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Workplace-Based Return-to-Work Interventions: A Systematic Review of the Quantitative Literature

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Introduction: *A systematic review was conducted to review the effectiveness of workplace-based return-to-work (RTW) interventions.* Method: *Seven databases were searched, in English and French, between January 1990 and December 2003 for peer-reviewed studies of RTW interventions provided at the workplace to workers with work disability associated with musculoskeletal or other pain-related conditions. Methodological quality appraisal and data extraction were conducted by pairs of reviewers.* Results: *Of a total of 4124 papers identified by the search, 10 studies were of sufficient quality to be included in the review. There was strong evidence that work disability duration is significantly reduced by work accommodation offers and contact between healthcare provider and workplace; and moderate evidence that it is reduced by interventions which include early contact with worker by workplace, ergonomic work site visits, and presence of a RTW coordinator. For these five intervention components, there was moderate evidence that they reduce costs associated with work disability duration. Evidence for sustainability of these effects was insufficient or limited. Evidence regarding the impact of supernumerary replacements was insufficient. Evidence levels regarding the impact of the intervention components on quality-of-life was insufficient or mixed.* Conclusions: *Our systematic review provides the evidence base supporting that workplace-based RTW interventions can reduce work disability duration and associated costs, however the evidence regarding their impact on quality-of-life outcomes was much weaker.*

KEY WORDS: return to work; disability management; compensation costs.

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INTRODUCTION

Employers, insurers and workers' groups have expressed a growing interest in return-to-work (RTW) interventions after injury or illness. As disability management is increasingly being integrated into employers' and insurers' mandates, there has been a focus on workplace-based RTW interventions. In light of this social attention and the need for a comprehensive summary of the effectiveness of workplace-based RTW interventions, we conducted a systematic literature review of international studies published since 1990 in this area.

Our review was focused on *workplace-based* RTW interventions, but included health-care provider (HCP) interventions if they 1) were initiated by the workplace and 2) were provided by HCPs who were integrated into the workplace, such as occupational physicians based in the workplace. Other clinical interventions were not included in our review.

This systematic review involved reviewing quantitative studies, qualitative studies, and systematic reviews. The current paper focuses on the review of quantitative studies only. The reviews of qualitative studies (1) and of systematic reviews (2,3) are available elsewhere.

Objectives of the Review of the Quantitative Literature

The first objective was to synthesize evidence on effectiveness of workplace-based RTW interventions and strategies that assist workers with musculoskeletal and other pain-related conditions to return to work after a period of work absence. Effectiveness was determined by examining evidence regarding the intervention impacts on work disability duration, and quality of life. Some studies evaluated the consequences and/or costs associated with interventions, and these economic evaluations were considered (4).

The second objective was to provide an assessment of methodological strengths and limitations of studies conducted in this field and will be addressed in a later paper.

METHODS

Literature Search

The literature search included a systematic review of seven electronic bibliographic databases,[7] a review of peer-reviewed working papers from relevant research institutes,[8] and a review of personal libraries. The search strategy combined two groups of terms using an "AND" strategy. The first group included RTW and workers' compensation terms, the second group included intervention terms. The search included articles in English or French, from 1990 to 2003.

[7] MEDLINE, EMBASE, CINAHL, PsycInfo, Sociological Abstracts, ASSIA (Applied Social Sciences Index and Abstracts), and ABI (American Business Index).

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Study Relevance

Inclusion and exclusion criteria for eligible studies are presented in Table I; select criteria requiring further explanation are discussed below.

Population of Interest

Studies involving workers' compensation claimants were included, as it is estimated that approximately 70% of claimants have an MSK condition (5). Studies with a mix of lost-time and non-lost-time claims were also included.

Nature of Intervention

Both interventions and strategies, aimed at reducing the burden of work disability met our inclusion criteria.[9] *Interventions* were defined as planned intervention programs. These were typically offered in a limited number of workplaces, by the same team of providers, often as part of a research study. Their evaluation was typically planned prior to implementation of the program. In contrast, *strategies* were approaches to improve RTW outcomes, which did not necessarily occur as part of a planned intervention program—these were typically examined in observational studies. Their evaluation was often initiated after implementation.

Study Design

We cast a wide net to include the full range of study designs used in evaluating workplace-based RTW interventions. Study designs were categorized using an algorithm developed by Briss *et al*. (13) for The Task Force on Community Preventive Services.

Quality Appraisal

Quantitative studies meeting inclusion criteria were assessed for methodological quality using nine methodological criteria developed by the authors' consensus (Appendix), based on previous work (14–19). One study was conducted by members of the research team (20,21) and its quality appraisal was conducted by two external reviewers to minimize bias.

The methodological quality of studies was categorized as follows: Very high—100% of the methodological quality criteria met, High—75–99% met, Medium—50–74% met, Low—0–49% met. A study proceeded to data extraction under the following circumstances: 1) all methodological quality criteria were met; or, 2) the study met at least 75% of the criteria, and the reviewers felt strongly that the study represented an important piece of work of sufficient quality that should be included in the review.

[9]The following types of interventions were excluded from primary studies but included in systematic reviews, as there have been previous systematic reviews focusing on the effectiveness of these interventions and they are not primarily implemented in the workplace: Multidisciplinary rehabilitation (6,7), back schools (8–11), exercise classes (9,10), and work-conditioning (12).

