



Review

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Workplace interventions to improve work ability: A systematic review and meta-analysis of their effectiveness

by Jodi Oakman, PhD,¹ Subas Neupane, PhD,² Karin I Proper, PhD,³ Natasha Kinsman, MND,¹ Clas-Håkan Nygård, PhD²

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Objective Extended working lives due to an ageing population will necessitate the maintenance of work ability across the life course. This systematic review aimed to analyze whether workplace interventions positively impact work ability.

Methods We searched Medline, PsycINFO, CINAHL and Embase databases using relevant terms. Work-based interventions were those focused on individuals, the workplace, or multilevel (combination). Work ability – measured using the work ability index (WAI) or the single-item work ability score (WAS) – was the outcome measure. Grading of Recommendations Assessment, Development & Evaluation (GRADE) criteria was used to assess evidence quality, and impact statements were developed to synthesize the results. Meta-analysis was undertaken where appropriate.

Results We reviewed 17 randomized control trials (comprising 22 articles). Multilevel interventions (N=5) included changes to work arrangements and liaisons with supervisors, whilst individual-focused interventions (N=12) involved behavior change or exercise programs. We identified only evidence of a moderate quality for either individual or multilevel interventions aiming to improve work ability. The meta-analysis of 13 studies found a small positive significant effect for interventions on work ability [overall pooled mean 0.12, 95% confidence interval (CI) 0.03–0.21] with no heterogeneity for the effect size ($\text{Chi}^2=11.28$, $P=0.51$; $I^2=0\%$).

Conclusions The meta-analysis showed a small positive effect, suggesting that workplace interventions might improve work ability. However, the quality of the evidence base was only moderate, precluding any firm conclusion. Further high quality studies are required to establish the role of interventions on work ability.

Key terms ageing; employment; GRADE; sustainable employment; WAI; work ability index; work ability score.

The ageing of the population will necessitate longer working lives for many workers. Official retirement ages are being raised in many industrialized countries as a strategy to encourage workers to delay their exit from paid employment (1). Remaining employed requires workers to have the ability to meet the inherent requirements of their work, which can be challenging for those with injuries, chronic conditions, or normal ageing processes, particularly in jobs with physical demands (2, 3). Good health and engagement with work (4, 5) are key aspects of maintaining employment; an increased

focus on sustainable employability is required to assist workers to remain employed for longer (6), consistent with the need for extended participation in the paid workforce.

Sustainable employment requires a good match between a person and their working environment. A person–environment (PE) fit model proposes that attitudes, behaviors and other individual-level outcomes result not only from the person or their environment but rather from the relationship and interactions between the two (7–9). The concept of work ability, defined as the degree

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to which an employee is mentally and physically capable of performing their current role, and a balance between a person's resources (eg, health, competence, and attitudes) and work demands (environment and community, organization of the work) (10, 11) is of relevance in the conceptualization of PE fit. Sustainable employability requires maintenance and promotion of work ability across all ages to prevent decline and potential early departure from the workforce.

Work ability has been measured using different methods. A widely-used measure is the work ability index (WAI), which comprises a set of measures to determine a person's current work ability (10, 11). The work ability concept and the WAI was developed in Finland in the 1980s and 90s with municipal employees in their midlife followed in a longitudinal study (10, 11). Factors related to the management, ergonomics, and lifestyles explained both a decline and an improvement in work ability during ageing. In other studies, poor work ability has been associated with older age, obesity, high mental work demands, lack of autonomy, poor physical work environment, and high physical work load (12). Individuals with poor work ability have an increased risk of early retirement (13–15), long-term sickness absence and work disability (16) as well as decreased functional ability and higher mortality in old age (17).

Workplace interventions to address issues of PE fit, which include work ability are complex and thus challenging to implement and appropriately measure the effectiveness of. According to macro-ergonomics theory, which focuses on the interactions between organizations and systems, work productivity is improved when individuals are well matched to the inherent requirements of their work, which results in better outcomes at an individual and organizational level (9). This is consistent with the requirements for sustainable employment, which requires cognizance of the relevant individual and organizational determinants of work ability. Appropriately targeted interventions are required to ensure maintenance of work ability and prevention of decline and to take into account the complex multifactorial relationships between employees and the work environment. Whilst interventions to improve work ability have been undertaken in a range of populations, for example nurses, cleaners and construction workers (18–20), a comprehensive understanding of whether these initiatives are most effective when targeted at individuals or the organizations in which they work is lacking (21).

The purpose of this review was to assess systematically the available evidence on the effectiveness of work-based interventions on the work ability of employees. In addition, it aimed to examine whether effectiveness is different for individual- or organizational-focused interventions.

Methods

Search strategy

To identify relevant studies of workplace interventions to promote work ability, an electronic literature search of the following databases was undertaken: Medline, PsycINFO, CINAHL, and Embase. The search was limited to English language, between January 2000 – August 2016 to capture articles relating to the contemporary work environment. Bibliographies of included papers were searched, and a cited reference search was undertaken using Web of Science. A sample search strategy for Medline is provided in the online appendix, table S1 (www.sjweh.fi/show_abstract.php?abstract_id=3685).

