Are workplace health promotion/wellness programs effective at improving presenteeism (on-the-job productivity) in workers? A systematic review and best evidence synthesis of the literature.

by

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I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Background: *Presenteeism* is highly prevalent and costly to employers. It is defined as being present at work but limited in some aspect of job performance by a health problem. Workplace health promotion (WHP) is a common strategy used to enhance on-the-job productivity.

Objectives: The primary objective is to determine if WHP programs are effective in improving presenteeism. Secondary objectives include identifying the types of risk factors and health issues affecting workers who work despite health problems, and to identify characteristics of the programs successful at improving presenteeism.

Study Design: Systematic search and best-evidence synthesis of the scientific literature.

Data Sources: The Cochrane Library, Medline, Embase, CINAHL Plus, PsychINFO, and other electronic databases were searched from 1990 to 2010 using key words such as *presenteeism, 'health and productivity management', 'health promotion',* and *workplace*. In addition, the reference lists of relevant studies were examined, specialized journals were hand-searched, experts were contacted, and websites of government and other organizations involved with WHP were scanned for relevant information.

Study Selection: Citations were screened for relevance using a priori criteria, and relevant studies were critically reviewed for scientific merit. After 2,032 titles and abstracts were screened, 47 articles were reviewed, and 30% of these were accepted as scientifically admissible (representing 14 unique studies).

Data Extraction: Data from accepted studies were abstracted into evidence tables relating to interventions implemented in specific work settings and employee groups, and their resulting effects on presenteeism.

Data Synthesis: The scientifically admissible studies consisted of 5 (36%) randomized controlled trials (RCTs), 5 (36%) cluster RCTs, 1 (7%) interrupted time series, 1 (7%) crossover design, 1 (7%) pre-post study, and 1 (7%) quasi-experimental study. Risk factors contributing to presenteeism include being overweight, poor diet, lack of physical exercise, high stress, and poor relations with coworkers and management. Contributing health conditions include arthritis, musculoskeletal disorders, allergies,

chronic pain, and depression and anxiety. There is preliminary evidence of a positive effect of some WHP programs. Successful programs offer organizational leadership, health risk screening, individually tailored programs, incentives, and a supportive workplace culture.

Conclusions: The presenteeism literature is young, heterogeneous, and inconsistent, limiting the ability to draw firm conclusions. Nonetheless, the available evidence suggests that presenteeism is an important issue for employers and society. Better quality research is needed in this area. Future research would benefit from standard presenteeism metrics, studies conducted across a broad range of workplace settings and employee populations, and better reporting of studies in line with current scientific standards.

Key Words: Presenteeism; Health and productivity management; Workplace health promotion; Primary prevention; Systematic review.

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CI = confidence interval
F = effect size
M = mean (standard deviation in brackets)
p = probability value
β = beta
RR = relative risk

Introduction

A healthy and productive workforce is critical for business success and to serve the population's needs. Illness at the workplace can result in lost productivity which arises from two sources: *absenteeism* and *presenteeism. Absenteeism* refers to an employee's time away from work due to illness, and includes short- and long-term disability for non-occupational illness or injury and workers' compensation for occupational causes (Schultz, Chen & Edington, 2009). *Presenteeism* refers to the "decrease in productivity for the much larger group of employees whose health problems have not necessarily led to absenteeism and the decrease in productivity for the disabled group before and after the absence period," (Burton, Conti, & Chen, 1999). It is defined as being present at work but limited in some aspect of job performance by a health problem. It is often a hidden cost for employers, as workers are physically present but unable to perform at peak levels (Shultz & Edington, 2007). It includes time not on task, decreased quality of work (e.g., product waste and product defects), unsatisfactory employee interpersonal factors, and unsatisfactory work culture (Loeppke, Hymel, Lofland, Pizzi, Konicki, Anstadt, et al., 2003). Presenteeism can be due to an acute illness (e.g., cold) or to a chronic, ongoing condition (e.g., arthritis) (Shultz et al.). Both of these states, absenteeism and presenteeism, are part of a continuum within which workers likely transition back and forth over time, and both create a financial burden to employers (Escorpizo, Bombardier, Boonen, Hazes, Lacaille, Strand, et al., 2007).

Presenteeism emerged as a new business issue in the 1990's, as there was a growing understanding of the link between workplace health and employee well-being and performance (National Business Group on Health, Towers Watson, 2010). The changing nature of work and the significant demographic shift observed in developed countries may result in a workforce that is likely to be at work despite chronic disease and disability. Subsequent rising health care costs, and increasing awareness of presenteeism losses, are increasing the demand for health promotion for working populations (Chapman, 2005a).

Determinants of Presenteeism and Magnitude of the Problem

Improved worker health can lead to increased on-the-job productivity. However, it is becoming a major challenge to maintain a healthy and productive workforce for developed countries due to an increasing number of people affected by chronic conditions, and an aging workforce that is more likely to be affected by such conditions. Many will have multiple health problems which will further impact their quality of life and ability to perform on the job (Kenny, Yardley, Martineau, & Jay, 2008; Schultz & Edington, 2007).

Chronic conditions are major causes of illness, disability, lost productivity, and death in North America. At least one third (nine million) of Canadians live with chronic disease (Broemeling, Watson, Prebtani, & Health Outcomes Steering Committee of the Health Council of Canada, 2008) and it is estimated that 160 million Americans will be affected by the year 2040 (Sturz & McMahan, 2006). The numbers of people affected are expected to increase as the population ages, especially if risk factors that contribute to poor health continue to rise (Broemeling et al.).

Arthritis and high blood pressure are among the most prevalent chronic issues and commonly co-occur with other conditions (Broemeling et al., 2008). Among those with chronic conditions, more than one third of adults and more than one half of seniors report co-morbidity. The more health risks an individual has, the greater the impact on their workplace productivity, and co-morbid mental and physical conditions result in further reduced productivity (Parker, Wilson, Vandenberg, DeJoy, & Orpinas, 2009; Shultz and Edington, 2007). The proportion of people with chronic conditions and associated co-morbidity increases consistently with advancing age (Broemeling et al). Unfortunately, less than 4% of a large sample of the older U.S. working population reported overall healthy behaviours, with the majority reporting current smoking and risky drinking habits, as well as decreased physical activity levels (Fleming, Lee, Martinez, LeBlanc, McCollister, Bridges, et al., 2007).

It is estimated that by the year 2026, one in five Canadians will be 65 years of age or older (Health Canada, 2002). Over the next ten years, the number of Canadian workers aged 55 to 64 will increase by more than 50% and, by the year 2015, they will make up 48% of the labour force (Human

Resources and Skills Development Canada, 2002). Worldwide, by the year 2050, the proportion of persons aged 60 years and older is expected to double and will account for 21% of the total global population (Kenny et al., 2008). With the recent recession and loss in savings for many people near retirement, the number of employees deferring retirement will also add to the proportion of older workers (National Business Group on Health, 2010), and in turn, to the number of persons working with illness.

While age-related changes in mental and physical function are inevitable, they do not invariably lead to reduced performance and productivity (Sturz & McMahan, 2006). In fact, in many ways, older workers possess a strong work ethic and are among the most experienced, skilled, loyal and productive employees. However, if employers fail to provide programs and policies to support their productive capacities, they may experience adverse impacts on worker quality, productivity, safety, and compensation. Programs which most effectively meet the needs of an aging workforce are not just programs for older workers, but are also for those starting their working career, in order to prevent or reduce chronic diseases at work (Silverstein, 2008). For instance, in a recent review of the literature, it was found that age-associated functional declines and the risk of injury and illness can be prevented and/or delayed by worksite health interventions that encourage physical activity during working hours (Kenny et al., 2008).

Recent reviews and studies have found that several health conditions significantly impact presenteeism including arthritis, allergies, migraine, chronic pain, diabetes, hypertension, gastro-intestinal conditions, gastro-esophageal reflux disease (GERD), musculoskeletal (MSK) disorders (mainly back and neck pain), respiratory disorders, mental health problems such as depression and anxiety, cancer, cardiovascular disease, and metabolic syndrome (Allen, Hubbard, & Sullivan, 2005; Berry, 2007; Burton, Chen, Schultz, & Edington, 2008; Burton, Pransky, Conti, Chen, & Edington, 2004; Goetzel, Gibson, Short, Bong-Chul, Waddell, Bowen, et al., 2010; Goetzel, Long, Ozminkowski, Hawkins, Wang, & Lynch, 2004; Kessler, White, Birnbaum, Qiu, Kidolezi, Mallett, et al., 2008; Leoppke, Taitel, Haufle, Parry, Kessler, & Jinnett, 2009; Lerner & Henke, 2008; Lerner, Mirza, Chang, Renzulli, Perch, & Chelmow, 2008; Mannion, Horisberger, Eisenring, Oezguer, Elfering, & Muller, 2009; Schultz et al.,

2009; Schultz & Edington, 2007, 2009a, 2009b; Stewart, Wood, Razzaghi, Reed, & Lipton, 2008; Weiss, Bernards, & Price, 2008; Williams, Wagner, Kannan, & Bolge, 2009).

Common health risks and/or behaviours associated with these conditions include poor diet, high BMI, high cholesterol, low physical activity, high stress, low use of preventive services, reduced fulfillment, high blood pressure, smoking, alcohol use, life and job dissatisfaction, and fatigue (Bernaards, Proper, & Hildebrandt, 2007; Burton, Chen, Conti, Schultz, Pransky, & Edington, 2005; Burton, McCalister, Chen, & Edington, 2006; Gates, Succop, Brehm, Gillespie, & Sommers, 2008; Goetzel et al., 2010; Pauly, Nicholson, Polsky, Berger, & Sharda, 2008; Ricci, Chee, Lorandeau, & Berger, 2007; Soler, Leeks, Razi, Hopkins, Griffith, Aten, et al., 2010). On the other hand, it has been reported that reducing health risk factors positively impacts work performance (Burton, Chen, Conti, Schultz, & Edington, 2006). Indeed, the risk of developing most of these chronic conditions can be reduced with improved diet, exercise, education, ergonomics, and assistive devices (Sturz & McMahan, 2006). It has been shown, for example, that higher levels of physical activity are associated with an increase in quality of work. Similarly, higher cardio-respiratory fitness is related to an increase in quantity of work performed, as well as a reduction in extra effort exerted to perform work (Pronk, Martinson, Kessler, Beck, Simon, & Wang, 2004).

While health limitations and risks are the strongest determinants of presenteeism, other factors can impact presenteeism risks. These include work/life balance, personal financial situation, age, ease with which a replacement can be found, conflicting demands at work, lack of control over pace of work, poor work environment, high mental and physical workload, poor physical strength and endurance, poor employee relations with management, and psychological issues (van den Berg et al., 2009). In a random Swedish sample of 3,136 persons, Aronsson and Gustafsson (2005) found that increased presenteeism was associated with organizational conditions such as difficulty finding worker replacements and insufficient resources, while decreased presenteeism was associated with workers who had a high level of control over their work, such as being able to determine their own work pace. In a previous cross-sectional study (Aronsson, Gustafsson, & Dallner, 2000), it was demonstrated that the degree of

presenteeism was strongly related to the type of work. These authors obtained data from workers in several occupational sectors (e.g., commercial, manufacturing, administrative, restaurant and service, and business and health professionals). They found high presenteeism levels in the welfare and education sectors (e.g., nurses and school teachers), indicating that individuals who are more likely to work through illness are in occupations which involve caring for others.

Previous Research in this Area

Research on interventions to improve presenteeism is still relatively new compared with other workplace issues such as healthcare costs and absenteeism. Most of the literature on presenteeism is about its measurement. With respect to studying presenteeism in different employee groups, the greatest attention has been given to nurses, manufacturing employees, and financial services corporations (Schultz & Edington, 2007).

To the best of my knowledge, only two other studies have systematically reviewed the literature to search for workplace health promotion (WHP) interventions that produce the greatest improvement in productivity (Riedel, Lynch, Baase, Hymel, & Peterson, 2001) and work ability (Kuoppala, Lamminpää, & Husman, 2008). Riedel and colleagues searched all English language primary studies, reviews, concept articles, and background articles related to WHP and its effect on worker productivity from 1993 through 1998. They reported extensively searching computer databases, manually searching selected journals, reviewing articles for relevance and rigor, searching references from pertinent articles, consulting with professional colleagues and business research groups, and identifying seminal publications and leading practices. They reviewed 146 articles but found that when productivity loss information was available, it was mostly measured in terms of absenteeism rather than presenteeism. They explained that there was a lack of attention paid to productivity outcomes, partly due to the complexity of the relationships between health changes and these outcomes. The interventions which seemed to provide short-term performance loss savings were depression screening, back pain exercise programs, smoking cessation, influenza vaccination, and care-seeking programs for minor illnesses. They concluded that two major challenges to

the success of WHP programs were getting high participation rates and maintaining behaviour change over time.

Kuoppala and colleagues (2008) studied the association between WHP and job well-being, work ability, absenteeism, and early retirement. Work ability was defined as employees' physical, psychological, and social capacity to work and depends both on their health and the contents of their work. They reported to have systematically searched and critically evaluated the literature in Medline and PsychINFO from 1970 to 2005 for original studies and systematic reviews. Out of 1312 references, 46 studies were included in their analysis. These authors concluded that with respect to work ability, there is moderate evidence that WHP involving exercise increases work ability (*RR* = 1.38, 1.15-1.66). However this finding was based on a study with weak methodological design (Pohjonen & Ranta, 2001) according to the analysis performed by Kuoppala and colleagues, as well as myself. It had substantial biases in the areas of participant selection, study design, confounding, blinding, and issues surrounding withdrawals and dropouts. In addition to these two reviews, presenteeism has been discussed in several different studies, regarding its definition, prevalence, causation, health and economic impacts, etc. (Alavinia, Molenaar, & Burdorf, 2009; Bergstrom, Bodin, Hagberg, Lindh, Aronsson, & Josephson, 2009; Birnbaum, Kessler, Kelley, Ben-Hamadi, Joish, & Greenberg, 2010; Bunn, Stave, Downs, Alvir, & Dirani, 2006; Burton, Landy, Downs, & Runken, 2009; Chan, Hales, Shear, Ho, Lynde, & Poulin, 2009; Daley, Morin, LeBlanc, Gregoire, Savard, & Baillargeon, 2009; Dew, Keefe, & Small, 2005; Dew & Taupo, 2009; Gilmour & Patten, 2007; Gisbert, Cooper, Karagiannis, Hatlebakk, Agreus, Jablonowski, et al., 2009; Goetzel, Carls, Wang, Kelly, Mauceri, Columbus, et al., 2009; Gucer, Oliver, Parrish, & McDiarmid, 2009; Hagberg, Vilhemsson, Tornqvist, & Toomingas, 2007; Hansen & Andersen, 2008; Hilton, Scuffham, Sheridan, Cleary, & Whiteford, 2008; Howard, Mayer, & Gatchel, 2009; Johnston, Westerfield, Momin, Phillippi, & Naidoo, 2009; Kleinman, Brook, Patel, Melkonian, Brizee, Smeeding, et al., 2007; Kleinman, Brook, Rajagopalan, Gardner, Brizee, & Smeeding, 2005; Kleinman, Harnett, Melkonian, Lynch, Kaplan-Machlis, & Silverman, 2009; Kolbe, Tirozzi, Marx, Bobbitt-Cooke, Riedel, Jones, et al., 2005; Lamb, Ratner, Johnson, Ambegaonkar, Joshi, Day, et al., 2006; Li, Gignac, & Anis,

2006; Martimo, Shiri, Miranda, Ketola, Varonen, & Viikari-Juntura, 2009; McIntyre, Wilkins, Gilmour, Soczynska, Konarksi, Miranda, et al., 2008; Musich, Hook, Baaner, Spooner, & Edington, 2006; Nichol, D'Heilly, Greenberg, & Ehlinger, 2009; Pransky, Berndt, Finkelstein, Verma, & Agrawal, 2005; Rosekind, Gregory, Mallis, Brandt, Seal, & Lerner, 2010; Rodbard, Fox, Grandy, & Shield Study Group, 2009; Tsai, Ahmed, Wendt, Bhojani, & Donnelly, 2008; Tunceli, Zeng, Habib, & Williams, 2009; van den Berg, Alavinia, Bredt, Lindeboom, Elders, & Burdorf, 2008; van den Berg, Elders, de Zwart, & Burdorf, 2009).

Economic Burden/Costs to Employers

The dollar value of presenteeism cannot be stated at this time because past studies have a large variation in their assessment, populations studied and the assigned dollar value of the losses. However, it appears that costs are considerable (Schultz et al., 2009; Tang, Pitts, Solway, & Beaton, 2009). A recent study of the ten most common health conditions associated with presenteeism showed that indirect health costs accounted for 18% to 60% of all costs (US data) (Goetzel et al., 2004). In addition, it was reported that on average, for every 1 dollar employers spend on worker medical or pharmacy costs, they absorb at least 2 to 4 dollars of health-related productivity costs, mostly in the form of presenteeism (US data) (Leoppke et al., 2009).

