, detection, attrition, reporting and 'other'. Each area of bias included several assessment domains. Due to the nature of workplace interventions, which does not allow for blinding, the criteria related to blinding of participants and of providers (domains within performance bias) was not assessed, consistent with approaches used by others³⁰, leaving a total of ten domains. Each domain was assessed as high, low or unclear risk. The risk of bias associated with intention to treat analysis was assessed as high if > 20% loss to follow-up occurred and with no intention to treat analysis³¹. To aid in the interpretation of bias, relevant information was requested from study authors if not clearly described in the article. In cases where information was not available or a trial protocol not published or registered, the corresponding risk of bias domain was assessed as unclear. The non-RCT studies were assessed against eight criteria as specified by the Cochrane Bias Methods Group²⁹.

Grading the level of evidence

The quality of evidence for each outcome was assessed using the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) tool as described in the Cochrane Handbook^{32 33}. Evidence quality was assessed in relation to six criteria: (1) study design, (2) risk of bias or study limitations, (3) consistency of results, (4) directness, (5) precision and (6) publication bias³⁴. Each outcome was examined by at least two of the authors, the GRADE process was undertaken by all authors and consensus reached by discussion.

Using the GRADE system, the study design for each included study prescribes the starting level of evidence and following further assessment can be downgraded or upgraded. An overall level of evidence was evaluated for each outcome as follows:

(1) *High quality* - further research is very unlikely to change our confidence in the estimate of effect or accuracy.

(2) *Moderate quality* - further research is likely to have an important impact on our confidence in the estimate of effect or accuracy and may change the estimate.

(3) *Low quality* - further research is very likely to have an important impact on our confidence in the estimate of effect or accuracy and is likely to change the estimate.

(4) *Very low quality* - any estimate of effect or accuracy is very uncertain.

A statement of evidence quality (an impact statement) was then developed, which takes into account the level of evidence and the likely impact on the particular outcome. Impact statements used in this review are based on standard qualitative statements developed by Glenton, Santesso, Rosenbaum et al ³⁵. A version of this systematic review for employees and employers is reported elsewhere³⁶.

Results

Selection of studies

A total of 6385 references were retrieved following a search of electronic databases (Medline 1588, PsychInfo 393, CINAHL 699, Embase 3705). After removing 4233 duplicates, 2135 unique references remained. When assessed on title and abstract 34 references were selected for potential inclusion (Figure 1). A bibliographic search of included articles identified four additional studies and a citation search via Web of Science a further three studies. Following consultation with an expert in the field an additional four studies were added (N=45).

Insert figure 1.

Following full text examination of the 45 potential articles, 27 were excluded on the basis they were either; not a workplace intervention (5 articles), had participants who were unemployed (5 articles), included chronic conditions other than musculoskeletal (4 articles) and the musculoskeletal results were not analysed separately, included a work related condition (4 articles) or had participants whose pain was of less than 3 months duration (9 articles). Eighteen articles (representing 14 studies) from 11 countries (Canada, Denmark,

Finland, France, Germany, Norway, The Netherlands, Sweden, Switzerland, United Kingdom, USA) with a range of policy structures were included in the systematic review. We identified three broad categories of public disability insurance systems. Category one: cause-based systems where the study participants were not receiving support from a workers' compensation scheme and had access to minimal workplace supports through other social security systems. Category two: cause-based systems where the study participants were not receiving support from a workers' compensation system, but there were generous workplace supports available through other social security support systems. Category three: non-cause based systems (see online supplementary Table S1). Study designs comprised 12 RCTs, one cohort study and one uncontrolled pre/post intervention study.

