Sustainable Employability of Construction Workers

KAREN M. OUDE HENGEL

SUSTAINABLE EMPLOYABILITY OF CONSTRUCTION WORKERS K.M. OUDE HENGEL Body@Work

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The study presented in this thesis was performed at the Netherlands Organisation for Applied Scientific Research TNO, Hoofddorp, the Netherlands. TNO participates in Body@Work, Research Center on Physical Activity, Work and Health, which is a joint initiative of VU University Medical Center (Department of Public and Occupational Health, EMGO Institute for Health and Care Research), VU University Amsterdam, and TNO.

The study was funded by the Netherlands Organisation for Health Research Development (ZonMw), project 12051.0004.

Financial support for the printing of this thesis has kindly been provided by Body@Work, Research Center on Physical Activity, Work and Health, the Netherlands Organisation for Applied Scientific Research TNO, Work Solutions, the EMGO+ Institute for Health and Care Research, and the VU university.

English title:	Sustainable employability of construction workers
Nederlandse titel:	Duurzame inzetbaarheid in de bouwnijverheid
ISBN:	978-94-622-8502-6

Cover design by:	Martijn Smits (Unique Media) & Karen Oude Hengel
Printed by:	Uitgeverij Buijten & Schipperheijn, Amsterdam

VRIJE UNIVERSITEIT

Sustainable Employability of Construction Workers

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad Doctor aan
de Vrije Universiteit Amsterdam,
op gezag van de rector magnificus
prof.dr. L.M. Bouter,
in het openbaar te verdedigen
ten overstaan van de promotiecommissie
van de Faculteit der Geneeskunde
op vrijdag 8 maart 2013 om 13.45 uur
in de aula van de universiteit,
De Boelelaan 1105

door
Karen Marieke Oude Hengel
geboren te Chertsey, Verenigd Koninkrijk

promotoren: prof.dr. A.J. van der Beek
prof.dr.ir. P.M. Bongers
copromotor: dr. B.M. Blatter

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Chapter 1

General introduction

From early retirement towards sustainable employability

Sustainable employability is an important topic in political and societal debates because it is one of the major challenges for industrialised countries nowadays. Sustainable employability is defined as “the situation in which workers throughout their working life have real opportunities and a set of capabilities - and the necessary conditions - that allows them to achieve valuable work functioning in current and future work with preservation of health and welfare. This implies a work situation (task and context) that facilitates them, as well as the attitude and motivation to exploit these opportunities.[1]”

The reason why current debates focus on sustainable employability is the recognition of the fact that the workforce is ageing and shrinking, and will continue to do so.[2] This is partly explained by lower birth rates in the past few decades, causing fewer young workers to enter the labour force. At the same time, despite the increased life expectancy, improved living conditions and better health status, the average time period people spend in paid work during their lifetime has decreased in most European countries.[3,4] One reason for this is that social security systems have encouraged workers to retire with a pension before the official retirement age of 65. This early retirement pension was implemented in the 70s and 80s of the 20th century, and was caused by high unemployment among the youngest workers. However, post-war baby-boom generations are nowadays still exiting the labour market in great numbers before the official retirement age.[5] As a result, the proportion of economically active people in Europe is shrinking while the relative number of those retired is expanding.[5] Early exits from the labour market are thus no longer affordable from an economic perspective. Because a shrinking working population has serious economic implications in the form of inducing pressure on public finances and social security systems, governments recognise the significance of extending working lives. However, the importance of shifting from early retirement towards sustainable employability has not been recognised by employers and workers to such an extent. Employers in Europe admit that the expected shortages will have serious negative consequences for the labour force.[6] The majority of them, however, are not aware of the importance of keeping workers employed until and after their retirement age in their own organisation.[6,7] In addition, even though the ability and willingness to continue working have increased in the last few years, half of workers are still neither able nor willing to continue working until the age of 65.[8]

Measures to support sustainable employability

In order to mitigate the adverse effects of an ageing population, industrialised countries are currently encouraging workers to extend their working life through several measures. First, economic incentives to retire early, such as tax benefits, have been restricted making voluntary early retirement from work more expensive. Second, some countries are debating over whether - or have already decided - to raise the retirement age in the upcoming decades. However, the risk of implementing these measures might be that some groups of workers transit into work disability pensions rather than extend their working lives until the official retirement age.

Whether workers actually retire early or not is not only influenced by measures at political and societal level, but also by health and work-related factors. It is evident that self-perceived health and chronic diseases are predictive for the transition to work disability, unemployment, and early retirement.[9,10] Additionally, work-related factors, such as high physical work demands, work pressure and low job satisfaction, push workers to leave the labour force early.[9] Lower support from supervisors[9] and little challenge at work[11] predict retirement as well.

Retirement is determined by both the ability and the willingness to continue working.[7] While several studies have investigated risk factors related to the ability to continue working, little is known about the factors that influence the willingness to continue working. Therefore, it is of particular interest to gain insight into the ability as well as the willingness to continue working in order to better understand the complex retirement process. To date, only one cross-sectional study on the ability and willingness to work until the retirement age has been published.[12] More insight into the factors that determine the ability and willingness to continue working may contribute to the development of interventions and policies that support the prolongation of working life.

Towards sustainable employability among blue-collar workers

The challenge of sustainable employability is most eminent in industries where the physical work demands are high. Compared to other industries, those with high physical work demands show higher ageing and higher shrinking rates of the working population. Fewer young workers are currently willing to perform physically demanding jobs. In addition, the retirement age of blue-collar workers is strongly influenced by collective labour agreements that give these workers the opportunity to actually retire earlier than white-collar workers.[13] The industries with physically demanding jobs face an additional challenge in extending working lives: the majority of blue-collar workers believe that they are not able and are not willing to continue working until the retirement age. Despite this, the self-reported ability to continue working until the age of 65 among workers preforming frequently heavy work increased from 19% in 2005 to 23% in 2010. Although this is a positive trend, this percentage is still far below the average amongst all workers (45%).[8,14] To a lesser extent, the same trend is noticeable for the willingness to continue working until the age of 65: in 2010 39% of blue-collar workers were willing to work until the age of 65, while 44% of all workers were willing to do so.[8]

The reasons for the earlier retirement age and the lower self-perceived ability and willingness to continue working among blue-collar workers can be explained by the fact that these workers run an increased risk of a lower health status as well as work ability. First, the health potential of blue-collar workers is threatened by their high physical workload[15] and unhealthy lifestyle (i.e., they smoke more, and are less physically active in leisure time)[16]. Hence, blue-collar workers generally report a lower self-perceived health status than white-collar workers.[17] Specifically, they more often report musculoskeletal symptoms and chronic health diseases.[18] Second, workers with physically demanding jobs run relatively higher risks of impaired work ability.[19,20] The concept of work ability has been developed to measure employability, is defined as how well workers can perform their job at present and in the near future, and is the result of the interaction between the individuals' capacity and their work demands.[21,22] The risk of lower work ability among blue-collar workers can be attributed, among others, to their working conditions. In particular, high physical workload (e.g., manual handling and awkward back postures) as well as psychosocial factors (e.g., lack of support and low job control) are recognised as risk factors for lower work ability. Lastly, health and work ability have a reciprocal relation.[23,24] Workers with a poor health status, such as musculoskeletal symptoms[25], have a lower work ability and vice versa.[19] Because of the impaired health status and work ability of blue-collar workers, they are more susceptible to transition from paid employment to work disability pensions[24] or early retirement[9,26] than white-collar workers.

Intervention programmes to support sustainable employability

Since blue-collar workers run an increased risk of work disability pensions and early retirement, raising the retirement age in collective labour agreements, as described previously, is not sufficient to retain these workers in the labour force. For this reason, it is also a matter of improving the ability of workers to continue working until the official retirement age. Thus, industries and companies are compelled to pay attention to policies and interventions in order to extend the healthy and productive working lives of their blue-collar workers.

To successfully implement interventions in companies, tailoring interventions to specific target groups may be a successful strategy because each group of workers shares a common culture and natural social network.[27] When taking this into account, intervention programmes to extend working lives among blue-collars should be tailored to specific target groups as well. Construction workers are an interesting target group for such an intervention because the prevalence of health problems such as musculoskeletal symptoms[30] and cardiovascular diseases[28] among these workers is even higher than among other blue-collar workers.[28,29]

To date, evidence-based intervention programmes among construction workers or other blue-collar workers that explicitly aim to support sustainable employability are lacking.[31] Only one intervention among construction workers at risk of early retirement can be found that aimed to improve work ability and prevent work disability pensions.[32] This six-month counselling and education programme showed no significant intervention effects on either outcome measure. Other intervention programmes in the construction industry targeted either the construction workers' health by means of a lifestyle programme[33,34] or the decrease of physical work demands by means of ergonomic measures[35,36]. However, taking into account the complexity and multidimensionality of the concept of sustainable employability[31], it could be hypothesised that a multidimensional intervention approach could potentially be more effective than a single intervention.

Even if a multidimensional intervention is tailored to the target group, implementing intervention programmes at worksites still faces several challenges. For instance, support from managers towards the programmes[27], workers' participation in the programmes[37], and social support at work from colleagues and staff[38] are key elements for a successful implementation. To gain more insight into the key elements of implementation as well as the effectiveness of intervention programmes, several reviews have highlighted the need for better and comprehensive evaluations of these programmes.[27,38] A comprehensive evaluation of an intervention not only investigates the effects of the outcomes, but also the process of implementing the intervention, and the costs in relation to the benefits. The process evaluation is important as it facilitates the interpretation of study findings by providing more detailed information about the content and degree of implementation of the intervention.[39] As the decision whether or not to invest in intervention programmes is not only based on effectiveness, insight into the costs in relation to the benefits is needed for employers.[40]

Aims

In order to support sustainable employability among workers, it is not only important to get insight into the determinants of the ability and willingness to continue working until the retirement age, but also into evidence-based intervention programmes. Coming forth out of this introduction, the current thesis addresses three primary objectives:

I. To provide an insight into factors that influence the ability and willingness in workers to continue working until the age of 65;
II. To develop a tailored intervention aimed at improving the work ability and health of construction workers in order to support their sustainable employability;
III. To evaluate this intervention in terms of the process evaluation, the effect evaluation and the economic evaluation.

Outline of this thesis

Following this general introduction and the three objectives, this thesis is divided into three parts. *Part one* of this thesis focuses on the factors associated with workers' ability and willingness to continue working until the age of 65 for two different target groups. Specifically, Chapter 2 identifies the predictors of the willingness and ability to continue working until the age of 65 in workers aged 45-63 years. It is followed by Chapter 3, which describes the associations of demographic, work-related and health-related factors with the ability and willingness to continue working until the age of 65 in construction workers. For these two chapters, the Netherlands Working Conditions Cohort Study[8] and the Netherlands Working Condition Survey[8,14] were used.

Part two of this thesis focuses on the systematic development of a prevention programme for construction workers. It was hypothesised that focusing on the health and work ability of construction workers is important to support sustainable employability. Chapter 4 describes the development of a worksite prevention programme aimed at improving both outcome measures, developed through an application of the Intervention Mapping protocol.[41] The Intervention Mapping protocol was applied to systematically incorporate empirical findings from the literature and input from all stakeholders (i.e., workers, managers and providers) into an intervention tailored to the construction workers. Chapter 5 presents the study design of the evaluation of the intervention.

Part three of this thesis includes the evaluation of the worksite prevention programme by reporting on the process evaluation and (cost-)effectiveness evaluation. The prevention programme was evaluated among 293 workers from six construction companies in the Netherlands using a cluster randomised controlled design. The feasibility of implementing an intervention at different worksites in the construction industry is presented in Chapter 6. Also, the reach and the satisfaction with the worksite intervention, the intention to use the intervention in the future and the role of contextual factors are described in this chapter. Chapter 7 presents the differences in the effects between the intervention and control group on social support at work, work engagement, physical workload and need for recovery. Whether the intervention was successful in improving work ability, health and sick-leave as well is described in Chapter 8. Additionally, the decision of employers to invest in the intervention is not only guided by the evidence of the effectiveness, but also by considerations in relation to their financial benefits. Therefore, Chapter 9 describes the cost-effectiveness and financial return of the intervention from the employer's perspective.

The final chapter, Chapter 10, summarises the main findings of the thesis and discusses the implications for practice and future research.

