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Workplace interventions to improve work ability: A systematic review and meta-analysis of their effectiveness¹

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1 *Supplementary material*

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Figure S1: Standard mean difference (intervention vs control) and their 95% CI for work ability index among studies with **individually focused interventions vs other intervention**

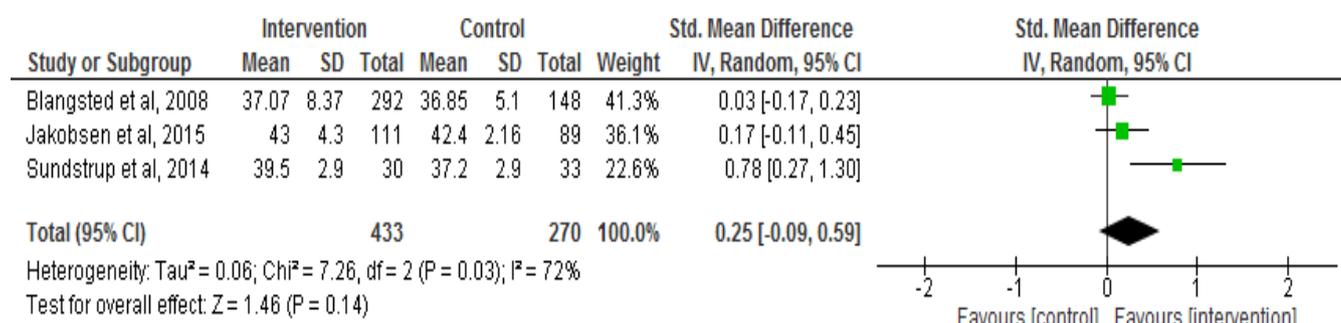


Figure S2: Standard mean difference (intervention vs control) and their 95% CI for work ability index among studies with **individually focused interventions vs current practice**.

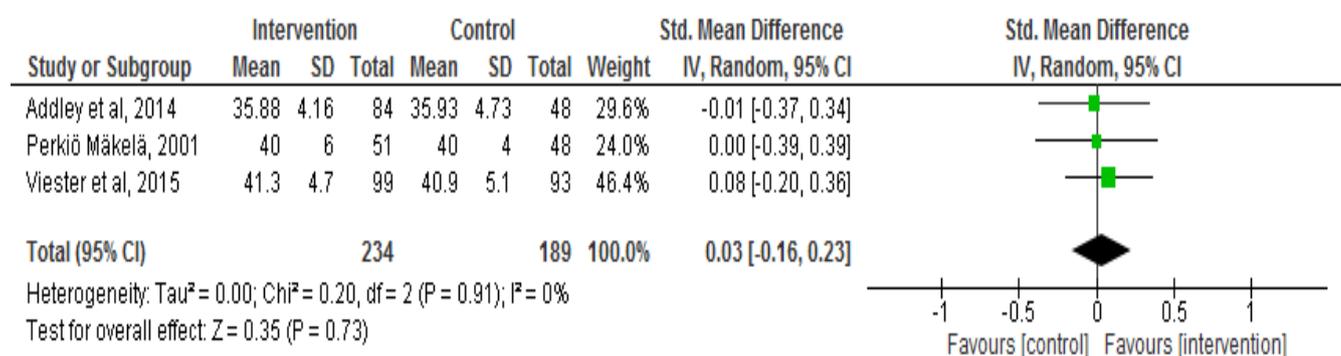


Figure S3: Standard mean difference (intervention vs control) and their 95% CI for work ability index among studies with **multilevel interventions vs current practice**