A study of the Dow Chemical Company is one of the most comprehensive attempts by a company to assess work impairment from chronic health conditions in its U.S. workforce (Collins, Baase, Sharda, Ozminkowski, Nicholson, Billotti, et al., 2005). Dow has a diverse workforce in a broad range of knowledge- and production-based jobs. The study clearly showed that chronic health conditions (primarily allergies, arthritis/joint pain or stiffness, and back/neck disorders) affect a majority of workers, and these conditions significantly impacted work impairment and productivity, in addition to absenteeism and medical costs. Consistent with other published findings, the cost associated with presenteeism greatly exceeded the combined costs of absenteeism and medical treatment. Two thirds of workers reported one or more chronic health conditions and these conditions were estimated to cost Dow more

than $100 million annually in lost productivity. These authors suggested that focusing on absenteeism and ignoring presenteeism underestimates the true magnitude of the impact of health on productivity, and inaccurately characterizes the financial return on various health interventions.

Presenteeism: Long-term Implications for Employees

There is a risk that workers who are present at work while sick today will be sick and absent in the future (Aronsson & Gustafsson, 2005; Bergstrom et al., 2009; Hansen & Andersen, 2009; Munir, Yarker, & Haslam, 2008). In the well-known Whitehall study, a large cohort of 5,071 male British civil servants without previous myocardial infarction, were followed for nine years (Kivimäki, Head, Ferrie, Hemingway, Shipley, Vahtera, et al., 2005). The incidence of serious coronary events of unhealthy employees who took no absence was twice as high as that of the unhealthy employees with moderate levels of sickness absenteeism. The authors stated that mechanisms potentially contributing to the association between presenteeism and increased serious coronary events include, (a) working while ill may produce a cumulative psychological burden with pathophysiological consequences, (b) working while ill may induce acute stressors that act on subclinical disease, and (c) presenteeism may be part of a lifestyle in which symptoms are ignored.

Measurement of Presenteeism

Compared to absenteeism, measuring presenteeism is a relatively new field. No agreement has been reached at this time as to the most appropriate method for measuring or monetizing it (Chen, Blanc, Hayden, Bleecker, Chawla, & Lee, 2008; Schultz et al., 2009). It is typically measured as the costs associated with reduced work output, errors on the job and failure to meet company production standards (Schultz & Edington, 2009b). There are three steps to determine the impact of presenteeism at the workplace: *measurement, conversion* and *translation* (Edington, 2010). Conversion consists of identifying relevant measures from an instrument (e.g., work quality) and creating a metric to quantify those measures. Translation attempts to monetize the loss in productivity (Edington, 2010).

Several self-report instruments have been developed to measure presenteeism across various types of jobs and organizations (Escorpizo, Cieza, Beaton, & Boonen, 2009; Lofland, Pizzi, & Frick, 2004; Prasad, Wahlquist, Shikiar, & Shih, 2004; Schultz et al., 2009). These types of measures are useful especially when it is difficult to obtain objective data regarding particular characteristics of a workplace or profession (e.g., number of parts manufactured). Evidence of their psychometric properties have been reported in varying degrees and most have gained acceptance as valid and reliable tools (Beaton, Bombardier, Escorpizo, Zhang, Lacaille, Boonen, et al., 2009; Beaton, Tang, Gignac, Lacaille, Badley, Anis, et al., 2010; Chen et al., 2008; Escorpizo, et al., 2007, 2009; Kessler, Ames, Hymel, Loeppke, McKenas, Richling et al., 2004; Lofland et al., 2004; Mattke, Balakrishnan, Bergamo, & Newberry, 2007; Prasad et al., 2004; Sanderson, Tilse, Nicholson, Oldenburg, & Graves, 2007; Schultz & Edington, 2007; Tang et al., 2009; Temkin-Greener, Zheng, Katz, Zhao, & Mukamel, 2009).

The first 16 instruments were used in at least one scientific publication and are listed in order of frequency publication (Edington, 2010):

1. Work Limitations Questionnaire (WLQ) (Beaton et al., 2010; Lerner, Amick, Rogers, Malspeis, Bungay, & Cynn, 2001),
2. Work Productivity and Activity Impairment (WPAI) (general or specific) (Reilly, Zbrozek, & Dukes, 1993; Wahlqvist, Guyatt, Armstrong, Degl'innocenti, Heels-Ansdell, El-Dika et al., 2007),
3. Health and Work Performance Questionnaire (HPQ) (Kessler, Barber, Beck, Berglund, Cleary, McKenas, et al., 2003),
4. Work and Health Interview (WHI) (Stewart, Ricci, Laotta, & Chee, 2004),
5. Stanford Presenteeism Scale (SPS) (Beaton et al., 2010; Koopman, Pelletier, Murray, Sharda, Berger, Turpin, et al., 2002),
6. Health and Labor Questionnaire (HLQ) (Prasad et al., 2004; van Roijen, Essink-Bot, Koopmanschap, Bonsel, & Rutten, 1996),

7. Work Productivity Short Inventory (WPSI) (Goetzel, Hawkins, Ozminkowski, & Wang, 2003; Goetzel, Ozminkowski, & Long; 2003; Ozminkowski, Goetzel, & Long, 2003),
8. Endicott Work Productivity Scale (EWPS) (Beaton et al., 2010; Endicott & Nee, 1997),
9. Migraine Work and Productivity Loss Questionnaire (MWPLQ) (Lerner, Amick, Malspeis, Rogers, Santanello, Gerth, et al., 1999; Loeppke, Hymel, Lofland, Pizzi, Konicki, Anstadt et al., 2003; Prasad et al., 2004),
10. Osterhaus Technique (Mattke, Balakrishnan, Bergamo, & Newberry, 2007),
11. Angina-Related Limitations at Work Questionnaire (ALWQ) (Lerner, Amick, Malspeis, Rogers, Gomes, & Salem, 1998),
12. Health and Work Questionnaire (HWQ) (Halpern, Shikiar, Rentz, & Khan, 2001),
13. Health-Related Productivity Questionnaire Diary (HRPQ-D) (Kumar, Hass, Li, Nickens, Daenzer, & Wathen, 2003),
14. Migraine Disability Assessment Questionnaire (MIDAS) (Prasad et al., 2004; Stewart, Lipton, Kolodner, Sawyer, Lee, & Liberman, 2000),
15. Work Instability Scale (WIS) (Beaton et al., 2010;Escorpizo et al., 2007),
16. Health Assessment Questionnaire (HAQ) (Wolfe, Michaud, & Pincus, 2004),
17. Workplace Activity Limitations Scale (WALS) (Beaton et al., 2010)
18. Work Productivity Survey (WPS) (Osterhaus, Purcaru, & Richard, 2009)

These instruments vary significantly in content, length and scope. The WLQ, WPAI, SPS, EWPS, WIS, WALS, and WPS have demonstrated moderate to good properties of reliability, validity, and responsiveness. There is evidence of moderate to good reliability and validity in the WPSI, ALWQ, and MIDAS. The HPQ, WHI, MWPLQ, HWQ, HRPQ-D, and HAQ have demonstrated moderate to good validity. There does not appear to be enough data to comment on the psychometric properties of the HLQ, or the Osterhaus Technique. All of the instruments listed have been utilized in different populations and settings, and there is insufficient data at this time to determine which are best.

Instruments assess presenteeism primarily in three different ways (Mattke et al., 2007). These are (a) assessment of perceived impairment, (b) comparative productivity, performance, and efficiency, and (c) estimation of unproductive time while at work. The most commonly used is the a*ssessment of perceived impairment* (e.g., HPQ, HWQ, SPS, WLQ, and WPAI). In this approach, employees are asked how much their illnesses hinder them in performing common mental, physical, and interpersonal tasks and in meeting job demands. The c*omparative productivity, performance, and efficiency* approach attempts to identify how a worker's performance differs from that of others or from one's usual performance (e.g., HPQ and HWQ). Finally, the e*stimation of unproductive time while at work* is only done by few instruments such as the WPSI.

The American College of Occupational and Environmental Medicine (ACOEM) recommends that presenteeism measures cover the following aspects: time not on task, quantity of work, quality of work (i.e., performance, mistakes, injury rates, etc.), and personal factors (i.e., physical, mental, emotional, social, etc.). Regardless of the type of instrument chosen, researchers must carefully interpret their findings because different instruments measure different aspects of presenteeism (Schultz & Edington, 2007).

Instrument features have been well described (Escorpizo et al., 2009; Edington, 2010). Some are specific for a particular condition such as migraines (e.g., MWPLQ); some are suitable across a broader range of health conditions (e.g., WLQ, WPAI, HPQ, and HLQ); some exclusively address presenteeism (e.g., SPS and HWQ) or absenteeism, while others address both. Some instruments include components to quantitatively estimate monetary loss (e.g., WLQ); some examine the effects of poor health on work, and others also assess the impact of work on health. Further characteristics include measures to quantify productivity losses in terms of the amount of time where difficulty was encountered, or the amount of difficulty experienced when completing specific work tasks (Tang et al., 2009). Certain measures also attempt to assess the potential mismatch between a worker's functional abilities in relation to the demands of his/her job (Tang et al.).

Additional measurement methods have recently been developed. An *imputation methodology* was developed in order to estimate health-related work performance and productivity (the outcomes) based on existing information about other characteristics (the predictors) (Lerner, Chang, Rogers, Benson, Schein, & Allaire, 2009). Lerner and colleagues found that fifteen commonly collected health variables may be used to predict WLQ impact for those with musculoskeletal pain and physical impairments. These authors argue that imputation is a practical, low-cost solution for estimating impacts on productivity in studies that have good health measurements but no direct measurement of productivity. Another study by Allen (2008) demonstrated how data captured by a more comprehensive health risk assessment (HRA) like the *Wellness Checkpoint* can be used to quantify lost productivity. This HRA includes measures such as impaired performance while on the job and absenteeism. It also includes other components that are thought to contribute to the prediction of productivity loss including job characteristics (e.g., demands and satisfactions), personal characteristics (e.g., predisposition toward stress), and company characteristics (e.g., industry, type, and location).

The ultimate objective of presenteeism instruments is to quantify the resultant financial loss of reduced on-the-job productivity (Edington, 2010). Once the instruments have been implemented, they usually produce outputs such as lost time, costs, or other estimates of productivity (e.g., efficiency, and quality of work). This is the *conversion* process which consists of identifying the relevant measures from the instrument and creating a metric to quantify those measures. The final step in the quantification of presenteeism is the *translation* process which attempts to monetize the loss in productivity. In general, the three areas that impact the credibility of translating self-reported measures into monetary equivalents are recall and recall duration time, the choice of conversion and translation methods, and cost indicators (Edington, 2010).

A variety of translation models have been proposed over the past few years, each of which have their own strengths and limitations. The *Human Capital Method* (HCM) and the *Friction Cost Method* (FCM) are the two techniques cited most frequently in the presenteeism literature; however no general consensus exists at this time with respect to a consistent approach to translation (Cyr & Hagen, 2007;

Edington, 2010; Loeppke, Taitel, Richling, Parry, Kessler, Hymel, et al., 2007; Mattke et al., 2007). The HCM is the most common and easiest method to apply. It uses self-reported unproductive hours multiplied by hourly wage (Mattke et al.). The FCM requires information on how long it takes to replace a sick worker and how long it takes for that replacement to become as productive as his/her predecessor. These two commonly used methods give very different estimates of productivity cost (Cyr & Hagen).

Workplace Health Promotion & Wellness

The number of employers offering comprehensive WHP programs has increased over the past three decades in both large and small worksites (Pelletier, 2005, 2009). In 2009, although 40% of U.S. and Canadian companies reported a decrease in their health and productivity budgets due to a sluggish economy, rising medical/pharmacy costs and higher rates of disability-related absences, they still continued to show commitment to health and productivity (National Business Group on Health, 2010). However, companies are becoming more selective buyers by offering only programs with evidence of a positive return on investment (National Business Group on Health).

Health promotion in the workplace has been defined as preventing, minimizing and eliminating health hazards in the workplace; maintaining and promoting the employee's work ability; and changing work practices, techniques and making the work environment a safer place (Naumanen, 2006). Worker health and wellness has been described as individual and holistic well-being and balance of the physical, mental and social ingredients, as well as work ability and health habits associated with good physical condition, energy and vitality (Naumanen). *Health and Productivity Management* (HPM) is the recognition that better management of employee health and its related productivity outcomes may drive economic growth and profits (Schultz et al., 2009).

Employers are compelled to seek effective measures for maintaining a healthy and productive workforce since there is an increasing burden of chronic illnesses, functional impairments, and work disability. This is especially the case since work disability can be prevented. While containing health care-related costs and absenteeism have been important strategies for companies, greater gains may be

realized by improving on-the-job productivity, and investing in preventive and early intervention services, (Goetzel, Shechter, Ozminkowski, Marmet, Tabrizi, & Roemer, 2007; Hillier, Fewell, Cann, & Shephard, 2005; Kuoppala, Lamminpää, & Liira, 2008; Pelletier, 2009; Special Committee on Health, Productivity, and Disability Management, ACOEM, 2009; Terry, Seaverson, Grossmeier, & Anderson, 2008; Tompa, Dolinschi, de Oliveira, & Irvin, 2009).

The ACOEM, the leading U.S. medical organization devoted to worker health and safety, believes that more resources should be devoted to health-related services in order to maximize workforce participation and productivity (Special Committee on Health, Productivity, and Disability Management, 2009). The ACOEM believes that a healthy workforce is one of the best indicators of a nation's overall health, and would reduce total costs consisting of health-related productivity loss, disability benefit costs, and medical costs. The organization finds it problematic that employers and insurers are not held responsible for helping people stay healthy and employed, and are often able to shift the costs of ill employees onto public programs such as welfare. Therefore, it recommends worksite programs in occupational, personal, and public health; benefits design; and economic and social policy; as well as implementing financial incentives to reward prevention activities.

Programs vary considerably in size and composition and have evolved significantly over the past 30 years. Comprehensive programs provide health education, supportive physical and social environments for health improvement, integration of health promotion into the organization's culture, and employee screening with adequate treatment and follow-up (Childress & Lindsay, 2006). Preliminary evidence suggests that integrated programs involving screening of all employees for risk followed by tailored individualized interventions are important elements of successful programs. However the tools to assess risk, the components of effective programs to improve productivity outcomes, how best to deliver programs and who should deliver them at the workplace have yet to be clearly identified.

As employers become more aware of presenteeism and the significant economic implications associated with it, they will be asking the next logical question: What can be done to decrease presenteeism in the workplace? The primary objective of this thesis is therefore to determine if

workplace health promotion/wellness programs are effective in improving presenteeism. Secondary objectives are to identify the types of risk factors and health issues affecting workers who work despite health problems, and to identify characteristics of the programs successful at improving presenteeism. With this last objective, I will attempt to answer how best to deliver an intervention and by whom, whether screening workers first (i.e., to determine if they should receive a specific intervention depending on their risk factors, etc.) is more successful, and whether tailored interventions and incentives lead to better results.

Methods

Literature Search

My objectives in this thesis are addressed by using a systematic search and best evidence synthesis of the scientific literature on presenteeism. I systematically searched the scientific literature published between 1990 and January, 2010. The primary sources of literature were the electronic databases of the Cochrane Library (i.e., Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, Cochrane Central Register of Controlled Trials, Cochrane Methodology Register, Health Technology Assessment Database, NHS Economic Evaluation Database), Medline, Embase, CINAHL Plus, NLM Gateway, PsychINFO, Evidence in Health and Social Care, AMED and the Trip Database. The following indexed terms and text words were used to search these databases: *workplace, 'health and productivity management', 'employee incentive plans', 'preventive health services', 'occupational health', 'occupational health services', 'health promotion', 'managed care programs', 'prevention and control', 'primary prevention', 'employee performance appraisal', 'task performance and analysis', 'work capacity evaluation', efficiency, 'efficiency, organizational', worksite, employee, worker, employer, corporation, company, health/wellness program, presenteeism, work limitation, work productivity, job/work performance, productivity loss, work disability, disability prevention, work impairment,* and *impaired performance* (see Appendix A). Additionally, I examined the reference lists of all relevant studies, and hand-searched three of the most relevant journals between January, 2005 and February, 2010 (i.e., *Journal of Occupational and Environmental Medicine, Ergonomics,* and *Journal of Industrial Medicine*). For unpublished literature, I conducted a Google search in January, 2010, using the search terms *presenteeism, health promotion,* and *workplace.* I also scanned government and other relevant websites, and contacted experts and organizations involved with WHP and presenteeism (see Appendix B).

