Return to work interventions for chronic pain: a systematic review

Authors: P A Wegrzynek, E Wainwright, J Ravalier

Author affiliations: Bath Spa University

Corresponding Author: P. A. Wegrzynek, Department of Psychology, Bath Spa University, Newton Park Campus, Newton St Loe, Bath BA2 9BN.

Abstract

Background: Chronic pain (CP) remains the second commonest reason for being off work. Tertiary return to work (RTW) interventions aim to improve psychological and physical capacity amongst workers already off sick. Their effectiveness for workers with CP is unclear**.**

Aims: To explore which tertiary interventions effectively promote RTW for CP sufferers.

Methods: We searched eight databases for randomised controlled trials evaluating the effectiveness of tertiary RTW interventions for CP sufferers. We employed the Cochrane Risk of Bias (ROB) and methodological quality assessment tools for all included papers. We synthesised findings narratively. Meta-analysis was not possible due to heterogeneity of study characteristics.

Results: We included 16 papers pertaining to 13 trials. The types, delivery format and follow-up schedules of RTW interventions varied greatly. Most treatments were multidisciplinary, comprising psychological, physical and workplace elements. Five trials reported that tertiary interventions with multidisciplinary elements promoted RTW for workers with CP compared to controls. We gave a high ROB rating for one or more assessment criteria to three out of the five successful intervention trials. Two had medium and low risk elements across all categories. One compared different intensity multidisciplinary treatment and one comprised work-hardening with a job-coach. Seven trials found treatment effects for secondary outcomes but no RTW improvement.

Conclusions: There is no conclusive evidence to support any specific tertiary RTW intervention for workers with CP, but multidisciplinary efforts should be considered. Workers' compensation is an important area for RTW policymakers to consider.

Key words: Work; chronic pain; intervention; psychology; occupational health

Introduction

UK figures show that 33-50% of the population suffers with chronic pain (CP) (1), which is the second commonest reason for sickness absence (2). CP can be defined as pain which persists for more than three months or beyond the expected healing time (3). CP conditions affect workers' well-being and are often co-morbid with other conditions, including stress (4). However, CP is a multi-factorial problem and its burden goes far beyond the individual's experience (2). Pain-related ill-health at work represents a significant challenge for stakeholders, including workers, employers, government, and healthcare providers (5). Costs in pain-related healthcare and lost productivity due to sickness absence exceed those associated with cardiovascular and oncological conditions (6). Evidence suggests that 32% of people who suffer with CP fail to return to work (RTW) within one month of being signed off work (7). Thus, to address the wide-ranging consequences of CP, it is essential to identify 'successful' interventions for enabling more people to RTW when appropriate, particularly as work has a positive effect on most individuals' well-being, including CP sufferers (8).

There are several approaches to classifying interventions. Kompier and Cooper (9) suggested the 'levels' framework, for interventions designed to improve workers' well-being or manage employees' stress levels, referred to as primary, secondary, and tertiary. Primary and secondary levels are preventative and focus on healthy workers, or those who are showing signs of stress but have not yet been signed off work, respectively. Tertiary interventions are reactive, addressing problems already experienced by employees, and following a period of sickness absence. These interventions aim to improve employees' psychological and physical capacity, enabling them to successfully RTW. As such, tertiary classification is useful to review RTW interventions for workers with CP.

A range of research has investigated interventions for workers with CP. One recent systematic review by Pike et al (10) assessed psychological interventions' effectiveness on

reducing healthcare use and improving work absence outcomes. Interventions with credible psychological components did not significantly affect work absence compared to usual care, waiting list, and active control groups (10). The authors acknowledged the difficulty of drawing overall conclusions due to the great variety of measures employed by the reviewed trials.

Another recent review and meta-analysis (11) found that for people with chronic back pain a year after a multidisciplinary intervention, the odds of being back at work are increased compared with physical treatment, but not compared with usual care. Equally, the authors reflected on inconsistent measures of work absence affecting their ability to draw firm conclusions from the studies.

Cullen et al (12) reviewed RTW interventions for employees with musculoskeletal problems (often used as a proxy for CP), as well as pain-related and mental health conditions. Their meta-analysis led the authors to recommend multi-domain interventions to reduce work-lost time in these populations.

A cohort study into cross-country differences in RTW found that the effectiveness of RTW interventions for chronic low back pain relies heavily on the type of intervention used and national compensation policies regarding long-term sick-leave (SL) (13). The authors postulated that employing work-oriented interventions and allowing more flexibility in the way the compensation schemes are applied could improve RTW prospects for individuals with CP. Scandinavian countries which allow less strict criteria in compensation assessment and use partial benefit entitlement were reported to achieve better RTW rates than other nations (13).

Recently recommended guidelines for CP care suggest that interventions should expand involvement of CP patients in their treatment, employ self-help strategies and stratified care approaches (e.g. 14). Haland Haldorsen et al (15) linked high rates of non-RTW for employees with CP to a combination of factors including medical (e.g. patients' motor status), sociodemographic (physical activity, number of children), and psychological (locus of control). Evidence suggests that

successful prediction of non-RTW can be achieved through a multifactorial model, which may support employing multidisciplinary approaches to RTW.

CP is a multifactorial issue and there is a need for interventions to increase RTW for employees with CP. Thus, our review aimed to analyse which tertiary RTW interventions may be useful in promoting RTW for this population. We sought to extend previous reviews such as Pike et al (10), which investigated the effectiveness of psychological treatments only on reducing healthcare use and improving work absence outcomes. Those authors excluded headache when operationalising CP. We included it. Also, apart from the interventions with credible psychological components (16), we included other types of tertiary level interventions aimed at promoting RTW, but which do not target any specific concept or trait.

Methods

We systematically searched PsycINFO, EMBASE, MEDLINE, PubMed, Science Direct, and the Cochrane Library of Clinical Trials from inception-October 2018. We identified eligible papers using a Boolean search strategy following other reviews (17). We searched Open Grey, and the first 10 pages of Google Scholar, manually searching reference lists of all selected articles (see Appendix 1 for search strategy).

We employed PICOS (Population, Intervention, Comparison, Outcome, and Study Design) criteria as the inclusion criteria for the current review. The study populations had to be workers (over the age of 18), employed on any type of contract or self-employed, who were signed off work for 4 weeks or longer due to CP. We chose the latter inclusion criterion because previous reports suggested that the risk of non-RTW is associated with long-term SL length prior to rehabilitation (18). Selected articles had to be randomised controlled trials (RCTs) published in English (we had no translation budget) and evaluate the effectiveness of individual, tertiary RTW interventions for workers with CP (as defined above; 3) versus a control group (e.g. usual care –

UC; treatment as usual – TAU). We chose tertiary interventions because our review focused on strategies for workers already sick-listed with CP. The primary outcome was RTW, operationalised using any easily measurable 'administrative' criteria, such as work status, number of hours worked, time until an employee returns to work for contracted hours/pay (19). Secondary outcomes were pain, disability and employee psychosocial/affective factors. We examined these secondary outcomes if provided and assessed via reliable psychometric measures.

From the studies which included both participants on SL at baseline and those who were not, we rejected trials where authors did not provide sub-group analyses or which authors did not provide such data upon request. Similarly, when the type of pain (acute versus chronic) was unclear, we contacted authors for clarification. If no reply was received within three weeks, we rejected the paper. Interventions had to be tertiary (9) as defined above.

The literature search and eligibility check were performed by one author (PW), and subsequently papers were read by authors EW or JR to independently validate the decision. We rated all included trials for risk of bias (ROB) using the Cochrane ROB tool (20) and methodological quality assessment by two reviewers independently. Discrepancies were arbitrated by the third. We assessed inter-rater reliability using Cohen's Kappa. Meta-analysis was not possible due to heterogeneity of study characteristics; see Appendix 2 for minor protocol deviations.

Results

Our initial search identified 2076 studies. Once duplicates were removed, 541 titles suggested possible relevance. Screening of abstracts, then full texts of the selected articles led to eight papers being retained. An additional search of Google Scholar and Open Grey databases, and screening of references identified a further eight papers, totalling 16 papers pertaining to 13 studies (see Figure 1). Most rejected papers were either not RCTs or focused on preventative rather than tertiary interventions. Table 1 summarises the included studies. A list of rejected

studies and reasons for rejection is available on request.

[Figure 1 here]

Included studies were published from 1994 to 2017 (four in 1991-2000; eight in 2001-2010; four in 2010-present). More trials and follow-up (FU) studies were set in Scandinavian countries than anywhere else, seven in Norway (21-26,36) and three in Sweden (27,28,35). Remaining trials were set in Canada (29-31), Hong Kong (32), and the Netherlands (33,34).

Table 1 shows the main characteristics of included studies (detailed descriptions are available in Appendix 3 [Table 1a] as a Supplementary data at *Occupational Medicine* Online). Study randomised population sizes ranged from 103 (32) to 654 (23) workers. The length of participants' sickness absence and type of occupations varied greatly across trials. Both male and female workers were recruited and in ten papers women outnumbered men (21-24, 26-28,34-36). One study sample comprised self-employed participants (33). We also included studies which described a proportion of their participants as off sick (23, 24, 35) and which included both participants who were off sick at baseline due to CP, as well as those who were unemployed (27, 28, 35). The authors of these studies provided sub-group analyses which allowed for review of their trials under our PICOS.