References

1. Van der Klink JJL, Brouwer S, Bültmann U, Burdorf L, Schaufeli WB, Van der Wilt GJ, et al. Duurzaam inzetbaar: een werkdefinitie. [Sustainable employability: a working definition]. `s Gravenhage: ZonMw; 2010.
2. European Commission. Europe 2020, a European strategy for smart, sustainable and inclusive growth. Brussels: 2010.
3. Ilmarinen J. Towards a longer and better working life: a challenge of work force ageing. *Med Lav* 2006;97(2):143-7.
4. Ilmarinen JE. Aging workers. *Occup Environ Med* 2001;58(8):546-52.
5. Eurostat. Europe in Figures; Eurostat yearbook 2011, chapter 5 labour market. Luxembourg: Eurostat European Commission; 2011.
6. Van Dalen HP, Henkens CJIM, Conen WS, Schippers J. Dilemma's rond langer doorwerken: Europese werkgevers aan het woord [Dilemmas of prolonging work life: the view of European employers]. Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen (KNAW); 2012. Report No.: 85.
7. Ybema JF, Geuskens GA, Oude Hengel KM. Oudere werknemers en langer doorwerken [Older employees and prolonging working life]. Hoofddorp: TNO; 2010.
8. Koppes LLJ, De Vroome EMM, Mol MEM, Janssen BJM, Van den Bossche SNJ. Nationale Enquête Arbeidsomstandigheden 2010: Methodologie en globale resultaten [The Netherlands working conditions survey 2010: Methodology and overall results]. Hoofddorp: TNO; 2011.
9. Van den Berg TI, Elders LA, Burdorf A. Influence of health and work on early retirement. *J Occup Environ Med* 2010;52(6):576-83.
10. Van den Berg T, Schuring M, Avendano M, Mackenbach J, Burdorf A. The impact of ill health on exit from paid employment in Europe among older workers. *Occup Environ Med* 2010;67(12):845-52.
11. Proper KI, Deeg DJ, Van der Beek AJ. Challenges at work and financial rewards to stimulate longer workforce participation. *Hum Resour Health* 2009;7:70:doi:10.1186/1478-4491-7-70.
12. Nilsson K, Hydbom AR, Rylander L. Factors influencing the decision to extend working life or retire. *Scand J Work Environ Health* 2011;37(6):473-80.
13. CBS. Pensioenleeftijd werknemers ruim 63 jaar. [Retirement age of employees over 63 years] 2012. Available at: http://www.cbs.nl/nl-NL/menu/themas/gezondheid-welzijn/publicaties/artikelen/archief/2012/2012-3557-wm.htm.
14. Van den Bossche SNJ, Hupkens CLH, De Ree SJM, Smulders PGW. Nationale Enquête Arbeidsomstandigheden 2005: Methodologie en globale resultaten [The Netherlands working conditions survey 2005: Methodology and overall results]. Hoofddorp: TNO; 2006.
15. Aittomäki A, Lahelma E, Rahkonen O, Leino-Arjas P, Martikainen P. The contribution of musculoskeletal disorders and physical workload to socioeconomic inequalities in health. *Eur J Public Health* 2007;17(2):145-50.
16. Seitsamo J, Ilmarinen J. Life-style, aging and work ability among active Finnish workers in 1981-1992. *Scand J Work Environ Health* 1997;23(Suppl 1):20-6.
17. Karpansalo M, Manninen P, Kauhanen J, Lakka TA, Salonen JT. Perceived health as a predictor of early retirement. *Scand J Work Environ Health* 2004;30(4):287-92.
18. Seitsamo J, Klockars M. Aging and changes in health. *Scand J Work Environ Health* 1997;23(Suppl 1):27-35.
19. Gould R, Ilmarinen J, Järvisalo J, Koskinen S. Dimension of work ability: results of the Health 2000 Survey. Helsinki: Finnish Institute of Occupational Health; 2008.
20. Aittomäki A, Lahelma E, Roos E. Work conditions and socioeconomic inequalities in work ability. *Scand J Work Environ Health* 2003;29(2):159-65.
21. Ilmarinen J. Ageing workers in the European Union - Status and promotion of work ability, employability and employment. Helsinki: Finnish Institute of Occupational Health, Ministry of Social Affairs and Health, Ministry of Labour; 1999.
22. Ilmarinen J. Work ability, a comprehensive concept for occupational health research and prevention. *Scand J Work Environ Health* 2009;35(1):1-5.

23. Alavinia SM, Van Duivenbooden C, Burdorf A. Influence of work-related factors and individual characteristics on work ability among Dutch construction workers. *Scand J Work Environ Health* 2007;33(5):351-7.
24. Alavinia SM, De Boer AG, Van Duivenbooden JC, Frings-Dresen MH, Burdorf A. Determinants of work ability and its predictive value for disability. *Occup Med (Lond)* 2009;59(1):32-7.
25. Neupane S, Miranda H, Virtanen P, Siukola A, Nygård CH. Multi-site pain and work ability among an industrial population. *Occup Med (Lond)* 2011;61(8):563-9.
26. Szubert Z, Sobala W. Current determinants of early retirement among blue collar workers in Poland. *Int J Occup Med Environ Health* 2005;18(2):177-84.
27. Sparling PB. Worksite health promotion: principles, resources, and challenges. *Prev Chronic Dis* 2010;7(1):A25.
28. Arndt V, Rothenbacher D, Daniel U, Zschenderlein B, Schuberth S, Brenner H. Construction work and risk of occupational disability: a ten year follow up of 14,474 male workers. *Occup Environ Med* 2005;62(8):559-66.
29. Peterson JS, Zwerling C. Comparison of health outcomes among older construction and blue-collar employees in the United States. *Am J Ind Med* 1998;34(3):280-7.
30. Boschman JS,Van der Molen HF, Sluiter JK, Frings-Dresen MH. Occupational demands and health effects for bricklayers and construction supervisors: A systematic review. *Am J Ind Med* 2011;54(1):55-77.
31. Brouwer S, De Lange A, Van der Mei S, Wessels M, Koolhaas W, Bültmann U, et al. Duurzame inzetbaarheid van de oudere werknemer: stand van zaken [Sustainable employability of the older worker: state of the art]. Groningen: Universitair Medisch Centrum Groningen, Rijksuniversiteit Groningen; 2012.
32. De Boer AG, Burdorf A, Van Duivenbooden C, Frings-Dresen MH. The effect of individual counselling and education on work ability and disability pension: a prospective intervention study in the construction industry. *Occup Environ Med* 2007;64(12):722-7.
33. Gram B, Holtermann A, Søgaard K, Sjøgaard G. Effect of individualized worksite exercise training on aerobic capacity and muscle strength among construction workers - a randomized controlled intervention study. *Scand J Work Environ Health* 2011; 38(5):467-75.
34. Groeneveld IF, Proper KI, Van der Beek AJ, Hildebrandt VH, van Mechelen W. Short and long term effects of a lifestyle intervention for construction workers at risk for cardiovascular disease: a randomized controlled trial. *BMC Public Health* 2011;11:836.
35. Luijsterburg PA, Bongers PM, De Vroome EM. A new bricklayers' method for use in the construction industry. *Scand J Work Environ Health* 2005;31(5):394-400.
36. Van der Molen HF, Sluiter JK, Hulshof CT, Vink P, Van Duivenbooden C, Holman R, et al. Implementation of participatory ergonomics intervention in construction companies. *Scand J Work Environ Health* 2005;31(3):191-204.
37. Robroek SJ, Van Lenthe FJ, Van Empelen P, Burdorf A. Determinants of participation in worksite health promotion programmes: a systematic review. *Int J Behav Nutr Phys Act* 2009;6:26: doi: 10.1186/1479-5868-6-26
38. Goetzel RZ, Ozminkowski RJ. The health and cost benefits of work site health-promotion programs. *Annu Rev Public Health* 2008;29:303-23.
39. Steckler A, Linnan L. Process Evaluation for Public Health Interventions and Research. San Francisco: Jossey-Bass; 2002.
40. Tompa E, Culyer AJ, Dolinschi R. Economic Evaluation of Interventions for Occupational Health and Safety - Developing Good Practice New York: Oxford University Press; 2008.
41. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach. San Francisco: Jossey-Bass; 2006.

Chapter 2

Predictors of the willingness and the ability to continue working until the age of 65 years

Goedele A. Geuskens, Karen M. Oude Hengel, Lando L. Koppes,
Jan Fekke Ybema

J Occup Environ Med. 2012 54(5):572-8

Abstract

Objective: To identify predictors of the willingness and ability to continue working until the age of 65 in older employees.

Methods: In this longitudinal study, 4,937 employees aged 45-63 included in the Netherlands Working Conditions Cohort Study were studied. Logistic regression analyses were applied.

Results: Employees who experienced emotional exhaustion and bullying or harassment by colleagues/supervisor were less often willing to continue working, whereas employees sometimes using force were more often willing to continue working. Emotional exhaustion, a work handicap, higher physical and emotional demands, lower supervisor's support, and intermediate satisfaction with salary predicted a lower likelihood to be able to continue working.

Conclusion: Prevention of emotional exhaustion and promotion of a healthy social work climate may support both the willingness and ability to work until the age of 65.

Introduction

In most European countries, the work force is ageing. Labour force participation among older persons is lower than in younger persons, with 46% of those aged 55-64 years participating in paid work and 78% of those aged 25-54 years.[1] Workers often retire well before the official retirement age. In the Netherlands, the average age to retire was 62 in 2007, whereas the official retirement age was 65.[2] However, the willingness and perceived ability to extend working life has increased during the last years. In employees aged 45-64 years, the willingness to continue working until the age of 65 increased from only 21% in 2005 to 36% in 2008. The perceived ability to do so in their current work increased from 41% to 50%.[3]

In the coming years, a shortage of workers is expected. At the same time, the rising ratio of retired elderly to the active working population induces pressure on public finances.[4] This raises the question which factors influence the prolongation of working life. In addition to financial incentives and collective agreements[5,6], health and work-related factors influence whether workers retire early or not. A review of longitudinal studies showed that poor health and lack of physical activity in leisure time predicted (non-disability) early retirement. Moreover, workers with high physical work demands, high work pressure, and low job satisfaction more often retired early.[7] Recent studies added that job stress, low job control[8], little challenge at work[9,10], low appreciation, and low support from the supervisor[6] predict early retirement as well.

To better understand the retirement process, insight in the willingness and ability to work until the retirement age is crucial. To our knowledge, one study on the willingness to work until the age of 65 has been published. In this cross-sectional study of workers aged 55-64 in the Swedish healthcare sector, Nilsson et al. (2011)[11] showed that good health, financial incentives to continue working, positive attitudes towards older workers among managers, higher importance of work in life, and not intending to retire early if the partner does were positively associated with the willingness to work until the age of 65. In contrast, the mental and physical working environment and competences and skill development were not associated with the willingness to continue working[11]. These findings are in line with a review of Kooij et al.

(2008)[12] on age-related factors that may influence older worker's motivation to continue working. Kooij et al. (2008)[12] described that poor health, age-related eligibility to retirement, financially attractive exit arrangements, and reduced workload may negatively affect the motivation to continue working. In addition, this review suggested that age norms and stereotyping by managers might reduce opportunities for promotion and training, and as a consequence, the motivation to continue working. Finally, partner's wishes and increased value placed on leisure time seemed to encourage the decision to retire.[12]

Little is known on the perceived ability to continue working until the age of 65. Nilsson et al (2011)[11] described that poor health and work-related factors were associated with the ability to work until the age of 65 in the healthcare sector. Physically and mentally demanding work and a rapid working pace were negatively associated with the perceived ability to continue working until the age of 65, whereas satisfactory use of competences and sufficient possibilities for supervision were positively associated. Financial incentives to continue working (e.g. intending to work beyond age 65 to get a better pension) and social factors (i.e. intending to retire early if partner does) were also positively associated with the ability to continue working.[11] However, especially for financial and social factors, it remains unclear whether these factors underlie the ability to continue working or vice versa due to the cross-sectional design of this study. Current work ability in relation to the present job and work ability in near future has frequently been studied. In a review study, poor work ability as assessed with the Work Ability Index was associated with poor musculoskeletal capacity, high physical workload, poor physical work environment, high mental work demands, and lack of autonomy.[13]

Despite the current debate on early retirement and the prolongation of working life, little is known on the factors that influence the willingness and ability of older workers to continue working until the official retirement age or beyond. Prospective studies in the general working population are lacking. Longitudinal studies are more suitable to make causal inferences than cross-sectional studies, since dependent variables precede outcome variables. Furthermore, longitudinal studies offer the opportunity to identify factors that influence changes in the willingness and ability to continue working, which is relevant for the development of interventions. It is possible that different factors play a role in different groups of workers, such as men and women.[14] More insight in the determinants of the willingness and the ability to continue working may contribute to the development of interventions that support the prolongation of working life. Therefore, the aim of the present study was to identify predictors of the willingness and ability to continue working until the age of 65 in employees aged 45-63 years.

On the basis of previous studies[11,12], we hypothesised that good health, financial factors (i.e. higher satisfaction with salary), and work characteristics (i.e. a healthy social climate at work, higher satisfaction with career perspectives and flexible working hours) predicted that employees were willing to continue working until the age of 65. The rationale behind satisfaction with flexible working hours was that flexible working hours may provide the opportunity to combine work with leisure time activities.[12] Second, we hypothesised that good health and work characteristics (i.e. lower physical- and psychosocial job demands, healthy social climate at work) predicted that employees perceived to be able to continue working in their current work until the age of 65.[11,13]

Methods

Participants

Data of the Netherlands Working Conditions Cohort Study (NWCCS) of 2007 and 2008 were used.[15] The NWCCS is a large cohort study on working conditions in the Netherlands. Employees aged 15-64 years are included, whereas self-employed individuals are excluded. In 2007, 80,000 individuals were sampled from the Dutch working population database of Statistics Netherlands. This database contains information on all jobs which fall under employee national insurance schemes, and are liable to income tax. Individuals in the sample received the written questionnaire by mail at their home address in the first week of November 2007. The questionnaire could be filled out with a pencil, or via internet using a personal code which was printed on the questionnaire.[15] Questionnaires of 32.8% of the employed sampled individuals were available for analysis in 2007 (n= 22,759), with 10,021 employees being aged 45-63 years (Figure 1).

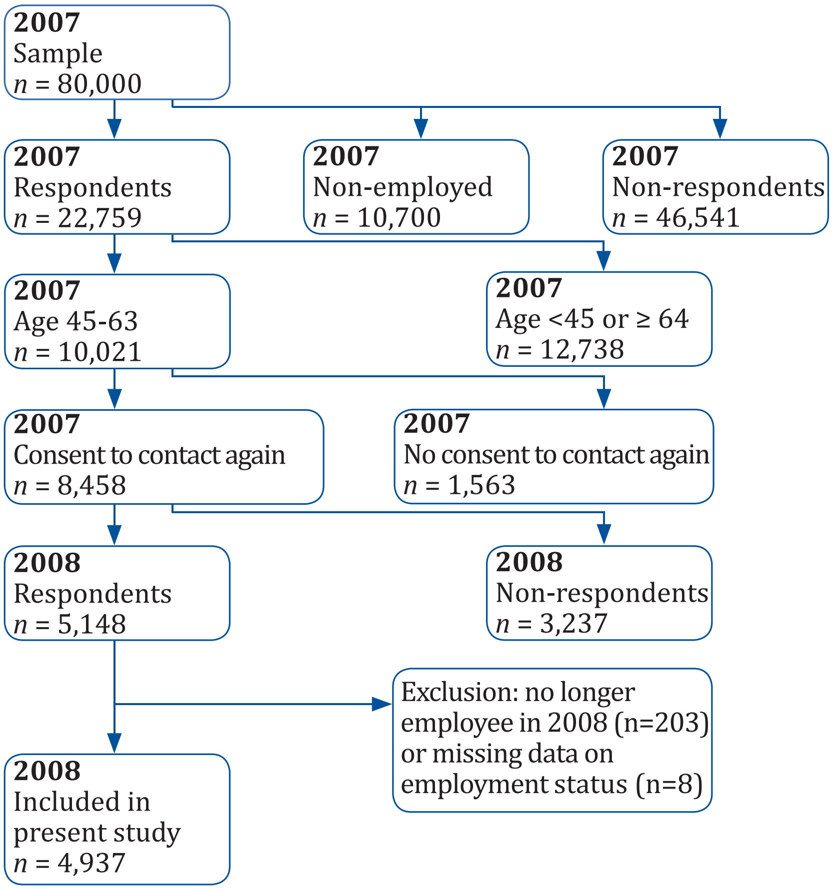

Figure 1. Employees in the Netherlands Working Conditions Cohort Study (NWCCS) included in the present study

Women aged 45 and older responded slightly more often than expected on the basis of the sample derived from the Dutch working population database of Statistics Netherlands (45% versus 42%). In addition, women aged 45-54 responded more often than expected compared to women aged 55 and older (71% in NWCCS versus 67% in Dutch working population).

