Systematic literature review on the effectiveness of OHS training and education for the protection of workers

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Presentation Outline

- Background
  - Concepts
  - Earlier literature reviews
- IWH systematic review
  - What we did
  - What we found
- Discuss in relation to other research
- Q & A

Will present separately for each research question

Presentation based on recent IWH report

- Robson L, Stephenson C, Schulte P, Amick B, Chan S, et al. A systematic review of the effectiveness of training & education for the protection of workers. Toronto: IWH; Cincinnati, OH: NIOSH; 2010

- Report and lay summary available from http://www.iwh.on.ca/sys-reviews/training-and-education-programs

- Journal manuscript will be submitted to American Journal Preventive Medicine in spring 2010

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IWH research question 1

- Does OHS training have a beneficial effect on workers and firms?

What do we mean by OHS training?

- "Planned efforts to facilitate the learning of specific OHS competencies" (adapted from Noe, 2005)

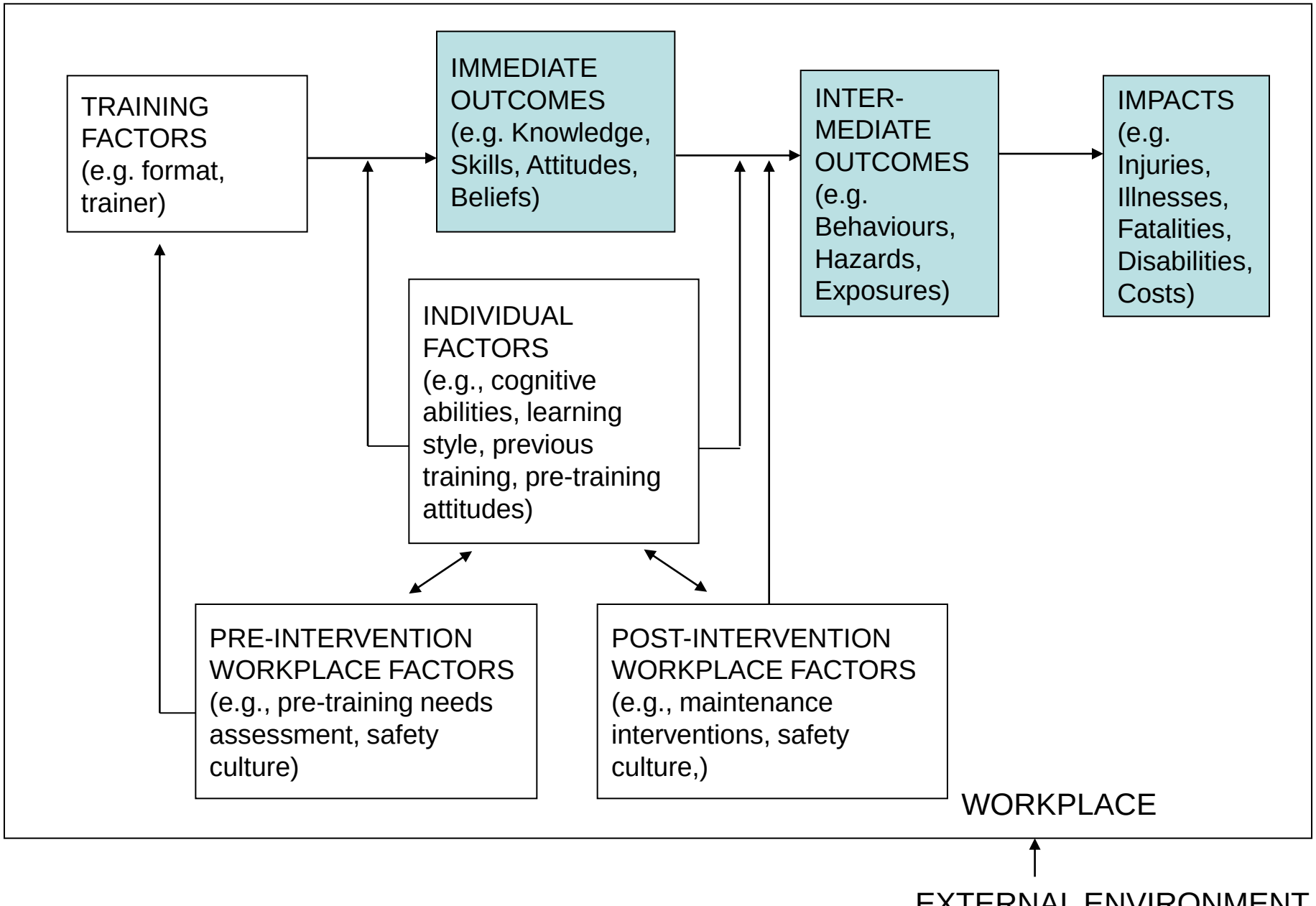
- Includes both training and education
  - For example, lectures, written materials, simple video, self-paced computer training, behavioural modeling, hands-on practice, etc.
    - Could be a combination of these
  - Excludes social marketing