Screening for Relevance to Best Evidence Synthesis Objectives

I screened all citations identified through my search strategy and included English-language reports; published reports of original research (randomized controlled trials, cohort studies, pre-post studies, and ecological studies), systematic reviews, meta-analyses, conference proceedings, government reports, guidelines, or unpublished grey literature manuscripts; studies containing data on at least 20 human research participants (including a control group if present) that were 18 years of age or older; and studies examining WHP and wellness programs including all types of measures aimed at promoting health and wellness, or reducing the risk of ill-health. These could be targeted at behavioural, physiological, organizational or environmental changes. I excluded studies examining only military personnel; return-to-work studies; narrative, editorial, or clinical reviews, opinion papers, editorials, and letters to the editor; studies where interventions were not implemented at the worksite; studies where productivity outcomes were not measured or specified; studies which grouped productivity outcomes together, such as presenteeism and absenteeism, and results could not be evaluated specifically for presenteeism changes; and studies that measured productivity only in terms of lost earnings.

Critical Review of the Literature

All studies judged relevant were critically appraised. The appraisal assessed clinical relevance and scientific merit by using a priori criteria (see Appendixes C and D). *The Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies* (Micucci & Thomas, 2007; Thomas, Ciliska, Dobbins, & Micucci, 2004) was used (Appendix D). It has demonstrated reliability, content and construct validity, and the ability to adapt current methods for systematic literature reviews of effectiveness to questions related to public health. Test-retest reliability was determined using the Cohen's Kappa statistic and is 0.74. Content validity was established by having six experts review the questionnaire, and it was independently tested on 10 primary studies by four experts in critical appraisal and community health. Construct validity was shown through comparisons with another highly rated instrument, the Guide to Community Preventive Services (Deeks, Dinnes, D'Amico, Sowden,

Sakarovitch, Song, et al., 2003). The EPHPP instrument is also relatively easy to use and the dictionary that accompanies it clarifies any questions related to the components. This tool prompted me to focus on issues of study design, study population, participation rates, data collection methods, follow-up rates, withdrawal and drop-out rates, measurement issues, and analysis.

For each paper, a second reviewer and I independently performed in-depth reviews. A consensus method was used to solve disagreements about study selection and methodological quality. A third reviewer was consulted if disagreement persisted. Studies were considered scientifically admissible if they were rated as *moderate* or *strong*, or scientifically inadmissible if they were rated as *weak,* or had fatal biases or other methodological flaws. Table 1 summarizes the criteria for classifying a paper as strong, moderate or weak (Thomas et al., 2004).

Table 1

Quality Assessment Components and Ratings for EPHPP Instrument

Components	Strong	Moderate	Weak
Selection bias	Very likely to be representative of target population; greater than 80% participation rate	Somewhat likely to be representative of target population; 60-79% participation rate	All other responses or not stated
Design	RCT & CCT	Cohort analytic, case-control, cohort, or interrupted time series	All other designs or design not stated
Confounders	Controlled for at least 80% of confounders	Controlled for 60-79% of confounders	Confounders not controlled for, or not stated
Blinding	Blinding of outcome assessor & participants to intervention &/or research question	Blinding of either outcome assessor or participants	Outcome assessor & participants are aware of intervention &/or research question
Data collection methods	Tools are valid & reliable	Tools are valid but reliability not described	No evidence of validity or reliability
Withdrawals & dropouts	Follow-up rate of > 80% of participants	Follow-up rate of 60-79% of participants	Follow-up rate of < 60% of participants or withdrawals & dropouts not described

Data Extraction into Evidence Tables

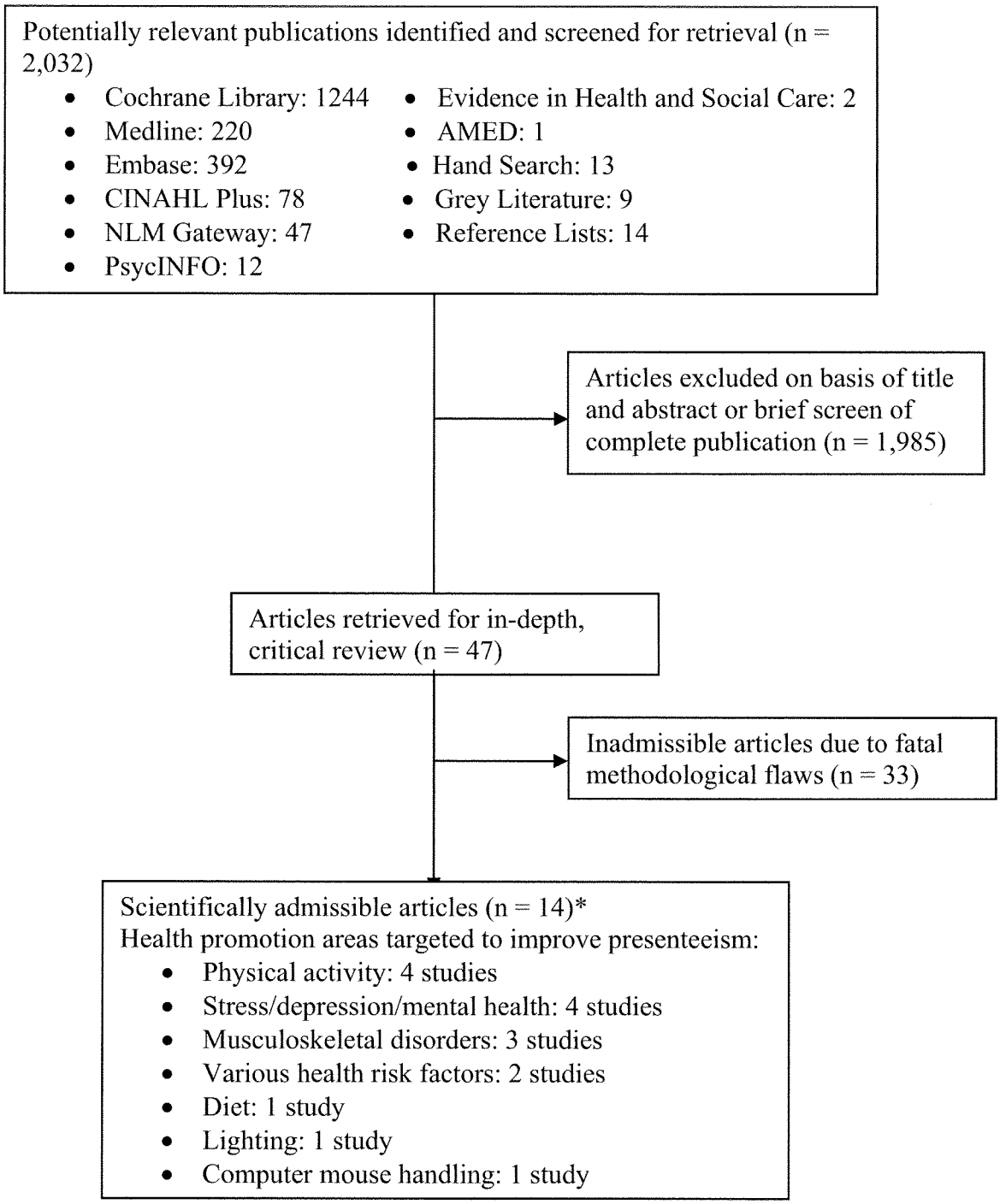
I extracted data from admissable studies into evidence tables. This facilitates synthesis of the information and conclusions based on the best evidence (Slavin, 1995). These evidence tables summarize my findings and form the basis of my recommendations. Attempts were made to statistically pool the data for the outcome measures, improved presenteeism and/or work productivity. However, a narrative synthesis was performed since the populations, interventions and outcome measures were too heterogenious to combine. The results are summarized using a rating system with three levels of evidence, based on the quality and outcome of the studies: strong, moderate, or weak evidence. The best evidence synthesis is based only on the results of the strong and moderate studies.

Results

After applying my inclusion and exclusion criteria to 2,032 identified titles and abstracts to assess their relevance, 47 articles were judged to be relevant and were critically reviewed. I and the second reviewer accepted 30% of these articles (i.e., 14 unique studies) as scientifcally admissible after critical appraisal (Fig.1). Four studies were given a strong rating (see Tables 1 & 2), and 10 studies were rated moderate (see Tables1 & 3). These studies are the basis for my findings and consist of 5 randomized controlled trials (RCTs), 5 cluster RCTs, 1 interrupted time series study, 1 crossover designed study, 1 pre-post study, and 1 quasi-experimental study. The source populations for the studies vary geographically, with three studies from The Netherlands, three from the U.S., two from Japan, two from the U.K., one from Canada, one from Denmark, one from Finland, and one from Sweden (see Tables 2 & 3).

Fig. 1

Flow Diagram of Literature Search



*Some studies target more than 1 health promotion area

Table 2

Studies of WHP Interventions Rated as Strong

Authors, country, study design	Setting, subjects & inclusion/exclusion criteria	Interventions & response rates	Outcomes & follow-up	Key findings & limitations
IJzelenberg et al., 2007 The Netherlands Cluster RCT & economic evaluation	9 large companies (> 500 workers) Mean age 41.3 yrs, 96-98% male Company Incl.: provide 2 clusters of workers with physically demanding jobs (e.g., warehouse operators), work ≥ 24 hrs/wk I: 9 clusters, $n = 258$ C: 9 clusters, $n = 231$	I: Integrative approach of 3 LBP preventive measures: individually tailored education/training, treatment, & ergonomic advice C: Usual care: by GP or OP according to Dutch guidelines Response Rate: ~ 85%	1°: LBP *(Nordic)*, sickness absence *(Q)* 2°: pain intensity *(NRS)*, functional limitations *(Roland Morris)*, UEC *(Nordic)*, sickness absence & productivity losses *(Q)**, general health *(SF-12)*, QofL *(EQ-5D)* IP: 12 mos FP: 6 & 12 mos	Presenteeism Improved? No Lim: possible inaccurate OMs, small sample size, selective loss to follow-up, lack of contrast between 2 groups (due to mandatory OH care); participating companies more likely to have OH care; intervention not successfully implemented; individually tailored interventions not appropriate in team-based processes.
Nurminen et al., 2002 Finland Multi-centered RCT	Laundry company Women ($N = 260$), mean age 40 yrs I: $n = 133$ C: $n = 127$ Incl.: women in permanent, physically demanding work Excl.: contraindications for PA; refused participation	I: Worksite exercise 1 hr/wk for 8 mos; 2 reinforcement sessions at 14 mos C: no intervention Response Rate: 80%	Perceived WA *(WAI, modified Nordic)**; sick leave IP: 8 mos FP: 3, 8, 12, & 15 mos	Presenteeism Improved? Yes, only slightly at short-term follow up. At 12 mos, WA increased more in I than in C (11%, 95% *CI* 0.2-21.9, $p = 0.04$) No change in sick leave. Lim: awareness of intervention & baseline assessments could have led to ↑ exercise in C; good perceived WA at baseline.
Takao et al., 2006 Japan	Sake brewery 45 supervisors, mostly male, each has ~ 5	I: Supervisor education program re: mental health promotion	Subordinates' psychological distress *(Brief Job Stress*	Presenteeism Improved? Yes, only for young male white-collar subordinates; significant improvement on

RCT	subordinates I: n = 150, subordinates of 23 supervisors (mean age 50 yrs) C: n = 100, subordinates of 22 supervisors (mean age 48.9 yrs) Incl./Excl.: none	C: waiting list Response Rate: ~ 95%	*questionnaire)* & job performance *(WHO-HPQ)** IP: 3 mos FP: at end of 3 mos	job performance (F = 5.40, p = 0.029). Lim: inadequate randomization; intervention not blinded; small sample size; difficult for young supervisors to advise older subordinates; un-validated questionnaire in Japanese setting; only short-term effects evaluated.
von Thiele Schwarz et al., 2008 Sweden Cluster RCT	6 workplaces of public dental care org., ≥ 25 workers Female, mean age 46.6 yrs I: "physical exercise" group (PE), n = 62 I: "reduced-work hours" group (RWH), n = 50 C: reference group (R), n = 65	PE: 2.5 hrs/wk mandatory PE, medium-to-high intensity RWH: e.g., 37.5 hrs/wk (instead of 40 hrs/wk) for full-time workers R: no intervention Response Rate: 99%	Biomarkers *(e.g., HDL, LDL, triglycerides, glucose, waist-to-hip ratio, BP, HR)*; measures of PA, health-related factors, WA *(Q)**; general & MSK symptoms *(Nordic)* IP: 6 months FP: 6 & 12 mos after intervention	Presenteeism Improved? No Lim: high baseline PA for all groups; all groups increased PA levels; differences between workplaces; additional employees not recruited to compensate for RWH, ∴ increased work demands may have reduced potential beneficial intervention effects.

Note. Incl. = inclusion criteria; Excl. = exclusion criteria; I = intervention group; C = control group; IP = intervention period; FP = follow-up period; OMs = outcome measures; Lim = study limitations; LBP = low back pain; GP = general physician; PT = physiotherapist; Q = other questionnaire; NRS = Numerical Rating Scale; UEC = upper extremity complaints; QofL = quality of life; EQ-5D = EuroQol questionnaire; mos = months; OH = occupational health; OP = occupational physician; PA = physical activity; WAI = Work Ability Index; WA = work ability; WHO-HPQ = World Health Organization Health and Productivity Questionnaire; BP = blood pressure; HR = heart rate; MSK = musculoskeletal

*Measure of presenteeism

Table 3

Studies of WHP Interventions Rated as Moderate

Authors, country, study design	Setting & subjects	Interventions	Outcomes & follow-up	Key findings & limitations
Blangsted et al., 2008 Denmark Cluster RCT	549 office workers I: Specific Resistance Training group (SRT): *n* = 180, mean age 46 yrs, 70% female I: All-round Physical Exercise group (APE): *n* = 187, mean age 43.9 yrs, 64.2% female C: *n* = 182, mean age 44.9 yrs, 59.3% female Excl.: hypertension, cardiovascular disease, symptomatic disc prolapses, severe neck disorders, neck & shoulder surgery, history of severe trauma, pregnancy	SRT: neck & shoulder resistance exercises 3x/wk APE: encouraged to ↑ PA during work & leisure time C: general health-promoting activities not including PA Response Rate: ~ 40%	Neck & shoulder MSK symptoms *(Nordic)*; perceived WA *(WAI)**; sick leave IP: 12 mos FP: end of 12-mos	Presenteeism Improved? No Lim: high WAI at baseline; insufficient program intensity; small sample size; high dropout & incomplete questionnaires; potential low intervention adherence; no neutral control.
Block et al., 2008 USA RCT	Kaiser Permanente of Northern California Non-medical employees, *N* = 787; all eligible Mean age 44 yrs, 74.3% female	I: *Alive!* (A Lifestyle Intervention Via Email): to improve PA & diet behaviours C: delayed control Response Rate: < 60%	1°: diet & PA *(HRA)* 2°: health status & QofL *(SF-8)*, presenteeism *(Q)**, Stage of Readiness for Change *(Q)*, self-efficacy *(Q)* IP: 4 mos FP: end of 4 mos	Presenteeism Improved? Yes; reduced difficulty in accomplishing work tasks in I compared to C (*OR* = 1.47, 95% *CI* 1.05-2.05, *p* = 0.02). I: improved QofL, health status, self-efficacy, stage of change. Lim: required internet access; possible spam-filtering of invitational messages/inactive email addresses; subjects that met diet & PA goals also

				included; possible low level of participation.
Dababneh et al., 2001 USA Interrupted time series	Meat-processing plant Workers from 1 production line, $N = 35$ mean age 39 yrs, 81% female Incl.: all workers who handled filets & final products Excl.: machine operators, line coordinator	36 min extra rest break time 2 different rest break schedules: 1. 12 3-min breaks 2. 4 9-min breaks Response Rate: 80-100%	Production rate *(video)**; discomfort in arms, neck, shoulders, back, legs *(Q)*; stress *(Q)* IP: 6 wks total: 2 wks for each break schedule, separated by 1-wk interval FP: after each 2-wk schedule	Presenteeism Improved? Yes. Production rate of 4th period significantly higher (25-30%) than during baseline weeks with both schedules, [F (3, 12) = 22.49, $p = 0.0$]. 9-min schedule preferred; taking more time for short breaks doesn't ↓ production. Lim: no attempt to counter balance order in which rest break conditions presented.
de Boer et al., 2004 The Netherlands RCT	Large electronic equipment manufacturing company Employees ≥ 50 yrs of age, mean age 53.4 yrs, 93% male I: $n = 61$ C: $n = 55$	OH program for workers at risk for early retirement I: assessment by OP; detailed action plan; consultation with managers; referral to other specialists C: usual care Response Rate: 73%	Early retirement, disability pension, WA *(WAI)**, stress *(Utrechtse Burn-out Scale)*, QofL *(Nottingham Health Profile)*, sick leave, satisfaction with OP *(Q)* IP: 6 mos FP: 6 mos & 2 yrs after randomization	Presenteeism Improved? Yes, at short-term follow up only (i.e., 6 mos); I had better WA than C ($p <$ 0.001). QofL & stress improved. 2-yr FP: fewer workers in I retired early but only to small degree (85% in C vs. 72% in I). Lim:
de Kraker at al., 2008 The Netherlands RCT	Dutch call centre Mean age 38 yrs, 73% female I: $n = 37$ C: $n = 23$	I: Used computer mouse with vibrating feedback signal to prevent hovering C: Used standard mouse without signal Response Rate: uncertain	Hovering behaviour *(The Observer software)*, productivity *(task performance, Q)**, usability & comfort *(Q)*, discomfort	Presenteeism Improved? No I: ↓ hovering time No differences in productivity, discomfort, usability & comfort. Lim: none reported