[Table 1 here]

Definitions of RTW varied greatly (Table 1; detailed descriptions are available in Appendix 4 [Table 1b] as a Supplementary data at *Occupational Medicine* Online). Data were obtained from national registers (27, 28, 35, 36) as well as self-reported (29,35) work status. One study's authors analysed and reported RTW and secondary outcomes separately for participants who achieved RTW, and for those who did not (returners and non-returners) (22).

There were noticeable differences across the included trials in the types, format of delivery and follow-up schedules of RTW interventions (Appendix 4 [Table 1b] at *Occupational Medicine* Online). Most treatments were multidisciplinary. Several trials had workplace-based (25,32), workplace-targeted (33), job coaching (32) or ergonomic elements (31,32) within them. Various education elements focused on Cognitive Behavioural Therapy (CBT) and goal setting, addressing health beliefs. Focusing on function and teaching active pain management techniques were also included in the multidisciplinary approach. Intensity of interventions varied considerably across the RCTs.

Six papers (five trials) compared RTW interventions to TAU (21,22,29-31,34). Cheng and Hung (32) used different delivery modes (clinic-based versus workplace-based) to compare their effect on RTW. Myhre et al (25) compared workplace-based and multidisciplinary interventions. Several RCTs compared rehabilitation programmes of varying intensity with each other (26,35, 36) or with each other as well as TAU (23,24,27,28,33,35). As part of the intervention, some authors (29) sent recommendations for GPs to promote proactive management, encourage activity, or limit medication. FU assessments varied from two weeks (26) to three years (28) - see Table 1b in Appendix 4 (Supplementary data available at *Occupational Medicine* Online).

Seven papers (five trials) reported statistically significant results and effect sizes suggesting that examined interventions promote RTW for CP sufferers (23,24,27-29,31,32) (Table 1 and Appendix 4). The effective tertiary RTW interventions included multidisciplinary programmes with CBT, graded activity (GA), and functional restoration (FR) elements (23,24,29,31); behavioural physiotherapy (27,28); and work-hardening with ergonomic exercises (32).

Corey et al. (29) found that a FR treatment resulted in self-reported “working” status in 32% of people in the intervention group vs 16% controls, which was statistically significant. In sub-group analysis of different pain sites, RTW was significantly greater among treated low-back pain patients but did not differ for non-back pain. Corey et al (29) was one of two (30) trials with an FR

intervention and the only one which reported its significant effects on RTW.

Lambeek et al (31) examined an intervention consisting of multidisciplinary integrated care, with elements of GA and CBT, and directed at CP sufferers and their workplace. The authors reported significant differences between groups in favour of integrated care for SL and functional status. In contrast, another reviewed trial (34) found that time until lasting RTW was longer for workers with CP who attended behavioural GA intervention ($p<0.05$). The difference in the intervention components between the two trials was the multidisciplinary, workplace-directed focus of the former (31) trial.

Cheng and Hung (32) found that 72% of workers in a workplace-based intervention could RTW or to modified duties versus 38% receiving a clinic-based treatment. RTW self-efficacy and having a job coach were important in achieving the RTW outcome. However, several other reviewed trials that examined RTW interventions with workplace elements reported mixed results. A multidisciplinary intervention with CBT and workplace elements helped only 50% of BP patients RTW at 12-month FU, which was comparable to 58% of patients from the control group (22). There were no significant differences in RTW for this multimodal multidisciplinary intervention (52% vs 53% TAU), independent of type of CP (21).

In another trial (33), multidisciplinary treatment with workplace elements resulted in better RTW vs TAU at six months, but the effects dissipated by the second FU, and none was statistically significant. However, a multidisciplinary approach was more effective than physical training on its own in promoting RTW (measured by shorter benefit claim duration). The SL median length was longer for the physical training intervention group versus TAU ($p < 0.05$ at six months; the only significant result) (33). A different trial (25) found no significant differences in RTW between a work-focused intervention and a multidisciplinary treatment but did not include TAU controls. A more recent trial (26) without TAU controls also found no significant differences in full RTW at FU between a new multidisciplinary treatment for employees with CP, which aimed

to promote patient-therapist communication, and a brief intervention. The percentage of workers in the multidisciplinary and brief interventions who achieved full-RTW at 12 months was 45%, and at 24 months 43% and 37%, respectively. However, patients in the multidisciplinary intervention achieved faster RTW than the group receiving the brief intervention.

Notably, when trials reported non-significant results, they often suggested a positive trend for RTW; for example, this was reported for a sub-group of CP employees receiving acceptance and commitment therapy vs those in multidisciplinary treatment and controls (35). The same trial suggested positive, albeit mostly non-significant effects of the multidisciplinary intervention on RTW for the whole sample including non-CP patients (35).

Another trial with multidisciplinary treatment (36) had four interventions and no CG; specifically, a brief cognitive intervention, brief cognitive intervention with one type of supplement, brief cognitive intervention with another type of supplement, and finally brief cognitive intervention combined with CBT. The findings suggested that the brief intervention on its own was superior in facilitating RTW vs other groups, although the results did not reach statistical significance.

One trial (23, 24) considered stratification to light and extensive multidisciplinary treatments. The authors found that CP sufferers with good RTW prognosis, determined by a score on a screening questionnaire, do equally well with RTW in any type of intervention or TAU. For individuals with medium risk of non-RTW, a light intervention was sufficient, an intensive programme provided no additional gains, but TAU resulted in poor RTW outcomes. High-risk profile may require extensive RTW intervention as the other two treatments gave poor RTW results. At FU (24), light multidisciplinary treatment increased full-RTW in men only vs TAU ($p<0.05$ at 12, 18, 24 months FU). There were no significant differences for extensive multidisciplinary intervention for men or women vs TAU.

Other studies found that women had medium or poor RTW prognosis, whereas men had good RTW prognosis (23) and several different variables (e.g. psychological problems at pre-test, reducing medication) predicted variance in RTW (e.g.22, 29). Different effects of interventions on RTW for men and women with CP were also found by Jensen et al. (27,28). The study compared physiotherapy, CBT, multidisciplinary intervention (including CBT and physiotherapy), and TAU and found no significant differences between groups in absence from work at 18-month FU. However, women in the multidisciplinary group had the best improvement in absence from work ($p < 0.05$) at three-year FU (28). Total absence from work was lower for women in the multidisciplinary and physiotherapy groups at 18 months (27) and in either of the treatment groups (physiotherapy, CBT, and multidisciplinary) at three years (28) vs controls, but for men CBT group had the highest absence rates. Women in the physiotherapy and CBT groups had a lower risk of early retirement vs the control group (CG) (27). Furthermore, women in the multidisciplinary treatment group returned to work faster than controls. Interestingly, physiotherapy group obtained better RTW results than the CBT group for both men and women, and better than the CG for women.

Ten papers (eight trials) reported results for secondary measures (21,22,27,28,29,31,32,33,34,36). Studies employed a variety of recognized, self-reported inventories and daily ratings on visual analogue scales (VAS) to report secondary outcomes which included: pain intensity, (health-related) quality of life (QoL) and sleep, frequency of doctor's visits and medication use, and other variables listed in Appendix 4 (Table 1b, available as Supplementary data).

Secondary outcomes such as pain level (21,29) and intensity (33,36), pain activity (36), sleep (29), ergonomic behaviour (21), work potential (21), subjective health (21), perceived health problems (32), functional status (31) and QoL (27,28) were significantly positively affected by RTW interventions in eight papers (seven trials). Five of those papers (four trials) were the same ones as those described earlier, in which RTW was positively impacted by the intervention

(27,28,29,31,32). Post-intervention, the returners had less pain and reported more psychological strength (22). Some improvements in secondary outcomes may be due to these variables deteriorating with TAU (29), some were only noted for women (27,28). Several trials reported improvements in some secondary outcomes, but these were non-significant (29,31,33) or in favour of the control group (34).

We assessed ROB for trials together with their FU studies (as such, papers 21 and 22, 23 and 24, and 27 and 28, were assessed together) (Table 2). There was between moderate and good agreement (37) between-raters for most ROB domains with the exception of "blinding of participants and personnel" domain where the inter-rater reliability was very good (*K*= 0.87, 95% CI 0.62-1). We gave a high ROB rating for one or more assessment criteria to three (27-29,31) of five successful intervention trials. For quality assessment, we reviewed all 16 papers separately as they included varying level of detail pertaining to the assessed criteria (Table 3). The highest quality ratings were for groups being similar prognostically (15/16 positive scores) and the lowest was for groups having equivalent treatment time (1/16 positive scores).

[Tables 2 and 3 here]

Discussion

Of 16 papers (13 RCTs and their FUs) reviewed, 7 papers (5 trials) reported statistically significant results and effect sizes to suggest that examined RTW interventions promote RTW among workers with CP (23,24,27-29,31,32), although not to the same extent for all participant groups or types of RTW outcomes. Whilst the results were varied, overall multidisciplinary treatments tended to yield better RTW results. Although not all employees with CP returned to work post-intervention, in eight articles (7 trials) secondary outcomes such as QoL and general functional ability improved at FU.