Noe RA. Employee training and development. Boston: McGraw-Hill, 2005.

What do we mean by beneficial effect?

- We examined four categories of outcomes
  - Knowledge
  - Attitudes & Beliefs (e.g. self-efficacy, behavioural intentions)
  - Behaviours (e.g. use of PPE, safe work practices, postures, workstation layout)
  - Health (e.g. injuries, illnesses, symptoms)

A Conceptual Model of Training Interventions for Primary Prevention in OHS



Current review starts where the earlier review by NIOSH ended

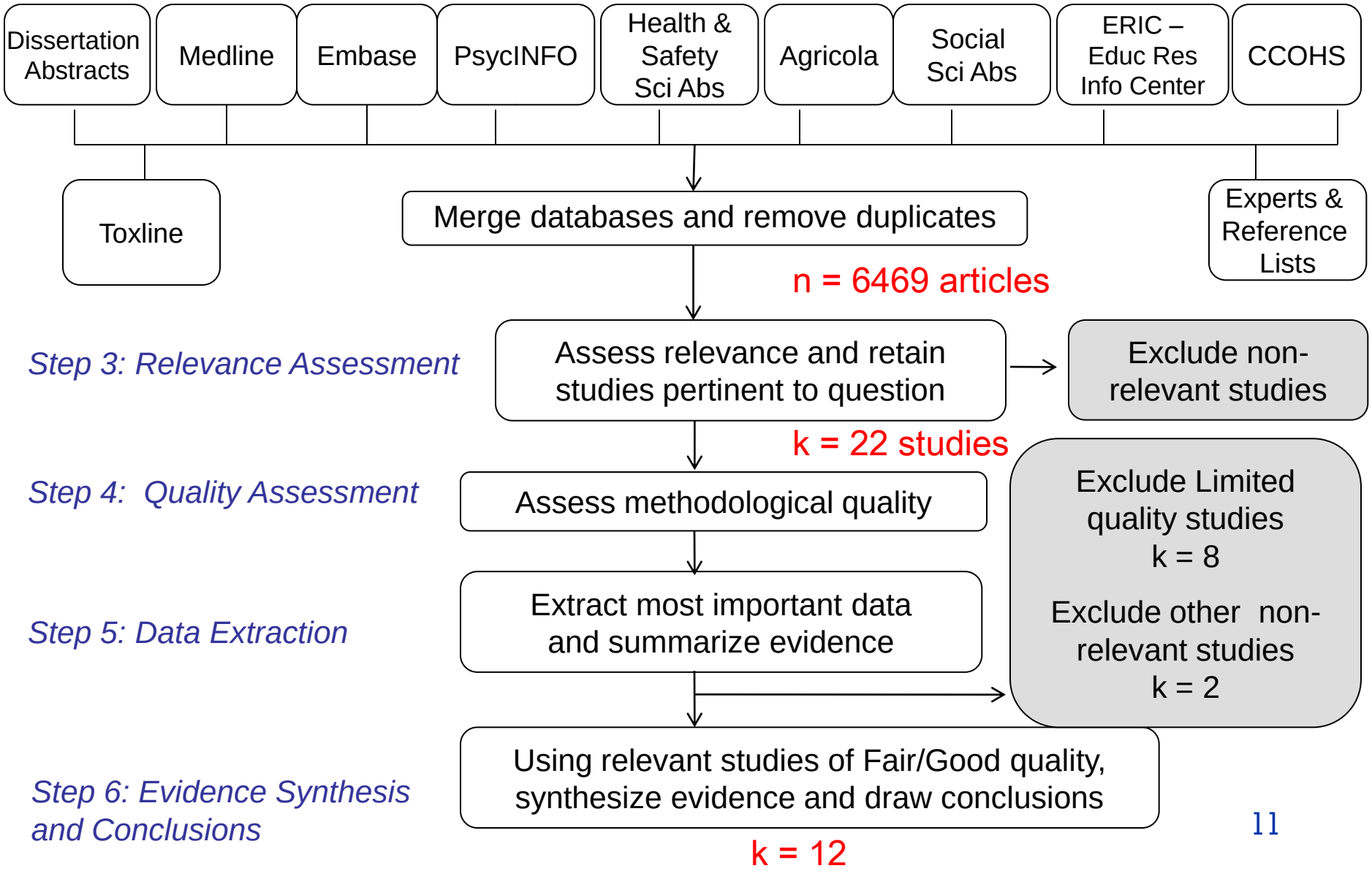
- **Traditional narrative literature review: NIOSH report**
  - 80 intervention studies, from 1980-1996
  - Findings:
    - Training is effective in changing knowledge
    - Training is effective in changing behaviours
    - Training is effective in changing health (i.e. illness & injury)
  - But more rigorous evidence needed:
    - Stronger study designs
    - Uncertainty about the attribution of health outcomes to training

