



Physical Activity and Exercise Interventions in the Workplace Impacting Work Outcomes: A Stakeholder-Centered Best Evidence Synthesis of Systematic Reviews

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Abstract

Background: The prevention of work disability is beneficial to employees and employers, and mitigates unnecessary societal costs associated with social welfare. Many service providers and employers have initiated workplace interventions designed to reduce unnecessary work disability.

Objective: To conduct a best-evidence synthesis of systematic reviews on workplace interventions that address physical activities or exercise and their impact on workplace absence, work productivity or financial outcomes.

Methods: Using a participatory research approach, academics and stakeholders identified inclusion and exclusion criteria, built an abstraction table, evaluated systematic review quality and relevance, and interpreted the combined findings. A minimum of two scientists participated in a methodological review of the literature followed by a consensus process.

Results: Stakeholders and researchers participated as a collaborative team. 3363 unique records were identified, 115 full text articles and 46 systematic reviews were included, 18 assessed the impact of physical fitness or exercise interventions. 11 focused on general workers rather than workers who were absent from work at baseline; 16 of the reviews assessed work absence, 4 assessed productivity and 6 assessed financial impacts.

Conclusion: The strongest evidence supports the use of short, simple exercise or fitness programs for both workers at work and those absent from work at baseline. For workers at work, simple exercise programs (1–2 modal components) appear to provide similar benefits to those using more complex multimodal interventions. For workers off-work with subacute low back pain, there is evidence that some complex exercise programs may be more effective

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Received: Dec 24, 2015
Accepted: Mar 8, 2016

Cite this article as: White MI, Dionne CE, Wärje O, *et al.* Physical activity and exercise interventions in the workplace impacting work outcomes: A stakeholder-centered best evidence synthesis of systematic reviews. *Int J Occup Environ Med* 2016;**7**:61-74. doi: 10.15171/ijoem.2016.739

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than simple exercise interventions, especially if they involve workplace stakeholder engagement, communication and coordination with employers and other stakeholders. The development and utilization of standardized definitions, methods and measures and blinded evaluation would improve research quality and strengthen stakeholder-centered guidance.

Keywords: Exercise; Physical activity; Costs and cost analysis; Efficiency; Presenteeism; Absenteeism; Review [Publication type]

Introduction

The mitigation of unnecessary work disability is of growing interest across industrialized countries given the burden of disease on individuals, employers and society at large.¹⁻³ The prevention of work disability is beneficial to employees, employers, families and communities and mitigates unnecessary societal costs associated with social welfare.⁴ The burden of disease associated with these problems includes direct and indirect costs associated with absence from work and consequent loss of productivity.¹ Many service providers and employers have initiated workplace interventions designed to mitigate unnecessary work disability. However, there is limited guidance accessible to stakeholders about the current state of research that could inform decision-making on intervention planning, its effectiveness and cost benefits.⁵ This study brought together academic researchers and other stakeholders to pilot-test and refine workflows underlying a new online knowledge translation platform called the Health and Work Productivity Portal (www.healthandworkproductivity.org). The purpose of the portal is to engage academics and other stakeholders in the identification and translation of relevant, credible research resources to inform training, policy and practice in disability prevention.

In earlier work, our research team conducted a best-evidence synthesis to identify which risk factors across health conditions increase the risk of work absence, or

impact performance, productivity or financial outcomes. In the first best-evidence synthesis, Wagner, *et al*,⁶ identified modifiable worker factors, including decreased physical activity, lack of family support, poor general health, emotional distress and increased depressive symptoms, negative enduring psychological factors (*eg*, neuroticism), and negative health/disability perception or negative recovery expectations among other factors.

Following the first synthesis, members of our academic and stakeholder team sought funding to conduct a second synthesis to identify workplace interventions that address the risk factors found in the first study. This paper reports the results of a subset of this second best-evidence synthesis on workplace-based interventions intended to modify the risk factors of physical activity levels and poor general health.⁷ It focuses specifically on physical activity and exercise interventions. The objective of this review is thus to identify physical activity and exercise interventions that most effectively reduce absenteeism, improve productivity or increase financial outcomes, among general workers and workers absent from work. To get the strongest scientific evidence, this synthesis is based on high-quality systematic reviews that include mainly quantitative studies.