Study characteristics

Studies were published between 2003 and 2014. Of the 14 studies, six compared interventions with usual care for PMP and eight compared interventions with other interventions. Interventions were categorised as either taking an individual, workplace or multilevel (individual and workplace) focus. Individually-focused interventions in the studies included, as examples, educational pamphlets or rehabilitation counselling for the employee. With these interventions, no workplace changes were made. Workplace interventions were targeted at making changes to the workplace such as working hours or schedules, the physical work environment or job design. However, none of the studies took a workplace focus without also including individual changes, so studies were categorised as only individually-focused or multilevel-focused. Examples of multilevel-focused interventions included a combination of workplace ergonomic assessments (individual component), consultations with employers (workplace component) and the use of case managers (individual component). Nine studies in the review included individually-focused interventions and five tested multilevel-focused interventions (see online supplementary Table S1). In cases where there was an option to involve the employer but the involvement was not

specified, studies were classified as individually focused³⁷⁻³⁹. Comparators to the intervention were classified as ‘usual care’ or ‘other interventions’. ‘Usual care’ was defined as the situation when no other intervention was instigated by the researchers; i.e. participants continued undertaking their usual program of care for their PMP, which may have included physician visits, or other treatments. ‘Other interventions’ were those prescribed by the research group as a comparator to the intervention being tested, such as education or ergonomic training. This might have been a less intense version of the intervention being studied. Placebo comparisons were not used in any of the studies.

Studies included in the review utilised several different scales to measure the five inclusion outcomes (Table 1). Heterogeneity between outcome measures meant a meta-analysis was not feasible.

Table 1: Outcome Measures

Outcome Measures	Measures identified in included studies
Productivity	Arthritis Impact Measurement Scale role score (AIMS 2), subjective working capacity, Workplace Activity Limitations Scale (WALS) change over 4.5 years, Rheumatoid Arthritis Work Instability Score (RA WIS), Work Ability Index (WAI).
Sick leave	Mean days per year over three years post treatment compared to one year pre treatment, hours over 2 years, mean difference over 10 week period, % participants in full-time work status, days per month over 6 month period, days over 1 year, % participants on sick leave for >30 days, days over 6 months, % participants reporting absenteeism as arthritis related work outcome pre/post intervention.
Pain-related	Arthritis Impact Measurement Scale symptom score (AIMS2), low back pain intensity scale, change in Pain Catastrophising Scale (PCS) over 4.5 years, researcher-developed questionnaire, Visual Analogue Scale (VAS), changes in AIMS2 and VAS over 6 months, change in pain numeric rating scale over 8 weeks.
Job Loss	Self reported job loss events either permanent (retirement or disability pension) or temporary (unemployment).
Cost benefit	Total reimbursement paid out to intervention group vs control group minus direct cost of intervention (therapists, training, costs of ergonomic improvements) Intervention, health/non-health care and productivity loss costs

Risk of bias analysis

Risk of bias assessments for all studies are presented in Table 2. Risk of bias was assessed as low, high or unclear for all study types.

Table 2: Summary of risk of bias

a) RCT studies

(-) = low risk, (?) = unclear, (+) = high risk

Allaire 2003/2005	Arnetz 2003	Baldwin 2012	Van den Hout 2007	de Buck 2005/	Fieten 2006	Jousset 2004	Kaapa 2006	Lambeek (x2) 2010	Macedo 2009	Meyer 2005	Roche-Leboucher 2011	Sundstrup 2014	Random sequence generation
-	-	-	-	-	-	-	-	-	-	-	-	?	Random sequence generation
-	-	-	-	-	-	?	-	-	-	-	?	-	Allocation concealment
-	-	-	-	-	-	?	-	-	?	-	+	-	Blinding of outcome assessors
-	-	?	?	-	-	-	-	-	-	-	+	-	Outcome data complete
?	?	?	-	?	?	?	?	-	-	?	?	-	Selective outcome reporting*
-	-	-	-	+	+	-	-	-	-	-	-	-	Group similarity at baseline regarding the most important prognostic factors
?	?	?	?	?	?	?	?	?	?	-	-	?	Co-interventions **
-	?	?	+	-	-	?	-	-	-	-	?	?	Compliance in all groups

-	-	-	-	-	-	-	-	-	-	+	-	Intention-to-treat analysis
-	-	-	-	-	-	-	-	-	-	-	-	Timing of outcome assessments in groups

* **selective outcome reporting** assessed as unclear if the protocol was not available (ISRCTN register checked and authors contacted if studies not registered). A possible limitation of this assessment – when assessing outcome reporting for studies with multiple articles in languages other than English, some articles may not have been detected in literature search (which was restricted to English) and therefore outcomes assessed as being not reported (resulting in overestimation of the risk).