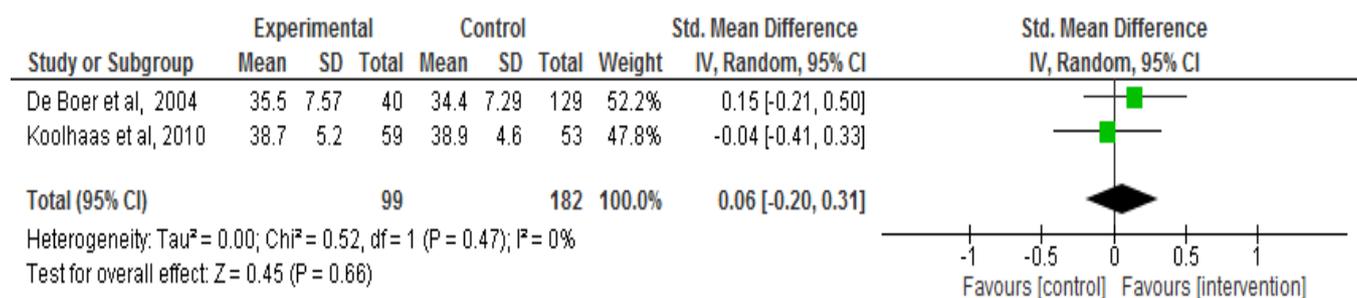


Table S1: Medline Search Strategy

1. (work or working or worker* or workplace or job or labor force or employ* or occupation*).m_titl.
2. workplace/ or *work/ or *employment/ or *employment, supported/ or *occupations/
3. 1 or 2
4. (intervention program* or organisational intervention* or change management or "prevention work disability").mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
5. (job change* or job rotation or job demand or job characteristics or job crafting or mobility or ergonom* or work demand* or work attitude* or motivation or motivated or intention* or willingness or flexibility or flexible or (term* adj4 employment) or (condition* adj4 employment)).tw.
6. ((effort* adj3 keep adj4 work*) or (extension* adj4 working life) or (assist adj4 well-being) or (encourage adj5 participation) or (maintain adj3 workforce)).tw.
7. *occupational health services/ or *occupational health/ or *health promotion/ or *healthy people programs/ or *preventive health services/ or *health education/ or *physical education and training"/ or *rehabilitation, vocational"/ or *exercise/ or *physical fitness/
8. 4 or 5 or 6 or 7
9. 3 and 8
10. (work ability* or work* capacity or work outcome* or work participation or labor participation or employability* or productivity).tw.
11. 9 and 10
12. limit 11 to (english language and humans)

Table S2: Study Characteristics

First author/country	Population and age in years (SD)	Intervention (I) and comparison (C) (level of intervention)	Follow-up	Outcome measurement	Statistical analysis	Results	Conclusion on effect
Studies using Work Ability Index (WAI)							
Addley et al 2014 Northern Ireland	Government department employees. N = 180 Age range: <25, N = 6 25-44, N = 71 45+, N = 55	I1: Lifestyle & physical assessment (personal health risk profile & general advice on health behaviour change) plus Health Coaching (monitoring at 4 & 8 months) and access to web based tools such as online personal trainer I2: Lifestyle & physical assessment only C: current practice (no intervention) (individual focus)	12 months	Work Ability Index; Seven items, Full scale (7-49), continuous	A one-way between-groups analysis of covariance (ANCOVA), adjusted for baseline values	Baseline I1 35.56 (0.67) I2 36.24 (0.59) C 35.89 (0.64) Post Test A 35.32 (0.66) B 36.02 (0.65) C 35.59 (0.69) P-value for baseline-follow-up within group = 0.94	No effect