Cohen A et al. Assessing occupational safety and health training: a literature review. Cincinnati, OH: NIOSH, 1998

Overview of the review process

Step 1: Research Question

Step 2: Literature Search



Relevance assessment criteria

Population

- Worker or worker-in-training

Training and education interventions

- Primary prevention of workplace injury or illness

Study design

- Randomized controlled trials
- Pre- and post-intervention measurement of outcome

Outcome

- OHS-related

Publication

- French or English language
- Published between 1996-2007
- Scientific, peer-reviewed journal

Results from screening for relevance:

- What types of studies did we end up with?

Hazards addressed by training

Hazard category	No. of studies	No. of interventions
Ergonomics - two-thirds office ergonomics	10	15
Traumatic injury	4	6
Chemical	3	5
Physical	3	7
Biological	2	3
ALL HAZARDS	22	36

Methods of delivering training

Method of training delivery	No. of interventions
Lectures	20
Printed materials	14
Hands-on training	14
Feedback	12
Videos	8
Discussions	7
Demonstration	7
Computer instruction	5
Problem-solving	5
Q & A	4
Behaviour modelling	3
Goal-setting	3
Role play	1

Number of training sessions in an intervention

Number of training sessions in intervention	Number of interventions
One	23
Two	8
Three	1
Five	1
Seven	1
TOTAL	34

Number of hours in a training session

Number of hours in a training session	Number of interventions
Less than one	12
One or two	9
Three or more	7
TOTAL	28

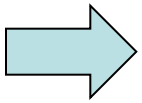
Types of outcomes measured in studies

	Immediate	Short-term ≤ 1 mo.	Intermediate-term >1 mo, ≤ 6 mos.	Long-term > 6 mos.	TOTAL
Knowledge	3	1	2	1	7
Attitudes & Beliefs	3	1	0	1	5
Behaviours	2	1	9	4	16
Health	0	1	7	4	12
TOTAL	8	4	18	10	40

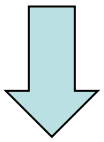
Methodological quality assessment method

- Standardized form assesses the credibility of the research results (internal validity)

- Four domains assessed by 15 items
  - Comparability of study groups
  - Intervention implementation
  - Outcome measurement
  - Statistical analysis