Materials and Methods

This best-evidence synthesis of systematic reviews is part of a larger dataset summarizing workplace interventions that ad-

dress modifiable factors associated with work disability across health conditions. This paper focuses on workplace-based physical activity and exercise interventions intended to improving physical fitness and whether they have positive impacts on worker absenteeism rates, productivity or economic outcomes. Other papers arising from body of work looked at different areas of interest identified by participating stakeholders including job demands and job control interventions,⁸ social support and supervisory quality interventions,⁹ and mental health interventions¹⁰. A meta-analysis was not feasible due to the scope of this review, which includes differing health conditions, participant work status, study designs, and outcome measures, as well as the level of detail reported in the reviews. Therefore, a best-evidence synthesis approach was considered better suited to this body of research evidence. Best-evidence syntheses determine the level of evidence available for research conclusions based on the quality, quantity and consistency of available evidence.^{11,12} The strength of the intervention effect is reported when available in the description of individual studies, but it is not possible to calculate an effect size due to issues of heterogeneity. Instead, the terms “strong,” “moderate,” and “limited” speak to the level and consistency of evidence rather than the strength of the effect on outcomes of interest (Table 1). The outcomes of interest for this review include work absence, productivity and financial impact. The effects of the interventions on other outcomes are not included.

This work was conducted by a collaborative team of researchers and stakeholders, referred to as the academic-community partnership (ACP), where communication and consultation was sought at every step of the research process. This included determining the purpose of the review, search terms, inclusion and exclusion criteria,

Table 1: Level of evidentiary support across systematic reviews. For syntheses with limited number of studies, we looked at the high-, moderate-, low-quality reviews and the original methodological review tool for making conclusions about strength of evidence.

STRONG: (over 70% effect positive—*eg*, 5/7 positive) AND
A minimum of 1 moderate and 2 weak/limited evidence OR
A minimum of 3 weak/limited evidence

MODERATE: (between 60% and 69% effect positive—*eg*, 3/5 positive) AND
A minimum of 1 strong AND 2 moderate evidence OR
A minimum of 3 moderate evidence

LIMITED: (50%–59% effect positive) AND
A minimum of 1 moderate and 2 weak/limited evidence OR
A minimum of 3 weak/limited evidence

INCONSISTENT: (50% or less of a positive effect) AND Does not meet above criteria.

INSUFFICIENT: Information is not inconsistent but does not meet the criteria for weak evidence.

data abstraction categories and framework, relevance and interpretation of the results and report preparation. Consultation was carried out through in-person or virtual meetings, active review of meeting minutes as “working documents,” circulated via e-mail and discussed at subsequent meetings. The ACP aimed to ensure that the resulting report was relevant to all stakeholders involved.

Search Strategy

We followed the PRISMA statement¹³ and the Institute of Medicine's Standards for Systematic Reviews¹⁴. Our process involved: (a) developing a search strategy with researchers and stakeholders, including consultation from two library information specialists and an external review librarian; (b) pilot testing the search strategies and reviewing results to refine search terms and validate them with ACP members for relevance and comprehensiveness; (c) assessing article relevance from titles and abstracts using two or more in-

For more information on search strategy see the online version of the article.

dependent reviewers; (d) in-depth review of selected full-text articles using two or more independent reviewers; and (e) pilot-testing the data abstraction process for relevance and comprehensiveness based on ACP feedback.

Databases searched included Medline, EMBASE, the Cochrane Database of Systematic Reviews, DARE, CINAHL, PsycINFO, and TRIP. Grey literature database searches included *health-evidence.ca*, Rehab+, National Rehabilitation Information Center (NARIC), and the Institute of Work and Health (IWH). Participating academics were asked to suggest relevant reviews for this study, and reference lists of included articles were hand-searched.