Table I. Criteria for Inclusion of Studies

	Inclusion	Exclusion
Population of interest	Workers who are off work due to one of the following: • MSK condition • Pain-related condition that was episodic or non-episodic, or associated with a degenerative or nondegenerative condition • Chronic pain OR • A workers' compensation claimant population	• Mental health conditions as a primary condition • Phantom limb pain • Short duration self-limiting pain • Pain associated with a malignant condition
Nature of intervention or strategy	Specifically aimed at improving RTW outcomes, including: • Disability management • Case management • Education to workplace staff, insurance case managers, or workers[a] • Changes in general organizational factors, but specifically aimed at improving RTW outcomes[a]	• Policies • Primary prevention ergonomic interventions • Clinical interventions provided outside the workplace
Provider of intervention	• Provided by the workplace, or by an insurance company (private or governmental) and which could be provided by the workplace • Provided by a healthcare provider in very close collaboration with the workplace.	• Provided by the healthcare provider with no or minimal integration with the workplace.
Receiver of intervention	• Workers • Workplace staff • Case managers from insurance company	
Outcomes	• Work disability duration: Self-reported time to return to work, time on benefits, total duration of lost time, recurrences; Point-prevalence of status (e.g., back at work versus not back at work) • Associated costs: Healthcare costs, wage replacement costs, intervention costs • Quality of life: Mental health, functional status, general physical health during and/or after work interruption; Quality of work life; Medication taken during and/or after work interruption.	• Absenteeism unrelated to MSK or other pain-related conditions
Study design—quantitative	• Randomized controlled trial (RCT) • Nonrandomized trial • Cross-sectional • Pre–postdesign • Time series • Case control • Cohorts (retrospective and prospective)	• Noncomparative studies: case series, case study

[a] Not included in this review. Details can be found elsewhere (2,3).

Data Extraction

A standardized form was developed by the authors, based on existing forms (17,19). Data extracted included study design, research question, study population characteristics, participation rates and sampling strategy, inclusion/exclusion criteria, type of intervention/strategy, type of outcomes, results, feasibility, benefits and/or barriers to intervention, and participation compliance.

Consensus-Based Procedure

Study selection, quality appraisal, and data extraction were conducted by rotating pairs of independent reviewers, meeting to reach consensus. Three senior researchers reviewed the first 18 quality appraisals, to ensure consistency among teams on interpretation of the quality appraisal criteria.

Evidence Synthesis

The nature of the research in this area is marked by highly heterogeneous study designs, types of interventions, populations sampled, units of analysis, statistical methods, and jurisdictional settings. This heterogeneity precludes the use of meta-analysis. Consequently, we used a "Best evidence synthesis" approach (22,23), which has been used previously in occupational health research (18). Best evidence synthesis is based on three aspects of the evidence on a particular question: *Quality*, *Quantity*, and *Consistency*. Quality refers to the methodological quality of pertinent studies, quantity refers to the number of studies, and consistency refers to the consistency of results across studies. Studies investigating a particular question were ranked on a scale from strong evidence to no evidence (Table II).

RESULTS

Summary of Search and Study Selection of Complete Systematic Review

A total of 4124 studies were reviewed for inclusion in this systematic review. Sixty-five studies met the inclusion criteria and were assessed for methodological quality. Of

Table II. Best Evidence Synthesis Guidelines

Level of evidence	Minimum quality	Minimum quantity	Consistency of findings[a]
Strong	Very high	Three studies	Very high quality studies are all consistent AND ≥50% of high-quality studies are also consistent
Moderate	High	Three studies	100% of high-quality studies are consistent, OR ≥66% of very high-quality studies are consistent with ≥50% of other high-quality studies consistent with very high-quality studies
Limited	High	Two studies	Two studies converge on the same findings
Mixed	High	Two studies	If there are two studies, they do not converge on the same findings. If there are three studies, only two are consistent
Insufficient	High	One study	Not applicable
None	There are no high or very high quality studies on the subject		

[a] Studies obtaining mixed results are reported, however they were considered as "neutral" and are not factored in the final evidence level.

these, 35 were quantitative studies, 15 were qualitative studies and 15 were systematic reviews.

Quality Appraisal

Eleven of 35 quantitative studies met our quality appraisal criteria. One study (24–26) consisted of an educational program only and consequently is not included in the evidence synthesis of this paper, leaving 10 studies for data extraction. Only results pertaining to quantitative studies will now be discussed.

Data Extraction

The 10 studies proceeding to data extraction are summarized in Table III.

Categorization of Interventions

Three main elements of interventions and strategies emerged across the high-quality and very-high-quality studies: components of RTW intervention, educational interventions, and organizational factors. The current paper focuses on the RTW intervention components only. Results regarding organizational factors (3) and educational programs (2) are summarized elsewhere.

Categorization of Key Outcomes

Three types of key outcomes were considered: work disability duration, associated costs, and quality-of-life outcomes.

Work Disability Duration

Work disability duration remains the most commonly used outcome in RTW research. In all studies retained for data extraction, work disability duration was assessed from an administrative database or from self-report. Administrative data reflect time on benefits, which does not necessarily concur with actual time to return to work (52). Although we recognize that work disability can refer to work limitations when a worker is still working, in this paper we use the term to refer to periods of time when a worker is absent from work.

Associated Costs

Economic analyses considered the following types of costs: wage replacement, compensated healthcare costs, other healthcare costs, and intervention costs.