Our study has limitations. The comprehensive literature search and a rigorous systematic process involving all three reviewers ensured that relevant studies were selected. However, as we could only review sources published in English, we acknowledge there is an element of language bias in our study. Furthermore, none of the reviewers were blind to the studies' authors or the publication. However, Verhagen et al (38) argue that blinding of reviewers is not a necessary requirement in systematic reviews. We also found a relatively small number of RCTs with varied designs and quality of tested RTW interventions, heterogeneous populations and descriptions of RTW outcomes, and inclusion of a group design which somewhat opposes the idea that individual patients may resemble the average patient (39). This restricts the generalisability of our findings and raises an issue of differentiating between the effectiveness and efficacy of interventions (e.g. 34).

It is also important to highlight some of the limitations due to methodological issues in the included RCTs. Three of five successful intervention trials received a high ROB rating for between one and four assessment criteria. For example, it was sometimes unclear whether the trials were blinded. Whilst non-blinded allocation is arguably the most important source of bias in RCTs (40), due to heterogeneity of treatments included in the reviewed trials, it could be argued that blinding was not possible. Included trials varied in quality. Limited detail in some of the older trials made it more complex to establish details of their procedure. It was unclear whether all trials conducted power calculation before recruiting their samples and in some cases statistical power was low. Whilst done in some papers, any significant effects of interventions presented under per-protocol criteria would provide lower quality evidence (41).

Whilst trials reported mixed results regarding multidisciplinary RTW interventions, these treatments seem to provide better support for workers trying to RTW versus CBT or physical treatments alone (27,33). In fact, CBT-only interventions resulted in delayed RTW versus TAU for

some CP sufferers (28). These findings echo the recent trial (10) which found no effect of psychological interventions on RTW with CP and support a more interdisciplinary approach.

The successful RTW interventions often comprised workplace elements (e.g. 31,32). One of the reviewed studies (32) took place in Hong Kong where it is not customary for employers to help to manage employees' work disability. However, findings from Cheng and Hung's (32) study support the idea of the importance of workplace factors and the role of a job coach in the RTW process. Benefits of vocational case management have been reported elsewhere (42). In this review, workplace-based intervention with a job-coach working in liaison with employers was more effective than clinic-based rehabilitation in promoting RTW in workers with CP (32).

Similarly, an integrated care intervention which was directed at both employees with CP and their workplace, helped to facilitate earlier RTW in comparison to TAU (31). Importantly, the authors reported that lack of approval from workers' employers meant that some workers did not participate in the RTW intervention (31). This may be essential when considering various stakeholders' influence on the RTW process, as Krause et al (43) suggested there is an association between low supervisory support and lower RTW rate.

Anema et al (13) found that job re-design and adaptations to workplace and working hours were related to earlier sustainable RTW. However, contrasting results regarding the effectiveness of work-focused interventions and multidisciplinary treatments with occupational elements were reported here (e.g.25, 26). Some authors (26) suggested that limited extent of the workplace element and placing responsibility of FU at work on employees with CP might have reduced the effectiveness of the multidisciplinary intervention.

Mixed findings reported in our review could be partially explained by the way in which trials operationalised RTW. Previously, similar issues related to inconsistent operationalisation of work absenteeism were reported (e.g. 11). In our review, Corey et al. (29) found enhanced RTW rates in treated workers who self-reported on the RTW measure, although the effect was stronger

in other studies where RTW was assessed more objectively by examining the status of workers' benefit payments (e.g. 23). Corey et al (29) argued that the latter RTW measure lacks validity, since the termination of benefit payments might stem from reasons other than RTW. Previously, Krause et al. (41) also argued against the usefulness of 'administrative' criteria for RTW. However, Mitchell and Carmen (30) argued that for approximately 90% of workers with CP, stopped benefit payments are a common signal of RTW.

Inconsistent operationalisation of work-related outcomes may be linked to social security systems and political contexts in the different trial countries and could affect varying success rates. Here, two of five trials with positive RTW intervention effects were based in Scandinavia, where sick-pay provision differs from non-Scandinavian countries (e.g.13,26). Evidence suggests that more flexible social security systems (e.g. allowing partial RTW whilst continuing to provide benefit payments) yield better results and are associated with earlier sustainable RTW (13).

Elsewhere, Johansson et al's (44) findings support the Swedish system which accepts that occupational training (measured by percentage of SL and the number of daily hours of occupational training patients did) is the first step when returning to work after sickness absence, either as a worker or as unemployed. In addition, Haland Haldorsen et al (15) suggested that compensation systems of various countries may impact the sick-role representation amongst CP workers. Flexibility in benefit provision alone may not lead to earlier and sustainable RTW without other cultural changes (13), such as increasing workplace involvement as suggested by the encouraging results from trials with workplace elements described above.

Our review included a trial finding that matching treatments' intensity to employees' risk profiles led to better RTW (23). This follows Rudy et al (45) who argued that matching interventions to different sub-groups of patients could lead to better effects. The stepped-care approach appears to yield promising results for CP sufferers with different risk profiles in the UK (e.g.46). However, there are significant challenges to implementing a stepped-care approach; for

example, heterogeneity of CP sufferers requires development of effective diagnostic tools (22). Furthermore, extensive treatments could provide a way of treating patients with generalised pain, whereas simple strategies might suffice for patients with more localised pain (24). However, Haland Haldorsen et al (21) found no differences in RTW between the multidisciplinary treatment and TAU for workers with CP who included back, neck, and shoulder, and differences for those with generalised pain were non-significant.

Trials included in our review found that multidisciplinary interventions improved psychological variables such as reducing distress or belief that participants should be cured by their doctor (e.g. 21), and promoted partial-RTW (26). However, Turk and Rudy (47) argued that CP patients may determine success of their therapy differently to their therapists, thus affecting RTW. Therefore, mutual agreement between a CP patient and their GP concerning achievable treatment goals is important to measure the effectiveness of treatments (48). Furthermore, mixed RTW results from multidisciplinary interventions could be partially due to difficulties associated with returning people with chronic health issues to employment (49).

The length of time that patients spent being off sick varied greatly across the reviewed studies. Previous reports suggested that the risk of non-RTW is associated with long-term SL prior to rehabilitation (18). Similarly, Staal et al (50) argued that participants do not tend to RTW during periods of active treatment, which could affect the results of trials of interventions with durations of several months. Furthermore, men do not tend to engage in partial-RTW, thus full-time SL might be a preferred option for this sub-group (28). However, elsewhere Watson et al. (5) found that time was not a key factor in RTW. Multidisciplinary intervention led to RTW in approximately 40% of participants who were unable to work for more than three years (5) and vocational services were an important design feature of the RTW intervention. The latter is a finding echoed by the reviewed trials, as discussed earlier.

Whilst many interventions seem beneficial for CP sufferers, the differences in outcomes between interventions and comparison groups seem to dissipate with FU as expected (27,33). These findings highlight the need to consider RTW interventions for CP not only in terms of their effectiveness, but also in terms of their potentially hindering RTW. Furthermore, this also has important implications for the design of future research in the area of RTW and CP, including optimising participant waiting times before the start of interventions, matching participants' (risk) profiles to intervention type and intensity, and incorporating better collaboration strategies between the various stakeholders in the RTW process.

We did not analyse cost savings. However, several studies suggested financial benefits of implementing multidisciplinary interventions (e.g. 28). Future studies summarising the evidence regarding the cost-effectiveness of such treatments would therefore be useful. Finally, we had to exclude some of the trials potentially meeting our inclusion criteria due to a lack of sufficient detail originally provided by the studies' authors and/or no reply to the attempted communication within a given three-week timescale. We therefore recommend further methodologically robust studies. As CP is a multifactorial problem, our review contributes to the discussion on what works for RTW with CP, but it does not fully answer it. Grouping multidisciplinary interventions is challenging due to their variability. Future studies should employ varied methodology to account for the subjective nature of CP and its impact on RTW

Key learning points

What is already known about this subject

- Chronic pain is a multi-factorial problem with high societal and economic costs
- UK figures show that 33-50% of the population suffers with chronic pain, which is the second commonest reason for sickness absence

- Evidence suggests that 32% of people who suffer with chronic pain fail to return to work within one month of being signed off work, but effectiveness of tertiary return to work interventions for workers with chronic pain is unclear

What this study adds

- There is no conclusive evidence to fully support any specific type of return to work intervention for workers with chronic pain, but multidisciplinary efforts seem most effective for this group
- More studies to examine the effectiveness of multidisciplinary treatments are needed, with agreed operationalisation of return-to-work outcomes

What impact this may have on practice, policy or procedure

- Effects of workers' compensation schemes on return to work are an important area for policymakers to consider
- Stakeholders should consider including both, worker- and workplace-targeted elements within return to work interventions for chronic pain sufferers to promote their return-to-work process
- As patients with different risk profiles seem to respond better to treatments of varying intensity which address the risk of non-return to work, identifying an effective stratification to multidisciplinary treatments could improve the overall effectiveness of treatment

Competing Interests The authors report no competing interests.