Inclusion/Exclusion Criteria

Only systematic reviews of interventions that occurred at, or were managed by, the workplace and that focused on adults (15+ years) who were working or trying to work were included. Articles were included if they were published between January 1, 2000 and the search date of September 2012. As these were systematic reviews, we limited the search strategy to reduce overlaps as some of the included reviews covered articles from earlier publication dates. Both quantitative (meta-analytic and non-meta-analytic) and qualitative literature was considered. Articles were required to address at least one of the outcomes of interest (absenteeism, productivity or cost), and to discuss a risk factor that is associated with work disability.^{6,15} Exclusion criteria included reviews that focused on severe or rare physical or mental conditions, or on specific occupations that would be difficult to generalize to other occupations (eg, firefighters, police). Two reviewers independently assessed the full-text of articles against these criteria.

We pilot-tested the search strategy for relevance and to refine search terms. Two or more independent reviewers assessed

titles for relevance, with disagreements resolved by reviewing abstracts. Retained abstracts underwent the same procedure in the second round of review, with disagreements resolved by examining the full-text. Final inclusion of articles was based on assessment by two independent reviewers, with disagreements resolved by consensus or by bringing in a third independent reviewer. The ACP team pilot-tested abstraction of data to ensure stakeholder relevance and comprehensiveness, and the final report involved stakeholder participation to ensure its relevance for their organizational contexts.

Quality Assessment

Quality assessment forms were developed for this study using a modified version of the *Health-evidence.ca* quality assessment tool,¹⁶ the EBM Glasgow Checklist for Systematic Reviews,¹⁷ and the AMSTAR methodological quality guidelines¹⁸. Stakeholders were involved in reviewing and refining the quality assessment form, and consensus was reached regarding the items to be included and any change made in questions or scoring. Other questions addressed during the methodological review included the relevance to small employers, strengths and weaknesses of research design, implementation recommendations from the authors and from the reviewers, and whether or not the systematic review met the inclusion/exclusion criteria for this study. The quality assessment form included 18 questions, and the numerical quality scores were developed based on 10 of these questions (Table 2). Categories of methodological quality were developed based on the percent of the total quality rating reached. Studies were considered “high quality” if they were rated 85% or over, “medium quality” if they were rated between 75% and 84%, and “low quality” if they were rated between 50% and 74%. Because sufficient high-quality reviews were

found on the topic of physical fitness and exercise, reviews that did not meet the high-quality cut-off (85%) were excluded (Table 3).

Data Abstraction

Data abstraction forms were developed

and reviewed by researchers in collaboration with stakeholders. These forms were pilot-tested and discussed by the ACP team to ensure all relevant findings were captured. Included reviews were categorized by different factors that are associated with work disability. These categori-

Table 2: Methodological quality review (questions and weighting)

Question	Answer choice	Score
Common criteria for both qualitative and quantitative methodological review		
Did the authors have a clearly focused question?	Yes	1
	No	0
Were inclusion/exclusion criteria used?	Yes	1
	No	0
	Not specified	0
Did the authors describe a search strategy that was comprehensive and reproducible?	Yes	1
	No	0
	Not specified	0
Please click the search strategies used.	(Selected/Unselected)	a. Five or more databases: 2 b. Two to four databases: 1 c. One database: 0
Did search strategy cover an adequate number of years? (10+ years)	Yes	1
	No	0
Does the data support the author's interpretation?	Yes, mostly	1
	No	0
Are there any concerns related to COI?	Yes	0
	No	1
Specific criteria quantitative methodological quality		
Did the review assess the methodological quality of the primary studies?	Yes	1
	No	0
What methods did the authors use to combine or compare results across studies?	Meta-analyses	2
	Descriptive + quality weight	2
	Descriptive no weight	1
	Other	0
How strong was the level of evidence supporting the strongest conclusions of the study?	Level 1 (RCT)	2
	Level 2 (non-random)	1
	Level 3 (uncontrolled)	0
	Unclear	0
		Total score possible: 13