<p>Blangsted et al 2008</p> <p>Denmark</p>	<p>Public administration authority employees</p> <p>N = 549</p> <p>Age: Men = 47.1 (9.2) Women = 45.5 (9.5)</p>	<p>Participants allowed 1 hour per week worktime to undertake intervention activities.</p> <p>I1: specific resistance training (exercise sessions for neck/shoulder region 20 mins 3x per week)</p> <p>I2: all round physical exercise (motivated to increase daily physical activity by instructors, organized exercise groups at worksite, supply of 8min CD based exercise program, exercise machines placed around workplace)</p> <p>C: Introduced to intervention via presentation of similar projects that had improved work conditions and occupational health. (individual focus)</p>	<p>12 months</p>	<p>Work ability Index with 6 items, final score (6-42), Continuous scale</p>	<p>Analysis of variance (ANOVA)</p>	<p>Women: Baseline I1 37.4 (0.37) I2 37.1 (0.32) C 36.7 (0.40)</p> <p>12 months I1 36.9 (0.42) I2 36.6 (0.39) C 36.5 (0.48)</p> <p>Men: Baseline I1 37.7 (0.54) I2 37.4 (0.37) C 37.1 (0.42)</p> <p>12 months I1 38.0 (0.49) I2 36.8 (0.66) C 37.2 (0.35)</p> <p>for post-test values : I vs C, p = 0.31 I1 vs I2, p = 0.42</p>	<p>No effect</p>
<p>De Boer 2004</p> <p>Netherlands</p>	<p>International manufacturing company employees</p> <p>N = 61 intervention N = 55 control</p> <p>Age: I = 53.2 C = 53.5</p>	<p>I: Occupational health program by occupational physician – assessment, action plan (adaptations/changes) and liaison with work supervisor, personnel manager, general practitioner, medical specialist or psychologist.</p> <p>C: current practice which included consultation with occupational physician on request.</p> <p>(multilevel focus)</p>	<p>6 months, 2 years</p>	<p>Work Ability Index, full index (7-49), continuous</p>	<p>Repeated measurement analyses were used to test for the effect of the intervention. Interaction effect of groups by time</p>	<p>Baseline I. 34.3 C.33.4</p> <p>6 month I. 35.2 C.30.7</p> <p>P<0.001</p> <p>2 year I. 35.5</p>	<p>+ve effect</p>

						C. 34.4 P = n.s. (p value not shown)	
Flannery et al 2012 USA	Nurse assistant residential aged care employees N = 24 intervention N = 15 control Age: I = 43.31 (13.07) C = 39.95 (13.06)	I = Worksite Heart Health Improvement Project; includes environmental assessment (2 hrs at beginning of study), Initial diet/physical activity education (30 mins at beginning of study), ongoing motivation (40 hrs/wk x 1 st month, 16hrs/wk x 2 nd month, 8hrs/wk x 3 rd month) C: education session only (individual focus)	3, 6 months	Work Ability Scale (0-80), with 8 items (each items ranging, 0-10) continuous	Independent-sample t test to assess means, SDs, and significance between groups.	Baseline I. 25.31 (20.52) C. 44.73 (11.70) 3months I. 34.50 (19.61) C. 44.91 (12.72) 6 months I. 43.13 (14.67) C. 35.12 (18.54) P value for Intervention vs control at follow-up = 0.05	+ve effect
Jakobsen et al, 2015 Denmark	Female health care workers N = 111 intervention N = 89 control Age: I = 40 (12) C = 44 (10)	I1: Work - supervised group based high-intensity strength training using kettle bells, Swiss balls and elastic bands. 10-weeks (5x10 min a week) I2: Home- leisure time physical exercise with training equipment (tubing, 3 posters showing exercises for the shoulder, abdominal and back muscles). 10-weeks (5x10 min a week) Both groups received ergonomic training and education. (individual focus)	10 weeks	Work Ability Index, seven items (7-49) continuous scale and each item separately	Repeated-measures two-way analysis of variance (ANOVA) adjusted for age and baseline WAI	Baseline: 42.8 (4.6) work 43.3 (4.2) Home Difference from 0 to 10 weeks in WAI and 95% CI 0.2 (-0.4, 0.9) Work: -0.9 (-1.6, -0.2) Home Group difference (Work vs Home) (0.3, 1.8) P = 0.03	+ve effect