			(LEO) IP: 2 wks FP: end of IP	
Mills et al., 2007 UK Quasi-experimental pre-post intervention-control study	Office-based service delivery employees I: n = 519, 46% male, mean age 34.3 yrs C: convenience sample, n = 1679 54% male, mean age 34.5 yrs	I: Multi-component health promotion program C: no intervention Response Rate: ~ 67%	Health risk factors *(HRA)*, absenteeism & work performance *(WHO-HPQ)** IP: 12 mos FP: end of IP	Presenteeism Improved? Yes. Large mean increase on work performance scale of I compared with C, 0.79 (0.11), $p < 0.001$. I: ↑ improvement in all 3 outcomes Lim: Only 51% completed questionnaire at FP; unknown reasons for dropping out; C recruited as "convenience" sample; possible non-equivalent grps.
Rivilis et al., 2006 Canada Longitudinal quasi-experimental	2 southern Ontario depots of large unionized courier company I depot: n = 71, mean age 40.4 yrs, 69% male C depot: n = 51, mean age 35.2 yrs, 68.6% male	I: Participatory ergonomic (PE) process C: no intervention Response Rate: ~ 86%	MSK disorder outcomes *(Q)*: perceived physical demands, organizational risk factors, pain; work function *(WLQ)** IP: 14 mos FP: end of IP	Presenteeism Improved? Yes. ↑ communication levels associated with ↑ *work role function* (WRF), p = 0.025. ↓ pain post-intervention related to ↑ WRF, p = 0.049. Lim: some changes introduced late; short IP & FP; barriers to implementation; low response rates; transfer between jobs.
Tsutsumi et al., 2009 Japan Cluster RCT	Medium-sized company producing electrical devices Blue-collar workers I: 6 assembly lines, n = 47 (42 general workers, 5 supervisors), 57% female, mean age 48 yrs C: 5 lines, n = 50 (42	Participatory intervention focused on environment improvement/job redesign C: no intervention Response Rate: 80-100%	Mental health *(GHQ, JCQ;,* productivity *(WHO-HPQ)** FP: 12 mos	Presenteeism Improved? Yes. I: ↑ productivity F (4.05), p = 0.048; ↑ job control & supervisor/co-worker support; mental health scores remained the same. C: ↓ productivity & mental health scores. Lim: small sample size; more older workers lost at follow-

	general workers, 8 supervisors), 36% female, mean age 44 yrs Excl.: re-streamlining of lines (3 lines)			up; psychometric properties of JCQ needs to be evaluated in Japan; potential information leakage in small factory; lack of longer follow-up data; possible burden of participatory approach on participants.
Viola et al., 2008 UK Cross-over design	Distribution company for electronic parts 94 white-collar workers on 2 floors *1st floor:* $n = 52$, 26 female, mean age 34.9 yrs *2nd floor:* $n = 42$, 19 female, mean age 37.4 yrs All invited to participate	Exposure to blue-enriched white light vs. white light during daytime work hrs Response Rate: uncertain	Alertness, mood, sleep quality, performance *(Workplace Questionnaire)** mental effort, headache, eye strain, evening fatigue, irritability, concentration, IP: 8 wks total (4 wks under each type of light) FP: end of each 4-wk IP	Presenteeism Improved? Yes. Mean change for work performance from baseline score: 0.5 (SE) *from error bar,* $p < 0.0001$. Also improved vitality ($p = 0.0008$), activity ($p = 0.008$), energy ($p < 0.0001$), alertness ($p < 0.0008$), ability to concentrate ($p = 0.005$), ability to think clearly ($p < 0.0001$). Participants felt less tired ($p < 0.0001$). Lim: self-rated OMs
Wang et al., 2007 USA RCT	604 workers from 16 large diverse companies (e.g., airline, insurance) Mean age 41 yrs, 70% female I: $n = 304$ C: $n = 300$ Incl.: employees aged ≥ 18 yrs, covered by managed behavioural health plan, have at least moderate depression Excl.: lifetime bipolar disorder, substance disorder, recent	I: Structured depression outreach-treatment telephone program C: Usual care Response Rate: < 50% (uncertain)	Depression severity *(QIDS)*, work performance *(WHO- HPQ)** IP: 12 mos FP: 6 & 12 mos	Presenteeism Improved? Yes. I: Higher # effective weekly hours worked compared to C at 6 mos ($\beta = 3.0$, 95% *CI* 0.4-5.6, $p = 0.03$) & 12 mos ($\beta = 3.3$, 95% *CI* 0.9-5.8, $p = 0.008$). Effect on job performance not significant but consistently positive. Lim: screening tool may have misclassified cases; participants may have had differences in prevalence, severity, or impairment than nonparticipants; differences in subgroups & workforce

	mental health specialty care, suicidality			characteristics.

Note. Incl. = inclusion criteria; Excl. = exclusion criteria; I = intervention group; C = control group; IP = intervention period; FP = follow-up period; Lim = study limitations; Q = other questionnaire; mos = months; OH = occupational health; OP = occupational physician; OM = outcome measure; GP = general physician; HRA = health risk assessment; PA = physical activity; QofL = quality of life; WAI = Work Ability Index; WA = work ability; LEO = Dutch validated scale for body part discomfort; WHO-HPQ = World Health Organization Health and Productivity Questionnaire; MSK = musculoskeletal; GHQ = General Health Questionnaire; JCQ = Job Content Questionnaire; QIDS = Quick Inventory of Depressive Symptomatology

*Measure of presenteeism

Interventions Demonstrating Positive Effects on Presenteeism

An intervention was classified as having a positive effect on presenteeism based on a positive direction and statistical signficance. In all, the results were mixed, however 10 interventions demonstrated preliminary evidence of promising effects on presenteeism in their respective employee populations and work settings. They used interventions to improve one or more of the following: physcial activity, stress/depression/mental health, MSK disorders, various health risk factors, diet, and lighting.

Strong evidence was found in two studies (see Tables 1 & 2, Appendix E). In the first study which consisted of a multi-centred RCT , worksite exercise was implemented for a group of women involved in physically demanding work at a laundry company in Finland (Nurminen, Malmivaara, Ilmarinen, Ylöstalo, Mutanen, Ahonen, et al., 2002). Subjects participated in hourly exercise sessions guided by a physiotherapist, once per week for eight months, and were given two reinforcement sessions at 14 months. At short-term follow up only (i.e., 12 months), work ability increased slightly more in the intervention group compared to the control group which received no intervention (11%, 95% *CI* 0.2-21.9, $p = 0.04$).

In the second study, an RCT was conducted at a Sake brewery in Japan. It investigated the impact of a supervisor education program regarding mental health promotion, on their respective subordinates' levels of psychological distress and job performance (Takao, Tsutsumi, Nishiuchi, Mineyama, & Kawakami, 2006). This study demonstrated signficant intervention effects for job performance ($F = 5.40$, $p = 0.029$). However, this result was shown for only one subgroup, the young male white-collar subordinates . The authors described that this was the subgroup who seemed to be most concerned about the deterioration of their work environments and therefore experienced a greater amount of psychological distress.

The remaining eight studies provided moderate evidence of positive intervention effects in their respective employee populations and workplace settings (see Tables 1 & 3, Appendix E). In a large RCT conducted in the U.S among non-medical regional employees , "A Lifestyle Intervention Via Email"

(Alive!) was implemented over four months to improve physical activity and dietary behaviours (Block, G., Sternfeld, Block, C. H., Block, T. J., Norris, Hopins, et al., 2008). It demonstrated that the odds ratio for having a reduction in difficulty accomplishing work tasks (due to physical/emotional problems) was 1.47 (95% *CI* 1.05-2.05, $p = 0.02$) for the intervention group compared to the waiting-list control.

Extra rest break time (i.e., 36 minutes) for workers engaged in highly repetitive and monotonous work, was given at a meat-processing plant in the U.S. (Dababneh, Swanson, & Shell, 2001). This was an interrupted time series design whereby two different rest break schedules,each lasting two weeks, were tested on the same group of workers. The first schedule consisted of 12 3-minute breaks, and the second consisted of four 9-minute breaks. With both schedules of extra rest break time, it was found that the average production rate of the last work period was significantly higher (25-30%) than during baseline weeks [F (3, 12) = 22.49, $p = 0.0$]. The 9-minute break schedule was preferred by the majority since it also helped to improve lower extremity discomfort and well-being.

A RCT was conducted at a large electronic equipment manufacturing company in The Netherlands (de Boer, van Beek, Durinck, Verbeek, & van Dijk, 2004). A 6-month multi-disciplinary occupational health program was implemented for workers greater than 50 years of age, targeting health, social, psychological, and work-related factors. At short-term follow up only (i.e., 6 months), the intervention group demonstrated better work ability than the control group that received usual care ($p <$ 0.001).

A multi-component health promotion program was examined among a large group of office-based service delivery employees in the U.K. (Mills, Kessler, Cooper, & Sullivan, 2007). In this 12-month quasi-experimental, pre-post intervention-control study, a large mean increase in the work performance scale was observed in the intervention group versus the control, $M = 0.79$ (0.11), $p < 0.001$. The investigators reported that this represents full productivity for an additional 7.9% of working time over four weeks.

In Canada, two depots of a large unionized courier company underwent a longitudinal quasi-experimental study (Rivilis, Cole, Frazer, Kerr, Wells, & Ibrahim, 2006). A participatory ergonomic

process was utilized to improve musculoskeletal health. Several changes were implemented in the intervention depot over 14 months such as new tools and workstation modifications. Interestingly, it was stated that this intervention had a greater impact on changing work organizational factors than on changing physical demands. The authors stated that this was potentially due to the the fact that psychosocial stressors in addition to physical stressors, were considered in the causation of MSK disorders. Furthermore, organizational factors improved most for workers with the greatest level of participation in the intervention. This study demonstrated that improvements in communication levels were associated with improved *work role function* (WRF) ($p = 0.025$) which was assessed with the WLQ instrument, and lower levels of pain after the intervention were also related to greater WRF ($p = 0.049$).

Japanese blue-collar workers of a medium-sized company producing electrical devices were involved in a cluster RCT (Tsutsumi, Nagami, Yoshikawa, Kogi, & Kawakami, 2009). Again, a participatory process was utilized, this time focusing on environment improvement or job redesign in order to improve mental health and job performance, rather than on behaviour change. The investigators reported increased job control and supervisor/co-worker raport in the intervention group. In addition, productivity scores increased in the intervention group, but decreased in the control group [F (4.05), $p = 0.048$].

A change in lighting was investigated among white-collar workers of a distribution company for electronic parts in the U.K. (Viola, James, Schlangen, & Dijk, 2008). This was a cross-over design which assessed the impact of exposure to blue-enriched white light during daytime working hours on work performance, compared to exposure to white light. It was shown that exposure to this blue-enriched light produced a mean change of 0.5 units for self-rated performance (on a scale of 1-9) compared to the baseline score. Additional results were improvements in how participants felt with respect to vitality ($p = 0.0008$), activity ($p = 0.008$), energy ($p < 0.0001$), alertness ($p < 0.0008$), ability to concentrate ($p = 0.005$), and ablity to think clearly ($p < 0.0001$). Participants also reported feeling less tired ($p < 0.0001$).

Finally, a large group of workers from 16 large and diverse American companies, including airline and insurance companies, participated in a RCT evaluating a 12-month telephone intervention

program for depressed workers (Wang, Simon, Avorn, Azocar, Ludman, McCulloch, et al., 2007). This study demonstrated improved presenteeism only in terms of quantity, but not quality, of work performed. Effective weekly hours worked were significantly higher in the intervention than the usual care group both at six months ($\beta = 3.0$, 95% *CI* 0.4-5.6, $p = 0.03$) and 12 months ($\beta = 3.3$, 95% *CI* 0.9-5.8, $p = 0.008$). Although, the intervention effect on job performance was not significant, the authors found that it was consistently positive.

Interventions not Demonstrating Improvement in Presenteeism

In all, four interventions were unsuccessful at improving presenteeism in their specific employee populations and work settings (see Tables 2 & 3, and Appendix F). Two of these were rated as strong (IJzelenberg, Meerding, & Burdorf, 2007; von Thiele Schwarz, Lindfors, & Lundberg, 2008). Both of these studies are cluster RCTs. The other two studies were rated as moderate (Blangsted, Sogaard, Hansen, Hannerz, & Sjogaard, 2008; de Kraker, de Korte, van Mil, Rijs, & Bongers, 2008). The former is also a cluster RCT, while the latter is a RCT. These interventions consisted of the implementation of a computer mouse with a feedback signal to prevent hovering behaviour (de Kraker et al.), a multi-dimensional program for low back pain prevention (IJzelenberg et al.), specific resistance training and all-around physical exercise (Blangsted et al.), and worksite exercise/reduced work hours (von Thiele Schwarz et al.).

Intervention Delivery Methods of Successful vs. Unsuccessful Interventions

Of the 10 successful interventions, three were delivered by a health professional (see Tables 2 & 3, Appendix E). These professionals were either physiotherapists or occupational health nurses (Nurminen et al., 2002), psychologists (Takao et al., 2006), or occupational health physicians (de Boer et al., 2004). Two interventions were delivered using a participatory approach, which consists of teamwork among employees, managers, human resources personnel, and researchers, (Tsutsumi et al., 2009; Rivilis et al., 2006). One intervention was delivered by telephone by mental health clinicians (Wang et al., 2007), one was delivered by email/internet (Block et al., 2008), one was an organizational change (i.e.,

rest break schedule) (Dababneh et al., 2001), and one was an environmental change (i.e., lighting), (Viola et al., 2008). A final successful intervention utilized a mixed delivery method consisting of email, paper-based packs, and worksite seminars (Mills et al., 2007).

Of the four unsuccessful interventions (see Tables 2 & 3, Appendix F), one was delivered by a health professional (i.e., physiotherapist), (IJzelenberg et al., 2007), one was delivered by an experienced fitness instructor (Blangsted et al., 2008), one was an equipment change (i.e., computer mouse) (de Kraker et al., 2008), and the final one consisted of an organizational change (i.e., work hours allocated to mandatory physical exercise) (von Thiele Schwarz et al., 2008).

Use of Employee Screening Methods in Successful vs. Unsuccessful Interventions

I looked at the use of screening workers before assigning them to an intervention. This can be an important first step since specific interventions might be more successful if they are targeted to appropriate employee groups with, for example, specific health risk factors, or levels of motivation or readiness to change. One of the most common screening methods is the health risk assessment (HRA) instrument. Its basic elements include the assessment of personal health habits and risk factors, estimation of future risk of adverse health outcomes, and feedback in the form of education and counseling to alter risk factors (Soler et al., 2010). It is valuable for identifying high-cost claimants; targeting individual program participation; and measuring and tracking individual behaviours that effect health care costs, absenteeism and presenteeism. It is generally easy to administer to a large number of people, conveys a lot of information quickly, provides workforce-wide estimates, and allows potential for follow up (National Business Group on Health, 2010; Soler).

Seven of the 10 successful interventions used screening methods (see Appendix E). These consisted primarily of HRAs, or other questionnaires and assessments (Block et al., 2008; de Boer et al., 2004; Mills et al., 2007; Nurminen et al., 2002; Rivilis et al., 2006; Tsutsumi et al., 2009; Wang et al., 2007). Two of these seven interventions (Rivilis et al., Tsutsumi et al.) utilized a participatory approach, whereby screening is inherent in the process (i.e., workers and managers first identify problems and

needs, and then develop solutions). On the other hand, screening methods were used in only one of the four unsuccessful interventions (von Thiele Schwarz et al., 2008) (see Appendix F).