Table 3: Methodological quality criteria and quality score

Citation	Year	Clearly focused question?	Inclusion/exclusion	Comprehensive	Number of search strategies	Number of years	Methodological quality	Methods weighting	Strength of evidence	Congruence data & author interpretation	COI	Quality score	Percent
Aldana	2001	1	1	1	2	1	0	2	1	1	1	11	85%
Bell	2009	1	1	1	2	1	1	2	2	1	1	13	100%
Bigos	2009	1	1	1	1	1	1	2	2	1	1	12	92%
Brewer	2007	1	1	1	2	1	1	2	2	1	1	13	100%
Cancelliere	2011	1	1	1	2	1	1	2	2	1	1	13	100%
Carroll	2010	1	1	1	2	1	1	1	2	1	1	12	92%
Chapman	2012	1	1	1	2	1	1	2	0	1	1	11	85%
Czabala	2011	1	1	1	2	1	1	2	2	1	1	13	100%
Elders	2000	1	1	1	2	1	0	1	2	1	1	11	85%
Furlan	2012	1	1	1	1	1	1	2	2	1	1	12	92%
Hlobil	2005	1	1	1	1	1	1	2	2	1	1	12	92%
Maher	2000	1	1	0	2	1	1	2	2	1	1	12	92%
Palmer	2012	1	1	1	1	1	1	2	2	1	1	12	92%
Proper	2002	1	1	1	1	1	1	2	2	1	1	12	92%
Schaafsma	2011	1	1	1	2	1	1	2	2	1	1	13	100%
Tuncel	2006	1	1	1	2	1	1	2	1	1	1	12	92%
Tveito	2004	1	1	0	2	1	1	2	2	1	1	12	92%
van Dongen	2011	1	1	1	2	1	1	1	2	1	1	12	92%

zations were discussed by the ACP team, leading to changes in article placement. If an intervention targeted more than one modifiable factor, the systematic review could be included in multiple categories. This synthesis describes the interventions targeting physical activity levels and gen-

eral health through exercise and physical activity occurring in or managed by the workplace.

Systematic reviews were evaluated for methodological quality, categorized according to factors identified in our prior synthesis,⁷ and then examined for the level

of evidence as reported by their author(s). Results were segmented by population workers at work at baseline which we have called “general workers” and workers off work at baseline we have called “workers off work” and by outcomes of interest—work absence, productivity or financial outcomes. Where review authors did not specify a level of evidence but suggested positive outcomes, a ranking of limited evidence was assigned.

Results

Data Treatment

The comprehensive search resulted in 3363 titles after duplicates were removed, which were uploaded into RefWorks for processing. An initial title review was completed by two team members in order to determine relevance to the larger review; as a result, 115 articles were selected for full-text review. Of these, 48 were excluded because they did not address work absence, productivity or financial outcomes, 21 were excluded for other reasons such as intervention not being managed by the workplace; and two were excluded because they did not meet the high quality rating standard (Fig 1). For the purpose of this specific review, an additional 26 titles were excluded because the interventions did not target physical activity or exercise. Overall, there were 18 high-quality systematic reviews^{3,19-35} that assessed the impact of physical activity or exercise/fitness interventions on the three outcomes of interest: work absence (11/18 reviews), work productivity (4/18 reviews) and financial impacts (6/18 reviews). In aggregate, the included systematic reviews report on 511 articles from 490 primary studies, of which 173 looked at our outcomes of interest.

There were more studies included in these reviews that address exercise among general workers (65% of studies), than

among workers who were away from work at baseline (35% of the studies). Eleven of the 18 reviews focused on physical activity associated with wellness and health promotion interventions. Six systematic reviews were not specific to a health condition.^{19-21,29,31,35} Ten addressed workers with low back pain, while three addressed mental health conditions. As there were 18 high-quality systematic reviews, the results below are solely based on the findings of these reviews. Overall, most pieces of evidence were of low to moderate quality.

General Workers (Workers at Work at Baseline)

Simple Interventions

Return-to-work/Sick leave outcomes: There were seven reviews that provided results on simple interventions (one or two foci) concerning physical fitness/exercise among general workers.^{19,20,23-27} The majority of these reviews (5 of 7) addressed sick leave or work absence for workers with low back pain. Four reviews,^{20,23,25,27} reported limited positive evidence, three reviews,^{19,24,26} reported moderate positive evidence that simple physical activity or exercise interventions among general workers reduced sick leave or work absence. There was consistent evidence (7 of 7) that physical activity interventions may reduce sick leave or work absence, particularly from low back pain.