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References

(1) Fayaz A, Croft P, Langford RM, Donaldson LJ, Jones GT. Prevalence of chronic pain in the UK: a systematic review and meta-analysis of population studies. *BMJ Open* 2016; **6**: (1-12). Available from: doi:10.1136/bmjopen-2015-010364.

(2) ONS. *Sickness absence in the Labour Market*. ONS, 2017. Available from: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/articles/sicknessabsenceinthelabourmarket/2016 [Accessed 17 August 2018].

(3) Treede RD, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. A classification of CP for ICD-11. *Pain* 2015; **156**: 1003-1007.

(4) McGeary CA, McGeary DD, Moreno, J, Gatchel RJ. Military chronic musculoskeletal pain as psychiatric comorbidity: is better pain management the answer?. *Healthcare* 2016; **4**(3): (1-10). Available from: doi:10.3390/healthcare4030038.

(5) Watson PJ, Booker CK, Moores L, Main CJ. Returning the chronically unemployed with low back pain to employment. *European Journal of Pain* 2004; **8**: 359-369.

(6) Di Lernia D, Serino S, Riva G. Pain in the body. Altered interoception in CP conditions: a systematic review. *Neuroscience & Biobehavioural Reviews* 2016; **71**: 328-341.

(7) Wynne-Jones G, Cowen J, Jordan JL, Uthman O, Main CJ, Glozier N, et al. Absence from work and return to work in people with back pain: a systematic review and meta-analysis. *Occupational & Environmental Medicine* 2014; **71**(6): 448-456.

(8) Waddell G, Burton K. *Is Work Good For Your Health and Wellbeing?* London: TSO, 2006.

(9) Kompier MAJ, Cooper CL. *Preventing stress, improving productivity: European case studies in the workplace*. London: Routledge, 1999.

(10) Pike A, Hearn L, de C Williams AC. Effectiveness of psychological interventions for CP on health care use and work absence: systematic literature review and meta-analysis. *Pain* 2016; **157**(4): 777-785.

(11) Kamper SJ, Apeldoorn AT, Chiarotto A, Smeets RJ, Ostelo RW, Guzman J, Van Tulder MW. Multidisciplinary biopsychosocial rehabilitation for chronic low back pain: Cochrane systematic review and meta-analysis. *Bmj* 2015; **350**: h444.

(12) Cullen KL, Irvin E, Collie A, Clay F, Gensby U, Jennings PA, Hogg-Johnson S, Kristman V, Laberge M, McKenzie D, Newnam S. Effectiveness of workplace interventions in return-to-work for musculoskeletal, pain-related and mental health conditions: an update of the evidence and messages for practitioners. *Journal of Occupational Rehabilitation* 2018; **28**(1): 1-5.

(13) Anema JR, Schellart AJM, Cassidy JD, Loisel PA, Veerman TJ, Van der Beek AJ. Can cross country differences in return-to-work after chronic occupational back pain be explained? An exploratory analysis on disability policies in a six country cohort study. *Journal of Occupational Rehabilitation* 2009; **19**: 419-426.

(14) Lee J, Gupta S, Price C, Baranowski AP. Low back and radicular pain: a pathway for care developed by the British Pain Society. *British Journal of Anaesthesia* 2013; **111**(1): 112-120.

(15) Haland Haldorsen EMH, Indahl A, Ursin H. Patients with low back pain not returining to work: A 12-month follow-up. *Spine* 1998a; **23**(11): 1202-1207.

(16) de C Williams AC*,* Eccleston C*,* Morley S*.* Psychological therapies for the management of chronic pain (excluding headache) in adults*. The* Cochrane Database of Systematic Reviews *2012;* **11***:* 1-83.

(17) Ravalier J, Wegrzynek P, Lawton S. Complementary Therapies and Employee Well-Being: A Systematic Literature Review. *Occupational Medicine* 2016; **66**(6): 428-436.

(18) Waddell G, Burton K. Occupational health guidelines for the management of low back pain at work: evidence review. *Occupational Medicine* 2001; **51**(2): 124-135.

(19) Hees HL, Nieuwenhuijsen K, Koeter MW, Bültmann U, Schene AH. Towards a New Definition of Return-to-Work Outcomes in Common Mental Disorders from a Multi-Stakeholder Perspective. *PLoS ONE* 2012; **7**(6): (1-7). Available from: doi:10.1371/journal.pone.0039947.

(20) Higgins JPT, Green S. *The Cochrane Collaboration: Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0*. The Cochrane Collaboration, 2011.

INCLUDED STUDIES' REFERENCES 21-36 INCLUSIVE

(21) Haland Haldorsen EMH, Kronholm K, Skouen JS, Ursin H. Multimodal cognitive behavioral treatment of patients sicklisted for musculoskeletal pain: A randomized controlled study. *Scandinavian Journal of Rheumatology* 1998b; **27**: 16-25.

(22) Haland Haldorsen EMH, Kronholm K, Skouen JS, Ursin H. Predictors for outcome of a multimodal cognitive behavioural treatment program for low back pain patients – a 12 months follow-up study. *European Journal of Pain* 1998c; **4**: 293-307.

(23) Haland Haldorsen EM, Grasdal AL, Skouen JS, Risa AE, Kronholm K, Ursin H. Is there a right treatment for a particular patient group? Comparison of ordinary treatment, light multidisciplinary treatment, and extensive multidisciplinary treatment for long-term sick-listed employees with musculoskeletal pain. *Pain* 2002; **95**(1): 49-63.

(24) Skouen JS, Grasdal AL, Haland Haldorsen E, Ursin H. Relative cost-effectiveness of extensive and light multidisciplinary treatment programs versus treatment as usual for patients with chronic low back pain on long-term sick leave. *Spine* 2002; **27**(9): 901-910.
(25) Myhre K, Marchand GH, Leivseth G, Keller A, Bautz-Holter E, Sandvik L, et al. The effect of work-focused rehabilitation among patients with neck and back pain. *Spine* 2014; **39**(24): 1999-2006.
(26) Brendbekken R, Eriksen HR, Grasdal A, Harris A, Hagen EM, Tangen T. Return to work in patients with chronic musculoskeletal pain: multidisciplinary intervention versus brief intervention: a randomised clinical trial. *Journal of Occupational Rehabilitation* 2016; **27**(1): 82-91.
(27) Jensen IB, Bergstroem G, Ljungquist T, Bodin L, Nygren ÅL. A randomized controlled component analysis of a behavioural medicine rehabilitation program for chronic spinal pain: are the effects dependent on gender?. *Pain* 2001; **91**: 65-78.
(28) Jensen IB, Bergstroem G, Ljungquist T, Bodin L. A 3-year follow-up of a multidisciplinary rehabilitation programme for back and neck pain. *Pain* 2005; **115**: 273-283.
(29) Corey DT, Koepfler LE, Etlin D, Day HI. A limited functional restoration program for injured workers: a randomised trial. *Journal of Occupational Rehabilitation* 1996; **6**(4): 239-249.
(30) Mitchell RI, Carmen G. The functional restoration approach to the treatment of chronic pain in patients with soft tissue and back injuries. *Spine* 1994; **19**: 633-642.
(31) Lambeek LC, van Mechelen W, Knol DL, Loisel P, Anema JR. Randomised controlled trial of integrated care to reduce disability from chronic low back pain in working and private life. *BMJ* 2010; **340**: (1-7). Available from: doi:10.1136/bmj.c1035.
(32) Cheng AS-K, Hung L-K. Randomized controlled trial of workplace-based rehabilitation for work-related rotator cuff disorder. *Journal of Occupational Rehabilitation* 2007; **17**: 487-503.
(33) Heinrich J, Anema JR, de Vroome EMM, Blatter BM. Effectiveness of physical training for self-employed persons with musculoskeletal disorders: a randomized controlled trial. *BMC Public Health* 2009; **9**(200): (1-12). Available from: doi:10.1186/1471-2458-9-200.
(34) Steenstra IA, Anema JR, Bongers PM, De Vet HC, Knol DL, van Mechelen W. The effectiveness of graded activity for low back pain in occupational healthcare. *Occupational & Environmental Medicine* 2006; **63**: 718-725.
(35) Lytsy P, Carlsson L, Anderzén I. Effectiveness of two vocational rehabilitation programmes in women with long-term sick leave due to pain syndrome or mental illness: 1-year follow-up of a randomized controlled trial. *Journal of Rehabilitation Medicine* 2017; **49**(2): 170-7.

(36) Reme SE, Tveito TH, Harris A, Lie SA, Grasdal A, Indahl A, et al. Cognitive interventions and nutritional supplements (The CINS Trial): a randomized controlled, multicenter trial comparing a brief intervention with additional cognitive behavioral therapy, seal oil, and soy oil for sick-listed low back pain patients. *Spine* 2016; **41**(20): 1557-64.

(37) Landis JR, Koch GG The measurement of observer agreement for categorical data. *Biometrics* 1977; **33**: 159-174.

(38) Verhagen A, de Vet H, de Bie R, Kessels AG, Boers M, Knipschild PG. Balneotherapy and quality assessment: interobserver reliability of the Maastricht criteria list for blinded quality assessment. *Journal of Clinical Epidemiology* 1998; **51**: 335-341.

(39) Carter R, Lubinsky J, Domholdt E. *Rehabilitation Research: Principles and Applications*. 4th ed. St Louis (MO): Elsevier Saunders, 2011.