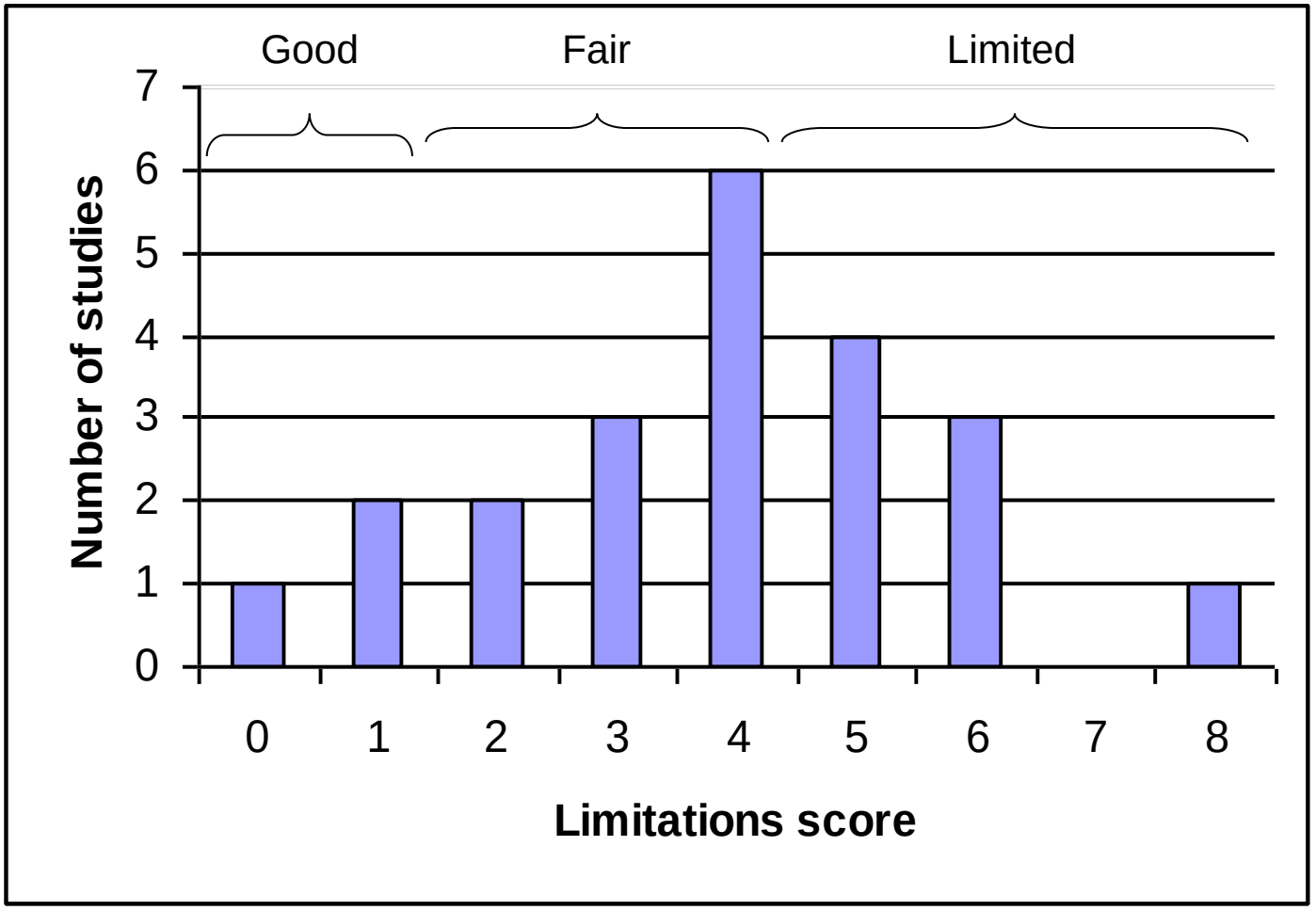


- Each domain then assessed by summary item: confident that potential for bias minimized?
  - yes = 0, partly = 1, no = 2