Tailored Intervention Use by Successful vs. Unsuccessful Interventions

Seven of the 10 successful interventions used individually tailored programs (Block et al., 2008; de Boer et al., 2004; Mills et al., 2007; Nurminen et al., 2002; Rivilis et al., 2006; Tsutsumi et al., 2009; & Wang et al., 2007) (see Appendix E). Of the four unsuccessful interventions, individually tailored programs were used by two of them (Blangsted et al., 2008; IJzelenberg et al., 2007) (see Appendix F).

Use of Incentives by Successful vs. Unsuccessful Interventions

Only one of the 10 successful interventions used an incentive which was in the form of lottery tickets (Mills et al., 2007) (see Appendix E). Incentives were not used in any of the unsuccessful interventions (see Appendix F).

Summary of Results of Strong vs. Moderate Studies

Four of the 14 admissible studies were rated as strong (see Tables 1 & 2). However, even in these studies, there was some bias with respect to thorough reporting of withdrawals and drop-outs (IJzelenberg et al., 2007), data collection methods (Takao et al., 2006), and participant selection (von Thiele Schwarz et al., 2008). All four studies also showed a risk of bias with respect to blinding of outcome assessors and/or participants, as well as intervention integrity (IJzelenberg et al.; Nurminen et al., 2002; Takao et al., & von Thiele Schwarz et al.).

Three of these four studies were cluster RCTs and the other was a RCT. Two of the four interventions improved presenteeism for their respective employee groups, workplace settings, and time periods (see Table 2, Appendix E). One consisted of worksite exercise with reinforcement group sessions (Nurminen et al., 2002), and the other consisted of a supervisor mental health education program (Takao et al., 2006). Both of these interventions were delivered by health professionals. Workers were screened and the intervention was individually tailored in only one of these interventions (Nurminen et al.). Employee incentives were not used in either intervention.

Two of the four strong studies did not improve presenteeism (see Table 2, Appendix F). One involved an integrative approach for low back pain prevention (IJzelenberg et al., 2007), and the other involved worksite exercise/reduced work hours (von Thiele Schwarz et al., 2008). Only one of these was individually tailored and delivered by a health professional (IJzelenberg et al.). Neither intervention involved worker screening or use of incentives.

Of the 14 admissible studies, 10 were rated as moderate and demonstrated similar biases although to a greater degree than the four higher quality studies mentioned above (see Tables 1 & 3). These consist of four RCTs, two cluster RCTs, one crossover design, one interrupted time series, one pre-post study, and one quasi-experimental study. Eight of these 10 interventions improved presenteeism for their respective employee groups and workplace settings (see Table 3, Appendix E). These include *Alive!* (A Lifestyle Intervention via Email) (Block et al., 2008), a 36-minute extra rest break time (Dababneh et al., 2001), a participatory intervention to reduce stress (Tsutsumi et al., 2009), lighting changes (Viola et al., 2008), a multi-component health promotion program (Mills et al., 2007), a participatory ergonomic change process (Rivilis et al., 2006), a telephone support program for depressed workers (Wang et al., 2007), and an occupational health program for older workers (de Boer et al., 2004). Two of these interventions were delivered by health professionals (de Boer et al., Wang et al.), two used participatory methods (Rivilis et al., Tsutsumi et al.), one was delivered by the internet (Block et al.), one involved mixed methods (Mills et al.), one involved an organizational change (Dababneh et al.), and the other involved an environmental change (Viola et al.). Six of these eight successful interventions involved employee screening methods (Block et al., de Boer et al., Mills et al., Rivilis et al., Tsutsumi et al., & Wang et al.). These six interventions, in addition to the one by Blangsted and colleagues (2008), were individually tailored. Only one of the eight interventions used an employee incentive (Mills et al.).

Two of the 10 moderate studies were not successful at improving presenteeism (see Table 3, Appendix F). One involved specific resistance training and all-around physical exercise (Blangsted et al., 2008), and the other involved a computer mouse with a feedback signal to prevent hovering behaviour (de Kraker et al., 2008). Neither of these were delivered by health professionals. One was delivered by a

fitness intructor (Blangsted et al.), and the other involved a change in equipment (de Kraker et al.). Only one intervention was individually tailored (Blangsted et al.). Workers were not screened and incentives were not used in either intervention.

Potential Intervention Improvements that Might Have Lead to Better Results

Various themes surfaced as investigators described ways in which improvements in presenteeism may have been (further) realized in their respective studies. WHP interventions should provide incentives to employees (e.g., monetary) to improve participation and response rates as well as intervention adherence (Block et al., 2008). Interventions such as exercise programs should be longer, more intense and frequent (Blangsted et al., 2008; Nurminen et al., 2002; Rivilis et al., 2006); and they should be based on a theory such as the behaviour change model (Block et al., 2008). Longer follow-up periods are needed to determine whether intervention effects improve or persist in the long term (Mills et al., 2007; Rivilis et al., 2006; Takao et al., 2006; Tsutsumi et al., 2009; von Thiele Schwarz et al., 2008). Care must be taken to ensure that interventions are appropriate for specific employee populations and work tasks, for example, individually tailored interventions may not be appropriate in team-based processes (IJzelenberg et al., 2007). Additional resources such as more support, training or counseling sessions, may be required to make interventions more robust (Blangsted et al., 2008; IJzelenberg et al., 2007; Nurminen et al., 2002). Moreover, broader actions may be needed such as organizational and environmental interventions that include a multi-professional approach (de Boer et al., 2004; Nurminen et al., 2002; Rivilis et al., 2006).

Discussion

This systematic review is an important contribution to the field of WHP and presenteeism. To the best of my knowledge, it is the first attempt to systematically collect and appraise the literature to investigate the effects of WHP programs on presenteeism alone. It is striking that 70% of the 47 articles I reviewed were judged as scientifically inadmissible because of bias. For example, subjects were not likely to be representative of the target population, or the selection method was not described. Participants are more likely to be representative of the target population if they are randomly selected from a comprehensive list of individuals in the target population (Thomas et al., 2004). On the other hand, they may not be representative if they are referred from a source in a systematic manner such as a clinic, or self-referred. Many studies had poor response and participation rates (i.e., less than 60%), and did not control for confounding factors such as gender, age, education, and health status. Some studies did not use sufficient blinding methods, for instance, the outcome assessor was aware of the intervention status of the participants, and/or the participants were aware of the research question. The data collection tools in some of the studies were not shown to be reliable and valid, or the methods were not adequately described. Insufficient description of interventions was also problematic for some studies, since this affects the reproducibility of an intervention. Finally, some studies had unacceptably high withdrawal and drop-out rates (i.e., follow-up rate was less than 60%) with inadequate explanations as to why, or the rates were not described.

I only accepted 14 (30%) of the 47 articles that I reviewed. This literature has many limitations. For example, measuring presenteeism is problematic and there is no accepted best way to do so. The admissible studies are very heterogeneous with respect to interventions, intervention delivery methods, presenteeism measurement tools, geographical locations, employee populations, work settings, and inclusion and exclusion criteria. This limits the comparability and interpretation of findings.

Despite the foregoing limitations, there are some important conclusions that can serve as a starting point for implementing WHP programs in order to improve presenteeism. With this guidance, it

is hoped that such programs can be further studied and modified to best suit the needs of each workplace setting and employee population.

It is generally well accepted that presenteeism is an important health, social, and economic issue for workers and employers. Initial objectives were to understand the types of health risks and health issues affecting workers who work despite health problems. Several physiological, organizational, and environmental risk factors and health conditions can contribute to presenteeism and are reported extensively in the literature. Risk factors include being overweight, poor diet, smoking, lack of physical exercise, high stress, poor relations with coworkers and management, and poor physical work environments. Health conditions affecting workers include arthritis, allergies, migraine, chronic pain, diabetes, hypertension, gastro-intestinal conditions, GERD, MSK disorders, respiratory disorders, mental health problems such as depression and anxiety, cancer, cardiovascular disease, and metabolic syndrome. In general, these risk factors and health conditions can decrease worker productivity by causing pain and fatigue, and by reducing physical and mental capacities.

My primary objective was to determine if WHP programs are effective in improving presenteeism. I found preliminary evidence of a positive effect for some programs. However, caution is needed in interpreting results due to several factors that include varying methods of measurement and response/participation rates, heterogeneous employee populations and workplace settings, and inexact matching of cases and controls that could lead to confounding of results. Further research is still needed in this area.

My final objective was to identify characteristics of WHP programs successful at improving presenteeism. While there is a lack of data to make generalizations, the admissible studies in my review, show preliminary, yet promising effects included one or more of the following components:

1. An intervention grounded in behaviour change models to help elicit and reinforce desirable lifestyle behaviours (Block et al., 2008);
2. Individually tailored programs (Block et al., 2008; de Boer et al., 2004; Mills et al., 2007; Nurminen et al., 2002; Rivilis et al., 2006; Tsutsumi et al., 2009; Wang et al., 2007);

3. Increased frequency and duration of rest breaks for workers who are required to stand for long periods of time at a production line (Dababneh et al., 2001);
4. Physical exercise is allowed to occur during working hours (Nurminen et al., 2002);
5. Improvement of supervisor/manager knowledge, attitude and behaviours regarding mental health in the workplace (Takao et al., 2006);
6. Use of participatory approaches to develop interventions, with high employee involvement (Rivilis et al, 2006; Tsutsumi et al., 2009);
7. Organizational and environmental factors are targeted and these can in turn, influence behavioural/physiological factors (Dababneh et al., 2001; de Boer et al., 2004; Nurminen et al., 2002; Rivilis et al., 2006; Takao et al., 2006; Tsutsumi et al., 2009; Viola et al., 2008);
8. Involvement of employee's supervisors/managers (de Boer et al., 2004; Rivilis et al., 2006; Takao et al., 2006; Tsutsumi et al., 2009);
9. Deliver interventions by various modes: telephone, email/internet, seminars, paper-based literature (Block et al., 2008; Mills et al., 2007); participatory teams (Rivilis et al., 2006; Tsutsumi et al., 2009); organizational changes such as rest breaks (Dababneh et al., 2001); environmental changes such as in lighting (Viola et al., 2008); and by various professionals such as physiotherapists (Nurminen et al., 2002); occupational physicians/nurses (de Boer et al., 2004; Nurminen et al.; Takao et al., 2006); psychologists (Takao et al.); and mental health clinicians (Wang et al., 2007). The results are too heterogeneous to compare, and I cannot say which method is best.
10. Screening of workers prior to intervention using HRAs or other methods (Block et al., 2008; de Boer et al., 2004; Mills et al., 2007; Rivilis et al., 2006; Tsutsumi et al., 2009; Wang et al., 2007).
11. Incentives were only used in one successful program in this review (Mills et al., 2007), however, various investigators suggest that providing incentives may lead to better results if geared toward increasing response/participation rates and program adherence (National Business Group on Health, 2010).

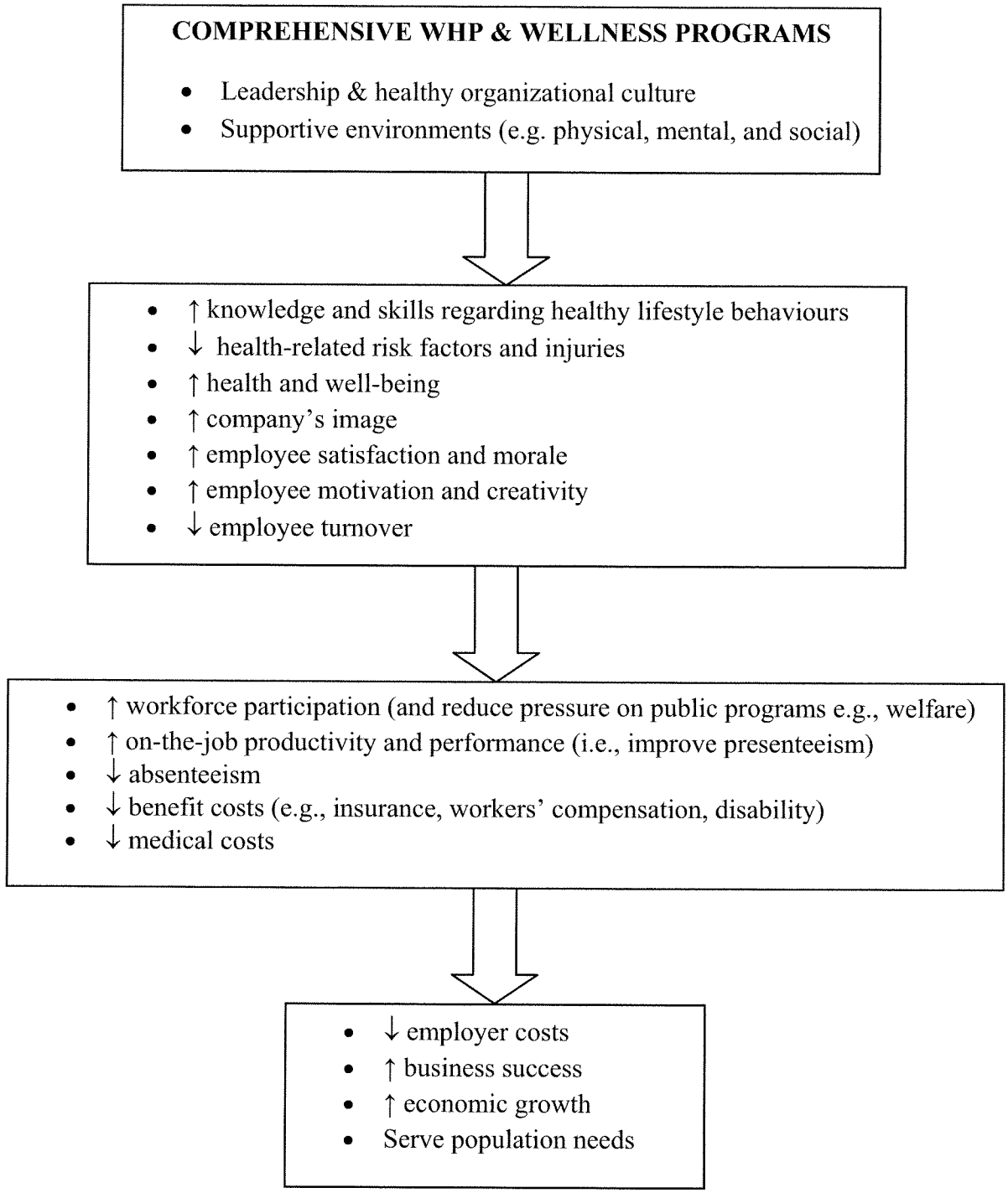
It is important to mention that some of these program components were also present in the four studies that did not demonstrate improved presenteeism (see Appendix F). These include physical activity (Blangsted et al., 2008; von Thiele Schwarz et al., 2008), ergonomic changes (de Kraker et al., 2008) and a multi-dimensional prevention program (IJzelenberg et al., 2007). Therefore, a distinction needs to be made between *theory failure* and *programme failure* (Kristensen, 2005). In these four unsuccessful interventions, it is more likely that programme failure occurred, e.g., the intervention was not implemented properly or compliance was poor. Theory failure would imply that physical activity, ergonomic changes or other prevention programs are not effective, and from the available evidence, this does not appear to be the case.

From the studies analyzed in this review, in addition to supporting literature, I developed a conceptual framework to illustrate how comprehensive WHP programs can lead to a healthy and productive workforce that could be better equipped to serve the population's needs (see Figure 2). It appears that comprehensive programs begin by providing good managerial practices and leadership skills, integration of health promotion into the organization's culture, and supportive physical and social environments for health improvement (Childress et al., 2006; Goetzel et al., 2007; Terry et al., 2008).

Kuoppala, Lamminpää, Liira and colleagues (2008) found that supervisory leadership plays an important role on employee job satisfaction, job well-being, sickness absences, and disability pensions. Another study by Kuoppala, Lamminpää and Husman (2008) demonstrated that WHP is valuable with respect to well-being and work ability and productive in terms of less sickness absences. These authors also suggested that WHP should target psychosocial environments in addition to physical environments at work. Indeed, the participatory interventions analyzed in this current review which addressed both psychosocial and physical factors seemed to be beneficial (Rivilis et al., 2006; Tsutsumi et al., 2009). Creating these positive environments can therefore help to reduce health risks and improve productivity in the workplace.

Fig. 2

Conceptual Framework



Barriers to Implementing WHP Programs

Various barriers to implementing WHP programs have been reported such as a lack of adequate budgets to pay for programs, insufficient staff, sustainability, and low participation or interest in programs (National Business Group on Health, 2010). Several barriers were discussed in a benchmarking study by Goetzel and colleagues (2007). For instance, many employers are not convinced that programs can improve health and achieve a positive financial effect. This may be the case if they are uneducated on the known benefits of WHP, unaware of financial impact studies, or are skeptical due to the lack of scientific rigor in many economic analyses. In addition, employers may feel ill-equipped with respect to appropriate tools and resources necessary to identify, implement, and evaluate effective programs on their own.