** **co-intervention** defined as treatment/activity that would not normally be experienced in standard practice – if studies did not explicitly state co-interventions were avoided, an unclear rating was applied

all criteria – if the study did not provide adequate details of the criteria in question, the rating was deemed unclear.

b) Non-RCT studies

Domain	Gignac 2009*	Gignac 2011*	Weiler 2009
1. Was the selection of exposed and non-exposed cohorts drawn from the same population?	-	-	-
2. Can we be confident in the assessment of exposure?	-	-	-
3. Can we be confident that the outcome of the interest was not present at start of study?	-	+	-
4. Did the study match exposed and unexposed for all variables that are associated with the outcome of interest or did the statistical analysis adjust for these prognostic variables?	-	-	-
5. Can we be confident in the assessment of the presence or absence of prognostic factors?	+	+	-
6. Can we be confident in the assessment of outcome?	-	+	-
7. Was the follow up of cohorts adequate?	+	+	?
8. Were co-interventions similar between groups?	-	-	-

* Same study but assessed separately for risk of bias as each article examined different outcome measures.

Grading the evidence and synthesis

Table three provides detail on evidence quality, as assessed by GRADE, for each outcome.

Three 'summary of findings' sub-tables were generated on the basis of intervention (individual/multilevel focus) and comparison groups (usual care/other intervention). The table also provides the impact statement for each outcome, based on the evidence quality.

Overall, the quality of evidence was low, usually due to the small numbers of studies and sample size. The GRADE approach assesses the overall body of evidence rather than the individual study; differences may results between a single study and an outcome effect.

Table 3: Summary of findings GRADE

Impact statements

Quality of evidence	Magnitude of effect		
	<i>Important benefit/harm</i>	<i>Less important benefit/harm</i>	<i>No effect</i>
1. High quality	'Will' increase/decrease...	'Slightly' increases/decreases...	'Makes little or no' difference...
2. Moderate quality	'Probably will' increase/decrease...	'Probably slightly' increases/decreases...	'Probably' makes little or no difference
3. Low quality	'May' increase/decrease...	'May slightly' increase/decrease...	'May' make little or no difference
4. Very low quality	It is not known whether the intervention increases/decreases...		

What characteristics of interventions targeting employees with persistent MSK pain, and/or their workplace, are most effective in supporting productive employment?			
<p>Patients or population: Working adults connected to workplace by employment agreements (may be on sick leave of duration <1 year) who have persistent MSK pain (>3 months duration) Settings: Based at the workplace, or addressed workplace processes Intervention: Individual focus (total of 2 studies) Comparison: Usual care</p>			
Outcomes	Impact: effect of individually focused workplace intervention on employment	Number of participants (studies)	Quality of evidence (GRADE)
Sick leave	Individually focused interventions probably slightly decrease sick leave in employees with persistent MSK pain	1111 (2 studies) <small>40 41</small>	Moderate ¹
Job loss	Individually focused interventions may make little or no difference in job loss for employees with persistent MSK pain	115 (1 study) <small>42</small>	Low ^{1,2}
Pain	Individually focused interventions may make little or no difference to pain attributes in employees with persistent MSK pain	115 (1 study) <small>42</small>	Low ^{1,2}
Cost benefit	Individually focused interventions may make little or no difference to cost benefit	121 (1 study) <small>40</small>	Low ^{1,2}
<p>Patients or population: Working adults connected to workplace by employment agreements (may be on sick leave of duration <1 year) who have persistent MSK pain (>3 months duration) Settings: Based at the workplace, or addressed workplace processes Intervention: Individual focus (total of 7 studies) Comparison: Other intervention</p>			