The data collection after 12 months of follow-up was very similar to the data collection at baseline. In total 8.458 of the 10.021 persons aged 45-63 years had provided consent to be contacted in future. In November 2008, 5.148 persons (61%) responded to the follow-up questionnaire (Figure 1). Persons who participated only at baseline (irrespective of consent to be contacted again) were less often high educated (31% versus 39%) and less often able to continue working in their current work until the age of 65 at baseline (44% versus 47%) than persons who participated both at baseline and follow-up. No differences were found for age, gender, and the willingness to continue working.

For the present analyses, employees were excluded if they had stopped working after one year of follow-up (n=203) or if their employment status was unclear (n=8). The reason is that employees who had stopped working no longer answered questions on their willingness and ability to continue working in their current work until the age of 65. Therefore, 4,937 employees were included.

Measurement

Employees filled out a questionnaire at baseline and after 12 months of follow-up. All independent variables were derived from the baseline questionnaire. Age, gender, and educational level were asked. Education was categorized according to the highest level attained into low (primary school, lower and intermediate secondary education or lower vocational training), intermediate (higher secondary education or intermediate vocational training), and high (higher vocational training or university). Employees were also asked whether they had a partner, and whether their partner had a paid job.[15]

Full-time employment was defined as working at least 36 hours per week according to the contract. Evening and night work was asked with a single question with answer categories on a 3-point scale (no, sometimes, frequently). Since a substantial proportion of the employees (8.2%) did not answer this question, a fourth category was added, i.e. "no answer". Physical workload was assessed with a single question, i.e. "Does your job require using a lot of force, e.g. lifting, pushing, pulling, dragging, or does your job involve the use of tools and machines that require you to use a lot of force?". Answers were on a 3-point scale (no, sometimes, frequently).[15]

Questions on job demands, job autonomy, and social support were based on the Job Content Questionnaire.[15,16] Job demands were assessed with four questions with answers on a 4-point scale ranging from never to always (Cronbach's alpha 0.77). For job autonomy five questions were asked. A 3-point scale was used for the answer categories, i.e. no, sometimes, and frequently (Cronbach's alpha 0.85). Support from colleagues and support from the supervisor were separately assessed with four questions on a 4-point scale ranging from totally agree to totally disagree (Cronbach's alpha respectively 0.88 and 0.82). In addition, employees could indicate the questions on social support were not applicable. Emotional job demands were assessed by means of three questions derived from the Copenhagen

Psychological Questionnaire (COPSOQ) with answers on a 4-point scale ranging from never to always (Cronbach's alpha 0.82).[15,17] The sum scores of job autonomy, job demands, emotional demands, support from colleagues, and support from the supervisor were classified into three categories (low, intermediate, high) using the 25th and the 75th percentile scores. For social support from colleagues and the supervisor, a fourth category was added. This included employees for whom social support was not applicable and employees that did not answer the questions.

Inappropriate behaviour by colleagues/supervisor and by customers was assessed separately by means of four questions on the occurrence of sexual harassment, intimidation, physical violence, and bullying in the past 12 months (e.g. "In the past 12 months, how often did you experience intimidation by customers (or patients, students, passengers, etc.)"). Answers were given on a 4-points scale (never, once in a while, often, very often).[15,18] Employees who reported that any of the four inappropriate behaviours occurred once in a while, often, or very often were classified as having experienced inappropriate behaviour. Satisfaction with salary, promotion and career perspectives, and flexibility of working hours was assessed by means of a numeric rating scale (1-10) (e.g. "Please indicate how satisfied you are with the following by reporting a report mark: Salary"). Respondents could also indicate they did not know the answer or the term of employment was not applicable. Scores were classified into low (1-5), intermediate (6-7), high (8-10), or no answer/not applicable. Missing values were classified as "no answer/not applicable".

The presence of longstanding diseases and conditions was assessed. Employees indicated whether these health problems limited their ability to perform their job (i.e. work handicap). Emotional exhaustion was assessed with five questions of the Utrecht Burnout Scale (UBOS).[15,19] The questions had answer categories on a 7-point scale ranging from never to every day (Cronbach alpha 0.86). The distributed of the scale (1-7) was skewed, and on the basis of the cut-off value of 3.2[19], the score was dichotomized into 'no emotional exhaustion' and 'emotional exhaustion'.

During the present study, the official retirement age in the Netherlands was 65 years. At baseline, the willingness to continue working until the official retirement age was assessed with a single question ("Do you want to work until the age of 65?") with answers on a three point scale (yes, no, don't know). The ability to continue working in the current work was also assessed with a single question ("Do you think you are able to continue working in your current work until the age of 65?") and the same answer categories.[15] Employees answering 'yes' were classified as being willing or able to continue working, whereas those answering "no" or "do not know" were not. At follow-up, the willingness to continue working was assessed with an open-ended question ("Until what age would you like to continue working?"). Employees who reported to be willing to work until the age of 65 or older were considered to be willing to work until the retirement age of 65. The ability to continue working at follow-up was assessed with the same question that was used at baseline.

Statistical analysis

To study the relation of demographic, work-related, and health-related variables at baseline with the willingness and the ability to continue working until the age of 65 at follow-up, logistic regression analysis was used. Separate models were constructed. First, crude logistic regression analyses were performed with one independent variable and one dependent variable. In these models, the willingness or the ability to continue working as assessed at baseline was included. This means that we studied factors that predicted a *change* in the willingness or ability to continue working, which is relevant for the development of interventions. The measure of association was expressed by odds ratio (OR) and the 95% confidence interval. The independent variables with a p-value <0.05 in the crude regression analyses were selected for further analyses. Second, multiple logistic regression models were constructed by backward selection. All independent variables with a p-value <0.05 were retained in the model. By default, the outcome measure as assessed at baseline, age, and gender were retained in the final multiple models. After the construction of the final multiple models, independent variables that were not included were added one by one to the models. Independent variables that significantly improved the fit of the model were included in the final multiple regression model. Persons with missing values on one or more variables were excluded from the analyses by listwise deletion. Statistical analyses were performed with the statistical package SPSS 17.0 for Windows (SPSS Inc, Chicago).

Table 1. Characteristics of the study population at baseline (n= 4,937)

	Baseline	Missing data
Demographic factors		
Age, median (IQR)	52 (7)	0%
Gender, % women	45%	0%
Educational level		1%
High	39%	
Intermediate	35%	
Low	26%	
Partner		4%
Partner has paid job	65%	
Partner does not have paid job	20%	
No partner	15%	
Work-related factors		
Hours of work per week, median (IQR)	36 (12)	1%
Evening and night work		
No	51%	
Sometimes	24%	
Frequently	17%	
No answer	8%	
Using force		2%
Never	66%	
Sometimes	20%	
Frequently	14%	
Job autonomy (1-3), median (IQR)	2.8 (0.6)	1%
Job demands (1-4), median (IQR)	2.3 (0.8)	1%
Emotional demands (1-4), median (IQR)	2.0 (1.0)	1%
Social support by colleagues (1-4), median (IQR)	3.0 (0.5)	
No answer/not applicable	4%	
Social support by the supervisor (1-4), median (IQR)	3.0 (0.5)	
No answer/not applicable	6%	
Inappropriate behaviour by colleagues/supervisor	18%	1%
Inappropriate behaviour by customers	26%	1%
Satisfaction with salary (1-10), median (IQR)	7.0 (3.0)	
No answer/not applicable	1%	
Satisfaction with perspectives (1-10), median (IQR)	6.0 (3.0)	
No answer/not applicable	18%	
Satisfaction with flexible working hours (1-10), median (IQR)	7.0 (3.0)	
No answer/not applicable	22%	
Health-related factors		
Longstanding health conditions		4%
None	55%	
Yes, no work handicap	21%	
Yes, and work handicap	24%	
Emotional exhaustion	12%	0%
Willingness and ability to work until the age of 65		
Willing to continue working until the age of 65, % yes	33%	0%
Able to continue working until the age of 65, % yes	47%	1%

IQR: Interquartile range, difference between 25th and 75th percentile

Results

At baseline, 33% of the employees (Table 1) and at follow-up 27% of the employees were willing to continue working until the age of 65 (question modified at follow-up). In total 19% remained willing to continue working, 58% remained unwilling to continue working, 8% changed to willing and 14% changed to unwilling to continue working at follow-up. A larger proportion of the employees felt able to continue working in the current work, i.e. 47% at baseline and 50% at follow-up. In total 35% remained able to continue working, 38% remained unable to continue working, 15% changed to being able and 12% changed to being unable to continue working until the age of 65. The willingness and the ability to continue working were significantly related (Spearman r=0.30).

In the crude regression analysis, older employees and employees with a partner without a paid job were more often willing to continue working until the age of 65, whereas women were less often willing to continue working (Table 2). Employees who sometimes used force at work or experienced high job demands, high emotional demands, or inappropriate behaviour were less often willing to continue working. Employees who reported emotional exhaustion were also less often willing to continue working, whereas the adverse influence of a work handicap was borderline significant. In the multiple regression analysis, older age and sometimes using force predicted that employees were more often willing to continue working. Women and employees reporting inappropriate behaviour by colleagues/supervisor and emotional exhaustion were less often willing to continue working.

The ability to continue working in the current work until the age of 65 was predicted by various demographic, work-related, and health-related characteristics in the crude regression analyses (Table 2). For several independent variables, the direction of the relation with the ability to continue working was similar to the relation with the willingness to continue working. One of the exceptions was using force. (Sometimes) using force was positively related with the willingness to continue working, but using force was negatively related with the ability to continue working. In the multiple regression analysis, employees aged 60-63 years were more often able to continue working until the age of 65, whereas women were less often able to

Table 2. Predictors of the willingness to continue working until the age of 65 and the ability to continue working in the current work until the age of 65 after 12 month of follow-up in logistic regression analyses[a]

	Willingness				Ability			
	Crude[b]		Multiple[c]		Crude[d]		Multiple[e]	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Willingness/ability at baseline	8.56	7.43-9.87*	8.66	7.46-10.1*	7.79	6.86-8.86*	6.12	5.33-7.03*
Demographic factors								
Age								
45-49	1.00		1.00		1.00		1.00	
50-54	0.98	0.82-1.18	0.98	0.82-1.18	1.04	0.89-1.21	1.08	0.92-1.27
55-59	1.51	1.25-1.82*	1.50	1.24-1.82*	1.14	0.96-1.35	1.11	0.93-1.33
60-63	4.21	3.18-5.59*	4.01	3.01-5.34*	2.57	1.91-3.48*	2.53	1.83-3.48*
Women versus men	0.81	0.70-0.94*	0.84	0.72-0.97*	0.78	0.69-0.89*	0.83	0.73-0.95*
Educational level								
High	1.00		.		1.00		.	
Intermediate	0.96	0.81-1.14	.		0.93	0.80-1.08	.	
Low	1.14	0.95-1.36	.		0.94	0.80-1.10	.	
Partner								
Paid job	1.00		.		1.00		.	
No paid job	1.47	1.23-1.76*	.		1.21	1.03-1.43*	.	
No partner	1.16	0.95-1.42	.		0.89	0.73-1.07	.	
Work-related factors								
Part-time versus full-time work	0.94	0.82-1.09	.		0.85	0.75-0.97*	.	
Evening/night work								
No	1.00		.		1.00		.	
Sometimes	1.04	0.87-1.24	.		0.97	0.83-1.13	.	
Frequently	0.98	0.80-1.19	.		0.88	0.74-1.06	.	
No answer	1.23	0.94-1.59	.		0.91	0.71-1.16	.	
Using force								
Never	1.00		1.00		1.00		1.00	
Sometimes	1.23	1.03-1.48*	1.29	1.07-1.55*	0.78	0.67-0.92*	0.82	0.69-0.97*
Frequently	1.02	0.82-1.27	1.09	0.87-1.37	0.46	0.38-0.57*	0.49	0.40-0.61*
Job autonomy								
High	1.00		.		1.00		.	
Intermediate	0.90	0.76-1.06	.		0.77	0.66-0.90*	.	
Low	0.93	0.78-1.12	.		0.65	0.55-0.77*	.	
Job demands								
Low	1.00		.		1.00		.	
Intermediate	0.84	0.70-1.01	.		0.69	0.58-0.82*	.	
High	0.68	0.54-0.86*	.		0.64	0.52-0.79*	.	
Emotional demands								
Low	1.00		.		1.00		1.00	
Intermediate	0.87	0.74-1.02	.		0.76	0.65-0.88*	0.82	0.70-0.97*
High	0.67	0.55-0.82*	.		0.56	0.47-0.66*	0.64	0.53-0.78*
Social support from supervisor								
High	1.00		.		1.00		1.00	
Intermediate	0.86	0.72-1.03	.		0.80	0.68-0.94*	0.84	0.71-0.99*
Low	0.85	0.69-1.04	.		0.65	0.54-0.79*	0.76	0.62-0.93*
Not applicable	1.02	0.74-1.40	.		1.09	0.81-1.46	1.11	0.81-1.53

Table 2. Predictors of the willingness to continue working until the age of 65 and the ability to continue working in the current work until the age of 65 after 12 month of follow-up in logistic regression analyses *(continued)*[a]