Loeppke and colleagues (2007) reported that employers are uncertain with respect to what is right for their organization and which specific areas to target. They stated that a significant challenge is obtaining a validated report on workforce productivity. In other words, many employers are unable to track total absence due to variances in work rules, leave policies, and shortcomings of absence management systems; and even fewer companies are able to track presenteeism.

Review Strengths and Limitations

My review has several strengths. I systematically gathered, appraised, and synthesized the best available evidence. I believe that limiting my findings to studies that are of better methodological quality is a notable strength. I also reported all steps of the comprehensive review explicitly, thereby making the process more transparent and reproducible.

Various limitations need to be mentioned. While my search was extensive, I could have searched additional electronic databases and hand-searched additional relevant journals. My review is also limited to the literature available as of January, 2010 and to English publications. Like all reviews of the literature, mine is limited by the quantity and quality of the available evidence. Presenteeism is an evolving field and is difficult to measure. Most of the studies that have been conducted on work

productivity have investigated absenteeism as an outcome, not presenteeism. Although the monetization of presenteeism output has typically received the most criticism, the validity and accuracy of the underlying measurements may be more critical (Edington, 2010).

Indeed, the uncertainties and inconsistencies surrounding the measurement of presenteeism may be one of the biggest limitations regarding the usefulness of my review. All of the current instruments have drawbacks and several significant issues have been raised (Edington, 2010; Loeppke et al., 2007; Prasad et al., 2004; Schultz & Edington, 2007, 2009a, 2009b; Schultz et al., 2009; Tang et al., 2009). Only a few of the instruments have been validated against objective measures of productivity, such as the number of calls made in a call centre, or the number of parts assembled in a manufacturing plant. This is easiest to do when dealing with piecework, but is much more difficult when concrete, measureable output is not available. This is the case with jobs in the knowledge sector, or when dealing with team work, where the presenteeism of a single team member may affect the job performance of a group of people. Additionally, each instrument measures a different quality of presenteeism, making results difficult to compare. For instance, the instrument may ask respondents to assess their own level of impairment, or ask them to compare themselves to the performance of others, or to their own "usual" performance. Respondents may also be asked to estimate the amount of unproductive time at work. There is no consensus as to which method is most valid or optimal.

There is no optimum recall period and duration for recalling the level of on-the-job productivity. More empirical work needs to be completed to investigate the ability of workers to recall this information. Similarly, the optimum length of a questionnaire and its appropriateness for a corporate setting must be considered. For example, some instruments have only one question, while others have 25 or more. Measurement across different employers, working populations, industry types, and the way in which work is remunerated (e.g., hourly, salaried) needs to be taken into account, as well as the seasonal nature of some types of health issues (e.g., allergies). Few studies compare multiple scales within a single population in order to establish the most ideal measures for specific populations under specific

circumstances. Along the same lines, it needs to be determined whether disease-specific instruments are more useful and/or appropriate than general health-related instruments.

Finally, the scoring and conversion process for some instruments is not straightforward and it is unknown whether instruments are responsive to changes over time. Very few studies on a limited number of instruments have examined their responsiveness. Moreover, indirect costs faced by employers having to respond to reduced productivity need to be taken into account, including hiring new or temporary staff, training staff, paying overtime to other employees, and dealing with lost revenue, to name a few.

Future Recommendations for Research

Better quality research is needed in this emerging area. Of critical importance is the issue of measurement, whereby standard presenteeism metrics need to be established so that research is comparable across studies. More research is then needed to better quantify the value produced by employees (Hillier et al., 2005), and to convert presenteeism losses into dollar amounts in order for employers to understand the impact of employee health (Schultz et al., 2009). Interestingly, it is argued that presenteeism should not be quantified monetarily. Instead, it could be considered a qualitative and/or quantitative measure such as functional status, which is associated with health care costs and absenteeism (Schultz et al.).

Since certain health conditions may impact presenteeism more than others and will be more prevalent in certain demographic groups, prioritizing conditions may help employers to know where to focus their efforts initially (Schultz et al., 2009). More meticulous attention to issues of bias, statistical methodology, appropriate study designs, and better reporting of studies in line with current scientific standards, is also essential to understanding the impact of WHP on presenteeism. Studies also need to be conducted in a broad range of populations, especially those in the information and service industries (Schultz & Edington, 2007; Edington, 2010).

Lastly, while changes in risk factors have been shown to positively affect work productivity, *why* or *how* these risks were changed has yet to be investigated. Interestingly, it has been suggested that

perhaps the mere participation or engagement in a wellness program may be sufficient to improve work-related outcomes such as productivity (D.W. Edington, personal communication, November 22, 2010). Essentially, the amount of *social capital* at the workplace affects employee satisfaction, which can, in turn, affect productivity. "Social capital has been defined as the set of cooperative relationships between social actors that facilitate collective action" (Requena, 2003). By generating social capital, that is, acceptable levels of trust, relationships, commitment, and communication among co-workers and management, organizations may be able to improve individual and institutional performance (Requena, 2003). Thus, any intervention that improves social capital may also improve presenteeism. Further research in this area is warranted.

Conclusion

Companies worldwide are focused on cultivating a healthy, engaged and productive workforce with the goal of creating a competitive advantage in an increasingly global economy (National Business Group on Health, 2010). WHP represents one of the most significant strategies for enhancing the productivity of workers at a time when their average age is increasing (Chapman, 2005b). Despite longstanding advocacy for comprehensive worksite programs however, more empirical evidence is needed to link these strategies to improvements in health and productivity (Terry et al., 2008).

A large number of U.S. and Canadian companies remain committed to such programs (National Business Group on Health, 2010). Investments in employee health are expected to reduce absenteeism, presenteeism, lower benefit costs, reduce injury and disability rates, reduce health insurance costs, reduce workers' compensation, enhance job satisfaction, improve a company's image and ultimately, lead to better financial outcomes (see Figure 2) (Collins et al. 2005; Goetzel et al., 2009; Kuoppala, Lamminpaa, & Husman, 2008; Kuoppala, Lamminpaa, Liira et al., 2008). As the field of measuring work productivity loss evolves, we are reminded by Beaton and associates (2009) that the relationship between worker health and productivity loss is not linear. In other words, more illness will not necessarily lead to a predictable and direct change in productivity levels. This is because employees may try to adapt and work environments may be modified to try to prevent absenteeism/presenteeism.

Planning for interventions should take into account the nature of work and the workforce, the prevalence of specific conditions, and the relationship of limitation patterns to work requirements (Burton et al., 2004). The magnitude of effect an employer might expect from implementing different types of WHP programs will vary and may be influenced by type and duration of intervention components offered, participation rates, and participant characteristics. For example, higher-risk participants may experience greater health gains (Soler et al., 2010). While employers should target high-risk workers, they should also offer programs to the vast majority of employees who are medium or low risk in order to prevent them from becoming high-risk in the future (Schultz & Edington, 2007).

The literature on the effect of WHP on presenteeism is young and developing. Nonetheless, there is evidence that presenteeism is very common among workers, is an important issue for workers and employers and can be improved by some programs. However, questions remain about which interventions are best, how best to deliver them and by whom, and especially how best to accurately and reliably measure presenteeism. It has been reported that the most effective programs offer organizational leadership, effective communication, health risk screening, incentives and rewards, supportive culture, comprehensive evaluation, and an adequate budget in order to provide the necessary intervention resources (Hillier et al., 2005; National Business Group on Health, 2010; Soler et al., 2010). My results are in line with these findings. Interestingly, it has been stated that the most important issue for organizations to address is not whether or not WHP programs should be implemented to reduce risks and enhance productivity, but rather how such programs should be designed, implemented, and evaluated to achieve optimal results (Pelletier, 2009). My thesis summarizes the literature, highlights its strengths and weaknesses, and provides suggestions for future research.

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Appendix A

Search Strategy

Cochrane Library (January 20, 2010)

ID	Search	Hits
#1	MeSH descriptor Workplace explode all trees	353
#2	(#1 OR worksite* OR employee* OR worker* OR corporat* OR employer* OR company*)	10,033
#3	MeSH descriptor Occupational Health explode all trees	337
#4	MeSH descriptor Occupational Health Services explode all trees	296
#5	MeSH descriptor Health Promotion explode all trees	2,237
#6	MeSH descriptor Primary Prevention explode all trees	2,698
#7	MeSH descriptor Employee Incentive Plans explode all trees	6
#8	MeSH descriptor Preventive Health Services explode all trees	15,950
#9	(#3 OR #4 OR #5 OR #6 OR #7 OR #8 OR program* OR "wellness program" OR intervention* OR prevent*)	171,836
#10	MeSH descriptor Employee Performance Appraisal explode all trees	35
#11	MeSH descriptor Task Performance and Analysis explode all trees	1,434
#12	MeSH descriptor Work Capacity Evaluation explode all trees	163
#13	MeSH descriptor Efficiency explode all trees	369
#14	MeSH descriptor Efficiency, Organizational explode all trees	277
#15	MeSH descriptor Disability Evaluation explode all trees	1,604
#16	(#10 OR #11 OR #12 OR #13 OR #14 OR #15 OR presenteeism OR "work* limitation*" OR productivity OR "job performance" OR "work* performance" OR "productivity loss" OR disabilit* OR "work* impairment*" OR "impaired performance")	12,903
#17	(#2 AND #9 AND #16)	1,279

Cochrane Reviews: 625
Other Reviews: 44
Clinical Trials: 271

Methods Studies: 5
Technology Assessments: 4
Economic Evaluations: 309

Medline (PubMed) (January 14, 2010)

("Workplace"[Mesh] OR worksite* OR employee* OR worker* OR corporat* OR employer* OR compan*) AND (((((("Occupational Health"[Mesh] OR "Occupational Health Services"[Mesh])) OR "Health Promotion"[Mesh]) OR "Managed Care Programs"[Mesh]) OR ("prevention and control "[Subheading] OR "Primary Prevention"[Mesh]) OR "health program*" OR "wellness program*" OR prevention) AND ("Work Capacity Evaluation"[Mesh] OR ("Efficiency"[Mesh] OR "Efficiency, Organizational"[Mesh]) OR presenteeism OR "work* limitation*" OR "work* productivity" OR "job performance" OR "work* performance" OR "productivity loss" OR "work* disabilit*" OR "disability prevention" OR "work* impairment*" OR "impaired performance") AND (((((((("Review "[Publication Type] OR "Review Literature as Topic"[Mesh] OR "Peer Review, Research"[Mesh])) OR ("Meta-Analysis "[Publication Type] OR "Meta-Analysis as Topic"[Mesh])) OR ("Randomized Controlled Trial "[Publication Type] OR "Randomized Controlled Trials as Topic"[Mesh] OR "Controlled Clinical Trial "[Publication Type])) OR "Multicenter Studies as Topic"[Mesh]) OR "Cohort Studies"[Mesh]) OR "Controlled Clinical Trials as Topic"[Mesh]) OR ("Evaluation Studies "[Publication Type] OR "Evaluation Studies as Topic"[Mesh]) OR ecological OR pre-post)

Yield: 281

Embase (January 21, 2010)

ID	Search	Hits
#1	'employee'/exp OR 'workplace'/exp OR 'worker'/exp OR 'employer'/exp OR worksite* OR corporat* OR compan*	240,807
#2	'occupational health'/exp OR 'occupational health service'/exp OR 'preventive medicine'/exp OR 'health promotion'/exp OR 'prevention and control'/exp OR 'education program'/exp OR 'health program'/exp OR wellness OR intervention OR program	1,902,098
#3	'work capacity'/exp OR 'productivity'/exp OR 'personnel management'/exp OR 'task performance'/exp OR 'job performance'/exp OR 'work disability'/exp OR efficien* OR 'employee performance' OR presenteeism OR 'work limitation' OR 'work performance' OR 'productivity loss' OR 'disability prevention' OR 'work impairment' OR 'impaired performance'	594,233
#4	'systematic review'/exp OR 'meta analysis'/exp OR 'randomized controlled trial'/exp OR 'cohort analysis'/exp OR ecological OR 'pre post'	744,243
#5	(#1 AND #2 AND #3 AND #4)	431

CINAHL Plus (January 17, 2010)

ID	Search	Hits
S1	(MH "Work Environment+")	10,023
S2	(MH "Corporations+")	7,541
S3	(MH "Workforce")	2,220
S4	S1 or S2 or S3	19,603
S5	S1 or S2 or S3 or workplace* or worksite* or worker* or employee* or employer* or compan*	98,417
S6	(MH "Occupational Health Services+")	4,047
S7	(MH "Employee Assistance Programs")	373
S8	(MH "Employee Incentive Programs")	658
S9	(MH "Occupational Health+")	24,337
S10	(MH "Health Services+")	461,790
S11	(MH "Health Promotion+")	21,537
S12	(MH "Preventive Health Care+")	112,949
S13	(MH "Diet Therapy+")	10,642
S14	(MH "Disability Management")	150
S15	(MH "Health Education+")	64,167
S16	(MH "Stress Management")	3,649
S17	(MH "Smoking Cessation Programs")	1,045
S18	(MH "Weight Reduction Programs")	562
S19	(MH "Health Screening+")	30,574
S20	(MH "Alternative Therapies+")	79,662
S21	S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19 or S20	579,888
S22	S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16	

	or S17 or S18 or S19 or S20 or "wellness program*" or prevention	745,207
S23	(MH "Employee Performance Appraisal+")	3,485
S24	(MH "Job Performance")	1,633
S25	(MH "Productivity")	4,045
S26	S23 or S24 or S25	8,865
S27	S23 or S24 or S25 or presenteeism or "work* limitation*" or "work* productivity" or "work* performance" or "productivity loss" or "work* disabilit*" or "disability prevention" or "work* impairment*" or "impaired performance"	9,879
S28	(MH "Systematic Review") or (MH "Cochrane Library")	8,673
S29	(MH "Meta Analysis")	9,601
S30	(MH "Clinical Trials+")	
S31	(MH "Concurrent Prospective Studies") or (MH "Prospective Studies+") or (MH "Nonconcurrent Prospective Studies")	115,109
S32	S28 or S29 or S30 or S31	202,349
S33	S28 or S29 or S30 or S31 or cohort or ecological or pre-post	215,336
S34	S5 and S22 and S27 and S33	110

NLM Gateway (January 19, 2010)

ID	Search	Hits
#1	Workplace[MESH] OR worksite OR employee OR worker OR Corporate OR company OR corporation Limit: English, 1990:2010	124,655
#2	Occupational Health[MESH] OR Occupational Health Services[MESH] OR Health Promotion[MESH] OR prevention & control[SH] OR Primary Prevention MESH] OR Employee Incentive Plans[MESH] OR Managed Care Programs[MESH] OR "health program" OR "wellness program" Limit: English, 1990:2010	768,045
#3	Employee Performance Appraisal[MESH] OR Work Capacity Evaluation[MESH] OR Efficiency[MESH] OR presenteeism OR "work limitation" OR productivity OR Task Performance and Analysis [MESH] OR "job performance" OR "work performance" OR "productivity loss" OR Disability Evaluation[MESH] OR "work disability"	

	OR "disability prevention" OR "work impairment" OR "impaired performance" Limit: English, 1990:2010	194,087
#4	Review Literature as Topic[MESH] OR Meta-Analysis as Topic[MESH] OR Controlled Clinical Trials as Topic[MESH] OR Cohort Studies [MESH] OR ecological OR pre-post OR "systematic review"	868, 380
#5	#1 AND #2 AND #3 AND #4	302

PsychINFO (January 21/10)

1. exp Personnel/
2. exp Business Organizations/
3. (workplace* or worksite* or employee* or worker* or corporat* or employer* or compan*).mp. [mp=title, abstract, heading word, table of contents, key concepts]
4. 1 or 2 or 3
5. exp "Industrial and Organizational Psychology"/ or exp Health Promotion/
6. exp Prevention/ or exp Professional Consultation/ or exp Public Health Services/
7. exp Health Education/
8. exp Educational Programs/ or exp Nutrition/ or exp Physical Education/
9. exp Preventive Medicine/
10. exp Mental Health Programs/
11. exp Well Being/ or exp Employee Assistance Programs/ or exp Holistic Health/ or exp Occupational Therapy/
12. ("occupational health" or wellness or program or intervention).mp. [mp=title, abstract, heading word, table of contents, key concepts]
13. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12
14. exp Personnel Evaluation/ or exp Job Performance/ or exp Employee Productivity/ or exp Employee Efficiency/
15. exp Disability Evaluation/ or exp Ability Level/
16. exp Monetary Incentives/ or exp Incentives/
17. 13 or 16
18. 14 or 15
19. (presenteeism or "work* limitation*" or "productivity loss" or "work* disabilit*" or "disability prevention" or "work* impairment*").mp. [mp=title, abstract, heading word, table of contents, key concepts]
20. 18 or 19