Work productivity outcomes: Only two reviews reported on simple interventions and their impacts on work productivity outcomes.^{20,22} Proper, *et al*,²⁰ found no evidence on work productivity gains whereas, Cancelliere, *et al*,²² in a later systematic review found limited positive evidence of work productivity gains.

Financial outcomes: Four reviews^{19,21,24,27} reported on financial outcomes for simple interventions also with mixed results. Two reviews reporting on

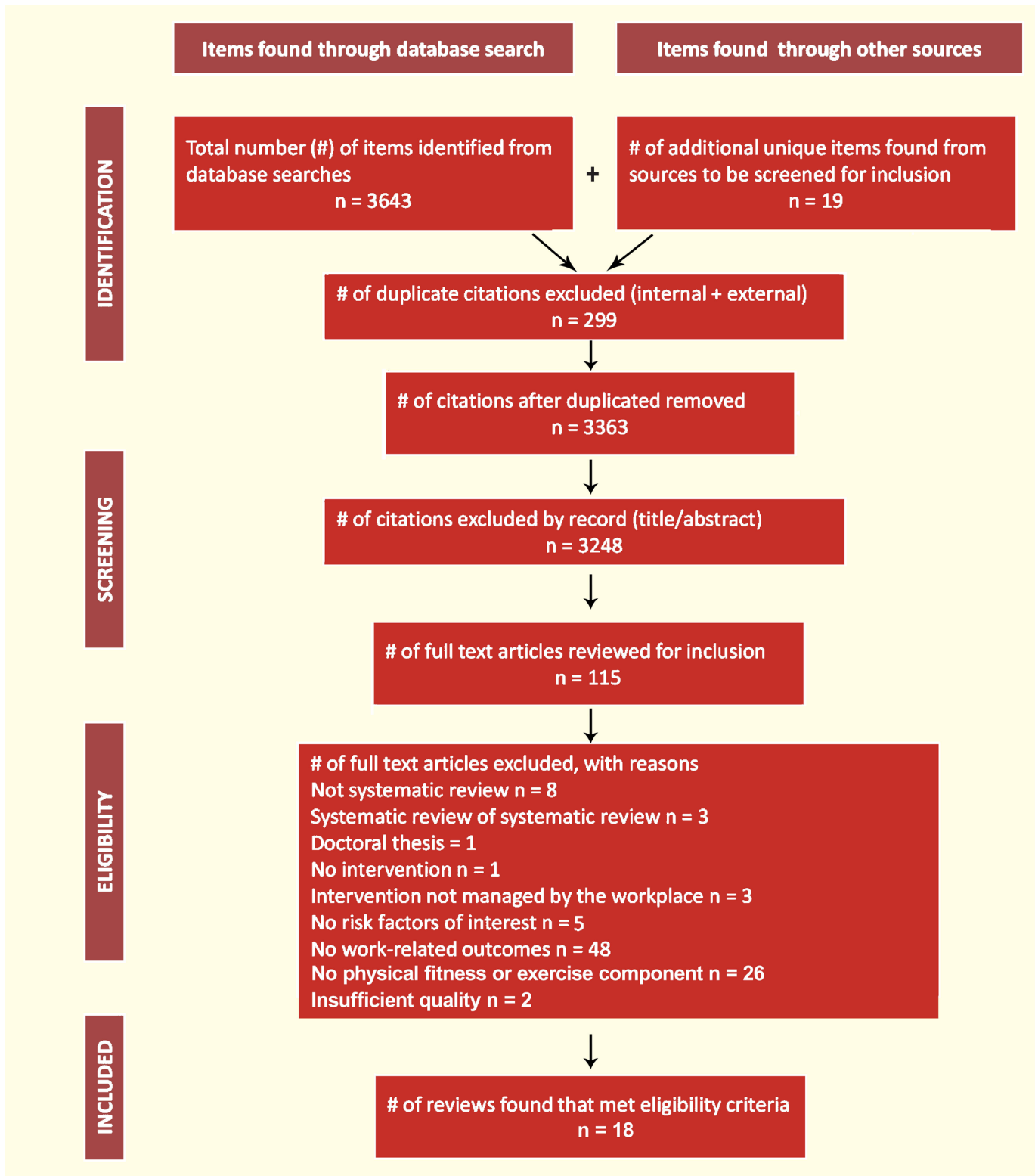


Figure 1: PRISMA diagram

general workers with low back pain provided mixed evidence.^{24,27} Specifically, Maher, *et al*,²⁴ reported no evidence of impact on financial outcomes, whereas Tveito, *et al*,²⁷ reported limited evidence of positive financial impact. For general workers participating in health promotion programs not specifically focused on a specific health condition, two reviews also reported mixed results.^{19,21} Aldana, *et al*,¹⁹ reported moderate evidence of positive impacts, whereas van Dongen, *et al*,²¹ a decade later, reported inconclusive evidence.

Complex Interventions

Return-to-work/Sick leave outcomes: For complex physical activity/exercise interventions, there were five reviews reporting on sick leave/work absence outcomes.^{19,25,27-29} Three of the reviews,^{25,27,28} focused on general workers with health conditions. Two reviews,^{25,27} concerned workers with low back pain. Tuncel, *et al*,²⁵ found limited evidence for a positive effect, whereas, Tveito, *et al*,²⁷ found limited evidence of no effect for complex physical fitness/exercise interventions. Czabala, *et al*,²⁸ concerned with mental health conditions, reported inconclusive evidence for return-to-work/sick leave outcomes. Two reviews,^{19,28} were not specifically focused on a given health condition for general workers participating in complex health promotion programs. Chapman, *et al*,²⁸ reported strong and moderate evidence for sick leave and work absence, respectively. Aldana, *et al*,¹⁹ reported moderate evidence that complex promotion programs had positive effects on work absence. They noted that one of the challenges facing the wellness/health promotion literature is the lack of independent high-quality randomized clinical trials (RCTs) that adequately address the risk of recruitment bias and attrition (lack of participation of individuals at higher risk). They also noted that many of the primary