Outcomes	Impact: effect of individually focused workplace intervention on employment	Number of participants (studies)	Quality of evidence (GRADE)
Job loss	Individually focused interventions probably will decrease job loss for employees with persistent MSK pain	196 (1 study) <small>39</small>	Moderate ²
Sick leave	Individually focused interventions may slightly decrease sick leave taken by employees with persistent MSK pain	390 (5 studies) <small>43-47</small>	Low ^{3,4}
Pain	Individually focused interventions probably make little or no difference to pain attributes in employees with persistent MSK pain	399 (5 studies) <small>37 43-46</small>	Moderate ³
Productivity	Individually focused interventions probably slightly increase productivity of employees with persistent MSK pain	236 (3 studies) <small>37 43 47</small>	Moderate ³
<p>Patients or population: Working adults connected to workplace by employment agreements (may be on sick leave of duration <1 year) who have persistent MSK pain (>3 months duration) Settings: Based at the workplace, or addressed workplace processes Intervention: Multilevel focus (total of 5 studies) Comparison: Usual care</p>			
Outcomes	Impact: effect of multilevel focused workplace interventions on employment	Number of participants (studies)	Quality of evidence (GRADE)
Sick leave	Multilevel focused interventions may slightly decrease sick leave taken by employees with persistent MSK pain	731 (5 studies) <small>15 48-51</small>	low ^{5,6}
Productivity	It is not known whether multilevel focused interventions will affect productivity of employees with persistent MSK pain	381 (2 studies) <small>50 52</small>	v.low ^{5,6}
Pain	Multilevel focused interventions may slightly decrease pain attributes amongst employees with persistent MSK pain	505 (3 studies) <small>49 50 52</small>	low ^{5,6,7}
Cost benefit	Multilevel focused interventions will probably increase cost benefit	271 (2 studies) <small>48 53</small>	moderate ⁴

¹ High risk of bias – low compliance

² Small sample size

³ High risk of bias for incomplete outcome data, intention-to-treat analysis, blinding of outcome assessors and co-intervention

⁴ Imprecision – wide confidence intervals

⁵ Includes non-RCT studies

⁶ High risk of bias – 4/8 domains assessed as high for one study

⁷ Inconsistency of results between studies – one found positive effect, other found negative effect

Effect of individually-focused interventions on employment compared to usual care

Two studies, represented by three articles ⁴⁰⁻⁴² investigated the effect of individually-focused interventions compared to usual care. Usual care involved referral of individuals to outpatient services, which occurs as standard practice ^{40 42} or being provided with written information ⁴¹. Individually-focused interventions included an education package ⁴¹ and multidisciplinary

rehabilitation^{40 42}. Three outcomes were assessed: sick leave, job loss and cost benefit. The overall quality of the evidence was low for job loss and cost benefit. For sick leave, the provision of an education package⁴¹ resulted in employees with arthritis taking less time off work. The education package contained information about return to work options and a questionnaire to measure outcomes. The study by van den Hout, de Buck, and Vliet Vlieland⁴⁰ concluded that a multidisciplinary rehabilitation intervention had no effect on the sick leave of individuals with PMP. One study⁴² assessed the impact of an individually-focused intervention on job loss, the same study also measured pain as an outcome. The rehabilitation program did not result in reduced job loss and evidence quality for this outcome was assessed as low. Although van den Hout, de Buck, and Vliet Vlieland⁴⁰ reported reduced costs of rehabilitation compared to usual care, the findings were not significant and evidence quality was low.