	Willingness				Ability			
	Crude[b]		Multiple[c]		Crude[d]		Multiple[e]	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Social support from colleagues								
High	1.00		.		1.00		.	
Intermediate	0.98	0.82-1.16	.		1.01	0.87-1.18	.	
Low	0.99	0.79-1.25	.		0.85	0.69-1.04	.	
Not applicable	0.97	0.68-1.40	.		0.77	0.55-1.07	.	
Inappropriate behaviour by colleagues/supervisor	0.77	0.64-0.93*	0.81	0.67-0.99*	0.98	0.83-1.15	.	
Inappropriate behaviour by customers	0.84	0.71-0.99[f]	.[g]		0.92	0.79-1.06	.	
Satisfaction with salary								
High	1.00		.		1.00		1.00	
Intermediate	1.05	0.89-1.25	.		0.71	0.61-0.83*	0.81	0.69-0.95*
Low	1.05	0.87-1.27	.		0.72	0.61-0.86*	0.93	0.77-1.13
Not applicable	2.61	1.22-5.56*	.		0.47	0.22-1.02	0.48	0.19-1.20
Satisfaction with career perspectives								
High	1.00		.		1.00		.	
Intermediate	0.89	0.71-1.12	.		0.80	0.64-0.98*	.	
Low	0.94	0.75-1.18	.		0.71	0.58-0.87*	.	
Not applicable	1.22	0.95-1.57	.		0.99	0.79-1.25	.	
Satisfaction with flexible working hours								
High	1.00		.		1.00		.	
Intermediate	0.94	0.78-1.13	.		0.79	0.67-0.94*	.	
Low	0.90	0.73-1.10	.		0.63	0.52-0.75*	.	
Not applicable	0.99	0.81-1.19	.		0.74	0.62-0.88*	.	
Health-related factors								
Longstanding health conditions								
None	1.00		.		1.00		1.00	
Yes, no work handicap	1.12	0.93-1.34	.		1.08	0.91-1.27	1.09	0.92-1.30
Yes, & work handicap	0.83	0.69-1.00	.		0.67	0.57-0.79*	0.76	0.64-0.90*
Emotional exhaustion	0.60	0.47-0.77*	0.69	0.53-0.89*	0.49	0.39-0.60*	0.61	0.49-0.78*

[a] All values are given as odds ratio (95% confidence interval), . not in included in the multiple models, [b] Crude models are adjusted for willingness at baseline, [c] 96.3% of the study population included, [d] Crude models are adjusted for the ability at baseline, [e] 92.7% of the study population included, [f] Significant interaction with gender, analysis stratified by gender: men OR 1.11 (0.88-1.41), women OR 0.69 (0.55-0.87), [g] Significant interaction with gender, multiple regression model stratified by gender: men OR 1.19 (0.92-1.52), women OR 0.77 (0.60-0.97), p<0.05.

continue working. Using force, higher emotional demands, and lower support from the supervisor predicted a lower likelihood to be able to continue working. Employees who were intermediately satisfied with their salary were less often able to continue working. Besides, a work handicap and emotional exhaustion predicted that employees were not able to continue working.

To investigate whether gender differences existed, interaction effects were studied in crude regression analyses. Significant terms were added to the multiple regression models. The relation between inappropriate behaviour by customers and the willingness to continue working differed by gender. Women who experienced inappropriate behaviour by customers were less often willing to continue working in multiple regression analyses stratified by gender (OR 0.77 (0.60-0.97)), whereas no relation was found in men (OR 1.19 (0.92-1.52)). No significant differences between men and women existed in the predictor variables of the ability to continue working in multiple regression analysis.

Including the ability to continue working at baseline in the multiple regression model of the willingness to continue working did not change the relation between the independent variables and the willingness to continue working. The same was found when willingness to continue working at baseline was included in the multiple regression model of the ability to continue working.

Discussion

Employees who experienced emotional exhaustion and inappropriate behaviour by colleagues/supervisor were less often willing to continue working until the age of 65, whereas older employees, men, and employees sometimes using force were more often willing to continue working. Emotional exhaustion, a work handicap, higher physical and emotional demands, lower supervisor's support, and intermediate satisfaction with salary predicted that employees felt less often able to continue working in the current work until the age of 65. Older employees and men more often thought they were able to continue working.

Previous studies found that health plays an important role in work ability[13], the motivation and ability to continue working[11,12], the intentions to retire[20,21], and actual early retirement.[13,22] The present study further emphasized the importance of health in prolonging working life, since emotional exhaustion adversely influenced both the willingness and the ability to work until the age of 65, and a work handicap was negatively related with the ability to continue working. In line with previous studies[11,12] and our hypotheses, the social climate at work predicted both the willingness to continue working (i.e. inappropriate behaviour by colleagues/supervisor and (only in women) inappropriate behaviour by customers) and the ability to do so in the current work (i.e. social support from the supervisor). Possibly, supervisor's support provides the opportunity to fit the work to the capacities of older workers. In addition, older age was related to both the willingness and the ability to continue working until the age of 65. This finding probably reflects a selection process, with only those willing and able to continue working remaining in the workforce.

Based on previous studies[11,12], we hypothesised that a higher satisfaction with salary, career perspectives, and flexibility of working would be related with the willingness to continue working. In the present study, satisfaction with salary may not have influenced the willingness to continue working because it may not only reflect an incentive to continue working, but also the financial opportunity to retire early. As hypothesised, employees with a lower satisfaction with career perspectives and the flexibility of working hours were less often willing to continue working in the crude regression analyses, but these relations were not statistically significant.

In line with Nilsson et al. (2011)[11], relatively few work-related factors significantly predicted the willingness to work until the age of 65. Possibly, the willingness to work until the age of 65 is mainly driven by non-work-related factors. Previous research showed that social factors, such as support from the partner, and financial factors, such as wealth and the availability of favourable early retirement schemes, influenced early retirement.[6] Moreover, perceived life expectancy[23] and increased value placed on leisure time[24] may influence the preference for early or later retirement. However, some work-related factors that may influence the willingness to continue working, such as reward and appreciation[6,9,24], were not assessed in the present study. Therefore, we recommend future studies to assess a broader range of work-related, social, and financial factors to gain more insight in which factors relate to the willingness of older workers to extend their working life. This is especially important since the willingness to continue working until the age of 65 is relatively low (e.g. 36% of older employees in The Netherlands in 2008)[3].

In addition to health and supervisor's support, the ability to continue working in the current work until the age of 65 was predicted by higher physical and psychosocial job demands. This is in line with our hypothesis based on previous studies on work ability[13], ability to work until the age of 65[11], intentions to retire early[9], and actual early retirement.[7,8] Moreover, a lower satisfaction with salary predicted that employees were not able to continue working in the current work. Satisfaction with salary might partly reflect the sustainability of the job, i.e. the quality of work, in relation to the financial reward. However, this finding remains unclear and requires more in-depth investigation.

The present study has a number of notable strengths. To our knowledge, it is the first longitudinal study that examines the willingness and ability to continue working until the official retirement age in older workers in the general working population, and it does so in a large and heterogeneous sample. However, a number of methodological considerations should be mentioned. First, selection bias may have occurred as a result of selective response to participate in this study. In the Netherlands response to surveys is usually low, and the response at baseline of about 33% in the current survey was considered to be satisfactory. We do not know whether selective response to participate in this study influenced our findings. However, in longitudinal studies, heterogeneity in the study sample is more important than representativeness, and heterogeneity was high. Second, bias may have occurred as a result of selective loss to follow-up. Persons lost to follow-up were less often highly educated, and it remains unclear how this may have influenced our findings. In addition, they were less often able to continue working until the age of 65 in their current work. Therefore, relatively many of those lost to follow-up may have stopped working during the follow-up period. This may have resulted in an underestimation of the influence of predictor variables. The possible influence of selective loss to follow-up on our findings, however, remains unclear. Third, the willingness and ability to continue working until the age of 65 were assessed by means of single questions. Although these complex concepts may preferably be assessed by more extensive measures, additional measures were not available in the NWCCS. However, it should be noted that in a previous study in the same study population, we found the willingness and the ability to continue working until the age of 65 to be predictive of early retirement.[25] Fourth, the question on the willingness to work until the age of 65 was slightly modified at follow-up. Although this may (partly) explain the decrease in the proportion of persons that was willing to continue working, we do not know whether it influenced the predictors of the willingness to continue working. Fifth, the follow-up period of one year was relatively short. It is important that future studies with longer follow-up periods replicate our analyses.

Many countries recently introduced financial regulations that require workers to extend their working life. However, a high willingness and ability to work are necessary for a fruitful and productive prolongation of working life. To attain this, health-related and work-related factors should be taken into account as well. The present study suggests that the prevention of emotional exhaustion and the promotion of a healthy social climate at work could contribute to the willingness and the ability of older workers to continue working until the age of 65. In addition, it is recommended to improve quality of work in terms of physical and psychosocial workload to support that older workers are able to work until older age. Or, alternatively, to offer the opportunity to change to jobs that better fit the capacities of the older worker.

In conclusion, prevention of emotional exhaustion in older employees and promotion of a healthy social climate at work may support both the willingness and the ability to continue working until the age of 65. Furthermore, improving quality of work in terms of physical and psychosocial workload may contribute to the ability to work until the age of 65.

References

1. Eurostat. Europe in figures. Eurstat yearbook 2010. Luxembourg, Eurostat European Commission; 2010.
2. CBS. Werknemers op hogere leeftijd met pensioen [Retirement age of employees increases]. Accessed Statline, 26-3-2010.
3. Klein Hesselink J, Houtman I, Hooftman W, Bakhuys Roozenboom M. Arbobalans 2009, Kwaliteit van arbeid, effecten en maatregelen in Nederland [OSH 2009, Quality of work and employment, effects and measures in the Netherlands]. Hoofddorp, the Netherlands: TNO; 2010.
4. Euwals R, De Mooij R, Van Vuuren D. Rethinking retirement. From participation towards allocation. The Hague: CPB Netherlands Bureau for Economic Policy Analysis; 2009.
5. De Grip A, Lindeboom M, Montizaan R. Scattered dreams: the effects of changing the pension system late in the game. Bonn: IZA; Report No.: IZA Discussion Paper No. 4034; 2009.
6. Henkens K, Van Dalen H, Van Solinge H. De vervagende grens tussen werk en pensioen. Over doorwerken, doorstarten en herintreders. [The fading border between employment and retirement. About continuing to work and re-entering employment.]. The Hague: NIDI; 2009.
7. Van den Berg TI, Elders LA, Burdorf A. Influence of health and work on early retirement. *J Occup Environ Med* 2010;52(6):576-83.
8. Olesen SC, Butterworth P, Rodgers B. Is poor mental health a risk factor for retirement? Findings from a longitudinal population survey. *Soc Psychiatry Psychiatr Epidemiol* 2012;47(5):735-44.
9. Proper KI, Deeg DJ, Van der Beek AJ. Challenges at work and financial rewards to stimulate longer workforce participation. *Hum Resour Health* 2009;7:70:doi:10.1186/1478-4491-7-70.
10. Damman M, Henkens K, Kalmijn M. The impact of midlife educational, work, health, and family experiences on men's early retirement. *J Gerontol B Psychol Sci Soc Sci* 2011;66(5):617-27.
11. Nilsson K, Hydbom AR, Rylander L. Factors influencing the decision to extend working life or retire. *Scand J Work Environ Health* 2011;37(6):473-80.
12. Kooij D, De Lange A, Jansen P, Dikkers J. Older workers' motivation to continue to work: five meanings of age. A conceptual review. *J Managerial Psychol* 2008;34(4):364-94.
13. Van den Berg TI, Elders LA, De Zwart BC, Burdorf A. The effects of work-related and individual factors on the Work Ability Index: a systematic review. *Occup Environ Med* 2009;66(4):211-20.
14. Larsen M. Does quality of work life affect men and women's retirement planning differently? *Appl Res Qual Life* 2008;3:23-43: doi 10.1007/s11482-008-9045-7.
15. Van den Bossche SNJ, Hupkens CLH, De Ree SJM, Smulders PGW. Nationale Enquête Arbeidsomstandigheden 2005: Methodologie en globale resultaten [The Netherlands working conditions survey 2005: Methodology and overall results]. Hoofddorp: TNO; 2006.
16. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 1998;3(4):322-55.
17. Kristensen T, Borg V. Copenhagen Psychosocial Questionnaire (COPSOQ). Copenhagen: Nationale Institute of Occupational Health; 2000.
18. Paoli P, Merllié D. Third European survey on working conditions 2000. Dublin: European Foundation for the improvement of living and working conditions; 2001.
19. Schaufeli W, Van Dierendonck D. Handleiding van de Utrechts Burnout SChaal (UBOS) [Manual of the Utrecht Burnout Scale (UBOS)]. Lisse: Swets & Zeitlinger; 2000.

20. Siegrist J, Wahrendorf M, Von dem Knesebeck O, Jurges H, Borsch-Supan A. Quality of work, well-being, and intended early retirement of older employees: baseline results from the SHARE Study. *Eur J Public Health* 2007;17(1):62-8.
21. Henkens K, Leenders M. Burnout and older workers' intention to retire. *Internat J Manpower* 2010;31(3):306-21.
22. Rice NE, Lang IA, Henley W, Melzer D. Common health predictors of early retirement: findings from the English Longitudinal Study of Ageing. *Age Ageing* 2011;40(1):54-61.
23. Boumans NP, De Jong AH, Vanderlinden L. Determinants of early retirement intentions among Belgian nurses. *J Adv Nurs* 2008;63(1):64-74.
24. Van Solinge H, Henkens K. Living longer, working longer? The impact of subjective life expectancy on retirement intentions and behaviour. *Eur J Public Health* 2010;20(1):47-51.
25. Ybema JF, Geuskens GA, Oude Hengel KM. Oudere werknemers en langer doorwerken [Older employees and prolonging working life]. Hoofddorp: TNO; 2010.

Chapter 3

Factors associated with the ability and willingness to continue working until the age of 65 in construction workers

Karen M. Oude Hengel, Birgitte M. Blatter, Goedele A. Geuskens, Lando L. Koppes, Paulien M. Bongers

Int Arch Occup Environ Health. 2012 85(7):783-90

Abstract

Objectives: The working population is ageing and a shortage of workers is expected in the construction industry. As a consequence, it is considered necessary that construction workers extend their working life. The purpose of this study was to explore factors associated with construction workers' ability and willingness to continue working until the age of 65 years.

Methods: In total 5,610 construction workers that participated in the Netherlands Working Conditions Survey filled out questionnaires on demographics, work-related and health-related factors, and on the ability and willingness to continue working until the age of 65. Logistic regression analyses were applied.