studies are published by service providers with vested interests in the results, which may increase the potential risk of bias.¹⁹

Work productivity outcomes: Only two reviews assessed the impact of complex physical activity/exercise interventions on work productivity outcomes among general workers.^{22,28} Czabala, *et al*,²⁸ reported inconclusive evidence while Cancelliere, *et al*,²² reported limited evidence of positive impacts.

Financial outcomes: Three reviews reported on financial outcomes for complex physical activity/exercise interventions.^{19,27,29} Tveito, *et al*,²⁷ concerned with low back pain, reported inconclusive evidence for financial outcomes. Two reviews, Chapman, *et al*,²⁹ and Aldana, *et al*,¹⁹ were not specifically focused on a given health condition for general workers, and reported strong and moderate evidence for financial outcomes, respectively.

Off-work Workers

Simple interventions

Return-to-work/Sick leave outcomes: There were two high-quality systematic reviews assessing the effect of simple interventions for off-work workers on return-to-work/sick leave outcomes.³⁰⁻³¹ The Palmer, *et al*,³⁰ review included all musculoskeletal disorders, whereas, Schaafsma, *et al*,³¹ investigated different phases of back pain (acute, sub-acute, chronic) and the intensity of exercise programs. The musculoskeletal disorder review³⁰ found moderate, consistent evidence that simple exercise/physical activity interventions reduce sick leave. The Schaafsma, *et al*,³¹ Cochrane review (RCTs only) found limited evidence that neither light nor intense physical conditioning programs reduce sickness absence significantly better than usual clinical care in workers with acute back pain. However, further analysis found a positive ef-

fect on sick leave when the workplace was involved in the intervention. The authors found that physical conditioning programs probably have a small effect on return-to-work for workers with chronic back pain, and conflicting results for intense physical conditioning programs compared to other exercise therapy in the first two years of sick leave.

Work productivity outcomes: No review studied the impacts of simple physical activity/exercise interventions on work productivity outcomes among off-work workers.

Financial outcomes: No review studied the impact of simple physical activity/exercise interventions on financial outcomes among off-work workers.