Effect of individually-focused interventions on employment compared to other interventions

Seven studies, represented by eight articles^{37-39 43-47}, were identified as comparing individually-focused interventions to other interventions. Interventions included vocational or multidisciplinary rehabilitation^{38 39 43}, ergonomic workplace assessments³⁷ and exercise programs⁴⁴⁻⁴⁷. While the control groups in some studies received a passive comparator intervention such as provision of information³⁷⁻³⁹, whilst in other studies the control group received an active comparator intervention such as individual physiotherapy⁴³⁻⁴⁵ therapy with work uptake advice⁴⁶ and ergonomic training with education⁴⁷. A total of four outcomes were assessed: job loss, sick leave, pain and productivity.

Compared with written education materials, vocational rehabilitation^{38 39} offered to individuals with PMP at work resulted in significant reductions in job loss. The quality of evidence for this outcome was assessed as moderate. Sick leave was measured in five studies⁴³⁻⁴⁷. Exercise-based interventions were used in all five studies, with one study⁴⁷ also

making ergonomic modifications, which comprised postural retraining. While two studies^{44 45} reported significant reductions in sick leave following a functional rehabilitation interventions compared to other therapies, three studies^{43 46 47} reported no significant effect compared with individual physiotherapy, exercise therapy, or ergonomic training. The quality of evidence for the outcome of sick leave was assessed as low.

In relation to improving of pain outcomes, three studies⁴⁴⁻⁴⁶ used exercise-based interventions compared with other active therapies designed by the researchers, one⁴³ used a rehabilitation approach compared to individual physiotherapy and one³⁷ undertook ergonomic workplace assessments compared to provision of written guides. However, none of the five interventions reported reductions of pain levels that reached statistical significance. The quality of evidence for this outcome was assessed as moderate.

Productivity was measured in three studies^{37 43 47}. Ergonomic workplace assessment³⁷ and exercise-based rehabilitation⁴⁷ and workplace rehabilitation⁴³ interventions were compared with provision of written guides, ergonomic training/education and individual physiotherapy, respectively. One study,⁴³ reported no significant changes in productivity measures. Two studies^{37 47} reported improvements in productivity measures following their respective interventions. Evidence quality for this outcome was assessed as moderate.

Effect of multilevel-focused workplace interventions on employment compared to usual care

Five studies, represented by seven articles^{15 48-53}, were identified as comparing a multilevel-focused intervention to usual care. Interventions in all studies involved several components including: education, liaison with employers, workplace modifications and participatory approaches. Three studies included a usual care group which was based in the workplace. These included a standard rehabilitation program^{48 49} and condition non-disclosure to the workplace^{15 52}. Two studies had a usual care group which was defined as usual treatment from medical specialists^{49 50}. Four outcomes were assessed: sick leave, productivity, pain

and cost benefit. Overall evidence quality was low, suggesting more studies of a higher quality are needed in the area of multilevel-focused interventions.

Sick leave was assessed by five studies^{15 48-51}. One study⁵⁰ reported a decrease in sick leave that did not reach statistical significance and two studies^{49 51} reported a statistically significant reduction of sick leave following the multilevel intervention. One study,¹⁵ reported a decrease in the amount of sick leave taken following the intervention. Evidence quality was assessed as low for the sick leave outcome. Productivity was measured in two studies^{15 50}. Macedo, Oakley, Panayi, and Kirkham⁵⁰ reported an improvement in productivity compared to the other interventions. However, Gignac, Cao, Tang, and Beaton¹⁵ found that productivity levels worsened over time, with a statistically significant result. The quality of evidence was assessed as very low for the productivity outcome.

Three studies measured pain outcomes^{49 50 52}. Macedo, Oakley, Panayi, and Kirkham⁵⁰ found pain outcomes improved following the intervention. Two studies^{49 52} found that pain outcomes did not change significantly following the intervention, with low evidence quality for this outcome. Two studies^{48 53} assessed the cost benefits of multilevel interventions and demonstrated a positive effect. Evidence quality was assessed as moderate for this outcome.