Few studies used statistical analyses to evaluate the significance of differences in costs associated with alternative interventions/strategies. The absence of statistical analyses relates to two issues. First, claims costs data distributions are highly skewed, as a small

Table III. Summary of Study Characteristics, Methodological Quality, Intervention Description, Statistical Analyses, and Results

QA rating, jurisdiction	Design, follow-up	Sample	Intervention description	Statistical analyses	Results
Very high, Maine, USA (27)	Prospective cohort, 6 month	Carpal tunnel surgery patients ($n = 197$)	Organizational policy and practices assessed for predictive ability of RTW 6 months postsurgery: Disability Management scale assessed presence of: EC, WA, HCP, RTWC	Logistic regression	**Work disability duration (+):** • The disability management scale was predictive of RTW status 6-mo. post-surgery: Odds ratio (OR) = 2.24 (Standard Error = 0.267, $p < 0.0025$)
Very high, Sweden (28)	RCT, 1 year	Workers with MSK related sickness absence Intvn: $n = 65$ Neck/shoulder: 28% Back: 45% Joint disorders: 6% Other MSK: 22% Ref: $n = 72$ Neck/shoulder: 21% Back: 33% Joint disorders: 6% Other MSK: 40%	Intvn: Proactive RTW insurance case management with EC, RTWC, WEV, and WA, Ref: Usual case management strategies.	T-test, chi-square, logistic regression	**Work Disability Duration (+):** • Shorter duration of mean sick days for intvn group compared to ref group ($p < .01$). • OR (RTW at 1 year for intvn) = 2.5 ($p < .01$; 95%CI: 1.2, 5.1). **Quality-of-life (M):** • At RTW, 22% of intvn workers and 9% of ref workers reported feeling "healthy and recovered" ($p < .05$). • No group differences at 6-mo. follow-up, on self-reported general health. **Economic Analyses (+):** • Lower wage replacement costs for intvn group ($p < .01$). • Benefit-to-cost ratio[a] = 1.8, based on the reduction in healthcare costs divided by cost of the program per person. • Benefit-to-cost ratio = 4.1, based on reduction in wage replacement and health costs divided by program cost.

Table III. Continued

QA rating, jurisdiction	Design, follow-up	Sample	Intervention description	Statistical analyses	Results
Very high, Ontario, Canada (20,21)	Prospective cohort, 1 year	Workers with compensable lost-time injuries ($n = 1833$) Back: 57% UE & LE: 43% For prognostic analyses, only workers with ≥4 wks lost-time were included ($n = 907$): UE: 27% LE: 15% Back: 59%	The following strategies were examined in this prognostic cohort study: EC, WA	Survival analyses, Frequency distributions, log-rank chi-square multiple regression	**Work Disability Duration (+ for WA, − for EC):** • Time receiving wage replacement was predicted by WA (HRR = 1.91, 95% CI: 1.48, 2.43) • An interaction between change in pain and WA predicted time on wage replacement (HRR = 0.70, 95% CI: 0.58, 0.85). WA provided the largest reduction in time on wage replacement for workers with stable or worsening pain, and with poor functional status or recovery expectations. • EC was not associated with shorter time on wage replacement.
Very high, Finland (29)[b]	RCT, 1 year	Workers with work-limiting LBP for >4 wks and <12 wks. Intvn A: $n = 56$ Intvn B: $n = 51$ Ref: $n = 57$	**Intvn A** (Mini-intervention): Assessment and consultation by physiatrist to explain clinical results, provide reassurance, discuss work conditions and good back posture. Also included HCP. **Intvn B** (Mini-intervention + worksite visit): Mini-intervention plus a 75-min worksite visit by a physiotherapist on good back posture which included supervisor, company nurse, and company physician. Included HCP and WEV.	Generalized estimating equations , Kruskal-Wallis tests.	**Work Disability Duration (+ Mini-intervention; −Worksite visit):** • Both intvn groups had fewer days on sick leave than ref group (Intvn A vs. Ref: $p = 0.019$; **Intvn B** vs. Ref: $p = 0.071$) • No difference between Intvn A or B for time on sick leave. **Quality-of-life (+Mini-intervention; − Worksite visit):** • Both intvn groups reported less daily pain than ref group (Intvn A: $p = 0.002$; Intvn B: $p = 0.030$). • Intvn A reported pain was less bothersome ($p = 0.032$) and interfered less with daily activities ($p = 0.039$) than ref group. • No group differences were found for pain intensity, condition-specific functional status, or generic health-related quality of life. • No difference between intvn A or B for any quality-of-life outcomes.

			Ref: Usual care from GP and a pamphlet on back pain.		**Economic Analyses (+ Mini-Intervention; − Worksite Visit):** • Diagnostic test costs were lower for intvn B vs. ref group ($p = 0.038$). • No group differences were found for direct healthcare costs. • Total costs (wage replacement and healthcare costs) were lower for both intvn A and B compared to ref group (Intvn A: $p = 0.075$; Intvn B: $p = 0.098$). • No difference in costs were found between intvn A and B.
Very high, Quebec, Canada (30–34)	Clustered RCT, 1 and 6.4 years	Workers from 31 workplaces with occupational back pain Intvn A: $n = 22$. Intvn B: $n = 31$ Intvn C: $n = 25$ Ref: $n = 26$	Intvn A (Occupational intvn): Included the following components: **EC**, **WA**, **HCP**, **and WEV**. Workers also received usual care by GP. Intvn B (Clinical intvn): Included back school, functional restoration, and cognitive-behavioural intervention offered at a back clinic, and the following components: EC, WA, HCP. Workers also received usual care by GP. Intvn C (Combined intvn): Combination of both Intvn A and B. Included the folloing components: EC, WA, HCP, WEV. Ref: Usual care from GP plus video on back pain to injured workers, and questionnaire to supervisors.	Survival analyses, log-rank tests	**Work Disability Duration (+):** • The rate of return to regular work was 2.23 times greater for intvn C than ref group (95% CI: 1.04, 4.80). • The return to regular work was 1.91 times faster in the two groups receiving an occupational intervention (Intvn A & C) than in the other two groups (95% CI: 1.18, 3.10). • No significant effect was found for the clinical intervention. • When comparing the four intvn groups, workers in intvn C returned to regular work 2.41 times faster than those ni ref group (95% CI: 1.19, 4.89). • At 6.4 yr follow-up, intvn groups A, B, & C saved days on full benefits compared to ref group. (Mean duration on full benefit—Intvn A: 228 days, Intvn B: 178.7 days, Intvn C: 125.6 days, Ref: 418.3 days) **Quality-of-life (M):** • Functional status was significantly improved in intvn C as compared to ref group. No significant differences in pain level and symptom severity.