Results: Older workers were more often able, but less willing, to continue working until the age of 65. Frequently using force, lower supervisor support, lower skill discretion and the occurrence of musculoskeletal complaints were associated with both a lower ability and willingness to continue working. In addition, dangerous work, occasionally using force, working in awkward postures, lack of job autonomy and reporting emotional exhaustion were associated with a lower ability to continue working, whereas working overtime was associated with a higher ability. Furthermore, low social support from colleagues was associated with a higher willingness.

Conclusion: In addition to physical job demands, psychosocial job characteristics play a significant role in both the ability and willingness to continue working until the age of 65 in construction workers. Moreover, preventing musculoskeletal complaints may support the ability and willingness to continue working, whereas preventing emotional exhaustion is relevant for the ability to continue working.

Introduction

As in many countries throughout the world, the Dutch construction industry faces the challenges of a rapidly decreasing and ageing working population.[1,2] This development is partly explained by the fact that less young workers are entering the construction industry.[3-5] Besides, many workers leave the labour market before their official retirement age.[6,7] The age of retirement among construction workers is strongly influenced by collective agreements in which workers are allowed to retire at an earlier age than the official retirement age of 65. However, to encounter the expected shortages of construction workers in the next decades, it is important that more construction workers prolong their (healthy) working life until the official retirement age. Although the willingness to continue working until the age of 65 in the construction industry increased from 25% in 2007 to 36% in 2009, the percentage of workers who thought they were able to continue working until the age of 65 only increased slightly (4%) in these years.[8,9] A previous report showed that the ability and willingness are strong predictors for actual taking retirement.[10] Thus, in order to support sustainable employability of construction workers until and after the official retirement age, there is a need to develop policies and intervention programmes to promote the ability and willingness to continue working.

To date, knowledge on determinants of sustainable employability among blue-collar workers is lacking. Studies on determinants of early retirement among blue-collar workers found that, in addition to collective agreements, mainly physically demanding tasks such as heavy lifting[11] and extreme bending of the back[12] were important predictors of early retirement. In addition, blue-collar workers with a poor health condition more often retire early.[11,13]

Although the previous studies provided knowledge on determinants of early retirement, this knowledge is insufficient for developing policies and intervention programmes that promote sustainable employability of construction workers at an earlier stage. For that purpose, the focus on the determinants should move from early retirement towards the ability and the willingness to continue working until the retirement age. Thus, the objective of the present study was to explore the associations of demographic, work-related and health-related factors with the ability and willingness to continue working until the age of 65 years in construction workers.

Methods

Study population and design

A cross-sectional study was performed, in which data from the Netherlands Working Conditions Surveys (NWCS) of 2007, 2008 and 2009 were used. The NWCS constitutes of a representative sample of the Dutch workforce in the 15-64 year age group, but excludes self-employed individuals.[9] Each year, 80.000 individuals were sampled from the Dutch working population database of Statistics Netherlands. This database contains information on all jobs which fall under the worker national insurance schemes and are liable to income tax. Sampling was random, except for a 50% over-sampling of workers with lower response rates, namely workers under the age of 25 years and workers with a non-western background. Individuals in the sample received the questionnaire mailed to their home address in the first week of November. After one or two weeks, reminders were sent to those who had not yet responded. Data collection was stopped after two months.

Questionnaires were filled out by 67,552 employees (28.1% of the total sample of workers). The responses were weighed for gender, age, sector, ethnic origin, level of urbanisation, geographical region, and level of education, to obtain a sample that is representative for the distribution of these factors in all employees in The Netherlands. In all cases, weight coefficients and standard deviations fall within acceptable limits. Of the 67,552 workers, 5,803 construction workers were selected for the present study. These workers were defined as those who were working as (a) painters, (b) plumbers, welders, fitters, (c) electricians, (d) assemblers, repairmen, mechanics or (e) bricklayers, carpenters and other construction workers. Due to the very small number of women (n=120), only men were included in the present study (n=5,683). Only those who had filled-out both questions on the ability and willingness to continue working until the age of 65 were included (n=5,610).

Measurement

The ability and willingness to continue working until the age of 65

The official retirement age in the Netherlands is 65 years. The ability to continue working until the age of 65 was assessed with a single question ("Do you think you are able to continue working in your current profession until the age of 65?"). Answer categories were 'yes', 'no', and 'do not know'.[9] Workers who answered 'yes' were classified as being able to continue working in the current profession until the age of 65, whereas those who answered 'no' or 'do not know' were classified as not having the ability.

The willingness to continue working until the age of 65 was also assessed with a single question ("Would you like to work until the age of 65?") with three answer categories (yes, no, do not know). Workers who answered 'yes' were classified as willing to continue working until the age of 65, whereas those who answered 'no' or 'do not know' were classified as not willing.

Demographic factors
Age was categorised into four groups, i.e., 15-34 years, 35-44 years, 45-54 years, and 55-64 years. Workers were also asked whether they had a partner, and whether their partner had a paid job.

Work-related factors
Working overtime was asked on a 3-point scale (no, incidentally, structurally). Those who answered 'incidentally' or 'structurally' were categorized as 'yes', whereas the others were classified as 'no'. Shift work and dangerous work were asked on a 3-point scale (no, yes sometimes, yes regularly) Those who answered 'yes sometimes' or 'yes regularly' were categorized as 'yes', whereas the others were classified as 'no'.

Three questions on physical job demands were derived from the Dutch Labour Force Survey (using force, working in awkward postures and exposure to vibrations) with answers on a 3-point scale (no, yes sometimes, yes regularly). The three physical job demands were interrelated with Spearman's correlation coefficients varying from 0.55 to 0.60.

Questions on quantitative job demands, job autonomy, skill discretion and social support were based on the Job Content Questionnaire.[9,14,15] Four items on a 4-point scale (never to always) were used to measure quantitative job demands. Job autonomy was measured with five items on a 3-point scale (no, yes sometimes, yes regularly) and skill discretion was measured with three items on a 4-point scale (never to always). Co-worker support and supervisor support were measured separately with four items, each on a 4-point rating scale (1=totally disagree; 4=totally agree) derived from the Job Content

Questionnaire.[9,14,15] Because of the skewed distributions, three levels (low, intermediate and high) were distinguished using the 25th and 75th percentile scores of the continuous scales. Emotional job demands were measured with three items derived from the Copenhagen Psychosocial Questionnaire on a four-point scale (never to always).[9,16] Based on the skewed total score, three levels (low, intermediate and high) were distinguished using the 25th and 75th percentile scores of the continuous scales.

Health-related factors

Emotional exhaustion was measured using five questions of the Utrecht Emotional Exhaustion Scale with answers on a 7-point scale ranging from never to every day.[17] Based on the cut-off value of 3.2 defined by Schaufeli and Van Dierendonck (2000), the skewed sum score was dichotomized into 'no emotional exhaustion' and 'emotional exhaustion'.

Regarding musculoskeletal symptoms, the questions were based on the Dutch Musculoskeletal Questionnaire.[18,19] Workers were asked to rate the occurrence of pain or discomfort in the neck or shoulders in the previous 12 months using two questions on a 5-point scale (never, once only but of a short duration, once only but of a long duration, more than once but always of a short duration, and frequent and prolonged). Workers who answered 'never' on both questions were classified as having no musculoskeletal symptoms. Those who answered 'more than once' or 'frequent and prolonged' on one of the two questions were classified as frequently having musculoskeletal symptoms. Workers who answered 'only once', were classified as having occasional neck or shoulder symptoms.

Statistical analyses

Logistic regression analyses were carried out in order to study the associations of demographic, work-related and health-related factors with the ability and willingness to continue working until the age of 65. Separate models were constructed for the ability and for the willingness to continue working until the age of 65. First, univariate logistic regression analyses were performed to study the association between one independent variable and the dependent variable. The measure of association was expressed by the odds ratio (OR) and the 95% confidence interval. Odds ratios of the independent variables with a p-value <0.05 in the univariate regression analyses were selected for further analyses. Second, multivariate analyses were carried out using backward selection. Only variables with a p-value of <0.05 were retained in the final multivariate model. After construction of these models, independent variables that were not in the final model, but had a p-value between <0.2 in the univariate regression analyses were included one by one to evaluate their influence on the overall fit of the model. By default, age was retained in the multivariate models. In additional analyses, willingness to continue working was added to the final multivariate model of the ability to continue working and vice versa. Nagelkerke's R^2 was used as measure for the explained variance of the multivariate models. All analyses were performed using version 17.0 of the Statistical Package of Social Sciences for windows (SPSS Inc. Chicago, Illinois, USA).

Results

Table 1 shows the characteristics of the study participants (n=5,610), which included 316 painters (6%), 1,030 plumbers, welders and fitters (18%), 1,072 electricians and assemblers (19%), 1,546 repairmen and mechanics (28%), and 1,646 bricklayers, carpenters and other construction workers (29%). In total, 30% of the construction workers stated to be able to continue working in their current profession until the age of 65, whereas 29% of the construction workers were willing to continue working until the age of 65. The ability and willingness to continue working were significantly correlated (Spearman r= 0.29). While 50% of all construction workers stated they were neither able nor willing to continue working until the age of 65, only 15% of all workers stated they were able as well as willing to continue working.

Table 2 shows the univariate and multivariate associations of demographic, work-related and health-related factors with the ability and the willingness to continue working until the age of 65. In the univariate analyses, all demographic, work-related and health-related factors, except shift work, were significantly associated with the ability to continue working until the age of 65. In the multivariate model, construction workers between 45 and 54 years (OR 1.30; table 2), or aged 55 years and older (OR 1.41), and those working overtime (OR 1.28) considered themselves more often able to continue working. Construction workers having dangerous work (OR 0.75) were less often able to continue working. With respect to physical job demands, occasionally or frequently using force (OR 0.71 and OR 0.44, respectively) and occasionally or frequently working in awkward postures

Table 1. Characteristics of the construction workers (n=5,610)

	Prevalence	Median (IQR[1])
Demographic factors		
Age		41 (30-51)
Having a partner		
No	22%	
Yes, without a paid job	24%	
Yes, with a paid job	54%	
Work-related factors		
Shift work	12%	
Overtime work	66%	
Dangerous work	63%	
Physical job demands		
Using Force		
No	16%	
Occasionally	37%	
Frequently	47%	
Working in awkward postures		
No	21%	
Occasionally	46%	
Frequently	33%	
Exposure to vibrations		
No	29%	
Occasionally	33%	
Frequently	38%	
Psychological factors		
Quantitative job demands (1-4)		2.3 (1.8-2.5)
Job Autonomy (1-3)		2.6 (2.2-3.0)
Skill discretion (1-4)		3.0 (2.3-3.3)
Emotional job demands (1-4)		1.3 (1.0-2.0)
Co-worker support (1-4)		3.0 (3.0-3.5)
Social support supervisor (1-4)		3.0 (2.5-3.0)
Health-related factors		
Emotional exhaustion	13%	
Musculoskeletal symptoms		
Never	42%	
Occasional	37%	
Frequent	21%	
Ability and willingness to continue working until the age of 65		
Ability	30%	
Willingness	29%	

[1]interquartile range (25th- 75th percentile)

(OR 0.76 and OR 0.47, respectively) were associated with a lower ability to continue working. Also low or intermediate job autonomy (OR 0.61 and OR 0.82, respectively), low skill discretion (OR 0.70), and low or intermediate support from the supervisor (OR 0.58 and OR 0.76, respectively) were associated with a lower ability to continue working (Table 2). With respect to health-related factors, construction workers reporting emotional exhaustion (OR 0.62) and those reporting the occurrence of occasional or frequent musculoskeletal symptoms (OR 0.63 and OR 0.40, respectively) were less often able to continue working. The multivariate model explained 20% of variance of the ability to continue working until the age of 65. Addition of the willingness to continue working in the final model did not substantially influence the associations between the independent variables and the ability to continue working until the age of 65 (data not shown).

Regarding the willingness to continue working until the age of 65, several demographic, work-related and health-related factors were significantly associated in the univariate analyses (table 2). Except for age and having a partner, a similar direction was found between the significant independent variables and the willingness to continue working as between these variables and the ability to continue working. However, most psychosocial factors (quantitative job demands, job autonomy, and emotional job demands) were not significant related with the willingness to continue working until the age of 65. In the multivariate model, workers aged 55 years and older (OR 0.56) were less willing to continue working. Furthermore, frequently using force (OR 0.71), intermediate skill discretion (OR 0.79), a low or intermediate social support from the supervisor (OR 0.59 and OR 0.72), and the occurrence of occasional or frequent musculoskeletal symptoms (OR 0.77 and OR 0.69, respectively) were associated with a lower willingness to continue working. Workers with low social support from colleagues (OR 1.37) were more often willing to continue working until the age of 65. The multivariate model explained 4% of the variance of the willingness to continue working until the age of 65. When adding the ability to continue working in the final model, this did not substantially influence the relation between the independent variables and the willingness to continue working until the age of 65 (data not shown).