Selection of studies

Inclusion criteria. Inclusion and exclusion criteria covered participants and the interventions. Only studies reporting on currently employed workers were included. In relation to the intervention, studies were included if they were connected to the workplace or a component of the intervention occurred at the workplace. Interventions could include modifications to: (i) the physical work environment, (ii) the work routine, (iii) work hours, and (iv) exercise or lifestyle change programs.

Comparators could include current practice or other interventions. Only randomized control trials (RCT) were included in the review to improve the quality of the studies reviewed. Three reviewers (SN, JO and NK) independently assessed studies for inclusion. Initial selection of studies was based on title and abstract. In cases of disagreement between reviewers, the fulltext of studies was accessed and consensus reached. The three reviewers assessed the fulltext of all studies selected for potential inclusion and, where consensus was not reached, a third or fourth reviewer were consulted to resolve any differences (KP/CHN).

Outcome measure

Work ability, using the WAI, was the outcome measurement used in this review (10, 11). The complete WAI includes a range of questions relating to the physical and mental demands in relation to their work, diagnosed diseases, work limitations due to disease, sick leave, work ability prognosis and psychological resources. The WAI score range is 7–49 (10, 11). Reliability and validity of the WAI have been previously reported (22, 23). One single item in the WAI, the work ability score (WAS), was also used; participants are asked to compare their current work ability with their lifetime best and rate this from 0–10. Previous studies have reported the WAS to be a reasonable alternative to WAI (15).

Data management

A customized form was used to extract data from the relevant studies. Study characteristics were extracted and summarized including: study design, country where intervention was implemented, participant details, type of intervention, and results.

Meta-analytic approach

A meta-analysis was conducted using Review Manager 5.3 developed by the Cochrane Community. The outcome variable, work ability, was measured and reported as a continuous variable in all included studies. However, only the studies reporting mean, standard deviation (SD) or standard error (SE) and sample size for both intervention and control group at the last round of follow-up, or the studies reporting the change in mean and SD values from baseline to follow-up, are included in meta-analysis. The pooled standard mean difference (intervention minus control) and their 95% confidence intervals (CI) is reported as an overall synthesized measure of effect size using random effect models. Random effect models are used because the data from a series of studies where the effect size is assumed to vary between studies (24). Heterogeneity among studies was assessed by Chi² test indicating heterogeneity when $P < 0.05$. Moreover, I² values are reported to describe the variability among studies (0–100%), where increasing values shows increasing heterogeneity. We first synthesized the effect size from all studies included in the meta-analysis, grouped by WAI and WAS. We also analyzed individual- and multi-level-focused interventions, grouped by WAI and WAS, to determine the effect of the individual and multi-level-focused workplace interventions on work ability. Sensitivity analysis was undertaken among studies that used WAI as the outcome measure to calculate the pooled effect size among studies using multilevel interventions versus current practice, individual-focused interventions versus other interventions and individual-focused interventions versus current practice. The findings are presented as forest plots.

Assessment of risk of bias

Individual studies were assessed for risk of bias using a domain-based evaluation as recommended by the *Cochrane Handbook* (25). Three reviewers (SN, JO, NK) independently assessed the studies, with any differences resolved by consensus. Six areas of bias were assessed: selection, performance, detection, attrition, reporting, and "other". Each area of bias included several assessment domains. Due to the nature of workplace interventions, which does not allow for blinding, the criteria related to blinding of participants and providers

(domains within performance bias) was not assessed, consistent with approaches used by others (26), leaving a total of ten domains. Each domain was assessed as high, low or unclear risk. The risk of bias associated with intention to treat analysis was assessed as high if >20% loss to follow-up occurred and with no intention to treat analysis (27). In cases where information was not available or a trial protocol not published or registered, the corresponding risk of bias domain was assessed as unclear.

Grading the level of evidence

The quality of evidence for the work ability outcome was assessed using the Grading of Recommendations Assessment, Development & Evaluation (GRADE) tool described in the *Cochrane Handbook* (28, 29). Evidence quality was assessed in relation to six criteria: study design, risk of bias or study limitations, consistency of results, directness, precision, and publication bias (30). Two authors (JO and SN) undertook the GRADE process with consensus reached by discussion.

Using the GRADE system, the study design for each included study prescribes the starting level of evidence and, following further assessment, can be down- or upgraded. An overall level of evidence was evaluated for each outcome as follows: (i) high quality - further research is very unlikely to change our confidence in the estimate of effect or accuracy; (ii) moderate quality - further research is likely to have an important impact on our confidence in the estimate of effect or accuracy and may change the estimate; (iii) low quality - further research is very likely to have an important impact on our confidence in the estimate of effect or accuracy and is likely to change the estimate; (iv) very low quality - any estimate of effect or accuracy is very uncertain.

A statement of evidence quality (an impact statement) was then developed, which took into account the level of evidence and the likely impact on the particular outcome. Impact statements used in this review are based on standard qualitative statements developed by Glenton and colleagues (31).