Table III. Continued

QA rating, jurisdiction	Design, follow-up	Sample	Intervention description	Statistical analyses	Results
					• Groups receiving the occupational intervention (A & C) showed a significant improvement in symptom severity. There were no differences in pain level and functional status. • Groups receiving the clinical intervention reported (B & C) significantly lower pain levels. There were no differences in functional status and symptom severity. **Economic Analyses (+):** • Cost-benefit[c]: At 1-year follow-up, only intvn A resulted in net savings compared to ref group. At 6.4-year follow-up, all interventions (A, B, C) resulted in net savings, but no statistical analyses were conducted. • Cost-effectiveness[d]: At 6.4-year follow-up, all interventions (A, B, C) were cost-effective, with intvn A being the most cost -effective.
High, Maryland, USA (35–39)	Pre–post- no control group, years	Workers with compensable work-related injury and illness (specific conditions were not reported) Intvn: *n* (1989) = 16,212 *n* (2002) = 39,063 Ref: None.	**Intvn: Integrated on-site** case management which included: EC, WA, HCP, WEV, RTWC	% change in outcomes for before–after intvn	**Work Disability Duration (+):** • Despite increasing working population, number of temporary total disability (TTD) days per 100 insured decreased 77% **Economic Analyses (+):** • Wage replacement cost for TTD per $100 payroll decreased 61% • Wage replacement cost for permanent partial disability decreased 63% • Medical losses per $100 payroll decreased 44% • Total losses per $100 payroll decreased 54%

High, Ontario, Canada (40)	Prospective cohort, 1.75 year	Workers with MSK lost-time claims ($n = 138$) UE: 24% LE: 7% Lower back: 48% Neck: 7% Other: 14%	The following strategy was examined in this prognostic cohort study: WA	Time-dependent proportional hazards regression	**Work Disability Duration (+):** • RTW rate was nearly twice as high when the worker had a modified job to return to (RR = 1.93; 95% CI: 1.54, 2.42).
High, Michigan, USA (41,42)	Cross-sectional, NA	Workplaces in 7 industrial sectors ($n = 220$).	The following strategies were examined in the Proactive RTW factor: EC, WA, HCP, RTWC	Multiple regression	**Work Disability Duration (+):** • A one−unit increase in Proactive RTW was associated with 16% fewer lost workdays ($p < 0.05$).
High, Netherlands (43)	RCT, 1 year	Hospital workers with LBP on sick leave at least 10 days. Intvn: $n = 61$ Ref: $n = 59$	Intvn: Training to occupational physicians on LBP management. It included: EC, WA, HCP. It also included the reference intervention Ref: Usual care from GP, pamphlet given to supervisors on LBP, and management by occupational physicians if off work 3 months post-injury.	Cox regression, chi-square, Mann–Whitney *U* tests	**Work Disability Duration (−):** • No group differences in time to first RTW at 3 and 12 months. • No group differences in total work disability duration. • At 12 months, the recurrence rate was 25% higher in intvn group (50%) vs. ref group (25%) (HRR = 2.4; 95% CI: 1.2, 4.7). **Quality-of-life (−):** • No group differences for pain intensity, condition-specific functional status, and general health perception.
High, Manitoba, Canada (44–49)[e]	Non-RCT, 1 year	Nurses with compensable soft-tissue back injuries Intvn: $n = 60$ Ref: $n = 158$	Intvn: Combined occupational-clinical intervention targeted to high-risk wards, which included: early assessment and treatment by a physiotherapist, EC,	Between group comparisons and multiple regression	**Work Disability Duration (+):** • Total time lost per 100 000 paid hours decreased 29% for intvn group vs. 51% increase in ref group. • Participation in intvn group was predictive of shorter duration of time−loss claims by as much as 45 days ($p < 0.016$).

Table III. Continued

QA rating, jurisdiction	Design, follow-up	Sample	Intervention description	Statistical analyses	Results
			WA, HCP, WEV, RTWC and SP. Ref: Usual care from GP.		**Quality-of-life (+):** • At 6 mo. follow−up, nurses in intvn group reported significantly lower disability scores than ref group ($p = 0.008$). **Economic Analyses (+):** • Total WC costs decreased 8% in intvn group, vs. 42% increase in ref group. • Intvn group had higher medical costs than ref group ($845 vs. $728) for lost-time claims. • Intvn group had lower wage replacement costs than ref group ($3 822 vs. $4 270) for lost time claims.

Legend: Intvn: intervention; Ref: reference; UE: upper extremity; LE: lower extremity; GP: general practitioner; +: positive findings; −: negative findings; M: mixed findings; EC: early contact with worker by workplace; WA: work accommodation offer; HCP: healthcare provider contact with workplace; WEV: worksite ergonomic visit; RTWC: return-to-work coordination; SP: Supernumerary replacement; HCP: healthcare provider contact with workplace.