<p>Koolhaas et al 2010 & 2015</p> <p>The Netherlands</p>	<p>Hospital and University employees</p> <p>N = 64 intervention N = 61 control</p> <p>Age: I = 51.7 (4.8) C = 52.9 (5.1)</p>	<p>I: 3 stages for workers: 1. inventory & assessment of workers' work problems & career opportunities 2. brainstorm between worker & supervisor to develop solutions 3. action plan to implement changes over next 12mths & incorporated into annual organization appraisal</p> <p>Supervisors trained (1x 2hr training course & 1 x 5hr training course) to support workers.</p> <p>C: Regular annual appraisal (multilevel focus)</p>	<p>Baseline, 3 & 12 months</p>	<p>Work Ability Index, 7 items (7-49) continuous scale</p>	<p>The t-test to compare the difference between the groups. In addition, linear multilevel analyses adjusted for baseline WAI and other potential confounders</p>	<p>Baseline I = 39.4 (5.2) C = 38.9 (5.6)</p> <p>3mths I = 38.9 (5.2) C = 38.9 (5.1)</p> <p>12mths I = 38.7 (5.2) C = 38.9 (4.6)</p> <p>B coefficient after 12 months = -1.33, (-2.45 to -0.20)</p>	<p>-ve effect</p>
<p>Nurminen et al 2002</p> <p>Finland</p>	<p>Female laundry workers</p> <p>N = 133 intervention N = 127 control</p> <p>Age: I = 40.7 C = 39.1</p>	<p>I: worksite exercise training (1 x 60min session with physiotherapist per week x 8 months) and 30 min feedback on physical capacity tests and advice on self-directed leisure time physical activity.</p> <p>C: 30 min feedback on physical capacity tests and advice on self-directed leisure time physical activity.</p> <p>(individual focus)</p>	<p>3, 8, 12, 15 months</p>	<p>Work Ability Index, 7 items (7-49) continuous scale and each item separately</p>	<p>Analysis of covariance (ANOVA) was used to compare the groups (baseline adjusted differences in the means with their 95% CI)</p>	<p>Baseline I = 40.7 C = 39.1</p> <p>3mth 0.5 (0.6, 1.7) P = 0.37</p> <p>8mth 0.5 (-0.7, 1.7) P = 0.37</p> <p>12mth 0.02 (-1.51, 1.47) P = 0.98</p> <p>15mth -0.01 (-1.4, 1.4) P = 1.00</p>	<p>No effect</p>
<p>Perkio-Makela 2001</p>	<p>female farmers</p>	<p>I1 = Physical exercise & ergonomics work techniques training group sessions with physiotherapist & Occupational Health Nurse (12-15hrs over 2.5mths)</p>	<p>1, 3, 6 years</p>	<p>Work Ability Index, 7 items (7-49)</p>	<p>MIXED SAS procedure in analyzing continuous</p>	<p>Baseline I 1 = 41 (4) C 1 = 40 (4)</p>	<p>No effect</p>

Finland	<p>N = 62 intervention</p> <p>N = 64 control</p> <p>Age:</p> <p>I 1 = 37 (6)</p> <p>I 2 = 39 (5)</p> <p>C 1 = 38 (5)</p> <p>C 2 = 37 (5)</p>	<p>I2 = as above plus lectures on work environment, work methods & personal protective equipment (2hrs), nutrition & weight control (1hr), musculoskeletal disorders (1hr) & coping with life (2hrs) (21-23 hrs over 2.5mths)</p> <p>C1: basic occupational health care services (Control group for I1)</p> <p>C2: basic occupational health care services (Control group for I2)</p> <p>(individual focus)</p>		continuous scale	WAI reporting mean and SDs and p-value for the baseline difference in the groups	<p>I 2 = 42 (3)</p> <p>C 2 = 43 (4)</p> <p>6 year</p> <p>I = 40 (4)</p> <p>P < 0.01</p> <p>C = 40 (4)</p> <p>P < 0.001</p>	
<p>Sundstrup et al 2014</p> <p>Denmark</p>	<p>Slaughterhouse employees</p> <p>N = 33 intervention</p> <p>N = 33 control</p> <p>Age:</p> <p>I = 48 (9)</p> <p>C = 43 (9)</p>	<p>I = strength training – high intensity strength training for shoulder/arm/hand during 3 x 10min sessions per week at worksite</p> <p>C = ergonomic training provided as per standard worksite prescription – hands on training & education based on outcomes of worksite analysis & hazard prevention system developed by H&S managers.</p> <p>(individual focus)</p>	10 weeks	Work Ability Index, 7 items (7-49) continuous scale and each items separately	Repeated measure analysis of variance adjusted for gender, age, workplace and baseline WAI. Effect size as Cohen's d for the difference in WAI between-group divided by pooled SD.	<p>Baseline</p> <p>I = 39.2 (3)</p> <p>C = 39.4 (3)</p> <p>Mean difference and 95% CI from 0 to 10 weeks</p> <p>I 0.3 (-1.1, 1.7)</p> <p>C -2.2 (-3.5, - 0.08)</p> <p>group difference 2.3 (0.9, 3.7)</p> <p>Cohen's d = 0.52 (≥0.50)</p>	+ve effect
<p>Viester et al 2015</p> <p>The Netherlands</p>	<p>Construction workers</p> <p>N = 162 intervention</p> <p>N = 152 control</p> <p>Age:</p> <p>I = 46.7 (9.2)</p> <p>C = 45.0 (12.1)</p>	<p>I: On-site life style coaching program tailored to the participant's weight program</p> <p>C: current practice</p> <p>(individual focus)</p>	6 and 12 months	Work Ability Index, 7 items (7-49) continuous scale	Mean and SD for WAI at baseline and follow-ups. Linear and logistic regression analyses for WAI at both 6 and 12 months adjusted for	<p>Baseline</p> <p>I = 40.6 (5.3)</p> <p>C = 40.8 (4.9)</p> <p>6 months</p> <p>I = 41.3 (4.1)</p> <p>C = 40.7 (5.2)</p> <p>12 months</p> <p>I = 41.3 (4.7)</p>	No effect