(40) Schultz KF, Chalmers I, Hayes RJ, Altman DG. Empirical evidence of bias: dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA* 1995; **273**(5): 408-412.

(41) Shah PB. Intention-to-treat and per-protocol analysis. *CMAJ* 2011; **183**(6): 696.

(42) Wynne-Jones G, Artus M, Bishop A, Lawton SA, Lewis M, Jowett S, Kigozi J, Main C, Sowden G, Wathall S, Burton AK. Effectiveness and costs of a vocational advice service to improve work outcomes in patients with musculoskeletal pain in primary care: a cluster randomised trial (SWAP trial ISRCTN 52269669). *Pain* 2018; **159**(1): 128-138.

(43) Krause N, Frank JW, Dasinger LK, Sullivan TJ, Sicnlair S. Determinants of duration of disability and return-to-work after work-related injury and illness: Challenges for future research. *American Journal of Industrial Medicine* 2001; **40**(4): 464-484.

(44) Johansson C, Dahl J, Jannert M, Melin L, Andersson G. Effects of a cognitive-behavioral pain-management program. *Behaviour Research & Therapy* 1998; **36**: 915-930.

(45) Rudy TE, Turk DC, Kubinski JA, Zaki HS. Differential treatment responses of TMD patients as a function of psychological characteristics. *Pain* 1995; **61**: 103-112.

(46) Foster NE, Mullis R, Hill JC, Lewis M, Whitehurst DG, Doyle C, et al. Effect of stratified care for low back pain in family practice (IMPaCT Back): A prospective population-based sequential comparison. *The Annals of Family Medicine* 2014; **12**(2): 102-111.

(47) Turk DC, Rudy TE. Neglected topics in chronic pain treatment outcome studies: determination of success. *Pain* 1993; **53**: 3-16.

(48) Mills S, Torrance N, Smith BH. Identification and Management of Chronic Pain in Primary Care: a Review. *Current Psychiatry Reports* 2016; **18**(22): 1-9.

(49) Wainwright E, Wainwright D, Coghill N, Walsh J, Perry R. Resilience and return-to-work pain interventions: systematic review. *Occupational Medicine* 2019; **69**(3): 163-76.
(50) Staal JB, Hlobil H, Twisk JW, Smid T, Köke AJ, van Mechelen W. Graded activity for low back pain in occupational health care: a randomized, controlled trial. *Annals of Internal Medicine* 2004; **140**: 77-84.

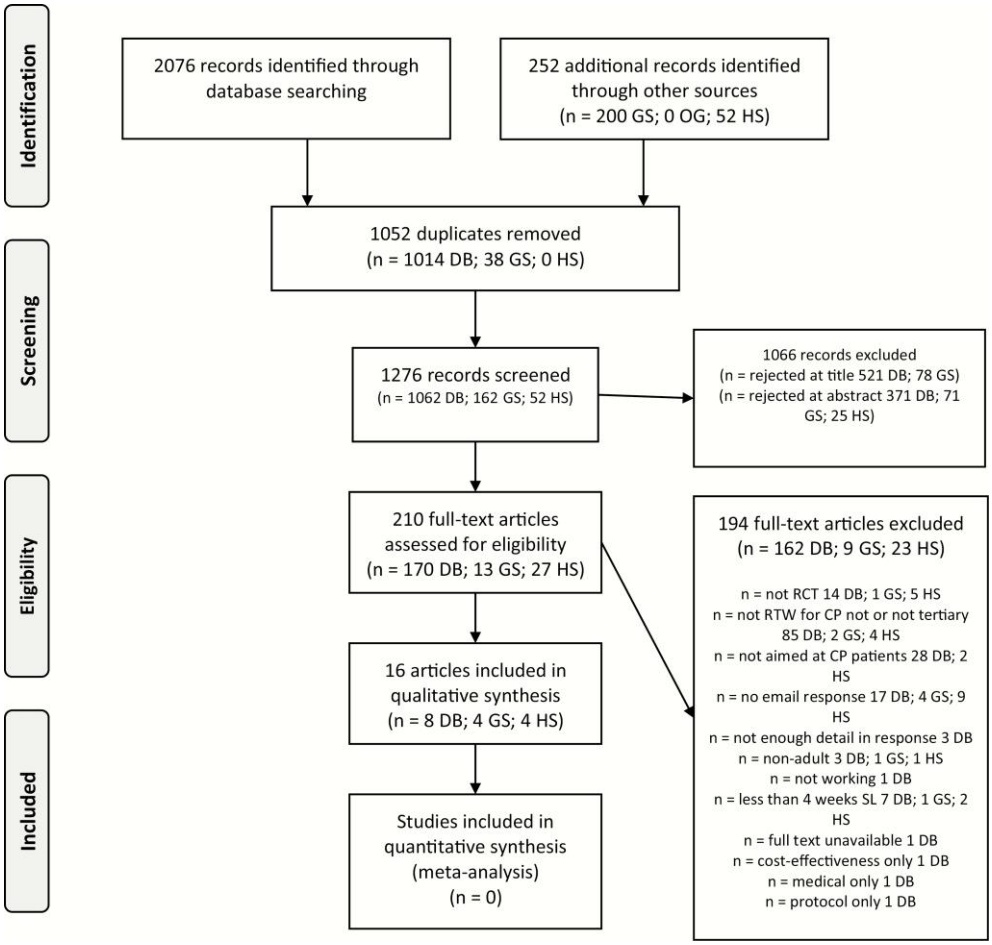
Tables/Figures Legends

Table 1. Summary of included trials and follow-up studies, and RTW results *[unavailable in this version]*

Table 2. Risk of bias assessment *[unavailable in this version]*

Table 3. Quality assessment of all reviewed papers *[unavailable in this version]*

Figure 1. Article exclusion – PRISMA diagram



Appendix 1. Search strategy

pain AND (chronic OR musculoskeletal OR musculoskeletal chest OR general musculoskeletal OR back OR LBP OR neck OR sciatica OR upper limb OR shoulder OR hand OR extremit* OR lower limb OR hip OR ankle OR foot OR knee OR elbow OR arthritis OR osteoarthritis OR inflammatory arthritis OR rheumatism OR fibromyalgia OR ankylosing spondylitis) AND (intervention* OR individual intervention* OR therap* OR (psycholog* intervention* OR psychotherap* OR cognitive OR CBT OR behavior* OR behaviour* OR psycholog*) OR rehabilitation) AND (employee* OR worker*) AND (sick* OR absence OR sickness absence OR sick* leave OR sick-listed OR incapacity OR work OR workplace OR job OR occupational OR return* to work OR RTW) AND (randomised OR randomized OR controlled trial* OR clinical trial* OR RCT)

Appendix 2. Updates to PROSPERO protocol [CRD42016048822]

13/10/2016

- Focus on evaluating evidence from RCTs only at this stage to ensure achievable scope
- RQ clarification: examining tertiary (individual) RTW interventions that focus on workers on SL with CP

7/11/2016

- Clarification: Google 'citations' checked = first 10 pages checked

30/08/2017

- Inter-rater reliability statistic changed from Fleiss Kappa to Cohen's Kappa
- SL re-occurrence secondary outcome omitted

22/10/2018

- Review update

Supplementary material Table 1a. Characteristics and population demographics of included trials and follow-up studies

Study	Population					Gender (*%*)		Mean age	Sample size *n*
	Country	CP type	SL inclusion criteria	SL duration	Occupation type	Male	Female		
Brendbekken et al. 2016 (26)	Norway	MSK	50-100% and <12 months	Mean days (SD)=147 (60.1); f/t SL I=85 (60.4%) CG=85 (59.2%)	Physically demanding 55.1%(I), 52.5%(CG) Mentally demanding 29.2%(I), 19.9%(CG)	I 45.4 CG 46.9	I 54.6 CG 53.1	I 40.9 CG 41.6	I=141 CG=143
Cheng and Hung 2007 (32)	Hong Kong	MSK	>90 days from claim	Mean days (SD) I=136.41 (35.99) CG=139.35 (39.95)	Unclear; medium and large sized organisations	I 80.4 CG 72.9	I 19.6 CG 27.1	I 32.6 CG 32.1	I=46 CG=48 (before dropouts I 53; CG 50)
Corey et al. 1996 (29)	Canada	LBP and non-back soft tissue injuries	3-6 month post injury	Disability duration in months I=4.6 CG=4.6	Unskilled labour 62.5% Skilled labour 27.8% Services 6.9% Office/professional 2.8%	I 73.6 CG 62.5	I 26.4 CG 37.5	Unclear	I=100 CG=100 (FU interviews I 74; CG 64)
Haland Haldorsen et al. 1998b (21)	Norway	generalised muscle pain including BP, NP, SP	>50% for 8 weeks – 6 months	SL participant data unclear	Industry, building and construction 22%(I), 21%(CG) Farming, forestry, fishing, seamen 2%(I), n/a(CG) Office, health service 44%(I), 54%(CG) Teacher, science 5%(I), 3%(CG) Transport 9%(I), 7%(CG) Administration 2%(I), 2%(CG) Other 16%(I), 13%(CG)	I 36 CG 38	I 64 CG 62	I 43 CG 43	I=312 CG=157
Haland Haldorsen et al. 1998c (22)	Norway	LBP	>50% for 8 weeks	SL participant data unclear; returners vs non-returners	Industry, building, construction 23%(I), 24%(CG) Farming, forestry, fishing, seamen 4%(I), n/a(CG) Office, health service 39%(I), 58%(CG) Teacher, science 7%(I), 1%(CG) Transport 13%(I), 6%(CG) Administration 2%(I), 1%(CG) Other 12%(I), 10%(CG)	I 49 CG 43	I 51 CG 57	I 43 CG 43	I=142 CG=81
Haland Haldorsen et al. 2002 (23)	Norway	MSK	>50% for more than 8 weeks or at least 2 months in the last 2 years	90% sick-listed for 8 weeks	Unclear; included government workers 8 govt*, 46 good, 116 medium, 60 poor prognosis(I1)	I1 32.4 I2 31.4 CG 36.8	I1 67.6 I2 68.6 CG 63.2	I1 43 I2 43 CG 44	I1=228 I2=169 CG=263