[a]These calculations were conducted by the IWH literature review group.

[b]Two-year follow-up results, published after the closing date of our review, showed that effects found at the 1-year follow-up were sustainable (50).

[c]Cost-benefit represented the amount of wage-replacement costs saved in each arm, calculated by subtracting the additional intervention costs compared to standard care, from the reductions in wage replacement costs against standard care.

[d]Cost effectiveness is represented by the cost for each saved day on full benefits.

[e]This study was later replicated with a larger number of participants with a 6-month follow-up. Results regarding savings in time loss and compensation payments were similar to the ones in the smaller study reviewed in our review (51).

percentage of individuals incur the largest percentage of costs and this distribution violates the assumptions of normality (53). Due to the skewed distribution of costs, statistical analyses are likely to result in nonsignificant results. Secondly, very small and statistically nonsignificant differences in costs can nevertheless translate into large net savings at the population level—for these reasons, many researchers choose not to use statistical analyses in their economic analyses. Another approach used in economic analyses to test robustness of results is to undertake sensitivity analyses, which none of the studies reviewed used. Therefore, we retained studies, which did not use statistical analyses or sensitivity analyses in the synthesis of studies undertaking economic analyses.

Quality-of-Life Outcomes

Four constructs of quality-of-life emerged: general health, condition-specific functional status, symptom severity, and pain levels. All constructs were measured by self–report using various instruments, most of which had established reliability and validity. Although these constructs do not measure exactly the same phenomena, they are highly correlated. For that reason, and to make the level of detail in the synthesis manageable, we collapsed across constructs to report on quality-of-life outcomes.

Evidence Synthesis

We chose to focus on intervention components, which have been recognized by research and advocacy groups (e.g. NIDMAR (54)) as established disability management activities. Evidence was synthesized for the following workplace-based RTW intervention components, with regards to the three outcomes of interest:

- Early contact with the worker by the workplace
- Work accommodation offer
- Contact between healthcare provider and the workplace
- Ergonomic work site visits
- Supernumerary replacements
- RTW coordination

Early Contact with the Worker by the Workplace

Work Disability Duration

Three very-high-quality studies (27,28,30–34) and two high-quality studies (41,42,44–49) found early contact with the worker associated with reductions in work disability duration, while one very-high-quality study (20,21) and one high-quality study (43) did not. Follow-up beyond a year was conducted in one study (33), which showed a sustainable effect, however with no statistical analyses conducted. Taken together, the best evidence synthesis approach provides *moderate evidence* that early contact with the worker significantly reduces work disability duration, with *insufficient evidence* to support the sustainability of this effect beyond 1 year (33).

Economic Analyses

Cost-benefit analyses of two very-high-quality studies (28,30–34) and two high-quality studies (35–39,44,48) showed that interventions involving early contact with the worker resulted in net savings, providing *moderate evidence* for this effect, with *limited evidence* to support its sustainability beyond 1 year (33,39).

Quality-of-Life Outcomes

Two very-high-quality studies (28,30–34) provided mixed results regarding the impact of early contact on quality-of-life outcomes. One high-quality study (46,47) showed a positive impact on functional status at six months follow-up. In a second high-quality study (43), no impact was found on quality-of-life outcomes. There is *mixed evidence* regarding the impact of early contact with the worker on quality-of-life outcomes.

Work Accommodation Offer

Work Disability Duration

While one high-quality study (43) did not find any association between the offer of a work accommodation and work disability duration, four very-high-quality studies (20,21,27,28,30–34) and three high-quality studies (40–42, 44–49) supported that a work accommodation offer reduces work disability duration, resulting in *strong evidence*, with *insufficient evidence* to support the sustainability of the effect (33).

Economic Analyses

The two very-high-quality (28,30–34) and two high-quality studies (35–39,44,48) considering the impact of work accommodation offers on costs are the same as for the early contact with worker component. Therefore, there is *moderate evidence* that work accommodation offers reduce costs associated with work disability with *limited evidence* to support the sustainability of this effect (33,39).

Quality-of-Life Outcomes

The four studies (28,30–34,43,46,47) considering quality-of-life outcomes are the same as for the early contact with worker component. Therefore, there is *mixed evidence* regarding the impact of work accommodation offers on quality-of-life outcomes.

Contact Between Healthcare Provider and the Workplace

Work Disability Duration

Three very-high quality studies (27,29–34) and three high-quality studies (41–49) examined the impact of healthcare provider contact with the workplace. Except for one

high-quality study (43), all studies supported that contact by a healthcare provider with the workplace significantly reduces work disability duration, resulting in *strong evidence* for the effect, with *insufficient* evidence regarding its sustainability (33).

Economic Analyses

Two very-high quality (29–34) and two high-quality studies (35–39,44,48) supported that healthcare provider contact with the workplace results in net savings, providing *moderate evidence* for this effect, with *limited evidence* to support its sustainability (33,39).

Quality-of-Life Outcomes

Two very-high-quality studies (29–34) provided mixed results regarding the impact of healthcare provider contact on quality-of-life outcomes, one high-quality study (46,47) had positive results, and another (43) had negative results. Therefore, there was *mixed evidence* regarding this efect.

Ergonomic Work Site Visits

Five studies included an ergonomic work site visit in their intervention: three very-high-quality studies (28–34) and two high-quality studies (35–39,44–49).

The degree to which the design of each study addressed the question of the additional value of an ergonomic work site visit varied, with the three randomized controlled trials (RCTs) (28–34) addressing it most directly. The degree to which content of the work site visit was *ergonomic* varied. Most notably, in one RCT study (29), the intensity of the ergonomic content was low.