Complex interventions

Return-to-work/Sick leave outcomes: There were five high-quality systematic reviews that assessed complex physical fitness/exercise interventions for workers off-work at baseline.^{3,32-35} Complex physical fitness/exercise interventions included more than two components, for instance: (a) functional restoration, (b) work hardening, (c) involvement of multiple health professionals, (d) ergonomic assessment, (e) cognitive behavioral therapy, (f) education, and (g) case management of varying intensity and duration, with or without workplace visits. Four of the five systematic reviews,^{3,33-35} found positive evidence that complex fitness/exercise interventions addressing low back pain (subacute/chronic) reduce sick leave. Carroll, *et al*,³ found that workplace-based exercise is effective in return-to-work for back pain, but only when compared to usual care and is not necessarily as effective as stakeholder engagement and collaborative interventions (with or without exercise). Brewer, *et al*,³⁵ found a moderate level of evidence that exercise programs had positive effects on sick leave. Hlobil, *et al*,³³ found mixed

results (positive and null) that return-to-work interventions involving exercise for subacute back pain were effective. Half of the studies (3 of 6) suggested a positive impact on work absenteeism and half found no difference between the exercise intervention and usual care.³³ Elders, *et al*,³⁴ found back schools combining exercise with functional conditioning, and training in working methods and lifting techniques (following 60 days of sickness absence) are more effective than non-back school interventions. Elders suggests this may be as a result of higher compliance to treatment in return to work. Furlan, *et al*,³² found very low evidence of no effect on sick leave or return to work of physical fitness/exercise programs for mental health conditions. There were, however, few pieces of evidence as to duration of effects. Hlobil's systematic review³ addressed this question for subacute low back pain and found mixed results.

Work productivity outcomes: Only one review, Furlan, *et al*,³² addressed work productivity outcomes in workers with mental health problems. They reported limited evidence of no impact.

Financial outcomes: Only one review addressed financial outcomes in workers with low back pain.³ The authors found limited evidence of positive impacts.

Summary

Overall, among general workers, there are more consistent results (7 of 7) that simple interventions have a positive effect on work absence among workers with low back pain (the majority of reviews [5 of 7] focused on low back pain). There is also limited to strong evidence that complex interventions have positive effects on work absence and financial outcomes, while evidence of any impact on work productivity outcomes is scarce.

Among workers off-work at baseline, there is limited to moderate evidence that

simple physical activity/exercise interventions have an impact on the return-to-work/sick leave outcomes especially if the workplace is engaged for workers with musculoskeletal disorders and subacute or chronic pain. No evidence is available as to work productivity and financial outcomes. There is however some limited to strong evidence for the positive impact of complex physical activity/exercise interventions on return-to-work/sick leave for workers with subacute low back pain. Data on the impact of interventions among disabled workers on work productivity and financial outcomes are too scarce to draw any conclusion.

Discussion

This paper reports the results of a best evidence synthesis of systematic reviews on the effects of physical activity/exercise interventions on return-to-work/sick leave outcomes, work productivity and financial outcomes among general workers, those at work at baseline and among disabled workers, those off-work at baseline. Despite a plethora of studies on this topic, summarized in 18 high-quality systematic reviews, only broad conclusions can be drawn: simple and complex interventions seem to impact positively on general workers, while only complex interventions were found to be effective for disabled workers (off-work at baseline) primarily with subacute low back pain. Overall, the level of evidence is very limited, with few studies on productivity and financial outcomes, and few specific studies on mental health. The gaps in the literature were particularly noted by participating stakeholders in our research team. Most primary studies continue to focus on clinical results without sufficient attention to business outcomes of interest to non-clinical stakeholders.

Based on these results there is evidence that very simple (and less costly) physical

TAKE-HOME MESSAGE

- Short simple exercise or fitness programs provide similar benefits to those using more complex and costly interventions for general workers.
- For workers off-work at baseline with subacute low back pain, there is evidence that complex physical activity or exercise programs with active communication, coordination and engagement among the different parties is more effective than simple physical activity and exercise programs than usual care.
- Future research investigating work productivity and financial outcomes is needed for both general workers and workers at baseline who are absent from work.
- The creation of recommended guidelines on work-related outcomes and operational definitions could improve the quality of research and support more rigorous meta-analysis approaches.
- Funding programs that facilitate and encourage corporate and academic partnerships in planning and evaluating health promotion programs may increase quantity and quality of primary studies.

activity and exercise interventions may help employers to reduce absenteeism and may help keep employees at work as effectively as more complex (and more costly) physical activity and exercise interventions. It should also be noted that exercise programs for disabled workers (those off-work) with subacute low back pain should engage and enhance coordination among other stakeholders engaged in the return-to-work process.