Results

Selection of studies

A total of 4737 references were retrieved following a search of electronic databases (Medline, PsycINFO, CINAHL, Embase). After removing 2517 duplicates, 2220 unique references remained. When assessed on title and abstract, 53 references were selected for potential inclusion (figure 1). A bibliographic search of included

articles and a citation search via Web of Science identified four additional references.

Following fulltext examination of the 58 potential articles published between 2001 and 2016, 36 were excluded on the basis they were either not an RCT (17 articles) or WAI/WAS not used as an outcome measure (19 articles).

Study characteristics

Of the 17 studies (22 articles), 10 compared interventions with current practice and 7 compared interventions with other interventions (table 1). Using a macro ergonomics approach as outlined previously, interventions were categorized as either taking an individual, workplace, or multilevel (individual and workplace) focus. Individual-focused interventions (12 studies) included exercise programs and education of individuals on healthy behaviors or coping strategies; however, no changes to the workplace were made. Workplace interventions were targeted at making changes to the

workplace such as working hours or schedules, the physical work environment or job design, reduction of workplace hazards (see supplementary table S2, www.sjweh.fi/show_abstract.php?abstract_id=3685). Of the studies, 5 were classified as multilevel and 0 were considered only workplace focused (table 1).

Comparators to the intervention were classified as "current practice" or "other interventions". Current practice was defined as the situation when no other intervention was instigated by the researchers; ie, participants continued all other activities in which they were usually involved. Other interventions were those assessed by the research group as a comparator to the intervention being tested, such as education or ergonomic training. This might have been a less intense version of the intervention being studied.

Meta-analysis

A total of 13 studies (8 with WAI and 5 with WAS) were analyzed in the meta-analysis. The pooled estimates of the effect of intervention on work ability were calculated

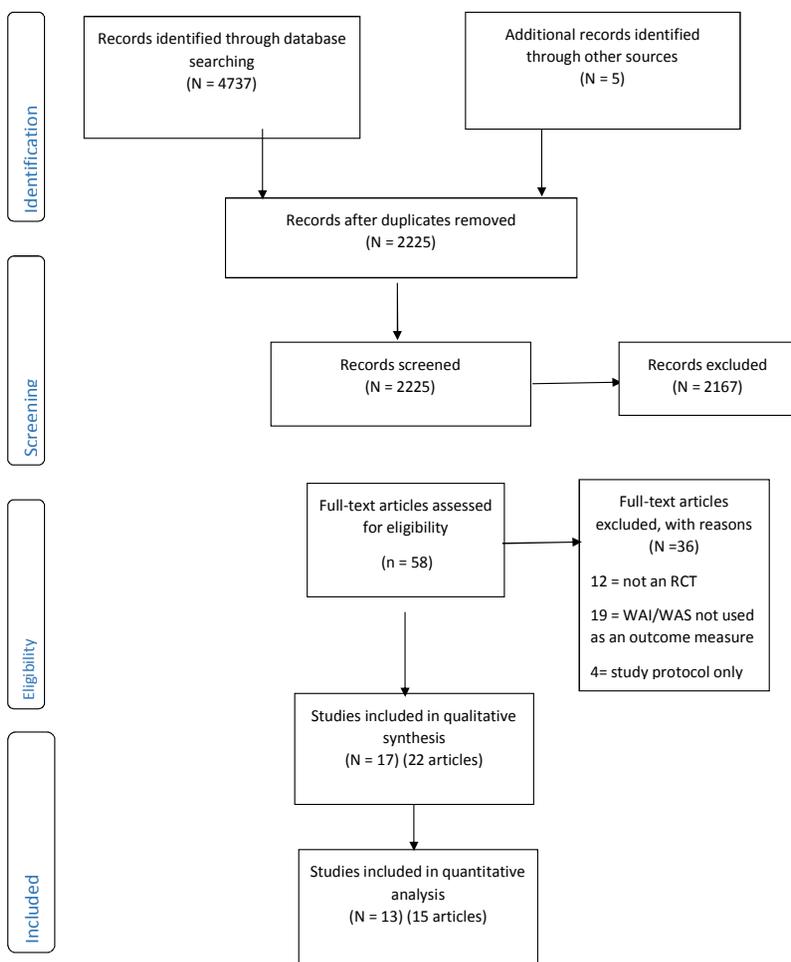


Figure 1. Selection of studies: PRISMA flowchart.