- Summed into limitations score
  - Possible range 0 to 8

Distribution of methodological quality scores

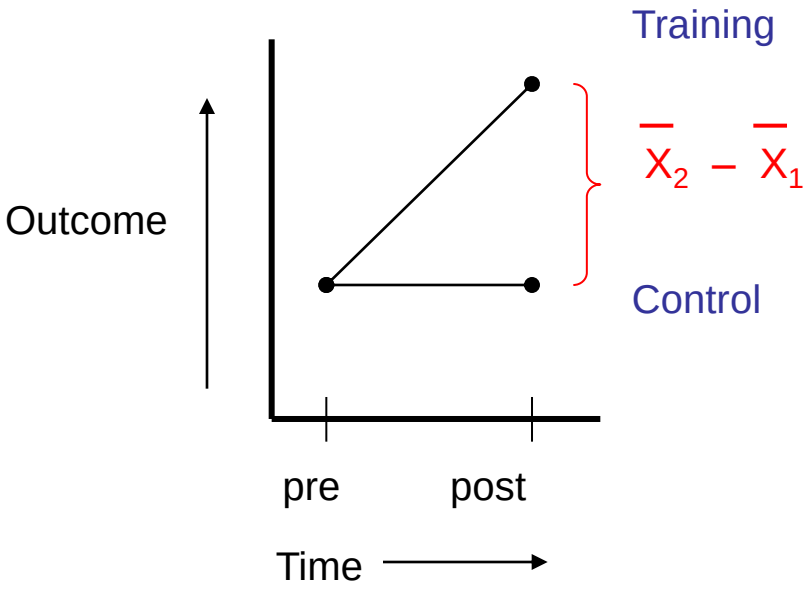


Algorithm used for qualitative evidence synthesis

Level of evidence	Method. quality	Quantity (min.)	Consistency	Effect Size
Strong	Good	2	Yes	Sufficient
	Fair/Good	5	Yes	Sufficient
	Meet criteria for Sufficient level of evidence			Large
Sufficient	Good	1	n/a	Sufficient
	Fair/Good	3	Yes	Sufficient
Insufficient	Any of the above 4 criteria not met			

Based on Briss et al. (2000) Developing an evidence-based *Guide to Community Preventive Services* – Methods. Am J Prev Med 18(1S):35.

Our review's form of effect size: Standardized mean difference (*d*)



Standardized mean difference (*d*)

$$= \frac{\overline{X}_2 - \overline{X}_1}{s_p}$$

- Expresses effects as a number of standard deviations
- Unitless

Guidance for understanding standardized mean difference (*d*)

- 0.2 ≈ Small
  - Same as the difference between average height of 15-yr old and 16-yr old girls
- 0.8 or more ≈ Large
  - Same as the difference between average height of 13-yr old and 18-yr old girls

Cohen J (1977) Statistical power analysis for the behavioral sciences, rev ed. New York: Academic Press.

Effect size criteria for evidence synthesis algorithm set by training experts

Outcome	Training versus control comparisons	
	Sufficient *d*	Large *d*
Knowledge	1.0	1.5
Attitudes & Beliefs	0.5	1.0
Behaviours	0.4	0.8
Health	0.15	0.30

Effect size criteria decrease as the outcome becomes more distant from training intervention

Studies contributing to evidence synthesis on behaviours

Intervention	Method of delivery	1st author, yr of publication
Office ergonomics	Multi-component, 1 session	Brisson 1999
Office ergonomics	Multi-component, 2 sessions	Eklöf 2004, 2006
Office ergonomics	Multi-component, 2 sessions	Greene 2005
Dermatitis prevention in "wet work" in health care organizations	Multi-component, 3 sessions	Held 2002
Farm safety, farmers	Multi-component, 2 sessions	Rasmussen 2003
Universal Precautions, health care workers	Computer-based, 2 sessions	Wright 2005

Effects contributing to evidence synthesis on behaviours

Intervention	Size of effects (*d*)
Office ergonomics (Brisson 1999)	+0.30 §, +0.33 §, +0.18 §, +0.28 §
Office ergonomics (Eklöf 2004; 2006)	+1.09, +0.95, +1.71, +1.35, +1.98, +2.36
Office ergonomics (Greene 2005)	+1.16
Dermatitis prevention, HCWs	+0.42 §
Farm safety, farmers	Not calculable, but positive direction
Universal Precautions, HCWs	+1.25

§ Median *d* of conceptually similar measures

Median effect size (*d*) = +1.09

Interquartile range = +0.33 to +1.35

Effects on behaviours relative to evidence synthesis algorithm

Outcome	Status of body of evidence relative to evidence synthesis criteria			**Resulting level of evidence**
	Number Fair/Good studies	Consistent	Median effect Size	
Knowledge				
Attitudes				
Behaviours	Enough (6)	Yes	Large (+1.09)	**Strong**
Health				

Studies contributing to evidence synthesis on health (i.e. injury, illness, symptoms)

Intervention	Method of delivery	1st author, yr of publication
Box cutter use, retail workers	Multi-component, 1 session	Banco 1997
Office ergonomics	Multi-component, 2 sessions	Eklöf 2004, 2006
Office ergonomics	Multi-component, 2 sessions	Greene 2005
Dermatitis prevention in "wet work" in health care organizations	Multi-component, 3 sessions	Held 2002
Farm safety, farmers	Multi-component, 2 sessions	Rasmussen 2003

Effects contributing to evidence synthesis on health (i.e. injury, illness, symptoms)