Table 2. Cross-sectional associations of demographic, work-related and health-related factors with the ability and the willingness to continue working until the age of 65 (n=5,610)

	Ability				Willingness			
	Univariate		Multivariate		Univariate		Multivariate	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Demographic factors								
Age								
≤ 34 years	1.00		1.00		1.00		1.00	
35-44 years	1.23	1.06-1.43*	1.13	0.92-1.40	0.98	0.84-1.13	1.02	0.84-1.22
45-54 years	1.29	1.11-1.50*	1.30	1.05-1.61*	0.89	0.77-1.04	0.92	0.76-1.12
≥ 55 years	1.40	1.18-1.66*	1.41	1.09-1.81*	0.57	0.47-0.68*	0.56	0.44-0.72*
Having a partner								
No	1.00				1.00			
Yes, without a paid job	1.17	1.02-1.35*	.		1.09	0.95-1.26	.	
Yes, with a paid job	0.94	0.81-1.10	.		1.26	1.09-1.46*	.	
Work-related factors								
Shift work (yes vs. no)	0.93	0.78-1.12	.		1.21	1.01-1.44*	.	
Overtime work	1.31	1.16-1.48*	1.28	1.07-1.35*	1.22	1.08-1.38*	.	
Dangerous work	0.45	0.40-0.51*	0.75	0.62-0.90*	0.84	0.75-0.95*	.	
Physical job demands								
Using force								
No	1.00		1.00		1.00		1.00	
Occasionally	0.56	0.48-0.66*	0.71	0.56-0.90*	0.84	0.71-1.00*	0.89	0.72-1.10
Frequently	0.23	0.19-0.27*	0.44	0.34-0.59*	0.73	0.62-0.86*	0.71	0.58-0.88*
Working in akward postures								
No	1.00		1.00		1.00		.	
Occasionally	0.45	0.39-0.52*	0.76	0.61-0.94*	0.83	0.72-0.97*	.	
Frequently	0.19	0.16-0.23*	0.47	0.35-0.62*	0.68	0.58-0.80*	.	
Exposure to vibrations								
No	1.00		.		1.00		.	
Occasionally	0.60	0.52-0.69*	.		1.04	0.89-1.20	.	
Frequently	0.33	0.28-0.38*	.		0.83	0.72-0.96*	.	
Psychosocial factors								
Quantitative job demands								
Low	1.00		.		1.00		.	
Intermediate	0.75	0.66-0.86*	.		0.94	0.81-1.08	.	
High	0.56	0.47-0.67*	.		0.87	0.73-1.03	.	
Job autonomy								
High	1.00		1.00		1.00		.	
Intermediate	0.61	0.53-0.69*	0.82	0.68-0.98*	1.07	0.93-1.23	.	
Low	0.40	0.34-0.47*	0.61	0.48-0.77*	1.03	0.88-1.20	.	
Skill discretion								
High	1.00		1.00		1.00		1.00	
Intermediate	0.98	0.83-1.16	0.86	0.70-1.05	0.83	0.70-0.98*	0.79	0.66-0.94*
Low	0.69	0.56-0.85*	0.70	0.54-0.91*	0.90	0.74-1.10	0.95	0.76-1.19
Emotional job demands								
Low	1.00		.		1.00		.	
Intermediate	1.08	0.94-1.24	.		1.02	0.88-1.17	.	
High	0.81	0.70-0.93*	.		0.98	0.85-1.13	.	

Table 2. Cross-sectional associations of demographic, work-related and health-related factors with the ability and the willingness to continue working 55 until the age of 65 (n=5,610; *continued*)

	Ability				Willingness			
	Univariate		Multivariate		Univariate		Multivariate	
	OR	95%CI	OR	95%CI	OR	95%CI	OR	95%CI
Co-worker support								
High	1.00		.		1.00		1.00	
Intermediate	0.85	0.74-0.98*	.		0.84	0.73-0.97*	1.13	0.94-1.37
Low	0.65	0.54-0.78*	.		0.85	0.71-1.01	1.37	1.08-1.75*
Supervisor support								
High	1.00		1.00		1.00		1.00	
Intermediate	0.70	0.61-0.80*	0.76	0.63-0.92*	0.76	0.67-0.88*	0.72	0.60-0.86*
Low	0.42	0.35-0.51*	0.58	0.45-0.76*	0.60	0.50-0.72*	0.59	0.46-0.75*
Health-related factors								
Emotional Exhaustion	0.37	0.30-0.46*	0.62	0.46-0.83*	0.79	0.66-0.95*	.	
Musculoskeletal ymptoms								
No	1.00		1.00		1.00		1.00	
Occasionally	0.57	0.50-0.65*	0.63	0.53-0.75*	0.80	0.70-0.91*	0.77	0.66-0.91*
Frequently	0.32	0.27-0.38*	0.40	0.32-0.51*	0.62	0.53-0.73*	0.69	0.57-0.85*

* p<0.05.

Discussion

The main findings of this study were that in a large population of Dutch construction workers, older workers were more often able, but less willing, to continue working in their current profession until the age of 65. In addition, using force, low skill discretion, lack of supervisor social support and the occurrence of musculoskeletal complains were associated with both a lower ability and willingness to continue working until the age of 65. Moreover, working overtime, dangerous work, lower job autonomy and emotional exhaustion were associated with the ability to continue working in the current profession until the age of 65, whereas low social support from colleagues was associated with the willingness to continue working.

As mentioned in the introduction, literature on determinants of the ability and willingness to continue working in the current profession until the retirement among blue-collar workers is lacking. Therefore, to provide explanations for the findings of the current study, our findings were compared with studies investigating the determinants of early retirement in blue-collar workers.

Several factors were associated with the ability and willingness to continue working. Regarding the work-related factors, in accordance with previous studies construction workers using force or working in awkward postures were less often able to continue working in the current profession until the age of 65.[11-13] Frequently using force was also associated with a lower willingness to continue working until the age of 65. Moreover, not in line with the study of Lund et al. (2001), construction workers reporting a lack of skill discretion were less often able and willing to continue working until the age of 65.[12] Furthermore, a lower support from the supervisor was related with both a lower ability and willingness to continue working until the age of 65. Although Lund et al. (2001) did not find that social support predicted an early retirement among blue-collar workers[12], social support from both colleagues and supervisors was found to postpone early retirement in a qualitative study[13]. This qualitative study found that more support from the supervisor could be defined as more rewards and appreciation.[13] Regarding health-related factors, the ability as well as the willingness to continue working were negatively related with poor physical health (i.e., the occurrence of musculoskeletal symptoms) which is in line with studies on the intention to retire[20,21], and actual early retirement[13,22]. Because of the high physical demands, construction workers have an increased risk to develop musculoskeletal disorders of the back or lower extremities.[23,24] As a consequence, construction workers with musculoskeletal complaints may experience more difficulties in meeting the high physical demands of their job such as lifting and carrying heavy loads or working in awkward postures.[25,26]

Regarding factors that were only associated with the ability to continue working in the current profession until the age of 65, the results showed that a lack of job autonomy was associated with a lower ability to continue working. This was not in agreement to the study of Lund et al. (2001) who found no association between job autonomy and early retirement.[12] Moreover, construction workers reporting emotional exhaustion were less often able to continue working. To date, not study reported about the role of emotional exhaustion and early retirement among blue-collar workers.

In addition to the factors associated with both the ability and willingness to continue working until the age of 65, the willingness to continue working was also influenced by social support from colleagues. Despite the fact that several factors were associated with the willingness to continue working, the combination of these factors explained only 4% of the variance. It is likely that the willingness to continue working is driven by other work-related factors than factors measured in the present study. Previous studies showed that work-related factors such as an appropriate effort-reward balance, more job control, challenging work, appreciation, competencies and skills were important to prolong working lives of older workers.[27,28] In addition to work-related factors, financial aspects[27,29], lifestyle factors[30], and subjective life expectancy[31] may influence whether older workers retire or not. These factors could also be relevant for the willingness and ability to continue working in construction workers.

To the current knowledge of the authors, the present study is the first study investigating the associations between several demographic, work-related and health-related factors and the ability and willingness to continue working until the age of 65 in construction workers. A strength of the study is the unique dataset which is large and representative for all employees in the Netherlands. Because of the large dataset, a large sample of workers at a specific industry where the issue of sustainable employability is at large (construction industry) could be included for the present study. Some methodological considerations deserve attention as well. The ability and the willingness to continue working were assessed with single-item questions, and one could question the reliability of these items. It remains unclear to what extent the variables in the present study predict whether construction workers will or will not leave the labour market. Nevertheless, a recent Dutch report showed that the questions on the ability and the willingness to continue working were strong predictors of early retirement in older workers.[10] Moreover, construction workers may have wrongly interpreted the question on the ability to continue working in their current profession until the age of 65. They may have interpreted “profession” in this question as their current “job”, leading to an underestimation of workers who are able to continue working in younger workers, who are more likely to change jobs than older workers. However, most construction workers, older as well as younger, work for the same employer for many years and do not change jobs often. Therefore, we believe that the possible wrongful interpretation of this question does not have notable consequences for this study. Furthermore, the dataset is large and representative for all employees in The Netherlands, but it is not clear to which degree the results can be generalized to construction workers in other countries. Nevertheless, these results are still of interest as they provide a first overview of factors that could be taken into account when developing interventions among construction workers to support sustainable employability.

Conclusion

In addition to physical job demands, psychosocial job characteristics play a significant role in both the ability and willingness to continue working until the age of 65 in construction workers. Moreover, preventing musculoskeletal complaints may support the ability and willingness to continue working, whereas preventing emotional exhaustion is relevant for the ability to continue working. More research is needed to identify what additional factors associated with the willingness to prolong the working life of construction workers.

References

1. Eurostat. Eurostat in figures. Eurostat yearbook 2008. Luxembourg: Eurostat European Commission; 2008.
2. United Nations. World economic and social survey 2007: development in an ageing world. New York: Nations, Department of economic and social affairs; 2007.
3. Beereboom HJA, Blomsma G, Corten IW, Muchall S. De bouwarbeidsmarkt in de periode 2005–2010 [The labour market of the construction industry in the period 2005–2010]. Amsterdam; 2005.
4. Griffiths A. Ageing, health and productivity: a challenge for the new millenium*.* *Work & Stress* 1997;11:197-214.
5. Sijpersma R. De oudere werknemer in de bouw. [The older worker in the construction industry]. Amsterdam; 2003.
6. Romans F. The transition of women and men from work to retirement. Luxembourg, Eurostat Communities; 2007.
7. Van Nimwegen N, Beets G. Social situation observatory. Demographic monitor 2005. Demographic trends, socioeconomic impacts and policy implications in the European Union. The Hague Interdisciplinary Demographic Institute; 2006.
8. Koppes LLJ, De Vroome EMM, Mol MEM, Janssen BJM, Van den Bossche SNJ. Nationale Enquête Arbeidsomstandigheden 2010: Methodologie en globale resultaten [The Netherlands working conditions survey 2010: Methodology and overall results]. Hoofddorp: TNO; 2011.
9. Van den Bossche SNJ, Hupkens CLH, De Ree SJM, Smulders PGW. Nationale Enquête Arbeidsomstandigheden 2005: Methodologie en globale resultaten [The Netherlands working conditions survey 2005: Methodology and overall results]. Hoofddorp: TNO; 2006.
10. Ybema JF, Geuskens GA, Oude Hengel KM. Oudere werknemers en langer doorwerken [Older employees and prolonging working life]. Hoofddorp: TNO; 2010.
11. Szubert Z, Sobala W. Current determinants of early retirement among blue collar workers in Poland*. Int J Occup Med Environ Health* 2005;18(2):177-84.
12. Lund T, Iversen L, Poulsen KB. Work environment factors, health, lifestyle and marital status as predictors of job change and early retirement in physically heavy occupations*. Am J Ind Med* 2001;40(2):161-9.
13. Van den Berg TI, Elders LA, Burdorf A. Influence of health and work on early retirement*. J Occup Environ Med* 2010;52(6):576-83.
14. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics*. J Occup Health Psychol* 1998;3(4):322-55.
15. Karasek RA. Job content questionnaire and user's guide. Lowell: University of Massachusetts Lowell, Department of Work Environment; 1985.
16. Kristensen T, Borg V. Copenhagen Psychosocial Questionnaire (COPSOQ). Copenhagen: Nationale Institute of Occupational Health; 2000.
17. Schaufeli W, Van Dierendonck D. Handleiding van de Utrechts Burnout SChaal (UBOS) [Manual of the Utrecht Burnout Scale (UBOS)]. Lisse: Swets & Zeitlinger; 2000.
18. Hildebrandt VH. Prevention of musculoskeletal disorders [Thesis]. Amsterdam: VU University; 2001.
19. Hildebrandt VH, Bongers PM, Van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities*. Ergonomics* 2001;44(12):1038-55.
20. Heponiemi T, Kouvonen A, Vanska J, Halila H, Sinervo T, Kivimaki M, et al. Health, psychosocial factors and retirement intentions among Finnish physicians*. Occup Med (Lond)* 2008;58(6):406-12.
21. Von Bonsdorff ME, Huuhtanen P, Tuomi K, Seitsamo J. Predictors of employees' early retirement intentions: an 11-year longitudinal study*. Occup Med (Lond)* 2010;60(2):94-100.

22. Van den Berg T, Schuring M, Avendano M, Mackenbach J, Burdorf A. The impact of ill health on exit from paid employment in Europe among older workers. *Occup Environ Med* 2010;67(12):845-52.
23. Boschman JS, Van der Molen HF, Sluiter JK, Frings-Dresen MH. Occupational demands and health effects for bricklayers and construction supervisors: A systematic review. *Am J Ind Med* 2011;54(1):55-77.
24. De Zwart BC, Broersen JP, Frings-Dresen MH, Van Dijk FJ. Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work. *Int Arch Occup Environ Health* 1997;70(5):352-60.
25. Welch L, Haile E, Boden LI, Hunting KL. Musculoskeletal disorders among construction roofers--physical function and disability. *Scand J Work Environ Health* 2009;35(1):56-63.
26. Welch LS, Haile E, Boden LI, Hunting KL. Age, work limitations and physical functioning among construction roofers. *Work* 2008;31(4):377-85.
27. Proper KI, Deeg DJ, Van der Beek AJ. Challenges at work and financial rewards to stimulate longer workforce participation. *Hum Resour Health* 2009;7:70:doi:10.1186/1478-4491-7-70.
28. Siegrist J, Wahrendorf M, Von dem Knesebeck O, Jurges H, Borsch-Supan A. Quality of work, well-being, and intended early retirement of older employees: baseline results from the SHARE Study. *Eur J Public Health* 2007;17(1):62-8.
29. Nilsson K, Hydbom AR, Rylander L. Factors influencing the decision to extend working life or retire. *Scand J Work Environ Health* 2011;37(6):473-80.
30. Alavinia SM, Burdorf A. Unemployment and retirement and ill-health: a cross-sectional analysis across European countries. *Int Arch Occup Environ Health* 2008;82(1):39-45.
31. Van Solinge H, Henkens K. Living longer, working longer? The impact of subjective life expectancy on retirement intentions and behaviour. *Eur J Public Health* 2010;20(1):47-51.

Chapter 4

Intervention Mapping as a framework for developing an intervention at the worksite for older construction workers

Karen M. Oude Hengel, Catelijne I. Joling, Karin I. Proper, Henk F. van der Molen, Paulien M. Bongers

Am J Health Promot. 2011 Sep-Oct;26(1):e1-10

Abstract

Background: The purpose of this study was to apply the Intervention Mapping approach as a framework in the development of a worksite intervention to improve the work ability of construction workers.
Design: Development of an intervention by using the Intervention Mapping approach. Setting: Construction worksite Subjects: Construction workers aged 45 years and older.
Measures & Analysis: According to the principles of Intervention Mapping, evidence from the literature was combined with data collected from stakeholders (e.g., construction workers, managers, providers).
Results: The Intervention Mapping approach resulted in an intervention with the following components: (1) two individual visits of a physical therapist to lower the physical workload, (2) a Rest-Break tool to improve the balance between work and recovery, and (3) two empowerment training sessions to increase the range of influence at the worksite.
Conclusion: Using Intervention Mapping in the development of a worksite prevention programme showed to be useful in the construction industry to obtain a positive attitude and commitment. Stakeholders could give input regarding the programme components as well as provide specific leads for the practical intervention strategy. Moreover, it also gives insight in the current theoretical and empirical knowledge in the field of improving the work ability of older workers in the construction industry.