					the baseline levels.	C= 40.9 (5.1) B, 95% CI 6 months 0.72 (-0.33, 1.77) 12 months 0.53 (-0.59, 1.65)	
Studies using Work Ability Scale (0-10)							
Barene et al 2014 Norway	Hospital employees N = 72 intervention N = 35 control Age: 45.8 (9.3)	I1: Soccer sessions 3 x1hour (30 minutes x 2) sessions per week for 40 weeks I2: Zumba sessions 3x 1 hour sessions per week for 40 weeks C: current practice (individual focus)	12 and 40 weeks	Work Ability Scale, first item of the WAI (0-10) continuous scale	Analysis of covariance (ANCOVA) with adjustment for baseline values of BMI and cluster affiliation. Changes in mean for work ability from baseline to follow-up and their 95% CI for the groups	Baseline I1 = 7.3 (1.3) I2 = 7.2 (1.4) C= 7.8 (1.1) 0 - 12 weeks I1 = 0.1 (-0.6, 0.8) P = 0.14 I2 = 0.5 (-0.2, 1.1) P = 0.14 0 - 40 weeks I1 = -0.0 (-0.7, 0.7) P = 0.91 I2 = 0.3 (-0.4, 0.9) P = 0.44	No effect
Coole 2012 United Kingdom	Employees with low back pain referred to rehabilitation service N = 28 intervention N = 23 control Age:	I: 16 weeks: Individual work support (8x 90 min appointments) included identification of barriers to back pain management at work, assessment of work, work focused interventions, communication with health care practitioners/employers. C: Group multi-rehab focused on self-management including education, physical conditioning, cognitive behaviour approach (2-3 hours per week x 10 weeks) (multilevel focus)	6 months	Work Ability Scale, first item of the WAI (0-10) continuous scale	Mean and their 95% CI for work ability at follow-up for the groups	I= 7.00 (5.75, 8.25) C= 6.78 (5.65, 7.90)	No effect