Work Disability Duration

In two of the three very-high-quality studies (28,30–34), and in one high-quality study (44–49), ergonomic work site visits were associated with significant reductions in work disability duration, providing *moderate evidence* that ergonomic work site visits significantly reduce work disability duration, with *insufficient* evidence to support the sustainability of this effect (33).

Economic Analyses

Two very-high-quality studies (28,30–34) and one high-quality trial (48) showed that interventions which included an ergonomic visit resulted in net savings at 1-year follow-up. In one very-high-quality study (29), except for diagnostic tests and radiological examinations costs, results did not support any cost reductions associated with interventions with a worksite ergonomic visit. Two studies (33,35–39) included economic analyses after more than 1 year, and showed sustained net savings. There is *moderate evidence* that

ergonomic visits are associated with important cost reductions at 1-year follow-up, with *limited evidence* that this effect is sustainable (33,39).

Quality-of-Life Outcomes

Results of three very-high-quality studies were not consistent: mixed results (28,30–34) and no support (29) for a positive impact of ergonomic visits on quality-of-life outcomes were reported. One high-quality study (46,47) reported positive results, providing an overall *mixed* level of evidence.

Supernumerary Replacements

Supernumerary replacements occur when financial support is available to cover the cost of an additional person to replace the injured or ill worker, while the worker is doing modified work. The added worker is not included in the assessment of production standards or the calculation of costs versus productivity. The funds can be provided by a public sector insurer, a private insurance company, or by the employer.

Only one study (44–49) was of sufficient quality to be considered in the evidence on supernumerary replacements. There is *insufficient evidence* to support the effectiveness of this intervention component in terms of its impact on work disability duration and quality-of-life outcomes, or its impact on costs.

Return-to-Work Coordination

Work Disability Duration

Two very-high-quality studies (27,28) and two high-quality studies (41,42,44–49) supported that interventions which include the presence of a RTW coordinator are associated with shorter disability duration, providing a *moderate evidence* for this effect.

Economic Analyses

Two high-quality studies (35–39,44,48) and one very-high quality study (28) demonstrated important net savings, providing *moderate evidence* that interventions which include a RTW coordinator lead to important cost reductions, with *insufficient evidence* to support the sustainability of this effect beyond 1 year (39).

Quality-of-Life Outcomes

The very-high-quality study (28) obtained mixed results regarding perceived general health, while the high-quality study (46,47) led to improved functional status, providing *insufficient* evidence that the presence of a RTW coordinator in an intervention program leads to improved quality of life.

Table IV. Summary Table of Level of Evidence

Intervention components	Work disability duration	Costs associated with work disability	Quality of life
Early contact by the workplace with worker	Moderate (but insufficient for sustainability over 1 year)	Moderate (but limited for sustainability over 1 year)	Mixed
Work accommodation offer	Strong (but insufficient for sustainability over 1 year)	Moderate (but limited for sustainability over 1 year)	Mixed
Contact between healthcare provider and workplace	Strong (but insufficient for sustainability over 1 year)	Moderate (but limited for sustainability over 1 year)	Mixed
Ergonomic work site visit	Moderate (but insufficient for sustainability over 1 year)	Moderate (but limited for sustainability over 1 year)	Mixed
Supernumerary replacement	Insufficient	Insufficient	Insufficient
Presence of RTW coordinator	Moderate (no evidence for sustainability over 1 year)	Moderate (but insufficient for sustainability over 1 year)	Insufficient

DISCUSSION

Our best evidence synthesis provides support that workplace-based RTW interventions can reduce work disability duration and associated costs. The evidence regarding improving quality-of-life outcomes was significantly weaker.

There was strong evidence that work disability duration is significantly reduced by work accommodation offers and contact between healthcare provider and workplace; and moderate evidence that it is reduced by interventions which include early contact with the worker by the workplace, ergonomic work site visits, and presence of a RTW coordinator (see Table IV for a summary of levels of evidence). For these five intervention components, there was moderate evidence that they reduce costs associated with work disability duration. Evidence for sustainability of these effects was insufficient or limited. Evidence regarding the impact of supernumerary replacements was insufficient. Evidence levels regarding the impact of the intervention components on quality of life were insufficient or mixed. Specific aspects of the RTW intervention components are discussed below.

Intervention Components

Contact with the Worker and With the Healthcare Provider

Contact with the worker was considered "early" when occurring within the first three months following onset of work disability. In some cases, contact occurred as early as within the first week of work disability (44–49) and the person initiating the contact varied. These variations leave questions regarding the best time and source of contact. Can too prompt a contact be damaging to the relationship with the worker? Should the person making contact be chosen on the basis of their occupation, or of their personal relationship with the worker?

Similarly, information regarding the timing and nature of the contact with healthcare providers was scant. Contact ranged from a simple report sent back to the workplace, to a more extensive visit to the workstation by a healthcare provider.

Work Accommodation Offers

The effectiveness of work accommodations in reducing work disability duration is well-supported by a previous high-quality systematic review (55). Of interest is the finding that work accommodations have the most significant impact for workers with decreasing pain levels but low functional status or recovery expectations, and for workers with stable or worsening pain irrespective of functional status and recovery expectations (20,21).