21. exp Treatment Effectiveness Evaluation/ or exp "Literature Review"/

22. exp Meta Analysis/

23. exp Cohort Analysis/

24. ("randomized controlled trial*" or ecological or pre-post).mp. [mp=title, abstract, heading word, table of contents, key concepts]

25. systematic review.mp. [mp=title, abstract, heading word, table of contents, key concepts]

26. 21 or 22 or 23 or 24 or 25

27. 4 and 17 and 20 and 26

55 results

Evidence in Health and Social Care (January 19, 2010)

(workplace* OR worksite* OR employee* OR worker* OR corporat* OR compan*) AND ("occupational health" OR "occupational health services" OR "health promotion" OR prevention OR program OR "wellness program" OR intervention) AND (presenteeism OR "work* limitation* OR impair* OR "work* productivity" OR efficiency OR "job performance" OR "work* performance" OR "productivity loss" OR "work* disability" OR "disability prevention" OR "work* impairment*" OR "impaired performance") AND ("systematic review" OR "meta analysis" OR "randomized controlled clinical trial" OR cohort OR ecological OR pre-post)

11 results

AMED (January 17, 2010)

ID	Search	Hits
S1	(DE "WORKPLACE")	128
S2	(DE "EMPLOYERS")	35
S3	S1 or S2	161
S4	S1 or S2 or worksite* or employee* or worker* or corporat* or compan*	3,448
S5	(DE "OCCUPATIONAL HEALTH")	131
S6	(DE "OCCUPATIONAL HEALTH SERVICES")	107
S7	(DE "HEALTH PROMOTION") OR (DE "HEALTH SERVICES")	1,681
S8	(DE "PREVENTION") OR (DE "PREVENTIVE HEALTH CARE") OR (DE "PREVENTIVE HEALTH SERVICES")	266
S9	S5 or S6 or S7 or S8	2,142
S10	S5 or S6 or S7 or S8 or "health program*" or "wellness program*"	2,258
S11	(DE "WORK CAPACITY EVALUATION")	244
S12	(DE "EFFICIENCY")	45
S13	(DE "DISABILITYEVALUATION")	5
S14	S11 or S12 or S13	294
S15	S11 or S12 or S13 or presenteeism or "work* limitation*" or "work* productivity" or "job performance" or "work* performance" or "productivity loss" or "work* disability" or "work* impairment*" or "impaired performance"	602
S16	(DE "META ANALYSIS")	17
S17	(DE "RANDOMIZED CONTROLLED TRIALS")	124
S18	S16 or S17	140
S19	S16 or S17 or "systematic review*" or cohort or prospective or evaluation or ecological or pre-post	21,858
S20	S4 and S10 and S15 and S19	1

Appendix B

Experts, Organizations, and Websites Contacted

American Psychological Association

Association of Workers Compensation Board of Canada (AWCBC)

Balfanz, D., Stanford Health Promotion Network, U.S.

Boocock, M. G., Auckland University of Technology, New Zealand

Buck Consultants, U.S.

Buffett & Company Worksite Wellness Inc., Canada

Canadian Association of Administration of Labour Legislation (CAALL)

Canadian Centre for Occupational Health & Safety (CCOHS)

Canadian Council for Health & Active Living at Work (CCHALW)

Canada/European Union Cooperation on Workplace Safety & Health

Canadian Institute for Health Information

Canadian Labour & Business Centre

Canadian National (CN)

Chevron Corporation, U.S.

Corbiere, M., Sherbrooke University, Canada

Crossman, D., Public Health Agency of Canada

de Boer, A. G. E. M., Coronel Institute for Occupational & Environmental Health, The Netherlands

Diversity Wellness, U.S.

Edington, D. W., University of Michigan, U.S.

European Network for Workplace Health Promotion

Faculty of Public Health, U.K.

Goetzel, R., Cornell University, U.S.

Gold-Knecht Associates, U.S.

The Graham Lowe Group, Inc., Canada

Hall, A., University of Windsor, Canada

Health Canada Workplace Health Bureau

Healthscore Inc., Canada

Health Work & Wellness Group, Canada

Human Resources & Social Development Canada – Labour Program

Human Solutions, Canada

Institute for Corporate Productivity, U.S.

Institute for Work & Health, Canada

Integrated Benefits Institute & National Business Coalition, U.S.

International Commission on Occupational Health (ICOH)

International Stress Management Association, U.K.

J.J. Keller & Associates Inc., U.S.

Jones, E., CDC Occupational Health & Prevention Services, U.S.

Kenny, G. P., University of Ottawa, Canada

Kronos Optimal Health Company, U.S.

Lainez, J. A., Hospital Clinico Universitario, Universidad de Valencia, Spain

Lamminpää, A., Division of Insurance, Finland

Lerner, D., Tufts-New England Medical Center, U.S.

LewChuk, W., McMaster University, Canada

Loeppke, R., Matria Healthcare, U.S

ManuLife Financial, Canada

The Matheson System, U.S.

McClone Wellness Group, U.S.

MDS Nordion, Canada

Medisys., Canada

Merck Frosst Canada & Co.

Meunier, Y. A., Stanford Health Promotion Network, U.S.

Meverden, A., Microsoft Corporation, U.S.

The National Institute for Occupational Health & Safety (NIOSH), U.S.

National Quality Institute (NQI), Canada

Occupational Health Clinics for Ontario Workers Inc., Canada

Ontario Healthy Workplace Coalition, Canada

Ontario Ministry of Labour, Canada

Owens, A., Qualcomm Inc., U.S.

Pelletier, K. R., University of California School of Medicine, U.S.

Pransky, G., Liberty Mutual, U.S.

Public Health Agency of Canada

Renfrew Insurance, Canada

Rothstein, M., University of Louisville School of Medicine, U.S.

Ruotsalainen, J. H., Finnish Institute of Occupational Health, Finland

Shepell-fgi, Canada

Tompa, E., Institute for Work and Health, Canada

University of Toronto, Centre for Health Promotion, Canada

Verbeek, J., Finnish Institute of Occupational Health, Finland

Veterans Affairs Canada

Vetter, D., EMC Corporation, U.S.

Yuen, H., Occupational hygienist & safety specialist, Canada

Wang, P. S., Harvard Medical School, U.S.

Weiss, K., Eddie Bauer Inc., U.S.

Wellness Works: Community Health Services Dept., County of Lambton, Canada

Workers' Safety and Insurance Board (WSIB), Canada

Workplace Health & Safety Centre, Canada

Work Well, Canada

World Health Organization (WHO)

The Yukon Department of Energy, Mines and Resources, Canada

Appendix C

Relevance Criteria

Study Name:
Author, Source, Database, Year:
Reviewer Name:

1.	The study involves an intervention/measure aimed at promoting health and wellness (or reducing the risk of ill-health). E.g. interventions can be targeted at behavioural, physiological, organizational or environmental changes. Pharmaceutical interventions are also relevant.	Y	N
2.	The intervention is implemented at the workplace. (It's acceptable if screening, education etc. is implemented at the workplace and then the participant goes elsewhere to carry out the wellness activity, e.g. seeking medical attention for high BP, using outside exercise facilities, etc.)	Y	N
3.	The workers are adults (18 years of age or older). Interventions directed only at military personnel are not relevant.	Y	N
4.	Outcomes include a measure of presenteeism/worker health-related productivity, e.g. Work Activity Limitations Scale (WALS), Work Instability Scale (WIS), Work Limitations Questionnaire (WLQ), Work Productivity and Activity Impairment (WPAI), Health Productivity Questionnaire (HPQ), Stanford Presenteeism Scale (SPS), Work Role Functioning (WRF), etc.	Y	N
5.	The study design is one of the following: systematic review, meta-analysis, RCT, cohort study, pre-post study, ecological study.	Y	N
6.	The study intervention is adequately described (so that it can be reproduced).	Y	N
	Reviewer Decision		
	Include in critical appraisal (only if answer 'yes' to all 6 relevance criteria).	Y	N
	If discrepancy in inclusion decision: Reason for discrepancy: Additional Comments:		
	Final Decision: Include in study	Y	N

Appendix D

Quality Assessment Tool

Author:
Year:
Reviewer:
COMPONENT RATINGS

A) SELECTION BIAS

(Q1) Are the individuals selected to participate in the study likely to be representative of the target population?

1. Very likely
2. Somewhat likely
3. Not likely
4. Can't tell

(Q2) What percentage of selected individuals agreed to participate?

1. 80-100% agreement
2. 60-79% agreement
3. Less than 60% agreement
4. Not applicable
5. Can't tell

RATE THIS SECTION: Strong (1) Moderate (2) Weak (3)

B) STUDY DESIGN

1. Randomized controlled trial
2. Controlled clinical trial
3. Cohort analytic (two groups pre + post)
4. Case-control
5. Cohort (one group pre + post (before and after))
6. Interrupted time series
7. Other specify_____
8. Can't tell

Was the study described as randomized? Y/N If NO, go to component C

If Yes, was the method of randomization described? (see dictionary) Y/N

If Yes, was the method appropriate? (see dictionary) Y/N

RATE THIS SECTION: Strong (1) Moderate (2) Weak (3)

C) CONFOUNDERS

(Q1) Were there important differences between groups prior to the intervention?

1. Yes
2. No
3. Can't tell

(Q2) If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

1. 80-100%
2. 60-79%
3. Less than 60%
4. Can't tell

RATE THIS SECTION: Strong (1) Moderate (2) Weak (3)

D) BLINDING

(Q1) Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

1. Yes
2. No
3. Can't tell

(Q2) Were the study participants aware of the research question?

1. Yes
2. No
3. Can't tell

RATE THIS SECTION: Strong (1) Moderate (2) Weak (3)

E) DATA COLLECTION METHODS

(Q1) Were data collection tools shown to be valid?

1. Yes
2. No
3. Can't tell

(Q2) Were data collection tools shown to be reliable?

1. Yes
2. No
3. Can't tell

RATE THIS SECTION: Strong (1) Moderate (2) Weak (3)

F) WITHDRAWALS AND DROP-OUTS

(Q1) Were withdrawals and drop-outs reported in terms of numbers and reasons per group?

1. Yes
2. No
3. Can't tell

(Q2) Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

1. 80-100%
2. 60-79%
3. Less than 60%
4. Can't tell

RATE THIS SECTION: Strong (1) Moderate (2) Weak (3)

G) INTERVENTION INTEGRITY

(Q1) What percentage of participants received the allocated intervention or exposure of interest?

1. 80-100%
2. 60-79%
3. Less than 60%
4. Can't tell

(Q2) Was the consistency of the intervention measured?

1. Yes
2. No
3. Can't tell

(Q3) Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

1. Yes
2. No
3. Can't tell

H) ANALYSIS

(Q1) Indicate the unit of allocation

Community organization/institution practice/office provider client

(Q2) Indicate the unit of analysis

Community organization/institution practice/office provider client

(Q3) Are the statistical methods appropriate for the study design?

1. Yes
2. No
3. Can't tell

(Q4) Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

1. Yes
2. No
3. Can't tell

COMPONENT RATINGS

Transcribe the previous information here.

A SELECTION BIAS

RATE THIS SECTION	Strong	Moderate	Weak

B STUDY DESIGN

RATE THIS SECTION	Strong	Moderate	Weak

C CONFOUNDERS

RATE THIS SECTION	Strong	Moderate	Weak

D BLINDING

RATE THIS SECTION	Strong	Moderate	Weak

E DATA COLLECTION METHODS

RATE THIS SECTION	Strong	Moderate	Weak

F WITHDRAWALS AND DROPOUTS

RATE THIS SECTION	Strong	Moderate	Weak

Is there a fatal bias in this paper? Y/N

GLOBAL RATING FOR THIS PAPER (circle one)

1. STRONG (four STRONG ratings with no WEAK ratings)
2. MODERATE (less than four STRONG ratings and one WEAK rating)
3. WEAK (two or more WEAK ratings)

WITH BOTH REVIEWERS DISCUSSING RATINGS:

Is there a discrepancy between the two reviewers with respect to the (A-F) ratings? Y/N
If yes, indicate the reason for the discrepancy

1. Oversight
2. Differences in interpretation criteria
3. Differences in interpretation of study

FINAL DECISION OF BOTH REVIEWERS (circle one):

1. STRONG
2. MODERATE
3. WEAK

Appendix E

Description of Interventions Demonstrating Positive Effect on Presenteeism

	Intervention
Block et al., 2008	*Alive!* (A Lifestyle Intervention via Email) Goal: to improve diet & PA through behaviour change Intervention period: 4 months Delivery method: completely automated; delivered entirely via email Subjects screened? yes Individually tailored? yes Incentives? no • Batch email sent by organization leaders to their employees. Completion of initial HRA was encouraged by promising immediate feedback on levels of diet & PA behaviours, regardless of intervention participation. • *Tailoring/Lifestyle Questionnaire* emailed to participants to obtain demographic data & tailoring information (presence of children at home, cooking and eating out habits, PA & food preferences, & stage of readiness for change). • *Barriers Questionnaire* identified potential barriers for achieving health behaviour goals (e.g., time, money, or travel). • Based on HRA feedback, participants chose health-behaviour module to work on for 4 months, either to: (a) ↑ PA, (b) ↑ fruits & vegetables, or (c) ↓ fats & sugars. • Received weekly messages offering 4-6 tailored, small-step goals to choose for the following week, e.g., "I will have a salad with lunch 2 days this week," or "I will buy walking shoes." Participants asked to commit to 1 or 2 goals. • Mid-week messages reminded participants of goals; total of 25 personalized email contacts occurred (sent weekly for first 2 months, then bimonthly for final 2 months). • Immediately after having chosen goal, participants taken to "personal home page" containing tips for achieving goal(s), tips regarding barriers, a goal tracker, an interactive simulation tool (graphic presentation of how much any specific change in diet or PA might move them closer toward recommended level), health information, & links to sites for additional information (e.g., government & organizational websites). A chat room provided opportunities to discuss problems & suggest solutions. Other components: • Easy to use (didn't require staff expertise or much time commitment); • Able to reach a large number of people; • Program based on *behaviour change model* to initiate & maintain desired behaviours; • Tailoring based on psychosocial characteristics (e.g., *stage of change*), & took into account current dietary & PA practices, life constraints; • Promoted social support, self-monitoring, increasing knowledge & skills, anticipating barriers; • Approach consistent with the concept of "stickiness," (Gladwell, 2000) – ideas/intentions are likely to "stick" when they are relevant to an individual & appear frequently in mental/social environment.
Dababneh et al., 2001	Two different rest break schedules