	C = 48.30 (10.14) I = 41.46 (11.93)						
Gram et al 2012 Denmark	Construction workers N = 35 intervention N = 32 control Age: I = 44 (11.1) C = 43 (10.0)	I. 12 week exercise program during workhours 3x20 mins per week C. no exercise training but received 1 hour lecture on general health promotion. (individual focus)	12 weeks	Work ability Scale, two items of WAI presented separately in continuous scale	Differences between groups was tested using ANCOVA. Post hoc analyses for within-group effects were performed by paired t test.	Baseline I = 7.8 (2.4) C = 8.4(2.2) 12 weeks I= 0.1(3.1) C= -0.7(1.7) I & C 0.5 (-0.6, 1.7) P=0.35	No effect
Jorgensen 2011 Denmark	Female cleaners from hospitals, cleaning companies & large businesses N = 95 intervention 1 N = 99 intervention 2 N = 100 control	I1: Physical coordination training – weekly 20 min exercise sessions x 3mths (reduced over following 9mths to 1 x monthly session for last 6mths). I2: Cognitive behavioural training – 2 hr group session twice a month x 3 months (group discussion about pain related attitudes, coping/management & education about coping techniques/problem solving including practicing coping skills at home) Over 9mths reduced s to 1 hour per month, focusing long term change C = health check of 1 hr duration at baseline (individual focus)	12 months	Work Ability Scale, first item of the WAI (0-10) continuous scale	Mean (SD) at baseline and follow-up	Baseline I1 = 7.6 (2.0) I2 = 7.5 (2.1) C = 7.3 (2.2) 12 months I1 = 7.8 (1.9) I2 = 7.5 (2.1) C = 7.4 (2.4) P>0.05	No effect
Muller et al 2016 Germany	Registered nurses N = 36 intervention N = 34 control Age: I = 44.7 (9.3) C = 42.74 (9.9)	I: Selection, optimization and compensation (SOC) training at work. Three modules with 6 training sessions from 0.5 hour to 8 hours. C: Received SOC training one year later	12 months	Work Ability Scale, first item of the WAI (0-10) continuous scale	ANCOVA was used to calculate the relative baseline adjusted change in work ability. Partial eta square was reported for	Baseline I= 3.70 (0.74) C= 3.78 (0.49) Follow-up I= 3.81 (0.55) C= 3.80 (0.70) P = 0.56	No effect

		(individual focus)			the variance in work ability at follow-up	Partial eta square=0.01 for ITT and 0.00 for per-protocol analysis	
Oude Hengel et al 2011 & 2013 The Netherlands	Construction workers N = 171 intervention N = 122 control	I = 6 month prevention program with 1) physical component: 2 x 30min individual training sessions - 1 st session = observation by physical therapist & recommendations how to reduce workload & advice on rest breaks) 2 nd session 4 months later = evaluation of advice & worker's experience; 2) mental component: 2x1hr empowerment training sessions (taking responsibility for health, discussing OHS behavior with colleagues, improving communication with supervisor) C = current practice (multilevel focus)	3, 6, 12 months	Work ability Scale, two items combined (0-20), continuous score	Linear multilevel mixed models to evaluate the effects on work ability in a crude and adjusted for potential confounder models. The intervention effect between the group and measurement time presented in betas and 95% CI.	Baseline I = 15.8 (2.2) C = 15.4 (2.5) 3 months I = 15.7 (1.8) C = 15.4 (2.2) 6 months I = 15.4 (2.4) C = 15.3 (2.2) 12 months I = 15.5 (2.1) C = 15.1 (2.3) Beta, 95% CI 3 months 0.15 (-0.31, 0.62) 6 months -0.26 (-0.73, 0.22) 12 months 0.15 (-0.34, 0.63) Overall effect 0.02 (-0.34, 0.37) ICC = 0.02	No effect

<p>Von Thiele et al 2015 Sweden</p>	<p>Hospital employees N = 111 Intervention N = 91 Control Age: I = 46.7 (9.2) C = 45.0 (12.1)</p>	<p>I: integration of new health promotion system with continuous improvement system (Kaizen) in a work unit, which included workshops for managers and workshops/coaching of unit managers/local management. (4 workshops over 12 months) C: employees not working in the new system (Multilevel focus)</p>	<p>Baseline, 12 and 24 months</p>	<p>Work Ability Scale, single item (0-10) continuous scale</p>	<p>Repeated- measures analysis of variance for the change in work ability at baseline and the follow-up using Pillai's trace</p>	<p>Baseline 8.6 (1.4) I 8.8 (1.3) C 12 months I= 8.7(1.3) C= 8.8 (1.1) 24 months I= 8.9 (1.3) C= 8.6(1.4) Diff between groups: Partial eta square = 0.029 and P = 0.06</p>	<p>No effect</p>
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