Discussion

This review systematically identified and appraised available evidence for interventions to assist people with PMP (not linked to a workplace injury in cause-based schemes) to maintain productive employment. A macroergonomics framework was used to evaluate interventions at different levels to examine where interventions should be targeted for maximum effectiveness, including cost benefit. In addition, consideration of the jurisdictional policy framework was undertaken, consistent with macroergonomics theory, and to the authors' knowledge this type of jurisdictional policy analysis in relation to non-work related

PMP has not been previously published. The range of studies included was highly varied in the type of interventions, method of participant recruitment, and outcome measures reported; thus precluding a meaningful meta-analysis. Importantly, we identified highly varied levels of evidence quality across the outcomes studied, with low levels of evidence quality outweighing higher levels. This creates challenges in making definitive recommendations for policy makers, health professionals, and those in workplaces managing occupational health. However, some clear directions exist for future research needed in the area.

In general, individually-focused interventions are likely to have some benefit on reducing job loss and sick leave but not reduce pain or have significant impact on improving productivity. In particular, the provision of simple information is a cost efficient intervention to improve sick leave outcomes⁴¹. Similarly, the provision of written, consumer-focused information about pain at the primary care level has also been demonstrated to improve work-related fear beliefs in people with chronic low back pain⁵⁴ and written information framed around a biopsychosocial rather than biomedical model is likely to be more effective⁵⁵.

In contrast, multilevel-focused interventions may provide some cost benefit compared to more standard forms of medical-centered care. However, the strong message from this review is the limited number of studies at both an individual and multilevel focus that address workplace interventions and the low quality of the available studies. Therefore, it is not possible to conclude which focus—individual or multilevel— is preferable. Indeed, this choice will depend somewhat on the available disability support systems for a given country. Nonetheless, considering the broader intervention literature which adopts a contemporary, biopsychosocial model of aetiology and then management of persistent pain⁵⁶ provides insight into future directions for intervention development and evaluation. Conversely, we cannot discard either approach as the evidence is of insufficient quality to warrant this.

Therefore, we need to take a pragmatic approach to developing suggestions for those involved with managing people with PMP in the workplace. Encouraging individuals to take control of their own condition through a shared understanding with their health professionals and employ strategies to enable productive performance at work, is consistent with contemporary pain management theory for self-management^{57 58} and a participative approach in occupational health^{59 60}.

Taking into account the important role of managers in the success of workplace interventions⁶¹, greater involvement of managers would seem appropriate; however, this was not a notable feature of the included studies. Other strategies previously documented as successful for managing people with PMP were also not evident in the included studies. One such strategy is flexible working arrangements which have been described as highly beneficial for those with PMP and in particular arthritic conditions where morning stiffness can be a major issue⁶², offering a later starting time can be of benefit in managing this⁶³. Other forms of flexibility might also be offered in the overall job design, working schedule and the amount of control over how work is done. Effectiveness of such work pattern modifications align with the well-accepted approach of time-contingent pacing in the management of PMP⁶⁴. A further issue related to interventions for employees with PMP, previously described by others⁵², relates to disclosure of a condition to an employer. Disclosure may be challenging for some employees, particularly in countries where a distinction between work and non work-related conditions is made. Those that choose not to disclose may not receive adequate assistance to maximise their ability to work productively.

The minimal impact observed of the studied interventions on pain outcomes, particularly pain intensity was perhaps not surprising, given the complex nature of PMP and its highly personal experience. A contemporary approach to the management of PMP adopts a

person-centred model of engagement and management where the unique set of factors driving the pain experience are addressed with specific multimodal interventions, provided in an appropriate sequence and volume for the person^{65 66}. A one size fits all model based on unimodal interventions is not appropriate; this is consistent with findings in returning people to work after absence, where successful reintegration is facilitated by using a multifaceted approach⁶⁷. Therefore, untailored, unimodal interventions that do not address the biopsychosocial factors associated with PMP are unlikely to meaningfully change pain outcomes for employees⁶⁸. Further, a contemporary focus of pain management is on improving function (ie work capacity) rather than pain intensity per se. Therefore, interventions that seek to ameliorate pain intensity, rather than pain-related function are less likely to demonstrate a positive effect.