Ergonomic Work Site Visits

There were important differences in ergonomic visits in the studies reviewed. Various disciplines were involved: Occupational therapists, ergonomists, and physiotherapists. The timing of the work site visits varied: the interventions in two studies (28,44–49) were offered within the first week of work absence, while in another study (30–34), the visit occurred after 6 weeks of work absence. The level of involvement of healthcare and workplace individuals also varied. At one end of the continuum (29), the worker, supervisor, company nurse, and company physician were all asked to attend the visit led by the physiotherapist, which was followed by a written report to the company physician and the worker's general practitioner, with a suggestion to provide it to the worker's manager. Other studies included fewer individuals attending the visit, and less intense follow-up.

Supervisors were often present during ergonomic visits (28–39). Only one study did not specify the presence or role of the supervisor (44–49). This possible confounding factor needs to be considered when examining the impact of work site visits. With ergonomic visits and involvement of supervisor so closely tied, it is possible that supervisors play an essential role in ensuring a positive impact of an ergonomic visit and in supporting a favorable RTW process.

It is important to note that the only study which did not support the effectiveness of ergonomic work site visits was the study with the lowest intensity of ergonomic content (29,56). This finding suggests that a moderate to high intensity ergonomic content is necessary for a visit to be effective in reducing work disability duration. Also, individuals participating in the study were not severely limited in their ability to work nor were they all off work when entering the trial. It is possible that for such individuals a work site visit, mainly focused on good back habits, has limited impact on subsequent work absence. These results are parallel to results previously mentioned showing that work accommodations have the least impact for less severely impaired workers (20,21).

Supernumerary Replacements

Supernumerary replacements could be powerful components of RTW interventions as they benefit multiple parties. They can remove the potential burden of coworkers when a worker returns to work on modified duty, the employer's burden of reduced productivity and increased costs, and they can reduce the pressure on a worker who returns to modified work as extra help is available. Only one study of sufficient quality examining supernumerary replacements was included in this review (44–49), pointing to the need for further research.

RTW Coordination

There was great variation in disciplinary backgrounds of the RTW coordinators suggesting that it is the coordination of RTW which is critical, not disciplinary background. Due to the small number of studies involving a designated RTW coordinator, it was not possible to examine the impact of having a third-party RTW coordinator versus an in-house one. There are pros and cons to each option—while a third party may offer more neutrality and possibly a perceived higher level of confidentiality, an in-house RTW coordinator may be more familiar with the workplace culture and daily aspects of conditions of employment in the workplace.

Quality-of-Life Outcomes

Evidence for a positive impact of interventions on quality-of-life outcomes was weak. These results are cause for concern, and should be examined in light of methodological aspects of the studies, reasonable outcomes to expect, and the social context of workers.

Measures used were generally adequate to examine quality-of-life. The majority of measures were condition-specific measures, which are more sensitive to change than general health perception measures (57). In only two studies were general measures of health or of symptom severity used (30–34,43). The pattern of results did not reflect a measurement bias: Positive and negative results were found for both condition-specific (30–34,43–49) and general measures (30–34,43); Length of follow-up period was reasonable, varying between 6 months and 1 year. However, sample sizes were often small and may have led to insufficient statistical power.

A question remains: How healthy can workers be expected to feel when they return to work after an injury or illness? Workers who return to work may experience poorer general health at the outset, with the expected goal of reaching better health later—the idea of "short-term pain for long-term gain." However, there is a limit to how much pain, symptoms, and poor health workers should tolerate before they are considered to be no longer fit to return to work. What is an "acceptable" level of pain or symptoms?

It remains unknown if work-disabled workers are in poorer health prior to their work disability onset, which would impact on what can be reasonably expected in terms of health after return to work. Recent data shows that during the 12 months prior to registration of a claim for a work-related injury, healthcare workers have a higher utilization rate of general healthcare services compared to an age and gender-matched comparison population (58). This may suggest that some workers are in poorer health and possibly more vulnerable to workplace injuries, prior to a work disability episode.

The risk of premature return to work must be recognized. Workers who return to work too early are at higher risk of relapse (59), and if re-injury occurs, this may generate fear among other workers about return to work, as well as resistance to future return to work for the affected worker. Hence, the cost of premature return to work can be high.

Economic Analyses

In European countries, where the health insurance system includes both injury-related and noninjury-related costs, concurrent reductions in work disability duration and in

healthcare costs were observed. However, for North American studies, where reported healthcare costs reflected only compensable injury-related health services costs, there remains the possibility that interventions do not result in savings for non-injury related healthcare services. The possible negative "cascading effect" (60) on health following an injury is not investigated by such studies, and points to the need to include healthcare costs not covered by compensation systems in future studies.

Economic analyses were conducted from workplace and insurer perspectives, as they primarily focused on wage replacement and healthcare costs. Future studies should seek to reflect a societal perspective, including costs to the worker such as lost income, and lost time at work of family members due to caregiving activities.

Sustainability of Effects

Evidence for sustainability of effects beyond 1 year was insufficient or limited. The absence of sustainable effects is however not surprising given that over time, the distribution curve for return to work of lost-time claimants flattens to a degree where very little improvement can be expected, when only the "most difficult" cases remain off work. It is in the middle portion of the curve, corresponding to time between 1 month and 1 year, where changes resulting from intervention are most likely.

Only two studies reviewed examined outcomes beyond 1-year follow-up (33,35–39). Sustainability of return to work is of primary concern when examining the impact of work disability on workers. Sustainability of effects is critical to evaluate as workplace injuries lead to future loss of income in workers associated with subsequent work disability periods as well as lower labor market earnings (18,61).

Search Strategies in the Area of Return-to-Work

As for many systematic literature reviews, the final yield of 10 relevant studies of sufficient quality in the data extraction and synthesis was low given that over 4000 studies were initially identified as potentially relevant. There are two main reasons for this extremely high oversampling of studies.