					4 govt*, 26 good, 92 medium, 51 poor prognosis(I2) 15 govt*, 70 good, 120 medium, 73 poor prognosis(CG)				*RTW data not available (*n*=27)
Heinrich et al. 2009 (33)	The Netherlands	MSK	1 day – 8 weeks (8 weeks from onset of claim to randomisation and another 4 weeks to I, therefore in pain for 12 weeks)	Disability duration median weeks (IQR) I1=8 (6-13) CG1=9 (6-16) I2=10 (5-14) CG2=8 (5-14)	Self-employed, predominantly agricultural workers	I1 93 CG1 96 I2 91 CG2 93	I1 7 CG1 4 I2 9 CG2 7	I1 46 CG1 45 I2 45 CG2 45	I1=53 CG1=50 I2=76 CG2=75 (reported before droupouts)
Jensen et al. 2001; 2005 (27,28)	Sweden	non-specific spinal pain	1-6 months	In the year prior to inclusion, mean (SD) I1 136(64) I2 153(62) I3 162(61) CG 135(60)	Blue-collar and service/care workers Employed 78%(I1), 86%(I2), 84%(I3), 94%(CG)	I1 32 I2 55 I3 52 CG 42	I1 68 I2 45 I3 48 CG 58	I1 43 I2 44 I3 43 CG 44	I1=54 I2=49 I3=63 CG=48 (at 3-year FU ITT=208, PP=181)
Lambeek et al. 2010 (31)	Canada	LBP	absence/p-absence <2 years	p/f-SL numbers reported; Median days (IQR) I=142 (54-173) CG=163 (64-240)	Unclear	I 56 CG 60	I 44 CG 40	I 45.5 CG 46.8	I=66 CG=68
Lytsy et al. 2017 (35)	Sweden	Pain syndrome incl. MSK	About to reach the maximum sickness benefit (≥1.5 years)	Mean years SL for CP pps (SD)=7.7 (3.3)	Unclear	n/a	I1 100 I2 100 CG 100	CP employed sub-group 50	CP employed sub-group=73
Mitchell and Carmen 1994 (30)	Canada	LBP, non-back soft tissue injuries	≥90 days	SL participant data unclear	Unclear	I 71 CG 72	I 29 CG 28	I 63% <45 y.o. CG 65% <45y.o.	I=271 CG=271
Myhre et al. 2014 (25)	Norway	NP, BP	1-12 months	Median days (IQR) I=109 (69-168) CG=115 (71-189)	High and low blue and white collar workers	I 55.7 CG 51.5	I 44.3 CG 48.5	I 40.2 CG 41	I=209 CG=204 (Analysed I 203; CG 202)
Reme et al. 2016 (36)	Norway	LBP	2-10 months, at least 50% SL	Unclear	Unclear	I1 44 I2 45.6 I3 47.6 I4 52.4	I1 56 I2 54.4 I3 52.4 I4 47.6	I1 44.8 I2 44.2 I3 44.2 I4 42.9	I1=100 I2=103 I3=105 I4=105

Skouen et al. 2002 (24)	Norway	LBP	At least 8 weeks or 2 months in the last 2 years, >50% SL	90% sick-listed for 8 weeks, 3 months on average	Unclear	I1 40 I2 30 CG 36	I1 60 I2 70 CG 64	I1 43.7 I2 42.9 CG 44	I1=52 I2=57 CG=86 (211 LBP only sub-group from Haland Haldorsen et al. 2002)
Steenstra et al. 2006 (34)	The Netherlands	LBP	>8 weeks	Mean days (SD) I=26.2 (9.2) CG=26.1 (9.6)	Industrial 12.7%(I), 5.3%(CG) Transportation 1.8%(I), 1.8%(CG) Office work 14.5%(I), 26.3%(CG) Healthcare services 65.5%(I), 61.4%(CG) Other 5.5%(I), 5.3%(CG)	I 35 CG 46	I 65 CG 54	I 41.3 CG 43.2	I=55 CG=57 (ITT I 55, CG 57; PP I 36PP, CG 53PP)

Key: BP=back pain; CG=control group; CP=chronic pain; FU=follow-up; govt=government; I=intervention; IQR=interquartile range; ITT=intention-to-treat; LBP=low back pain; MSK=musculoskeletal; NP=neck pain; PP=per protocol; pps=participants; RTW=return to work; SD=standard deviation; SL=sick-leave; SP=shoulder pain;

Supplementary material Table 1b. Description of RTW interventions and outcomes for included trials and follow-up studies

Study	Setting	Intervention type	Control	Intervention and FU schedule	RTW		Secondary measures	
					Measure	Results	Measure	Results
Brendbekken et al. 2016 (26)	Two outpatient clinics at the Department of Physical Medicine and Rehabilitation, Innlandet Hospital Trust	Patient-centred Interdisciplinary Structured Interview and Visual Education Tool (ISIVET), to facilitate patient-therapist communication, focusing on psychosocial and work factors and designed to strengthen motivation and coping	Brief intervention – active controls; based on non-injury model, emphasises the importance of normal activity resumption; includes cognitive and medical assessment, and education	I: 3.5 hrs at baseline, at 2 weeks with physiotherapist and at 3 months with whole team to review all plans CG: 2.5 hrs at baseline with physician and physiotherapist, followed by 2 week FU session with a physiotherapist FU: 2 weeks (I, CG) 3 months (I) 12 months (all) 24 month (all; data available for 26 months)	"partial RTW" (p-RTW, if more than 50% of workdays per month were spent on part-time sick-leave) or "full RTW" (f-RTW, if more than 50% of workdays per month were spent without sickness benefits)	No differences between groups on f-RTW at 12 or 24 months FU (the highest RR was at month 23, RR=1.42, 95% CI 0.87-2.33, p=0.17) MD leads to faster RTW via people using partial sick-leave option (the highest RR was at month 7, RR=2.31, 95% CI 1.19-4.51, p=0.01)	n/a	Authors mention that I group pps improved faster on mental and physical symptoms, functional ability and coping versus BI; outcomes described in a separate paper
Cheng and Hung 2007 (32)	Clinic-based and workplace-based	Workplace-based work hardening program with a job coach assigned to each worker to liaise with employer to arrange suitable work tasks, biomechanics and ergonomic education, shoulder-specific exercises	Clinic-based work hardening program - comparable in nature to the I program, but no workplace-based intervention or liaison with the employer	Assessment at intake, 3 sessions p/w (all), monitoring of progress reports for I and CG to ensure comparison of content, frequency, and duration FU: at 4 weeks	self-reported "resumption of occupational activities", including normal, modified, or alternative duties	Both I and CG could improve RTW; Higher RTW (normal or modified duties) rate for I vs CG (71.7% vs 37.5%, χ^2=11.095, p=0.001)	self-reported 10-point scale of psychosocial workplace factors (intensified workload, social support, job satisfaction, job control, monotonous work), SPADI, FCE (measured active range motion of the shoulder joint and basic functional work capabilities and strength)	Significant decrease in perceived shoulder problem for the I group (two-way repeated measures ANOVA F=4.607, df 1, p=0.034) Differences in lowering of self-perceived shoulder problem and