There are several limitations to this study. Systematic reviews are limited by the availability of high-quality primary studies, lack of consistency in methodological screening and reporting, and variability in outcome measures used. A common problem with health promotion studies is insufficient reporting and analysis on number of employees participating

in health promotion activities and difference in the health risk profile, *ie*, workers who are motivated to participate in physical activities are more likely interested in participating in workplace interventions than those at greater health risk that leads to volunteer bias. The potential volunteer bias is likely present in both those participating in simple and more complex physical activity and exercise interventions for workers at work. As noted by Aldana, *et al*,¹⁹ a large proportion of health promotion literature is conducted and evaluated by service providers who are interested in reporting results associated with program effectiveness. This may result in an underreporting of interventions showing no program effect of negative results, resulting in a publication bias. The lack of public research funding to support investigation into the impact of physical activity and exercise interventions for the general worker population is problematic. In Canada, there has been little government funding support in the area of health promotion in the workplace and its evaluation. Feedback from stakeholders participating in this report noted that many employers are engaged in workplace intervention that address physical activity and exercise interventions; however, very few of these interventions are rigorously evaluated by blinded evaluators or published in the academic literature.

Given the resources available and the involvement of stakeholders in the process, the search strategy was limited to English. There is a possibility that important literature published in other languages was not included. The identification and translation of keywords and MeSH terms across different databases is an iterative process and was reviewed by several information resource professionals; however, it is possible that some systematic reviews were missed.

It should be noted that the focus of this

synthesis was solely on assessing work-related outcomes (work absence, work productivity and financial outcomes). This resulted in the elimination of studies that focused solely on clinical outcomes. It would be inappropriate to conclude that interventions that do not appear to impact work-related outcomes also do not impact clinical outcomes.

Our results considered the methodological quality of the systematic reviews and the consistency of findings across high and lower quality primary studies. Beyond weighting and reporting findings based on methodological quality, it was not possible to determine the potential impact of any single or group of interventions on work absences (*ie*, overall estimate of variance-accounted-for effect size) given the variety of research designs and literature available for synthesis. Finally, our interpretation of evidence level is limited in clarity and precision by heterogeneity in intervention type, health condition and outcome measurement.

This study and synthesis process identifies the need for better research methods across workplace intervention studies. It also indicates that many stakeholders are interested in working with researchers to create evaluation frameworks, and to help them better understand the impact of interventions in their workplaces. This collaborative process can inform future research needs, by helping researchers take the work context into consideration when planning research and determining outcomes of interest that will be evaluated. Many studies potentially eligible for inclusion in systematic reviews were assessed to be of low quality and offered little by way of contribution to scientific evidence. Intervention research requires more high-quality studies (where risk of bias is minimized) and published replications. The strength of the evidence is enhanced when findings are consistent, and

outcomes are standardized, despite different study populations, workplace settings and implementation strategies. Future research would benefit from higher quality research on workplace interventions using standard definitions for primary and secondary work disability outcomes.

In conclusion, short simple exercise/fitness programs seem to provide similar benefits to those using more complex interventions for general workers.^{20,23-25,30} For workers off-work at baseline with sub-acute low back pain, there is evidence that complex physical fitness/exercise may be more effective than simple interventions, especially interventions that involve workplace and other stakeholder engagement, communication and coordination. Overall, the level of evidence is very limited, with few studies on productivity and financial outcomes, and few specific studies on mental health. There was a notable lack of high quality RCTs using similar work-related outcome measures across different health conditions, with the exception of low back pain. Standardizing definitions and methods would make a major contribution to the field. Despite a vast number of primary studies and systematic reviews on the effects of exercise/fitness interventions, high-quality evidence is mostly lacking.

Conflicts of Interest: None declared.

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