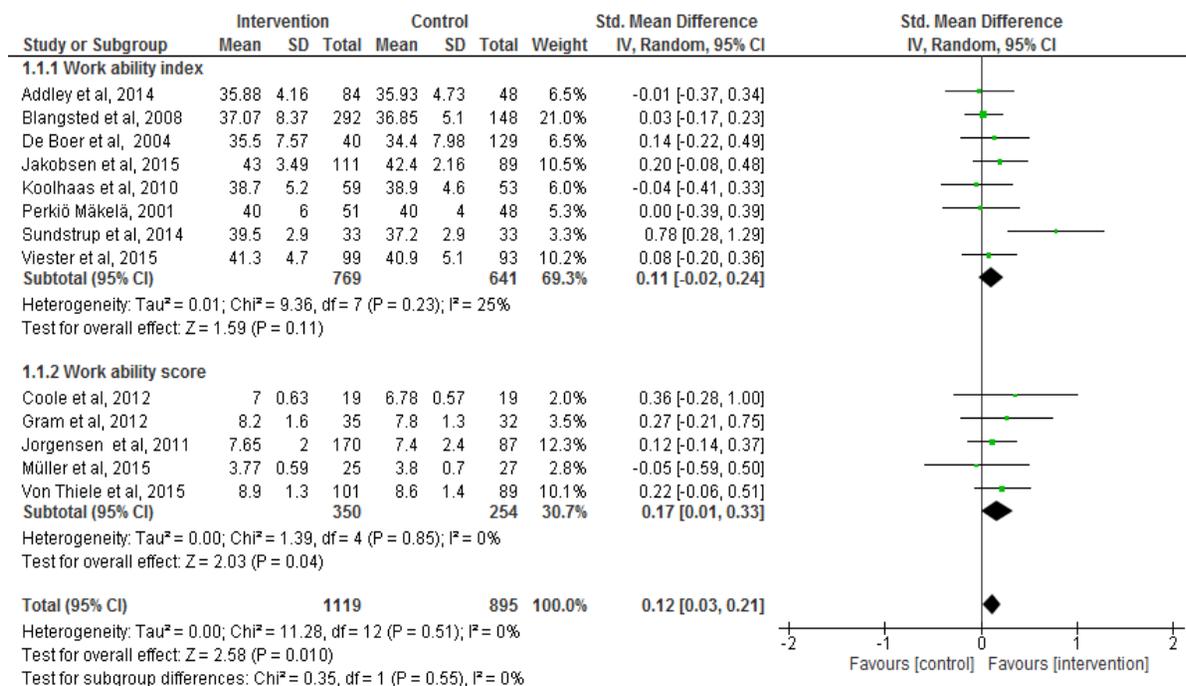
Table 1. Summary of studies. [+ = positive effect; - = negative effect.]

First author/ country	Population	Intervention (I) and comparison (C)	Follow-up	Conclusion on effect
Addley et al, 2014, Northern Ireland	Government department employees, N=180	I: Lifestyle & physical assessment plus Health Coaching) and access to web based tools such as online personal trainer I: Lifestyle & physical assessment only C: current practice	12 months	No effect
Blangsted et al, 2008, Denmark	Public administration authority employee. N=549	I: specific resistance training I: all round physical exercise C: Introduced to intervention via presentation of similar projects that had improved work conditions and occupational health.	12 months	No effect
De Boer, 2004, Netherlands	International manufacturing company employees N=116	I: Occupational health program by occupational physician, liaison with employer and health practitioners. C: current practice that included consultation with occupational physician on request.	6 months, 2 years	+
Flannery et al, 2012, USA	Nurse assistant residential aged care employees N=39	I: Worksite Heart Health Improvement Project C: education session only	3, 6 months	+
Jakobsen et al, 2015, Denmark	Female healthcare workers N=200	I: Work or home based physical exercise for 10-weeks I: Home based physical exercise for 10-weeks	10 weeks	+
Koolhaas et al, 2010 & 2015, The Netherlands	Hospital and university employees N=125	I: Individual workplace assessment, action plan and support training for supervisors C: regular annual appraisal	Baseline, 3 & 12 months	-
Nurminen et al, 2002, Finland	Female laundry workers N=260	I: worksite exercise training, feedback on physical capacity tests and advice on self-directed leisure time physical activity. C: Feedback on physical capacity tests and advice on self-directed leisure time physical activity.	3, 8, 12, 15 months	No effect
Perkio-Makela, 2001, Finland	Female farmers N=126	I1: Physical exercise & ergonomics work techniques training group sessions I2: as above plus lifestyle and risk management education C: basic occupational health care services	1, 3, 6 years	No effect
Sundstrup et al, 2014, Denmark	Slaughterhouse employees N=66	I: strength training for shoulder/arm/hand C: ergonomic training provided as per standard worksite prescription	10 weeks	+ve effect
Viester et al, 2015, The Netherlands	Construction workers N=314	I: On-site life style coaching program C: current practice	6 and 12 months	No effect
Barene et al, 2014, Norway	Hospital employees N=107	I1: Soccer sessions I2: Zumba sessions C: current practice	12 and 40 weeks	No effect
Coole, 2012, United Kingdom	Employees with low-back pain referred to rehabilitation service N=51	I: Individual work support, liaising with health practitioners/employer. C: Group multi-rehab focused on self-management including education, physical conditioning, cognitive behavior approach	6 months	No effect
Gram et al, 2012, Denmark	Construction workers N=67	I: 12 week exercise program during work hours 3x20 mins per week C: no exercise training but received 1 hour lecture on general health promotion.	12 weeks	No effect
Jorgensen 2011, Denmark	Female cleaners from hospitals, cleaning companies & large businesses N=294	I1: Physical coordination training I2: Cognitive behavioural training C: health check of 1 hr duration at baseline	12 months	No effect
Muller et al, 2016, Germany	Registered nurses N=70	I: Selection, optimization and compensation (SOC) training at work. C: Received SOC training one year later	12 months	No effect
Oude Hengel et al, 2011 & 2013, The Netherlands	Construction workers N=293	I: Physical therapy advice and cognitive training	3, 6, 12 months	No effect
Von Thiele et al, 2015, Sweden	Hospital employees N=202	I: integration of new health promotion system with continuous improvement system C: employees not working in the new system	Baseline, 12 and 24 months	No effect