First, the search was designed to capture not only quantitative studies but also qualitative studies and systematic reviews, which increased the denominator of the ratio of retained quantitative studies to total number of studies identified.

Second, current search engines rely on terms which are primarily biomedical in nature and which are therefore not well targeted to complex topics such as those found in the occupational health intervention field. This lack of specificity of terms to the topic requires that we use not only controlled terms (specific to each database) in the search strategies, but also uncontrolled terms in order to cast a sufficiently wide net of search terms to capture the majority of relevant papers. While this approach is desirable, it does lead to a lack of specificity resulting in oversampling of papers.

When reviewing papers for relevance, we designed a hierarchy of reasons for exclusions. At the first level of the hierarchy, 73.5% of quantitative papers were excluded as they were not related to return-to-work, due to the lack of specificity of search terms described above. At the subsequent levels of the hierarchy, studies were excluded for the following

reasons: 1) no intervention was provided (4.9%), 2) the intervention was not workplace-based (8.4%), 3) workers did not have a pain-related condition (2.9%), 4) the outcome did not meet our criteria (0.3%), 5) the study design did not meet our criteria (6.4%), 6) other reasons (3.6%). These reasons reflect a process whereby a paper was excluded as soon as one of the above reasons was found using the hierarchy described, and therefore no further reasons for its exclusion were sought.

Limitations and Strengths of the Systematic Review

The very nature of a systematic review requires that the process focuses on the commonalities across studies at the expense of features which are unique to each study. We have attempted to curtail this limitation by including in our discussion reference to details of the studies.

In the studies reviewed, the RTW intervention always consisted of several components, and across the studies, the mix of components varied. This limits the degree to which the evidence regarding any one specific component can provide definitive answers, and remains an important caveat.

The role of healthcare providers was considered only within the context of workplace-based RTW interventions. Any other role of the healthcare provider, within the context of clinical RTW interventions, is not addressed in our review. Phase-specific effects for healthcare provider intervention (62) would not be revealed in our review.

Variations in jurisdictional settings of the studies reviewed present both strengths and limitations of the literature reviewed. While it increases generalizability of findings, it limits the comparability of studies across widely varying policies, compensation systems, healthcare systems, and social values relating to return to work.

The main strength of our review was its comprehensiveness. It included a wide range of study designs to reflect the emerging consensus in intervention research that well-conducted studies using designs other than RCTs have important scientific merit (63). Our quality appraisal system also gave more weight to the quality of the execution of a study design than to the design itself. As well, not only was quantitative literature reviewed but also qualitative literature (1). While the quantitative literature identified the effective components of RTW interventions, the qualitative literature contextualized the interventions. To our knowledge, this is the first review of workplace-based RTW interventions to cast such a wide net in terms of types of literature and designs considered.

Recommendations for Future Research

Our research team was struck by the limited details provided about the interventions offered. Increased attention in intervention research is now being given to the importance of "intermediary variables" (64,65). Intermediary variables refer to the processes related to the implementation, feasibility, and compliance aspects of interventions. They are of critical importance since they address the real issues of how easily an intervention can be implemented and how well the intervention is received. There is clearly a need for more information about process and intermediary variables in intervention studies.

Although at the outset of this project many researchers cautioned that there would be very few RCTs in this area, interestingly, there were still four RCTs of sufficient quality to

be considered in the data synthesis (28–34,43). This suggests that despite the difficulties associated with conducting RCTs and the general consensus to incorporate other types of research designs in occupational health, it remains possible to conduct studies incorporating this level of experimental control and rigor.

More research should be conducted examining the impact of variations in intervention components. For instance, comparing the effectiveness of in-house versus third-party RTW coordination should be considered. As well, while we are confident that a work accommodation offer is critical in a positive RTW process, more research needs to be conducted to clarify the specific content and process of work accommodations. Finally, organizational factors such as organizational culture were rarely considered in relation to return-to-work outcomes. This line of research should be further developed.

The range of outcomes in future research needs to be considerably expanded. No studies reviewed measured quality of work life, medication use, or participation in other social roles, such as caregiving or community participation. Poor general health following return to work can affect participation in other life roles and translate into indirect and human costs. Little research has been conducted to measure and describe personal costs to workers, such as lost vitality and inability to pursue other interests. Regarding economic analyses, future research should consistently incorporate intervention costs and healthcare expenditures not covered by the compensation system. Finally, the sustainability of effects beyond 1 year duration needs to be prioritized.

All studies of sufficient quality to proceed to data extraction included samples of workers with musculoskeletal conditions or claimants. More research of solid methodological quality needs to be conducted on workplace-based RTW interventions with other types of injured or ill work-disabled workers. Principles of disability management developed with injured workers with musculoskeletal conditions need to be adapted and evaluated with work-disabled workers with other types of injuries and health conditions.

APPENDIX: METHODOLOGICAL QUALITY CRITERIA

1. Source population is identified
2. Inclusion and exclusion criteria are described and appropriate
3. Participation rate is greater than 40%, OR there are no major differences between participants and non-participants
4. Follow-up is reported and loss to follow-up is less than 50%, OR there are no major differences between drop-outs and participants remaining in the analyses
5. The intervention(s) or strategies are sufficiently described to allow reasonable replication
6. Important confounding variables (including functional status, pain, comorbidity, or physical demands) and cointerventions are controlled for, OR are distributed equally among groups
7. Outcome is defined and measurable
8. Design of the study is appropriate to answer the study question about the literature review's primary outcomes
9. No other serious flaws were identified by the reviewers for this study

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