Intervention	Size of effects (*d*)
Box cutter training	+0.06
Office ergonomics (Eklöf 2004; 2006)	-0.13, -1.34, -0.37
Office ergonomics (Greene 2005)	-0.12 [§], +0.27 [§]
Dermatitis prevention, HCWs	+0.05
Farm safety, farmers	+0.06

[§] Median *d* of conceptually similar measures

Median effect size (*d*) = -0.04

Interquartile range = -0.25 to +0.06

Effects on health (i.e. injuries, illness & symptoms) and behaviours relative to evidence synthesis algorithm

Outcome	Status of body of evidence relative to evidence synthesis criteria			**Resulting level of evidence**
	Number Fair/Good studies	Consistent	Median effect Size	
Knowledge				
Attitudes				
Behaviours	Enough (6)	Yes	Large (+1.09)	**Strong**
Health	Enough (5)	No	Not sufficient (-0.04)	**Insufficient**

Effects on all outcomes relative to evidence synthesis algorithm

Outcome	Status of body of evidence relative to evidence synthesis criteria			**Resulting level of evidence**
	Number Fair/Good studies	Consistent	Median effect Size	
Knowledge	Two few (2)	Yes	Large (+2.52)	**Insufficient**
Attitudes	Two few (1)	n/a	Sufficient (+0.84)	**Insufficient**
Behaviours	Enough (6)	Yes	Large (+1.09)	**Strong**
Health	Enough (5)	No	Not sufficient (-0.04)	**Insufficient**

Sensitivity analysis 1: Allow each study to contribute only one effect to synthesis

Outcome	Status of body of evidence relative to evidence synthesis criteria			**Resulting level of evidence**
	Number Fair/Good studies	Consistent	Median effect Size	
Knowledge	Two few (2)	Yes	Large (+2.52)	**Insufficient**
Attitudes	Two few (1)	n/a	Sufficient (+0.84)	**Insufficient**
Behaviours	Enough (6)	Yes	Large (+1.16)	**Strong**
Health	Enough (5)	Yes	Too small (+0.06)	**Insufficient**

Sensitivity analysis 2: Include limited quality studies too; and allow each study to contribute only one effect to synthesis

Outcome	Status of body of evidence relative to evidence synthesis criteria			**Resulting level of evidence**
	Number of studies	Consistent	Median effect Size	
Knowledge	Enough (5)	Yes	Sufficient (+1.27)	**Sufficient**
Attitudes	Enough (3)	Yes	Sufficient (+0.85)	**Sufficient**
Behaviours	Enough (10)	Yes	Sufficient (+0.79)	**Sufficient**
Health	Enough (10)	Yes	Too small (+0.05)	**Insufficient**

What is your explanation for these findings?

- How can OHS training be found to be ineffective in impacting health?
- Why is there strong evidence of an effect of OHS training on worker practices (behaviours), yet insufficient evidence of an effect on health?

How does this fit with other research evidence?:
Recent reviews on ergonomic interventions (1)

- Various IWH reviews have not been supportive of OHS training on MSDs
  - Ergonomics training
    - Mixed evidence (Brewer et al. 2006; Amick et al. 2008)
    - Moderate evidence of NO effect (Brewer et al. 2007)
  - Manual lifting training
    - Mixed evidence (Brewer et al. 2007)

Brewer S, Van Eerd D, Amick BC III, Irvin E, et al. Workplace interventions to prevent musculoskeletal and visual symptoms and disorders among computer users: A systematic review. J Occup Rehabil 2006;16:325.

Brewer S, King E, Amick BC, Delclos G, et al. Systematic review of injury/illness prevention and loss control programs. Toronto: IWH, 2007.

Amick BC, Kennedy C, Dennerlein J, Brewer S, et al. Systematic review of the role of OHS interventions in the prevention of upper extremity musculoskeletal symptoms, signs, disorders, injuries, claims and lost time. Toronto: IWH, 2008.

How does this fit with other research evidence?:

Recent reviews on ergonomic interventions (2)

Martimo KP, Verbeek J, Karppinen J, **Furlan AD**, et al. Effect of training and lifting equipment for preventing back pain in lifting and handling: systematic review. British Medical Journal 2008; 336:429-431.