	Goal: to improve productivity & well being Intervention period: 2 weeks per rest break schedule (separated by 1-week interval) Delivery method: organizational change Subjects screened? no Individually tailored? no Incentives? no • Workers received 36-min extra rest break time beyond usual 30-min lunch break & 2 15-min breaks/day. • 2 different rest break schedules were tested on same group of workers: (a) 12 3-min breaks (break every 27 min of work), and (b) 4 9-min breaks (break every 51 min of work). • Participants could do whatever they liked during breaks, but were not to leave production area. Seats provided for all workers. • Longer rest breaks provided workers opportunities to attend to their physical needs (e.g., take restroom breaks), without interrupting group production. Group production was interrupted if worker had to take a break during production, leaving an empty spot on the conveyer, & placing more pressure on coworkers.
de Boer et al., 2004	Occupational health program Goal: to improve work ability & quality of life; prevent early retirement Intervention period: 6 months Delivery method: worker's own OP, in collaboration with supervisors/managers Subjects screened? yes Individually tailored? yes Incentives? no • Comprised at least 3 consultations between employee & OP. • OPs trained by principal researcher with structured protocol. • Assessment interview: OP explored reasons of employee not being able to work up to pension date, focusing on health, work- related, & social/psychological factors. • Action plan focused on factors to change: involved collaboration with supervisors/managers, GP, medical specialist, or psychologist. • 2 more scheduled consultations with OP took place 10 & 16 weeks after initial interview, in addition to consultations on request. • OP wrote a personal file for each participant which included: number of visits to OP , main problem, type of problem, & main action of OP, e.g. contact with supervisors/managers to alter work conditions (including changes in work tasks, extra tools & aids, improvement in work relations), "wait & see", start psychosocial counseling, or refer employee to another physician. *Control group:* • Usual care: not invited for consultation with OP but could always consult with their OP on request. Other components: • Multidisciplinary approach; • Most of the participants were very satisfied with OP's care; • Participants most satisfied with communication skills, friendliness, trustfulness,

	listening well, & taking enough time for the employee.
Mills et al., 2007	Low-cost multi-component health promotion program Goal: to reduce health risks, improve work productivity & performance Intervention period: 12 months Delivery method: email, paper packages, & seminars Subjects screened? yes Individually tailored? yes Incentives? yes (lottery tickets) • HRA data used to inform & implement program. • All elements of program offered via email. • Received personalized health & well-being report that gave a wellness score & information/advice tailored to level of readiness to change health-related behaviours. • Report focused on health areas in need of improvement & gave practical suggestions as to how to achieve recommended changes. • Given unlimited access to password-protected personalized health, well-being, & lifestyle web portal that included articles, assessments, & interactive online behaviour-change programs. • Received tailored emails every 2 weeks on personal wellness topics that were relevant to them. • Tailoring based upon age, gender, & known health risks from HRA. • Each email was ~ 400 words: provided practical tips for self-improvement, encouraged use of health portal. • Received 4 packages (consisting of 2-page newsletter & health promotional literature) & 4 on-site seminars based upon 4 most prevalent health risks identified from HRA across whole population: stress management, sleep improvement, nutritional balance, & PA. *Control group:* • Completed baseline questionnaires. • No health promotion initiatives provided.
Nurminen et al., 2002	Worksite exercise Goal: to improve work ability; reduce sick leaves Intervention period: 8 months Delivery method: specially trained occupational health care personnel (PT, OHN) Subjects screened? no Individually tailored? yes Incentives? no • Occupational health care personnel received written material & had phone contact with principal researcher when needed. • Principal researcher visited all 11 production units of company to give 1-hr presentation on work ability promotion. • PT gave every subject 30-min feedback on physical capacity test results, & prescription

	for exercise & counseling to ↑ self-directed PA during leisure time. • Participated as a group in worksite exercise guided by PT. Sessions lasted 60 min once per week during work hours & totaled 26 sessions (i.e., 12 sessions in autumn, 1996 & 14 in spring, 1997). • Group sessions consisted of moderate worksite exercise based on guidebook by Finnish Institute of Occupational Health for promoting work ability & PA through group exercise. Involved strengthening, stretching, & cardiovascular exercise. Exercise intensity increased progressively. • After each session, PT rated intervention adherence & mode of exercise. • 2 additional 60-min reinforcement sessions given in autumn, 1997 to promote PA. • Company agreed not to arrange other campaigns promoting PA during study. • Rate of attendance in PA was moderately good, most likely because it occurred during work hours.
Rivilis et al., 2006	Participatory ergonomic (PE) intervention Goal: to improve MSK health Intervention period: 14 months Delivery method: Ergonomic Change Team (ECT): 7 workers from several departments (dock workers, couriers, a line haul driver, a mechanic), unit manager, administrative assistant, human resource manager, corporate health & safety regional manager, ergonomic facilitator Subjects screened? yes Individually tailored? yes Incentives? no • ECT underwent 4 training sessions (lasting 6 hours each) covering basic ergonomic principles, identification & management of workplace risk factors, & tools to perform ergonomic assessments & measurements. • Iterative process; progressed according to PE Blueprint including identification, assessment, solution building & testing, & implementation (Laing, Frazer, Cole, Kerr, Wells, & Norman, 2005). • ECT met weekly for first 7 months, then bimonthly for latter half. • 14 changes implemented (e.g. new & redesigned tools, workstation modifications, reduced conveyor speeds) – most improved jobs. Other components: • Considered contribution of both physical & psychosocial stressors in causation of MSK disorders; • Changed work organizational factors (in addition to physical demands); • Greatly participatory – high level of involvement by labour, union, & management; • Good forum was provided for workers to voice concerns; • Great deal of openness at meetings where everyone's opinion mattered regardless of position held.
Takao et al., 2006	Job stress education for supervisors Goal: to improve subordinates' psychological distress & job performance Intervention period: 3 months Delivery method: OP, psychologists

	Subjects screened? no Individually tailored? no Incentives? no • Single-session, 60-min education program (standardized; based on detailed protocols & manuals). • 1 OP & 1 psychologist gave lectures on basic knowledge regarding mental health promotion & 'Active Listening Training' with a role-playing exercise. • 90-min basic program entitled "Positive Mental Health in the Workplace – Managers' Responsibilities" was developed according to guidelines for promotion of the mental health of employees. • Supervisors were provided information re: early awareness of mental problems, support for those returning to work, consultation for subordinates, improvement of working environments, self-care recommendations, and mental problems. • 2 psychologists in charge of 'Active Listening Training' (composed of 60-min lecture & 120-min practice session). • Contents of lecture: "Consultation as a role of supervisors," "Attitudes requested by listeners," & "Active listening method." • In practice session, roles of "Listener," "Talker," & "Observer" were played out. Each member's impressions & questions were discussed afterwards.
Tsutsumi et al., 2009	Participatory intervention Goal: to improve mental health & job performance Intervention period: 12 months Delivery method: participatory Subjects screened? yes Individually tailored? yes Incentives? no • Several meetings held with administrators & human relations personnel to discuss needs for work environment improvements. Researchers ensured that president & factory manager were provided with rationale behind participatory activities. • Focused on environment improvement or job redesign rather than on behavioural change. • *Half-day training workshop for facilitators* (i.e., human resource personnel & factory chief) (May 2005): provision of comprehensive information on mental health in workplace, lecture on participatory approach for stress reduction, role play based on real cases using action check list. • *Supervisory education program by facilitators* (Oct. 2005): information on significance of positive mental health, improvement of work environment & examples of good practices; ensured supervisors equipped with knowledge & skills needed to identify occupational stressors; helped supervisors design initiatives to clarify ambiguity, reduce conflict, overcome sources of stress. • *Set-up workshop* (Nov. 2005): held by workers; introduction on methodology for improving work environment; lecture on hazard identification based on stress surveillance & risk evaluation; application of action checklist; group discussion on work improvements; presentations of action plans. • Checklist: used to organize discussion to identify immediate, low-cost improvements in workplace; developed through a review of related references & collection of examples of workplace improvements.

	• Using these tools, workers listed & prioritized issues to be improved based on results of their stress surveillance. • Facilitators led group discussions to assist workers in listing activities for improvements. • Each group proposed action plans while considering effectiveness, feasibility, priority, & cost. • *Implementation of work environmental improvement:* workers implemented action plans; facilitators supported & sustained employee autonomous activities. • *Follow-up workshop 1* (Apr. 2006): repeated check & readjustment of activity by facilitators; presentation of activity processes by line foremen; discussion on problems of implementation & barriers to activities; suggestions for further improvement; encouraged workers to sustain autonomous activities. • *Evaluation* (Aug. 2006): process evaluation using psychosocial job condition data; post intervention interview with factory manager & facilitators. Principles of participatory approach: • Utilized team-based, problem-solving approach based on active employee involvement, shared work-related goals, & action planning; • Focused on problems in existing practice; carried out by employees & researchers in a joint cooperative effort; • Begin with real problems of organization instead of priorities of outsiders; • Focus on achievements & good practices already available; • Link working conditions with management goals such as productivity; • Encourage exchange of experience; • Promote employee involvement; • Use "learning-by-doing" approach.
Viola et al., 2008	Blue-enriched white light Goal: to investigate effects of exposure to blue-enriched white light on factors such as job performance & alertness Intervention period: 4 weeks per lighting condition (8 weeks total) Delivery method: workplace physical environment change Subjects screened? no Individually tailored? no Incentives? no • Employees exposed during workday hours, to a fluorescent light source with a highly correlated colour temperature (17,000 K, Philips master TL-D Activiva Active, Philips, Roozendaal, Netherlands). • This was compared with a similar light source with a lower colour temperature (4000 K, Philips master TL-D super 80). • Both types were 18 W & had similar spectral power distribution in the medium & long wavelength ranges, but the 17,000 K light produced more output between 420 – 480 nm.
Wang et al., 2007	Structured depression outreach-treatment telephone program Goal: to evaluate effects of program on workplace outcomes

	Intervention period: 12 months Delivery method: licensed master's degree-level mental health clinicians (care managers) Subjects screened? yes Individually tailored? yes Incentives? no • Specific treatments provided according to clinical need & participant's willingness to accept treatment. • Care managers given 12 hours of training on didactic instruction, role-play, & observed care manager contacts; received 60 min of supervision each week throughout study period; each had 50-70 individuals in caseloads. • Initial telephone contacts included structured assessment of depressive symptoms, prior treatment, complicating factors, & motivation for treatment. • For all participants with significant depressive symptoms, care managers recommended in-person psychotherapy & medication evaluation. • For participants declining in-person treatment, care managers provided brief motivational intervention & asked permission for continued telephone contact. • Following initial contacts, all participants were mailed a psychoeducational workbook emphasizing behavioural activation, identifying & challenging negative thoughts, & developing long-term self-care plans. • For participants entering in-person treatment, subsequent care manager contacts included assessments of depressive symptoms, treatment adherence, & barriers to continuing treatment. • Care managers provided feedback & algorithm-based recommendations to treating providers, as needed. • A psychiatrist was available for consultation to clinicians if needed. • For participants receiving 1 mode of treatment, adding a 2nd mode was recommended if significant depressive symptoms persisted after 2 months. • For participants declining in-person treatment, care managers maintained regular telephone contact; frequency determined by need (weekly for severe symptoms, bimonthly for mild symptoms). • Participants declining in-person treatment with significant symptoms after 2 months were offered an 8-session cognitive behavioural psychotherapy program. Weekly sessions lasted 30-40 min & followed above workbook. Booster sessions scheduled every 4-8 weeks to monitor & support progress. • All care management activities organized & supported by electronic decision support system. *Control group:* • Usual care: advised to consult with clinician; could receive any available insurance benefit, just not additional telephone management Other components: • Use of telephone program with care managers rather than more expensive in-person visits with traditional clinicians. • Participants received twice as many contacts as controls when care manager contacts were included, & were 70% more likely to receive any mental health specialty treatment.

Note. HRA = Health risk assessment; PA = physical activity; OP = occupational physician; GP = general physician; MSK = musculoskeletal; PT = physiotherapist; OHN = occupational health nurse

Appendix F

Description of Unsuccessful Interventions

	Intervention
Blangsted et al., 2008	2 different worksite PA interventions Goal: to evaluate effects on neck-shoulder symptoms, work ability, & sick leave Intervention period: 12 months Delivery method: experienced fitness instructor Subjects screened? no Individually tailored? yes Incentives? no • Participants in all 3 groups allowed to use 1 hr/wk during work hours for intervention activities. *Specific resistance training (SRT) group:* • Trained muscles in shoulder & neck; 3 sessions/wk each lasting 20 min; 2 of the weekly sessions supervised. • SRT performed with dumbbells: shoulder extension, abduction (with special attention to supraspinatus), & shoulder lift; 2-3 sets, 10-15 repetitions (~10-15 repetition maximum) of each exercise performed in each session. • In first 2 weeks, worked with loads at 50% max to focus on technique; subsequently encouraged to add to load if could perform > 15 repetitions. • Static neck exercises performed sitting. Inelastic strap positioned around head & was connected to scale. Repetitions performed forward, sideways, & backward; each repetition lasted 5 sec. • Ergometers used for rowing (Concept2, Inc. Morrisville, VT, USA) & kayaking (Dansprint, Vanlose, Denmark) exercises to ↑ explosive strength. Ergometers displayed mean power output in each bout. A max. of 10 all-out bouts, lasting 15-30 sec, could be performed in each session (rowing or kayaking). • Encouraged to keep training diaries. *All-around physical exercise (APE) group:* • Participants motivated to ↑ daily PA at worksite & during leisure time. • Introduced to exercise activities by instructors with pep talks (scholarly, motivating, and humoristic). • Made "a contract" – listed ways to include more PA in daily lives. • Frequency of visits from instructors ranged from 1- 4 times/month. • Groups organized for activities, e.g., Nordic walking, running; some supplied with step counters. • Introduced 8-min CD-based exercise program for aerobic fitness & general strength (but not specifically for neck & shoulders). • Exercise instruments, e.g., steppers, placed at strategic places (e.g., by photocopier). • Encouraged by 2 campaigns to bike to work & ↑ daily PA during leisure time; given information on location & hours of local sports & fitness centres, swimming pools. • Most activities involved large muscle groups & resulted in cardiopulmonary loading. *Reference group (R):*

	• Main purpose of activities was to ensure that participants received attention similar to 2 PA intervention groups, except they wouldn't perform additional PA. • Given presentation of previous projects in other companies in which researchers from the National Research Centre for the Working Environment (NRCWE), Denmark, in cooperation with managers & employees, had improved work conditions & occupational health. • Encouraged to form groups to improve existing non-optimal health & work conditions (e.g., ergonomics, stress, work organization, food quality in cafeteria, indoor air). • Participants organized presentations about various health-promoting initiatives such as diet, stress, relaxation. Experts from NRCWE supported their work (e.g., helped organize presentations).
de Kraker et al., 2008	Use of a new computer mouse Goal: to reduce hovering behaviour; improve productivity, comfort, & usability Intervention period: 2 weeks Delivery method: environmental change (physical equipment) Subjects screened? no Individually tailored? no Incentives? no • Regular computer mouse compared to newly developed mouse with a tactile, vibrating feedback signal (Hoverstop mouse®; Hoverstop BV, Amsterdam, The Netherlands). • New mouse comparable with regular mouse except it was equipped with small vibrating motor (comparable to vibration signals used in mobile phones). • Motor started to vibrate when user kept their hand on/above mouse for > 10 sec without actively using mouse (e.g., clicking/scrolling). • Vibration signaled to let go of mouse & place hand on desk in order to ↓ unnecessary muscle tension. • Motor vibrated at 40% level of motor power, with max. duration of 4 sec.
IJzelenberg et al., 2007	Multi-dimensional low back pain (LBP) prevention program Goal: to prevent LBP Intervention period: 12 months Delivery method: in-company PT Subjects screened? no Individually tailored? yes Incentives? no • Integrated approach of 3 preventive measures based on principles of *biopsychosocial model.* • Involved key stakeholders; had strong workplace component. • *Measure 1:* offered to all participants: 3 back training groups sessions consisting of tailored education & training in appropriate working techniques; emphasized self-limiting nature & favourable outcome of LBP, & therapeutic benefit of movement & participation in normal work & leisure activities; coping strategies & helpful exercises were practiced.

	• *Measure 2:* immediate treatment of (sub) acute LBP to prevent chronicity through an easily accessible in-company PT. In keeping with normal clinical practice, choice of elements of care was at PT's discretion. Content & treatment frequency was individually tailored to risk profile of patient. Specific advice given on how to cope with complaint at workstation. • *Measure 3:* aimed at workers with LBP complaints. 3 extra sessions of on-the-job training given when needed; or workplace examination preformed. Based on results, advice on ergonomic adaptations was given to employer. *Control group (usual care):* • Given by GP or OP according to Dutch guidelines for LBP. • Most workers with LBP first consult with GP. • For first 6 weeks after consultation, GP stresses staying active, & prescribes analgesics/nonsteroidal anti-inflammatory drugs (if necessary). • GP may refer those with subacute LBP (6 weeks) to PT. • OP emphasizes resuming daily activities & returning to work within 2 weeks. • Workplace interventions mentioned as an option. • Clinical intervention recommended after 12 weeks of sick leave. • Subjects informed that they could receive intervention after study finished. *Intervention vs. control group:* • Both groups unrestricted with respect to obtaining additional health care; co-interventions were registered & evaluated.
von Thiele Schwarz et al., 2008	2 worksite interventions: (1) physical exercise, (2) reduced work hours Goal: to examine health-related effects of interventions Intervention period: 6 months Delivery method: organizational Subjects screened? yes Individually tailored? no Incentives? no *Physical-exercise group (PE):* • 2.5 hours of weekly work hours allocated to mandatory PE on 2 different days. • PE had to be medium-to-high intensity (i.e., 55-89% max HR); such that it was difficult to converse while exercising, and sweating occurred enough to warrant a shower afterward. • Free to choose any type of PE. • All employees recorded type of activity & duration of each PE session; reports checked weekly by assigned employee. *Reduced-work hours group (RWH):* • Full-time weekly hours were reduced from 40 hrs/wk to 37.5 hrs/wk. • Part-time employees in PE & RWH: time allocated to PE & reduction of work hours was 2 hours for those working 30-39 hrs/wk (39% of employees), 1.5 hours for those working 21-29 hrs/wk (14%), 1 hour for those working < 20 hrs/wk (2%). • All employees in intervention groups retained their salaries; no additional personnel

	employed; expected to deliver full services throughout study period.

Note. PT = physiotherapist; PE = physical exercise; GP = general practitioner; OP = occupational physician; HR = heart rate