and presented in two groups according to the scale used to measure work ability (figure 2). A synthesis provided a positive effect of intervention (overall pooled mean difference 0.12, 95% CI 0.03–0.21) with no heterogeneity for the effect size ($\text{Chi}^2=11.28$, $P=0.51$; $I^2=0\%$). The pooled standard mean difference between intervention and control for the group of 8 studies that used WAI was 0.11 (95% CI -0.02–0.24) with low heterogeneity ($\text{Chi}^2=9.36$, $P=0.23$; $I^2=25\%$). The pooled effect size from 5 studies using the WAS was 0.17 (95% CI 0.01–0.33) with no significant heterogeneity problems identified ($\text{Chi}^2 = 1.39$, $P=0.85$; $I^2=0\%$).

Figure 3 shows individual-focused interventions grouped by either WAI or WAS. A small positive significant overall pooled effect was found (overall pooled mean 0.12, 95% CI 0.01–0.22) among individual-focused interventions studies with no heterogeneity for the effect size ($\text{Chi}^2 = 8.68$, $P=0.37$; $I^2=8\%$). The pooled effect size from six studies using the WAI and three studies using WAS was positive but not statistically significant with no major heterogeneity problems identified.

Figure 4 shows multi-level focused interventions. The overall pooled effect of such interventions (four studies in total) was positive but not statistically signifi-



† Flannery et al, 2012 study was excluded because of the different scale (0-80) used to measure work ability index. Nurminen et al, 2002 study was excluded because of no detail data on work ability index provided at the last round of follow-up.

‡ Hengel et al, 2011 study was excluded because of different scale used to measure work ability score (0-20). Barene et al, 2014 study was excluded because of no detail data on work ability score provided at the last round of follow-up.

Figure 2. Standard mean difference of work ability index † and work ability score ‡ and their 95% confidence interval (CI) between intervention and control group at the last round of follow-up.

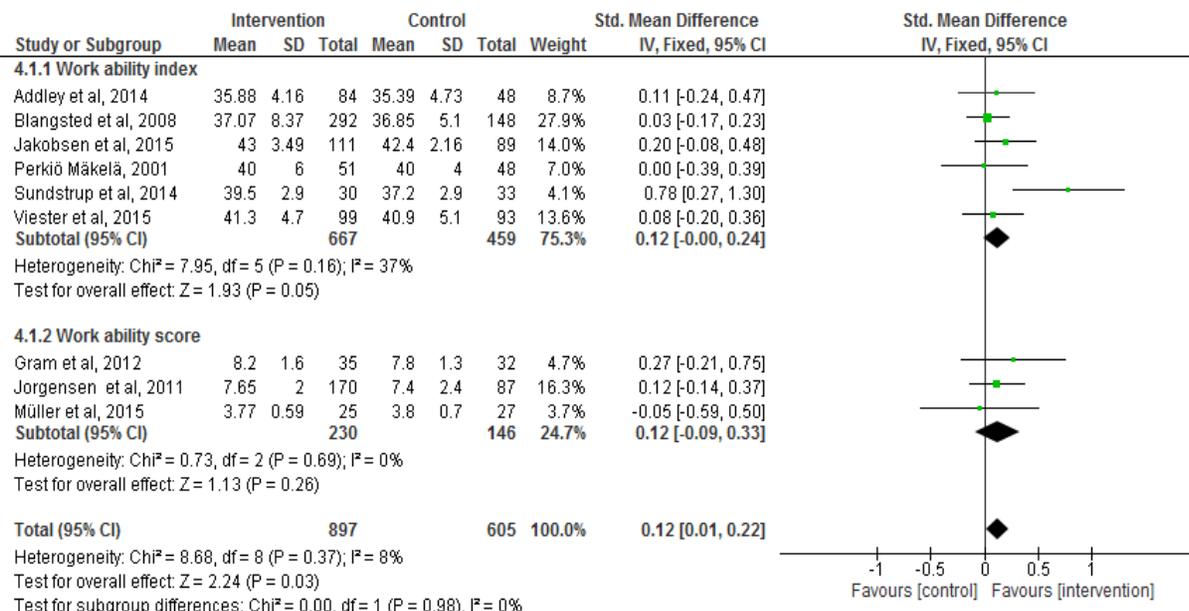


Figure 3. Standard mean difference (intervention vs control) and their 95% CI for work ability index and work ability score among studies with individually focused interventions.