- Cochrane review on lifting training and back pain
- "No evidence to support use of advice or training in working techniques"

How does this fit with other recent research evidence?:

Size of effects seen in IWH review similar to those seen in other recent review

	IWH study (2010)	**Burke et al. study (2006)***
Behaviours	Median *d* = 1.09	Mean *d* = 0.72
Health	Median *d* = -0.04	Mean *d* = 0.25

* For this comparison, Burke et al. data are restricted those most comparable to IWH study (involving high engagement interventions, between-group study designs)

Burke MJ et al. Relative effectiveness of worker safety and health training methods. American Journal of Public Health 2006;96:315.

Practical messages

After considering the evidence from this review:

The review team **recommends** that workplaces continue to conduct education and training programs, since they have a positive impact on worker OHS practices (behaviours). However, OHS training **as a lone intervention** has not been demonstrated to have an impact on health (e.g. injuries, symptoms).

Practical messages (cont.)

- We strongly suggest that decision-makers consider more than just training when addressing a risk or an emerging problem in the workplace, since **large impacts of training alone cannot be expected**
  - Traditional hierarchy of controls approach would say:
    - Better to eliminate hazard or use engineering solution
  - Theory and experimental findings suggest multiple component approach to intervention might be best:
    - e.g. change in policy, equipment & training effective in preventing injuries from lifting patients (Amick et al. 2006)

IWH research question 2

- Does higher engagement OHS training have a greater beneficial effect on workers than lower engagement OHS training?

What do we mean by level of engagement in training?

- Refers to the degree to which the learner is engaged in the training process
- You might use other terms:
    - low engagement vs. high engagement
    - passive learning vs. active learning
    - teacher-centred vs. learner-centred

Prior literature review

- **Meta-analysis**
  - 95 studies from 1971-2003
  - Quasi-experimental study designs
  - Outcomes: Knowledge, behaviours, health
  - Higher engagement training is more effective than lower engagement training

Burke MJ et al. Relative effectiveness of worker safety and health training methods. American Journal of Public Health 2006;96:315.

Evidence synthesis algorithm: same as before

Level of evidence	Method. quality	Quantity (min.)	Consistency	Median Effect Size
Strong	Good	2	Yes	Sufficient
	Fair/Good	5	Yes	Sufficient
	Meet criteria for Sufficient level of evidence			Large
Sufficient	Good	1	n/a	Sufficient
	Fair/Good	3	Yes	Sufficient
Insufficient	Any of the above 4 criteria not met			

Based on Briss et al. (2000) Developing an evidence-based *Guide to Community Preventive Services* – Methods. Am J Prev Med 18(1S):35.

Effect size criteria smaller for comparisons of two trainings

Outcome	Training versus control comparisons		Higher versus lower engagement training comparisons	
	Large *d*	Sufficient *d*	Large *d*	Sufficient *d*
Knowledge	1.50	1.00	0.38	0.25
Attitudes & Beliefs	1.00	0.50	0.25	0.12
Behaviours	0.80	0.40	0.20	0.10
Health	0.30	0.15	0.08	0.04

Divided by 4

Evidence syntheses: higher vs. lower engagement studies

Outcome	Status of body of evidence relative to evidence synthesis criteria			**Level of evidence**
	Number Fair/Good studies	Consistent	Median effect size	
Knowledge	Two few (1)	n/a	Not available	**Insufficient**
Attitudes	Two few (1)	n/a	Sufficient (+0.12)	**Insufficient**
Behaviours	Enough (3)	Yes	Insufficient (+0.06)	**Insufficient**
Health	Two few (1)	n/a	Large (+0.60)	**Insufficient**

Evidence synthesis statements

Insufficient evidence that a single session of *high engagement* training is more effective than a single session of *medium/low engagement* training on behaviours

- Because observed effects are too small

Insufficient evidence that *higher engagement* training is more effective than *lower engagement* training on knowledge, attitudes or health

- Because there are too few studies of sufficient methodological quality available

Burke et al. review: Mean effect sizes* *(d)* by level of learner engagement

Level of engagement	Knowledge	Behaviours	Health
Least	+0.58	+0.65	-0.20
Moderately	+0.66	+0.74	+0.04
Highly	+1.27	+0.72	+0.25

* Burke et al. data are restricted those most comparable to IWH study (between-group study designs)

Burke MJ et al. Relative effectiveness of worker safety and health training methods. American Journal of Public Health 2006;96:315.

Practical messages:

The review team is unable to make recommendations about the nature of training (e.g., computer versus lecture, number of sessions)

We suggest that training should be designed to be as engaging as possible for the method of delivery used or the resources employed

Questions?

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