		and job-specific activity training						functional capability for I vs CG were significant (p<0.05)
Corey et al. 1996 (29)	Clinic-based intervention	Functional Restoration Program: a limited interdisciplinary program emphasising active strategies, comprising exercise, work conditioning, group education and behavioural intervention, with an aim to improve pain coping strategies, restore function, and help with RTW	TAU ("usual care" prescribed by family physicians, included physiotherapy, exercise, chiropractic treatments etc.)	Screening at baseline 6.5 hours per day (max. 35 days, median 35, range 3-35) FU: at variable times by telephone (9-27 months and 17.9 months on average)	patient's self-reported work status ("working", or "work ready" when looking for work)	I was effective in enhancing RTW for claimants with CP (specifically LBCP, t=3.28, p=0.002). No differences between I and CG for NBCP (t=-.07, p=0.95)	pain levels (non-VAS), medication use, quality of sleep (3-point scale), depression, enjoyment of life, perception of quality of life, frequency of doctor's visits due to pain, type of pain management strategies	I effective in reducing subjective pain levels (t=-2.70, p=0.008) and improving sleep (t=3.18, p=0.002; but CG reported deterioration in the quality of sleep). No differences in QoL, use of active pain management strategies, and frequency of doctor's visits
Haland Haldorsen et al. 1998b (21)	Clinic-based	Multimodal CBT treatment: Partially individual and partially group cognitive behavioural modification (including coping strategies), education, exercise, workplace interventions (including negotiation of modifications); encouraging pps to take responsibility for lifestyle and consider	GP care, no advice or therapy feedback	Baseline assessment 6 hour session 5 days p/w for 4 weeks FU: 4 weeks, 2, 6, 10, 12 months (at the clinic and post-test by the pre-test physiotherapist); Telephone contacts; Individual FUs at the clinic delivering the intervention arranged for 'risk patients'	absence of benefit payments for a calendar month	At 12 months, I group had not returned to work at a higher rate than controls (52% I vs 53% CG), independent of CP type or gender (all differences ns)	subjective well-being (7-point scale), QoL (six item-scale), pain (VAS), daily activities (activity discomfort scale), subjective health (UHI), subjective work ability (GRWA), Health LoC (MHLC – Form A), anxiety (STAI I-II), psychological distress (HSCL-23), Personality (EPI – Form A), physical activity and training	At 12 months, I group had improved pain (t(127)=6.50, p<0.05), ergonomic behaviour (e.g. ergonomic performance, F(1,244)=11, p<0.01), work potential (e.g. possibilities to perform in work, F(1,279)=5.75, p<0.02), life quality, physical health (e.g. increase of physical activity, F(1,307)=3.53, p<0.06) and

		functionality not pain.						subjective health (F(1,256)=5.22, p<0.03)
Haland Haldorsen et al. 1998c* (22)	Clinic-based	Multimodal CBT treatment: Partially individual and partially group cognitive behavioural modification (including coping strategies), education, exercise, workplace interventions (including negotiation of modifications); encouraging pps to take responsibility for lifestyle and consider functionality not pain.	GP care, no advice or therapy feedback	Baseline assessment 6 hour session 5 days p/w for 4 weeks FU: FU: 4 weeks, 2, 6, 10, 12 months (at the clinic and post-test by the pre-test physiotherapist); Telephone FU at 2 weeks, 4 months, and 8 months Individual FUs at the clinic delivering the intervention arranged for 'risk patients'	analysis and reported outcomes for returners and non-returners	I returned 50% of pps to work at 12-month FU vs 58% from CG	pain (VAS), daily activities (Activity Discomfort Scale), subjective health (UHI), subjective work ability (GRWA), Health LoC (MHLC Form A), anxiety (STAI I-II), psychological distress (HSCL), personality (EPI Form A), questionnaire including subjective well-being (7-point scale), QoL (5-point scale of six items), work-related conditions	In I group returners with a good RTW prognosis had less pain, more psychological strength, and lower education
Haland Haldorsen et al. 2002 (23)	Outpatient clinic	(I1) Light multidisciplinary treatment program: lecture on exercise, lifestyle and fear-avoidance advice, graded activity program (I2) Extensive multidisciplinary treatment program: cognitive behavioural modification, education, exercise, workplace interventions,	GP advice	Assessment at baseline to establish prognosis, treatment 1-2 months later (I1): 1 session followed by up to 12 additional sessions (I2): 6 hour session 5 days p/w for 4 weeks FU: all pps followed up for up to 12 months with	absence of benefit payments for a calendar month	Light and extensive interdisciplinary interventions increase the possibility of RTW after 14 months by about 10% (I1 vs TAU $\chi^2 = 3.6$, df = 1, p=0.05; I2 vs TAU $\chi^2 = 4.6$, df = 1, p<0.04) Good prognosis: no treatment advantageous Medium prognosis: I1 seemed sufficient and I2 gave no additional effect, but TAU gave poor	Cost-benefit analysis	economic benefits and estimates of productivity gains due to RTW following the RTW intervention

		graded activity program;		average 3 FUs and appointments offered at 3, 6, and 10 months (study reported data based on FU for the first 14 months)		results; differences between I1 vs TAU (n = 71 vs n= 48, χ^2 =5.5, df = 1, p <0.02) and I2 vs TAU (n = 55 vs n = 54, χ^2 = 3.9, df = 1 P < 0.05) Poor prognosis: I2 most suitable; I2 vs TAU (n = 28 vs n = 26, χ^2 = 3.79, df = 1, p < 0.05)		
Heinrich et al. 2009 (33)	Clinic-based with exercises done at workplace	(I1) Physical training: cardiovascular training, relaxation, strengthening, and postural group exercise; co-intervention allowed (I2) Physical training with CBT and workplace specific exercises: all components from I1 (without co-intervention), CBT training towards functional way of thinking; workplace exercises discussed following a workplace visit and pps responsible for training	Usual GP care	Baseline questionnaires (I1):2-3 times p/w for 1-1.5 hours, during 3 months, continued with RTW, with intensity decided at intake (I2): as in I1, with added 30 minutes for CBT FU: at 6 and 12 months; claim duration data collected continuously	"claim duration" (days of work disability compensation payments from randomisation until 12 months later) with the end classed as "less than 25% work disability" for minimum of four weeks	I1 and I2 were not shown to be effective on claim duration at 12 months follow-up; (I1): In the first 6 months there was a significant difference in claim duration in favour of CG vs I1 (I1 median claim duration 181, range 119 – 184 vs CG 153, 48 – 181, log rank test, p=0.03; HR 0.5, 95%CI 0.3 – 0.9, p=0.03); At 12 months the difference in claim duration between CG vs I1 was ns (I1 median claim duration 228, range 122 – 365 vs CG 165, 48 – 365, log rank test, p=0.18; HR 0.7, 95%CI 0.4 – 1.1, p=0.12) (I2): At 6 months I2 133, 70-183 vs CG 137, 48 – 181, log rank test, p=0.60; HR 0.8, 95%CI 0.5–1.3, p=0.43); At 12	pain severity (2 questions on a scale), NPDI, QBPDS, prognostic factors such as RTW expectation, claim duration, history of complaints	Over time both types of interventions and CG improved in pain and functional status (with the only significant difference in favour of I1 on pain improvement at 6 month FU, ITT only)

						months I2 148, 75 – 343 vs CG 137, 48 – 365, log rank test, p=0.95; HR 0.9, 95%CI 0.6 – 1.4, p=0.72		
Jensen et al. 2001; 2005*[a] (27,28)	Multicentre trial	(I1) Behaviour-oriented physiotherapy: Individually tailored programme, of goal-setting, increasing exercise and relaxation (I2) CBT: goal setting, problem solving, relaxation, cognitive coping techniques, assertion training (I3) F/t Behavioural Medicine Rehab (BM): combined I1 and I2	Normal routines in health-care	Assessment pre-treatment and post-treatment (I1): 20 scheduled hours per week (I2): 13-14 scheduled hours per week (I3): combined I1 and I2 All interventions lasted 4 weeks FU: 6 and 18 months, 3 years[a]	"absence from work" and early retirement post-intervention (obtained data from the National Social Insurance Board)	Risk of early retirement lower for women in I1 and I2 vs CG over 18 month FU (odds ratio I1=0.1, 95%CI 0.0-0.6; I2=0.1, 95%CI 0.0-0.8); The decrease in absence from work was higher for females in treatment groups vs CG; Total absence from work was not significantly different in CG compared with treatment groups, but absence rate for men in I2 was higher compared to other conditions (parameter estimate from covariance analysis 65, 95%CI -39-169, ns) [a]At 3-year FU women I3 group had the best improvement to absence from work (ANCOVA p<0.05, PP only) and returned to work faster than controls. Physiotherapy was better than CBT for both genders.	Health-related QoL (SF-36) perceived relevance of rehabilitation and adherence to lifestyle plan [a]Cost-effectiveness and healthcare utilisation analysis at 3 year FU	No statistically significant differences for relevance of rehabilitation, but I3 seems to have 'higher face validity' At 18 month FU health-related QoL was statistically significant for women (Wilk's Lambda=0.72, F(18,255)=1.7, p=0.036) and I2 group reported a significant improvement in five out of six SF-36 variables in women. [a]QoL – females in I3 a moderate to strong effect size (ITT=0.74; PP=0.79); healthcare use – the I3 group consulted physiotherapists the least (p<0.05), CG contacted social