Introduction

Because of their high physical workload[1,2], construction workers run an increased risk to develop health problems such as musculoskeletal disorders of the back or lower extremities.[3,4] In the construction industry, the prevalence of musculoskeletal disorders is increasing because of the large proportion of older workers (45 years and older).[3,5-8] As in all sectors, the baby boom cohort moves towards the retirement age, and less young workers enter the construction industry.[9-11] Because of the increased risks to develop health problems while ageing, in general the work ability of workers in the construction industry is expected to decline.[12,13] Work ability is defined as how well workers can perform at present and in the near future. Work ability is the result of the interaction between the resources of the individual like health and functional capacity, and the demands at work, like physical workload and work organization.[12,14-17]

A worksite health promotion programme focusing on the improvement of the work ability could thus be beneficial for older workers in the construction industry. Previous intervention studies in the construction industry have addressed the separate determinants of work ability. For instance, interventions were focused on decreasing the work demands by means of ergonomic measures[18-21] or on improving the health of construction workers by means of a lifestyle program[20,21]. Only one study was found that aimed to improve the work ability by an individual counselling and education programme but showed a slight but not significant improvement of the work ability.[22] Moreover, all these previous studies in the construction industry have provided little detail on the development of the intervention and on the underlying methods. As a consequence, it is difficult to interpret the effectiveness of these interventions and to replicate the interventions.

The present paper aims therefore to systematically describe the development of an intervention programme to improve the work ability of older construction workers. Different models have frequently been used to develop a health promotion programme such as the Precede-proceed model[23] and Tannahill model.[24,25] These models emphasized mainly on the needs assessment and less on the development and planning of the intervention. However, focusing on both is valuable as it not only gains insight into the content of the programme but also on the practical strategies and feasibility. Furthermore, the models combined in less extent the theoretical evidence with practical information from stakeholders (e.g., workers, employers, providers). By combining theories and practical information, the intervention components and accompanying materials are not only tailored to the needs of the target population but also to the abilities and opportunities of the programme implementers. For that reason, the Intervention Mapping approach (IM) was developed based on the importance of guiding researchers through the planning of programmes by theoretical, empirical and practical information.[26]

The outline of this paper follows systematically the six steps as defined by IM (Figure 1). Each step comprises of several tasks which resulted in a clear end product that is the guide for the subsequent step. The completion of all steps serves as a blueprint for the intervention based on theories, empirical evidence and practical information.[26] Applying IM can be a complex and time-consuming process, but it ensures that each programme objective is based on literature as well as on experience and opinions of the target group.

By using IM as the framework of an intervention in the construction industry, this paper not only describes the systematically development of a health promotion programme in the construction industry, but also gives insight in the current theoretical and empirical knowledge in the field of improving the work ability of older workers.

Design

This paper describes the development of an intervention at the workplace by using IM. This approach consists of six steps: (1) needs assessment, (2) preparing matrices of change objectives, (3) selecting theory-informed intervention methods and practical strategies, (4) producing of programme components and materials, (5) planning programme adoption, implementation and sustainability, and (6) planning for evaluation (Figure 1).[26]

Setting

Companies in the construction industry were approached by means of (1) a list of companies (approximately 250) obtained from a foundation governed by employers and workers organizations and (2) an open membership list

	Steps	Tasks
	Step 1 Needs assessment	- Plan needs assessment - Assess health-quality of life, behaviour and environment - Assess capacity - Establish programme objectives
	Step 2 Matrices of performance objectives, determinants , and change objectives	- State expected change in behaviour and environment - Specify performance objectives - Specify determinants - Create matrices of change objectives
	Step 3 Theory-based methods and practical strategies	- Review programme ideas with stakeholders - Identify theoretical methods - Choose programme methods - Select or design strategies - Ensure that strategies match change objectives
	Step 4 Programme	- Consult with intended participants and implementers - Create programme scope, sequence and material list - Develop documents and protocols - Review available materials - Pre-test programme materials with target groups and implementers and oversee materials production
	Step 5 Implementation plan	- Identify adopters and users - Specify adoption, implementation, and sustainability performance objectives - Create planning table - Write implementation plan
	Step 6 Evaluation plan	- Develop an evaluation model - Develop effect and process evaluation questions - Develop indicators and measures - Specify evaluation designs
	Implementation & Evaluation	

Figure 1. Intervention Mapping, source: Bartholomew et al.[26]

of a trade union. Finally, five companies specialized in house-, or industrial building committed themselves to this study. Reasons to commit were (1) the consecutive possibilities for them to exert influence on the content of the programme and the intervention strategy and (2) the high percentage of sick-leave among their blue-collar workers. The companies agreed that they would enable and stimulate their workers and human resource managers to participate in the development of the intervention during working hours.

Participants

According to the World Health Organization, indications of age-related problems such as a decline in maximum oxygen uptake and muscular capacity appear around 45 years of age.[27] Construction workers who perform the actual construction work (blue-collar workers) age 45 years and older were, therefore, subject of this study.

Methods

Step 1: Needs assessment

The personal and external factors that are associated with the work ability of the workers were assessed by means of a literature review, round table discussions with older construction workers and interviews with human resource managers. Following Bartholomew et al. (2006), those factors that rest within individuals and are subject to their direct control or influence are referred to as personal factors.[26] Those factors that rest outside the individual and influence work ability or environmental conditions such as social influences or structural influences are referred to as external determinants.[26]

First, literature was searched to obtain studies identifying factors associated with work ability or evaluating interventions among blue-collars workers that were effective in improving health or work ability. The search was conducted for relevant papers and reports through electronic databases (MEDLINE, Psychinfo and Cochrane Database). Second, five round table discussions with older construction workers (n=23) were held. For each company, all older workers of one worksite were invited, and they all attended the semi-structured round table discussion.[28] The aim of these meetings was to address the topics retrieved from the literature and to collect new information. During the round table discussion, open questions were asked and propositions were posted on pocket-size cards. These propositions were derived from the literature and presented the possible factors associated with work ability. With oral permission of the participants, all round table discussions were audio-taped and fully transcribed. Lastly, semi-structured interviews were held with human resource managers of the five companies (n=5). The interviews aimed to gain insight into the managers' view regarding the health promotion needs of their construction workers.

The analysis of the needs assessment was based on the grounded theory.[29] This theory starts by collecting data and analysing instead of beginning by developing a hypothesis.[29] From the data collected in the present study, the transcriptions were coded and classified into categories of factors associated with work ability (e.g., weather conditions, lifestyle, communication).[30] All categories were ranked based on two criteria; (1) the importance of the factors for the construction workers, and (2) the changeability of the factors within the time frame of the intervention period. Based on these criteria, the intended programme objectives (what workers are supposed to do as a result of the program) of the intervention were formulated.

Step 2: Preparing matrices of change objectives

During this step of IM, performance objectives were specified for each of the programme objectives, from which the most important and changeable behavioural and environmental determinants were selected.

Performance objectives are the effects of the intervention in terms of behaviour that should be learned or specific behaviour that should be changed. To compose a list of performance objectives, six researchers of different universities in the Netherlands with a broad experience in the construction industry or the programme objectives were invited to participate. The final performance objectives were selected during four round table discussions with older construction workers (n=26) and semi-structured interviews with human resource managers (n=5). Four of the 26 construction workers and the five human resource managers in this step already participated in the previous step. Besides the performance objectives, the most important determinants were identified. Determinants were selected based on the needs assessment of step 1 and linked to behavioural models from the literature. Based on this, a theoretical framework was defined.

Finally, a matrix was developed of performance objectives crossed with the determinants, resulting in very specific intervention goals.

Step 3: Selecting theory-informed intervention methods and practical strategies

Theoretical methods and strategies were identified which were likely to achieve the expected change in determinants. A theoretical method describes the association between an intervention action and a change in the identified individual and environmental determinants.[26] Thus, theory-based methods should improve workers' abilities and the environmental opportunities to effectively act on their motivation. Methods were then translated into practical strategies in order to accomplish a successful shift from motivation to action and maintenance. The identification of the theories and strategies was conducted by means of (1) a review of the literature, (2) a brainstorm session with researchers (n=7), and (3) six meetings with providers of the potential intervention components (n=7). Finally, the most promising theoretical methods and strategies for this intervention were discussed and selected together with the five human resource managers.

Step 4: Producing programme components and materials

The products of step 4 include a description of the scope and sequence of the intervention components and the materials. A brainstorm session was conducted with the members of the project group (n=6) to translate the theories and strategies of step 3 into a programme plan. In addition, the plan was developed in detail with two providers specialized in the intervention components. New tools were developed when tools were not available or were not tailored enough to the construction workers. Finally, a meeting with three construction workers was organized to discuss the programme plan and to pilot the developed tools.

Step 5: Planning programme adoption, implementation and sustainability

This step is an overview of all previous IM steps, now focusing on developing a plan to ensure the adoption and implementation of the intervention by the trainers and the users.

Step 6: Planning for evaluation

Step 6 is the anticipation of the process and effect evaluation. Using the products from step 1-5, an evaluation plan with the defined variables and corresponding evaluation measures was developed.

Results

Step 1: Needs assessment

The needs assessment led to the identification of different personal and external factors that are associated with work ability among older construction workers.

Regarding the personal factors, high physical workload, fatigue and lifestyle factors were associated with work ability among older construction workers. First, high physical workload was emphasized by all three sources (literature, construction workers and human resource managers) as an important risk factor to decrease the work ability. In particular, awkward postures, repetitive movements, static postures,[12,14,31] but also lifting heavy objects and working on unequal floors were recognised as risk factors. Second, as a consequence of the high physical work demands and also a risk for a lower work ability was fatigue and needs for recovery.[3,13,32] Third, studies indicated that blue-collar workers have a worse lifestyle than white-collar workers[31,33,34], they appear to be less active[34] and report more smoking[35,36]. Although the human resource managers in our study mostly supported these findings, the workers themselves did not consider their lifestyle as poor.

With regard to the external factors, poor weather conditions, a continuous work pressure and communication with colleagues, supervisor and subcontractors were associated with work ability. First, a cold or windy environment was mentioned by construction workers as difficult to work in. Additionally, a continuous work pressure leading to unsafe situations at the workplace (e.g., not replacing or clearing up tools) was emphasized by the literature[13,37], construction workers and human resource managers as another external factor. Finally, less communication at the worksite appeared to be associated with a lower job satisfaction and motivation at work, and therefore with a lower work ability. In the literature, poor leadership was found to have a negative influence on work ability.[33,37] According to the construction workers, they experienced poor leadership from their supervisors, in particular in relation to listening, encouraging and motivating them. In addition, communication with colleagues and working in a team was one the most important positive aspects of their work. When working in a team, younger workers can learn skills from the more experienced construction workers, while the older constructions workers can ask assistance when work tasks are physically too challenging to perform. Lastly, construction workers mentioned poor communication with subcontractors and their foreign workers as a negative factor of job satisfaction and therefore work ability.

Based on the ranking criteria, the factors that should be counteracted during the intervention were defined as: (1) physical workload, (2) fatigue and (3) range of influence at the worksite (e.g., improving the communication). Programme objectives based on these factors were defined by specifying what and who needs to change to improve the work ability. The following overall programme objectives emerged: (1) construction workers improve the balance between physical workload and need for recovery, and (2) construction workers improve their range of influence at the work site.

Table 1. An example of performance objective 'blue-collar construction workers improve the balance between physical workload and need for recovery'

Worker will do to reduce the physical workload	
1.	monitor the physical workload in the present situation
2.	indicate the causes for the physical workload in the present situation
3.	identify solutions to lower the physical workload
4.	identify barriers to lower the physical workload
5.	lower the physical workload by changing working methods
6.	provide feedback about good and bad practices about changing the physical workload
Worker will do to improve the need for recovery	
1.	monitor when more recovery is needed
2.	identify solutions to improve recovery
3.	discuss the need for recovery and solutions with colleagues and supervisor solutions
4.	improve the need for recovery by taking rest breaks

Step 2: Preparing matrices of change objectives

Performance objectives

The performance objectives were selected for both programme objectives. By way of illustration, the performance objectives for programme outcome 1 'blue-collar construction workers improve the balance between physical workload and need for recovery' are presented in table 1.

Personal and environmental determinants

Changeable personal and environmental determinants that may facilitate and stimulate workers to improve their balance between physical workload and need for recovery and to increase their range of influence at the worksite were selected. Awareness, attitude and self-efficacy were identified as important personal determinants whereas physical, economic, policies and social-cultural determinants were selected as environmental determinants. To illustrate, construction workers are not always aware of situations with high physical workload (awareness) nor have a high confidence that they could change these situations themselves (self-efficacy). For implementation of specific tools to lower the physical workload, there needs to be money to buy tools (economic) and a policy to use these tools (policies).

Theoretical framework

The theoretical framework for the study contains two theoretical models incorporating the individual as well as the environmental determinants. First, the ASE-model (Dutch abbreviation for attitude, social influence and self-efficacy) by De Vries et al. (1988) was used to describe the individual determinants attitude, self-efficacy and social norms to explain behaviour.[38,39] Second, the ANGELO-model (analysis grid for environments linked to health promotion to reduce obesity) was selected to describe the environmental determinants (i.e., physical, economic, social-cultural and political).[40] Despite the fact that this model is originally developed for weight-gain prevention interventions, the environmental determinants identified in the present study matched with the determinants of the ANGELO-model. For the purpose of this study, awareness was added to the theoretical framework for this intervention because this determinant was identified during the round table discussions. Figure 2 presents the theoretical framework for the programme.