In considering the policy structures operating in the countries where studies were undertaken, four studies were from cause-based systems, with little access to work place supports, and ten from countries where workers had access to generous workplace supports, either through social security or non cause-based systems. Accurate analysis comparing results across the different compensation systems is not possible within the scope of this review. However, it is reasonable to infer that in cause-based systems the lack of support for those with chronic conditions, such as PMP, is a major incentive for workers to remain at work even with significant disability and pain, particularly when considering the threat of exiting the workforce on retirement wealth⁹, and more so in the context of multimorbidity⁸. The ratio of four to ten for intervention studies from countries with cause-based systems, compared to non cause-based or general social security systems suggests a greater incentive for interventions to be developed for workers with non-work related PMP in societies where these interventions are supported by social disability policies. The influence of the sociotechnical regulatory environment in which the studies are positioned is

an important factor and provides context to the types of workplace supports that might be offered.

Study strengths and limitations

Strengths of this review include a systematic search of the literature from 2000 to March 2014. A rigorous systematic approach was used to examine study design, biases, outcome measures, methods of analysis and reporting. However, limitations exist in taking this approach. Firstly, RCTs and cohort studies with pre and post measures were included, and only those studies published in English. As such, studies with alternative designs but useful findings or in other languages may have been excluded. Future research needs include a greater focus on measurement of interventions using a controlled methodology so that stronger recommendations can be developed to assist those in workplaces who make decisions about workplace accommodations. Whilst a randomised control trial (RCT) design, is considered the gold standard for determining intervention effectiveness, and more highly regarded in systematic reviews than other designs, it is perhaps not the most appropriate design for occupational interventions and more debate is required in this area^{69 70} to discuss alternative methodologies. Significant challenges face researchers in workplace settings, with engagement of employers, turnover of staff who may be participating in projects and linking research and organisational outcomes. Only published peer-reviewed studies were included in this review. To assess the risk of publication bias, all studies were compared for each outcome to ascertain direction of results. Direction of results was mixed, many with no effect, suggesting a low risk of publication bias. Heterogeneity in the outcome measures was an issue and as such a meta-analysis was not possible. This review utilised the structural groupings of individual versus multilevel interventions, separated based on the control group, with each outcome category considered separately. It must be acknowledged that there may have been other possibilities for the review structure and, although every attempt was made

to group similar studies, the variation of interventions across the categories may influence the study findings.

Generalisability of results is potentially limited due to the range of regulatory processes across the different countries of origin in which the studies included in the review took place. We specifically examined non work-related conditions; however as we have discussed, the social security systems of some countries do not distinguish between work-related and non work-related conditions; that is, all employees have access to the same systems of support regardless of whether their conditions are considered to be work- or non work-related⁷¹. To minimise the potential impact of comparing studies operating under different regulatory schemes we only included studies of participants with non work-related conditions from countries where this distinction was relevant. A key purpose of the review is to provide guidance for policy-makers, clinicians, employers and employee advocates about individuals with non work-related conditions and how to assist those with PMP to remain productively employed.

Conclusion

High-level evidence about the characteristics of interventions targeting employees with persistent musculoskeletal pain was not identified in this systematic review. In future, a need exists for high quality intervention studies to inform the development of effective management strategies to facilitate improved person environment fit for those with PMP. Study design should take into account the complexity of the work environment and the sociotechnical regulatory environment within which the study is situated. Studies also need to be of sufficient size to ensure firm conclusions can be drawn.

Main Messages

- A macro ergonomics framework was applied to the review to examine the effectiveness of workplace interventions for people with persistent musculoskeletal pain-

- Workplace interventions with a focus on individuals probably reduce sick leave and job loss
- Workplace interventions with a multilevel focus probably reduce sick leave and provide some cost benefit

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Authorship

All authors contributed to the development and writing of the manuscript. All authors reviewed and approved the final manuscript.

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