								services the least (p<0.05)
Lambeek et al. 2010 (31)	Primary and secondary care settings	Integrated care: interdisciplinary program comprising graded activity exercises with cognitive behavioural principles and workplace ergonomics intervention, aiming to restore function instead of pain reduction; provision and monitoring of treatment plan	Usual care from a medical professional	Baseline assessment followed by a treatment plan in week 1, workplace element from week 3-12, graded activity from week 2 till RTW FU: 12 weeks, 6, 12 months	duration of sick-leave in calendar days from randomisation until full RTW for four weeks without sickness absence recurrence, and either in the same or different employment	At 12 months median no. of SL days for I was 82 (IQR 51-164) vs CG 175 (IQR 91-365; Mann-Whitney U test, p=0.003)	pain intensity (VAS), functional status (Roland-Morris Disability-24), prognostic factors for the duration of SL=work-related psychosocial factors (the job content questionnaire), data on workload (the Dutch musculoskeletal questionnaire)	functional status (p=0.01) in favour of IC) and pain intensity (ns) improved for both IC and TAU
Lytsy et al. 2017 (35)	Clinic-based, with optional sessions at home/workplace	(I1) Acceptance and Commitment Therapy: A form of a CBT, using acceptance, mindfulness, and behavioural approach to increase QoL rather than decreasing symptoms; included multidisciplinary assessment (I2) TEAM: Multidisciplinary, assessment and individualised RTW plan; Acceptance and Commitment Therapy was an option here too; pps	No planned treatment, but pps free to receive usual care	Baseline assessment, length of Is individualised FU: 12 months	returning to health insurance (national registry data) self-report: number of reimbursed days during first year FU self-report: change in working hours self-report: increased work-related engagement	Overall, at FU there was a trend for I2 to support RTW for the study pps, both for the register data (ns) as well as self-reported values: self-reported change in working time I2 38.5% vs CG 22.4% (OR 2.20, 95% CI 1.09-4.44, p=0.02); self-reported change in work engagement I2 50.8% vs CG 29.9% (OR 2.20, 95% CI 1.19-4.95, p=0.01) However, RTW for employed CP pps (n=73) at 12-month FU: the results for the sub-group differed from the overall results, with a trend for	n/a	n/a

		able to accept all/parts of the RTW plan; regular evaluations Neither included work-directed interventions, but meetings with the administrator at the employment office and a contact person for the project were available				I1 to have a positive effect on RTW (significance not stated), apart from self-reported change in reimbursed days where CG reported a lesser number of days utilising health insurance: Returned to health ins. % (n/group) n=73: I1:9/17 I2: 12/28 CG: 13/28 Number of reimbursed days during first year FU, median (IQR) n=73: I1:138(0-210) I2:83(0-235) CG:59(0-180) Self-reported change in working hours, ordinal variable (<0, 0, >0), % n=73: I1:20.0/40.0/40.0 I2:11.1/50.0/38.9 CG:13.0/52.2/34.8 Self-reported increased work-related engagement, %(n) n=73: I1:50 (5/5) I2:50 (9/9) CG:39.1 (9/14)		

Mitchell and Carmen 1994 (30)	Clinic-based, multicentre	Functional restoration: active group exercise program (physical training and a functional simulation) aiming to restore function, leading to increase in control and, if possible, resolution of the pain	Treatment by the primary care provider; principles of treatment outlined in a letter to a GP	Pre-treatment assessment 7 hours per day, 5 times p/w for 8 weeks=40 treatment days (not all pps required this duration); One clinic provided the program comprising 40 days over 12 weeks FU: 12, 24 months	working full-time, either in the same or different employment, but not part-time or in modified work duties "cessation of wage loss payments", in some cases confirmed via telephone	No significant advantage of the rehabilitation group RTW at the end of the 12-month FU was 79%(I) and 78%(CG), ns At 24 months the total no. of days off work was less for I and BP only pps but both were ns	compensation costs	findings related to savings were ns, one clinic performance was better but also ns number of CP patients who were granted a disability pension was lower for I ($p < 0.05$)
Myhre et al. 2014 (25)	Multicentre	Work-focused rehabilitation: Part 1 - Clinical exam, imaging, reassurance. Removing fear avoidance, restoring activity, enhancing self-care and coping Part 2: 2-3 individual appointments with case worker: work history, family life, RTW obstacles, creating RTW schedule; slight variation between the treatment delivery sites	Control - multidisciplinary rehabilitation, either brief or comprehensive; Part 1 - Clinical exam, imaging, reassurance. Removing fear avoidance, restoring activity, enhancing self-care and coping, no case-worker contact	Baseline (I) Part 1: for 3-4 weeks, 3 hours p/w (CG) Part 1: for 3-4 weeks, 3 hours p/w FU: 12 months	the first 5-week period with no sickness benefit	A focus on the workplace in specialist care does not substantially alter the RTW rate c.f. standard multi-disciplinary treatments (in secondary care) RTW within 12 months: I 142(70%), CG 152 (75%) Median days before RTW: I 161, CG 158 (Breslow test, p=0.45, ns), separate sites also ns	Baseline data only for pain intensity (numeric scale), the Oswestry Disability Index, neck disability index, emotional distress (Hopkins Symptom Checklist), the Waddell Fear-Avoidance Belief Questionnaire (FABQ)	n/a
Reme et al. 2016 (36)	Clinic-based	(I1) Brief intervention: cognitive approach, based on a non-injury model and fear avoidance, educational and	No CG	Baseline (I1): FU with a physio, option of 2 booster sessions	transition from f/t SL to partial SL or f/t RTW (national registry data) transition from p/t SL to lower gradient SL or	I1 superior in facilitating fast RTW vs other groups I2 (or I3, I4) had no additional benefits over I1 on RTW	Subjective Health Complaints, Hospital Anxiety and Depression Scale, Oswestry Disability Index, pain	I2 (or I3, I4) had no additional benefits over I1 on secondary outcome measures, except 3 sign. differences in favour of I2 on less

		behavioural elements during a FU with a physio (I2) (Brief I+CBT): building on the message from the brief intervention, aimed at changing behavioural and cognitive factors assumed to be linked to symptom maintenance In I3 and I4 CBT was combined with the administration of supplements		(I2): 7 individual sessions over 2-3 months FU: 3, 6, and 12 months	f/t RTW (national registry data)	At 12-month FU: reduced SL and p/t or f/t RTW I1 60% I2 50% (I3 51%, I4 53%), ns Comparison of f/t RTW at 12-month FU: I1 56% I2 47% (I3 51%, I4 48%), ns The only sign. difference between treatment groups for the first 3 months of FU: pairwise comparison suggested that sign. difference related to the lower SL rate in I1 vs other groups	intensity, Health-related QoL (EQ5D)	gastrointestinal complaints at 6mths, LBP intensity and pain activity at 12mths
Skouen et al. 2002* (24)	Outpatient spine clinic	(I1) Light multidisciplinary treatment program: lecture on exercise, lifestyle and fear-avoidance advice, graded activity program (I2) Extensive multidisciplinary treatment program: cognitive behavioural modification, education, exercise, workplace interventions, graded activity program;	GP advice	Baseline assessment (1.5 hours) (I1): 1 session followed by up to 12 additional sessions (I2): 6 hour session 5 days p/w for 4 weeks FU: proportion of pps back at work recorded monthly and reported at 12, 18, and 24 months, data available for the first 26 months post-treatment	absence of benefit payments for a calendar month	I1 increased fRTW in men vs TAU (LDS post hoc test, p=0.03 at 12, p=0.02 at 18, and p=0.02 at 24 months); no statistically significant treatment effects between the groups for women; no statistically significant differences for I2 for men or women vs TAU	Cost-benefit analyses	Economic benefits for treating male LBCP pps with I1 instead of TAU

Steenstra et al. 2006 (34)	In-company and out-company physiotherapy centres	Graded activity: exercise program inclusive of operant-conditioning behavioural approach, focused on restoring occupational function, physiotherapist as a coach with hands-off approach to encourage pps to actively participate in RTW	TAU guided by Dutch Occupational Physicians guidelines	Half-hour physical examination during the first session, then 26 one-hour sessions, 2 sessions p/w FU: 12, 26 weeks	duration of sick-leave in calendar days from the first day of sick-leave until full RTW for four weeks without sickness absence recurrence, and either in the same or different employment total number of sick-leave days in the follow-up period post-intervention	Median time until lasting RTW longer for I vs CG (139, IQR=69 vs 111, IQR=76, Kaplan-Meier survival calculation, $p<0.05$)	functional status with the Roland-Morris Disability-24 questionnaire and pain intensity, healthcare use	Both groups improved on secondary outcomes, but pain differences were statistically significant in favour of CG at 26 weeks FU; visits to physiotherapist were comparable between I and CG

*Key: * - follow-up study; BI=brief intervention; BP=back pain; CBT=cognitive-behavioural therapy; CG=control group; CI=confidence interval; CP=chronic pain; f-RTW=full return to work; f/t=full-time; FABQ=Fear-Avoidance Belief Questionnaire; EPI=Eysenck Personality Inventory; FCE=functional capacity evaluation; FU=follow-up; GRWA= Graded Reduced Work Ability scale; HSCL=Hopkins Symptom Check List; I=intervention; IQR=interquartile range; ITT=intention-to-treat; LBCP=low-back chronic pain; LBP=low-back pain; LoC=locus of control; MD=multidisciplinary; MHLC=Multidimensional Health Locus of Control; NBCP=non-back chronic pain; NPDI=Neck Pain Disability Index; ns=not statistically significant; QBPDS=Quebeck Back Pain Disability Index; QoL=quality of life; p-RTW=partial return to work; p/t=part-time; p/w=per week; pps=participants; RR=relative risk; RTW=return to work; SF-36=Short Form 36; SL=sick-leave; SPADI=Shoulder and Pain disability Index; STAI=State-Trait Anxiety scale; TAU=treatment as usual; UHI= Ursin Health Inventory; VAS=visual analogue scale;*