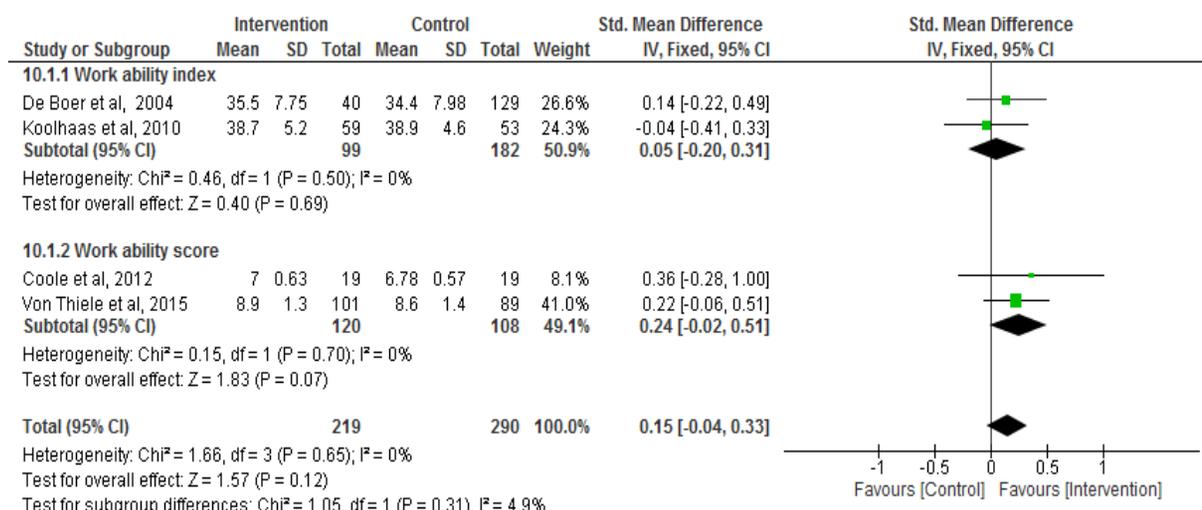


Figure 4. Standard mean difference (intervention vs control) and their 95% CI for work ability index and work ability score among studies with multi-level focused interventions.

cant effect (overall pooled mean difference 0.15, 95% CI -0.04–0.33).

Sensitivity analysis of those studies examining individual-focused versus other interventions and individual-focused interventions versus current practice using WAI as an outcome are presented separately (see supplementary figures S1 and S2, www.sjweh.fi/show_abstract.php?abstract_id=3685). Individual-focused interventions with WAI as an outcome (three studies in the meta-analysis), showed no statistically significant pooled effect (mean 0.25, 95% CI -0.09–0.59) and a substantial level of heterogeneity (Chi²=7.26, P=0.03; I²=72%). No statistically significant pooled mean effect of individual-focused interventions versus current practice (0.03, 95% CI -0.16–0.23) was found.

The pooled effect size of the studies that used multi-level interventions versus current practice with WAI as an outcome (two studies in the meta-analysis), found no statistically significant effect of the intervention (mean 0.06, 95% CI -0.20–0.31) with no heterogeneity (Chi² =0.52, P=0.47; I²=0%) among studies (supplementary figure S3, www.sjweh.fi/show_abstract.php?abstract_id=3685).

Risk of bias analysis

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

Grading the evidence and synthesis

Table 3 provides detail on evidence quality as assessed by GRADE. Four "summary of findings" subtables were

generated on the basis of the focus of the intervention (individual/multilevel focus) and comparison groups (current practice/other intervention). The table also provides the impact statement for the outcome, based on the evidence quality. The GRADE approach assesses the overall body of evidence rather than the individual study; differences may result between a single study and an outcome effect for groups of studies.

Effect of individual-focused interventions on work ability compared to current practice

Six studies investigated the effect of individual-focused interventions compared to current practice. Current practice involved consultation with health physicians (32), health checks (19), and no changes to current practices (18, 33–35).

Individual-focused interventions included health assessments and advice on behavior change (33, 34); three studies used exercise programs as the intervention (18, 19, 32) and one study involved training nurses in the use of selection, optimization and compensation to develop active coping skills (35). Three studies used the full WAI as the outcome measure and three studies used the single-item WAS measure (table 1).

The overall quality of the evidence was moderate. The principal reason for downgrading of the evidence was poor compliance in four of the six studies. Of these four studies, three involved exercise programs (18, 19, 32) and one involved lifestyle coaching (33). None of the studies reported a significant effect on work ability, either as WAS or WAI.

Table 2. Summary of risk of bias (-) = low risk, (?) = unclear, (+) = high risk. [ITT=intention to treat]

Study	Selection bias			Detection bias		Attrition bias	Reporting bias	Performance bias		ITT analysis performed
	Random sequence generation	Allocation concealment	Group similarity at baseline for the most important prognostic factors	Blinding of outcome assessors	Timing of outcome assessments comparable in all groups	Outcome data complete	Free of selective outcome reporting ^a	Co-interventions avoided ^b	Compliance acceptable in all groups	
Addley et al, 2014	-	?	-	-	-	-	-	?	-	-
Barene et al, 2014	-	-	-	-	-	+	-	?	+	-
Blangsted, 2008	-	-	-	-	-	-	-	?	+	-
Coole, 2012	+	?	-	-	-	-	-	?	+	-
De Boer, 2004	?	?	-	-	-	-	-	?	+	-
Flannery et al, 2012	-	-	-	-	-	+	-	?	+	-
Gram et al, 2012	-	-	-	-	-	-	-	-	+	-
Jacobson, 2014	-	-	-	-	-	-	-	?	+	-
Jorgensen, 2011	-	-	-	-	-	-	-	?	+	-
Koolhaas, 2010 & 2015	?	-	-	-	-	-	-	?	?	+
Muller, 2016	-	-	-	-	-	-	-	?	-	-
Nurminen, 2002	-	-	-	-	-	-	-	-	-	-
Oude Hengel et al, 2011 & 2013	-	-	-	-	-	-	-	?	+	-
Perkio-Makela, 2001	?	?	-	-	-	+	-	?	+	+
Sundstrup et al, 2014	-	-	-	-	-	-	-	?	?	-
Von Thiele et al, 2015	-	-	-	-	-	?	-	-	?	?
Viestar, 2015	-	-	-	-	-	-	-	?	+	?

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

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

Effect of individual-focused interventions on work ability compared to other interventions

Six studies represented by seven articles (table S2) compared individual-focused to other interventions. Interventions were either based on exercise (36–40) or lifestyle education of employees (41).

Other interventions included a passive comparator such as information (36–38, 40, 41) and in one study training and education was provided as part of a hazard prevention system (39). Five studies used the full WAI and one used the single-item WAS. Only one exercise-based intervention reported a significant positive impact on work ability (39).

Overall evidence quality was moderate. Again, the principal reason for the downgrading of the evidence was low compliance in four of the six studies. Of the four studies with low compliance, three were exercise-based (36–38) and one was based on physical activity education (41).

Effect of multilevel-focused workplace interventions on work ability compared to current practice

Four studies represented by seven articles compared multilevel focused interventions to current practice (20, 42–47). Interventions in the four studies were multifaceted and included several components: empowerment training, use of a tool to design rest breaks, an education booklet, supervisor training, and the implementation of a system to integrate health and work through the use of a continuous improvement process.

Work ability was measured using the full WAI in three studies (20, 42, 44) and the single-item WAS in one study (43). Evidence quality was moderate, and downgrading was primarily due to low or uncertainty about compliance across all four studies reviewed (20, 42–44).

Effect of multilevel-focused workplace interventions on work ability compared to other interventions

One study compared a multilevel-focused approach to other interventions (48).

The intervention covered eight vocational sessions along with group rehabilitation. The other intervention

Table 3. Summary of findings GRADE

Impact Statements			
Quality of evidence	Magnitude of effect		
	Important benefit/harm	Less important benefit/harm	No effect
1. High quality	'Will' Increase/decrease...	'Slightly' increases/decreases...	'Makes little or no' difference...
2. Moderate quality	'Probably will' increase/decrease...	'Probably slightly' increases/decreases...	'Probably' makes little or no difference
3. Low quality	'May' increase/decrease...	'May slightly' increase/decrease...	'May' make little or no difference
4. Very low quality	It is not known whether the intervention increases/decreases...		
What characteristics of interventions are most effective in improving the work ability of employees?			
Patients or population: Working adults			
Settings: Based at the workplace or with a connection to the workplace			
Outcome	Impact: Effect of individually focused workplace interventions on work ability compared to current practice	Number of participants (studies)	Quality of evidence (GRADE)
Work ability	Individually focused interventions probably make little or no difference in improving employees' work ability	891 (6)	Moderate ^{a, b}
Outcome	Impact: Effect of individually focused workplace intervention on work ability compared to other		
Work ability	Individually focused interventions probably make little or no difference in improving employees' work ability	1191 (6)	Moderate ^a
Outcome	Impact: Effect of multilevel focused workplace interventions on work ability compared to current practice		
Work ability	Multilevel focused interventions probably make little or no difference to employees' work ability	740 (4)	Moderate ^{b, c}
Outcome	Impact: Effect of multilevel focused workplace interventions on work ability compared to other		
Work ability	It is not known whether multilevel focused interventions make difference to employees' work ability	51 (1)	Very Low ^{a, d, e}
^a High risk of bias – low compliance and incomplete outcome data. ^b High risk of bias – intention to treat analysis not performed. ^c High risk of bias – low compliance. ^d High risk of bias – non-random sequence generation, group dissimilarity at baseline, timing of outcome assessment not comparable. ^e Imprecision – wide confidence intervals.			

group received only the group rehabilitation. The WAI was used as the outcome measure. The intervention included identification of barriers impeding effective back pain management at work, a work-focused intervention tailored to the individuals, and communication with health care practitioners and employers. Evidence quality was very low for this outcome, due to the high risk of bias in the single study. No effect was reported in the study.

Discussion

This review systematically identified and appraised available evidence for interventions designed to improve employees' work ability. A macro-ergonomics framework was used to structure the analysis and explore the levels at which interventions should be targeted to maximize effectiveness. This approach was adopted to identify how to design the most effective interventions and to take into account recent suggestions that sustainable employment should consider a broad range

of factors beyond that of the individual worker (6, 49).

From the qualitative analyses and meta analyses, we can conclude that only a moderate quality of evidence was found that interventions are effective in improving work ability. While a small positive effect was found for interventions improving work ability, this should be interpreted in the context of this level of evidence. The use of work ability as an outcome measure is an important consideration and the length of follow up periods in the studies may be of significance.

Work ability was originally developed as a screening tool to prevent work disability but further work has reported its use as an occupational measure and something that can be influenced through interventions (11, 12, 15). However, the relatively short follow-up periods of some of the studies (range 10 weeks to 6 years) may be of significance here as there may be insufficient measurement time to realize a change in work ability score. Given the constructs in the measure, such as sick leave in the past 12 months, a minimum of 12 months is likely to be needed. The relevance of no effect though is worth considering as this may indicate a maintenance effect, which is prevention of further decline, although this is

difficult to interpret from the data presented in the studies reviewed. Previous research has reported a decline in work ability with age especially in midlife (>50 years of age, 0.5–0.7 points/year) (11).

Individual-focused interventions largely targeted behavior change through education or physical activity and were not found to significantly impact work ability. Many of the studies in this grouping reported that compliance was an issue and this resulted in the downgrading of the quality of evidence. Multiple factors may account for the low compliance rate amongst participants. The adoption of individual-based exercise and education strategies are influenced by a range of factors including individual attitudes, work environment, and organizational climate (50). These factors can create barriers to behavior change and, if not addressed, it is likely that compliance will be low (50). Research in the effectiveness of public health campaigns reinforce the premise that individuals are more likely to change their behavior if there is a supportive environment and other strategies, eg, law enforcement in the case of alcohol impaired driving (51, 52). Wakefield et al (53) reviewed numerous health-behavior-change campaigns and outlined factors that contributed to positive outcomes "...concurrent availability of required services and products, availability of community-based programmes, and policies that support behavior change" (p1261, 53). Those campaigns that lacked environmental supports, eg, those targeting physical activity (lack of walking paths) and nutrition (lack of access to fresh fruit and vegetables), were less likely to have a positive behavior change outcome. Unless there are workplace mechanisms to facilitate compliance, further studies that investigate the effectiveness of individual-focused interventions are likely to face similar problems.

Employees were encouraged to change their individual behavior (eg, through exercise programs), however the environmental, organizational and physical factors are likely to continue to impact work ability. The World Health Organization's concept of health promotion (subsequently adopted by the European Network for Workplace Health Promotion) (54) outlines the importance of addressing all factors when promoting a change in behavior. Therefore, as a primary mechanism to improve work ability, without other workplace changes to support individuals, the impact of these individual-focused interventions is likely to remain limited.

Multilevel interventions were fewer in number and also did not result in significant improvements to work ability. However, it is plausible that further development of multilevel interventions may result in findings different to those presented in the current study. Reconceptualization of interventions to include all aspects of job design and individuals' capacities is required to further investigate whether multilevel interventions positively

impact work ability. This is consistent with the growing literature around sustainable employment, which proposes that worker capability requires consideration so that workers are able and enabled to achieve within the context of the organization (49, 54).

Study strengths and limitations

Strengths of this review include a systematic search of the literature from January 2000 to March 2016. A rigorous systematic approach was used to examine study design, biases, outcome measures, methods of analysis and reporting. The homogeneity of a number of studies enabled a meta-analysis to be undertaken. However, limitations exist in taking this approach. Firstly, only RCT and studies published in English were included. As such, studies with alternative designs but useful findings or in other languages may have been excluded. While a RCT design is considered the gold standard for determining intervention effectiveness, and more highly regarded in systematic reviews than other designs, it is perhaps not the most appropriate design for occupational interventions and more debate is required in this area (55, 56). Significant challenges face researchers in workplace settings with respect to engagement of employers and turnover of staff. Only published peer-reviewed studies were included in this review. To assess the risk of publication bias, all studies were compared to ascertain direction of results. Direction of results was mixed, many with no effect, suggesting a low risk of publication bias. This review utilized structural groupings of individual versus multilevel interventions, with further separation based on the comparison group (current practice or other intervention). Other constructions for the review are possible and although every attempt was made to group similar studies, the variation of interventions across the categories may influence the study findings, although the exclusion of some studies in the meta-analysis was undertaken to reduce this possibility (57).

Concluding remarks

An ageing population will necessitate longer working lives and a stronger focus on sustainable employment. Sustainable employment requires good job design that takes into account the capacities of workers and the requirements of the work in order to achieve good PE fit; that is, a good balance between individual resources and work demands. Maintaining and promoting work ability is an important part of this relationship and workplace interventions are a useful consideration to support this. This review did not find high quality evidence to support the role of interventions, with either individual or multilevel focus, to improve work ability. Whilst a small positive effect was identified in meta-analysis,

this requires further support through future high quality research using well-designed interventions that particularly focus on improving compliance. Maintenance of work ability, that is prevention of decline, is important and further research is required to identify what aspects of interventions are effective in achieving this goal. Further high-quality intervention research is required which systematically explores different aspects of organizations, and the impact on individuals and their work ability, with due consideration to the issue of compliance.

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