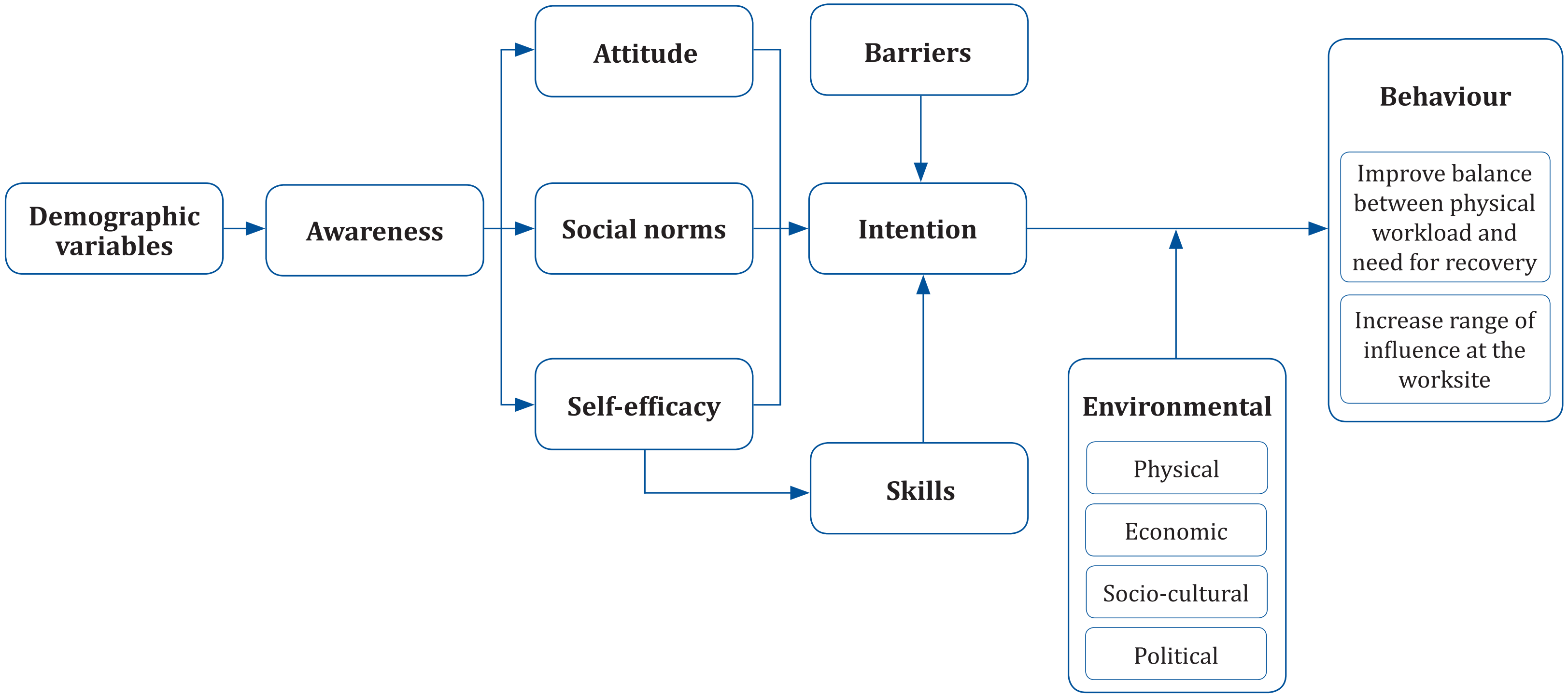

Figure 2. Theoretical framework based on ASE-model and ANGELO-model

Table 2. Example of change objectives

	Change objectives[1]						
Performance objective	**Personal determinants**			**External determinants**			
	Awareness and attitude	**Skills**	**Self-efficacy**	**Social norms**	**Economic**	**Physical**	**Policies**
Lower the physical workload by changing working methods	Worker identifies situations with high physical workload	Worker compares previous situation with present situation	Worker feels confident in changing workings methods	Supervisor encourages the workers to change physical workload	Company is willing to invest in tools to lower the physical workload	Availability of training to lower physical workload	Company provide tools
	Worker become familiar with the new working methods	Worker expresses causes, solutions and barriers	Worker feels confident in working with a lower physical workload	Supervisor help worker to overcome barriers		Availability of tools of lower physical workload	Company invest time for new working methods
	Worker is aware of the advantages of the new working methods	Worker is able to implement solutions in daily situations	Worker feels confident with the positive consequences	Supervisor accepts changes in working methods			
		Worker lists the positive consequences of lowering the physical workload		Workers are willing to help each other			

[1] Change objectives are based on the performance objectives and determintants

4

Change objectives

Finally, matrices were developed of the performance objectives crossed with the determinants, resulting in specific change objectives. Table 2 presents an example of the change objectives for performance objective 'lowering physical workload' of programme outcome 'blue-collar construction workers improve the balance between physical workload and need for recovery'.

Step 3: Selecting theory-informed intervention methods and practical strategies

A list of suitable theories and strategies were identified that are likely to create the expected change in the selected determinants.[26,39] For example, goal setting and the corresponding action plan were selected as one of the theories and strategies to improve self-efficacy. In addition, possible programme ideas (e.g., gaming, individual physical training, empowerment training) that fit the chosen theories and strategies were listed. Finally, the programme ideas that matched the programme objectives, performance objectives and determinants were selected and expanded into a programme concept. For instance, more feedback and communication from colleagues and supervisors but also from specific external trainers is needed to increase the awareness and learn skills to reduce the physical workload. Table 3 presents in detail the theoretical models and practical strategies as well as materials and tools for each determinant.

Step 4: Producing programme components and materials

Programme plan

With regard to the first programme objective (improve the balance between the physical workload and need for recovery), a protocol for two individual trainings sessions of a physical therapist and a Rest-Break tool were developed. First, to reduce the physical workload, a physical therapist will assess work style, working methods, physical workload and rest breaks, and associated health risks. This will be done by means of a quick scan questionnaire and a 15-20 minute observation at the worksite. Based on this assessment, the therapist will provide individual advice on how to reduce the physical workload by improving work style, working methods or rest breaks. At the end of the first training, three advices will be given on a pocket-size card. During the second visit, the therapist will discuss the experience so far and reconsider

Table 3. Theoretical models and practical strategies

Determinant	Methods from theory	Strategy	Tools/Materials
Personal determinants			
Awareness	Scenario-based risk information	Recognizing behaviour Role modelling	Film for CW and S Posters for CW and S ET and PT emphasize the important of changing behaviour to CW and S CW become familiar with the Rest-Break Tool
	Stimulating communication	Discussions Meetings	CW and S discuss weekly about rest breaks and need for recovery by the flexible Rest-Break Tool CW discuss their range of influence at the worksite
Skills	Guided practice	One-to-one instruction Group training Guidance sheet	PT provides individual training and exercises PT explain flexible Rest-Break Tool to CW & S ET provides group training to improve the range of influence
	Modelling	Good examples during meeting	PT provides good examples to lower physical workload ET provide good examples of proactive behaviour PT and ET provide good examples of their training to S
	Feedback	Individual & Group feedback	PT provides a second training with CW PT provides a card/list with three goals ET provides a second training with CW ET provides a poster with minimal two points of interests ET and PT provide group feedback to S CW and S receive feedback from flexible Rest-Break Tool
Self-efficacy	Goal setting	Action plan	PT provides individuals goals ET and CW state appointments during the intervention period
	Positive reinforcement	Team reinforcement	CW and S receive incentives during inter-vention period
Social norms	Modelling	Recognizing behaviour	Film for CW and S
Environmental determinants			
Socio-cultural	Social support	Discussion	S encourage workers to fulfil the flexible Rest-Break Tool CW and S discuss weekly about rest breaks and need for recovery by the work- Rest-Break Tool
		Encouragement	S encourage CW to lower physical workload en increase the range of influence
Economic	Availability	Approval	EP and S approve training during working time S provide extra rest breaks if necessary EP is willing to invest in tools
Physical	Availability	Environmental	S provides empty room for training EP and S provide tools if necessary
	Knowledge	Providing information	ET and PT inform S about training and project ET and PT provide group feedback to S

CW=construction worker, S=supervisor, PT=physical therapist, ET=empowerment trainer, EP=employer the given advices with the worker. Second, a Rest-Break Tool is developed to raise awareness about the importance of reducing fatigue among workers by taking flexible rest breaks. The Rest-Break tool is a flowchart and consists of four steps: (1) the expectations of the workers about their fatigue at the end of the working day, (2) short term advice to take mini rest breaks or an additional break of ten minutes, (3) selection of the possible causes of fatigue and (4) long term advice about structurally lowering fatigue. The workers will be asked to fill in the tool weekly, alone or with colleagues, and they will discuss the results with their supervisor.

With regard to programme objective 2 (the increase of the range of influence at the worksite), the workers will receive two interactive empowerment training sessions. The workers will be taught how to change their attitude from a passive towards a more proactive attitude by increasing the self-efficacy regarding (1) taking responsibility for their own health, (2) discussing with colleagues about the responsibility for their own behaviour (e.g., taking rest breaks, asking for assistance during lifting tasks) and (3) improving the communication with the supervisor. A proactive attitude supposes that workers will control and change the working situations by themselves. During the first training, the workers will receive an explanation about why and how to change a passive attitude towards a more proactive attitude, they will create a list of topics they would like to change during the intervention period, and they will write down an action plan for at least the next three months. The training will be interactive and the protocol serves just as a rough outline of the training. After five months, during a follow-up meeting, the empowerment trainer and workers will discuss, evaluate and reconsider the action plan and results that are already booked.

Expected barriers for the intervention

Two main barriers for the practical implementation of the intervention programme are expected that need to be counteracted. First, the components will be delivered by different trainers (i.e., physical therapist and empowerment trainer) which could lead to an unclear cohesion of the programme for workers and supervisors. To facilitate coherence between the different components, the intervention will be introduced to the workers and supervisors by showing a 3-minute video. The second barrier that need to be anticipated are possible communication problems because of the involvement of many people e.g., researchers, trainers and employees, supervisors and managers of different companies. To avoid communication problems, a separate communication chapter is included in the protocol.

Target population of the intervention
Although the intervention was originally developed for older construction workers, we decided to include construction workers of all ages for different reasons. First, the older workers considered the selection for the intervention on the basis of the age criterion as discrimination at the worksite. Second, the nature of the intervention programme gave rise to the belief that more commitment and a higher effectiveness could be expected if all workers at the worksite would be involved in the project. Finally, due to the recession of 2009, several construction companies participating in the development of the programme were forced to lay-off workers and withdraw therefore from this entire project. Therefore, statistical power also played a role in the decision to include workers from all ages from the remaining participating companies.

Step 5: Planning programme adoption, implementation and sustainability
A protocol including a plan for implementation of the intervention programme was written down together with a physical therapist and empowerment trainer. This protocol contains the content of the programme, the organization of the programme and the communication between all stakeholders involved (e.g., workers, trainers, researchers, and supervisors). The protocol aimed to standardize the training sessions across the different trainers and across the different worksites. A follow-up session was held after a few training sessions with all trainers of the programme to discuss difficulties and problems with working within the protocol. Moreover, this follow-up session was held with the aim to briefly remind the trainers about the overall content of the programme.

Second, time and place are two important factors to successfully adopt and implement the programme by the workers and supervisors. Therefore, all training sessions will be organized within the existing so-called “toolbox education system” in the construction industry. The toolbox education system consists of at least 10 obligatory health and safety training sessions at the work site for workers which have to be organized by the participating companies in the construction industry each year to obtain an official safety and health certificate.

Last, the supervisor has a key role at the worksite during the intervention. Except motivating the workers, he also has to manage the intervention at the worksite. Therefore, special attention will be paid to the supervisors by keeping them up to date about the overall programme by sending newsletters during the intervention and by providing information in advance about the upcoming training and feedback afterwards by the trainers.

Step 6: Planning for evaluation

The programme will be evaluated in a randomised controlled trial. Primary and secondary outcomes will be measured at baseline, and at three, six and 12 months after the start of the intervention. The primary study outcomes are work ability and health related quality of life, including the physical and mental health aspects. Musculoskeletal complaints, self-efficacy, work engagement, and need for recovery are defined as secondary outcomes. Additionally, a process evaluation will be conducted in order to facilitate implementation. The study protocol was approved by The Medical Ethics Committee of the VU University Medical Center (Amsterdam, The Netherlands), Trial Registration NTR 1278.

Discussion

This paper described the development of the worksite prevention programme for construction workers using the framework of IM. IM provides a checklist to guide the researchers through the development of the intervention in a structured manner which was valuable in this study.

By systematically incorporating empirical findings from the literature, theories and input from the stakeholders though all steps of IM, the intervention is developed in a specific context of workers, supervisors and employees in the construction industry. Because worksites are temporary and mobile and different professions at the worksite are interdependent, it was useful to find solutions together with workers, human resource managers and trainers with respect to the feasibility of the worksite prevention programme without disrupting the work process. To illustrate, supervisors and employers emphasized to take advantage of the already existing “toolbox education system”. Because of the familiarity and the obligation of this toolbox, a high commitment from supervisors as well as employers and thereby a higher participation of workers is expected.

The participatory approach during IM also led to new insights regarding the target population. The older workers mentioned age-discrimination as one of the most important obstacles for a successful implementation. Therefore, we decided to include construction workers of all ages instead of only those who are aged 45 years and older. By changing the target population, the older workers may feel more comfortable with the worksite prevention programme and a higher compliance is therefore expected.

Although we found IM useful and challenging, a limitation of IM is the time-consuming process.[41,42] Initially, IM was developed and applied for more simple and uni-dimensional behaviours (e.g. weight gain prevention).[43] However, behaviours like those described in this study are mostly multi-dimensional and in such cases IM is a more time-consuming process. The entire process of IM in the present study lasted more than one year. To be more efficient in future research, qualitative data (in-depth interviews and focus groups) could be combined with quantitative data (surveys). Starting with a survey among the target population and managers could lead to a short-list of specific topics as start of the needs assessment. Subsequently less focus groups will be needed in step 1 and 2 of IM. Moreover, due to the multidimensional behaviour, the matrices in step 2 of IM resulted in overwhelming matrices of change objectives. It was impossible to address all the change objectives in this intervention. For future research, reduction in performance objectives and determinants to a minimal amount for the specific intervention is needed. Researcher should only choose those performance objectives and determinants that are needed for a real change. By simplifying the matrices in that way, it is less time-consuming and more efficient to go through step 3-6 of IM.

Some limitations need to be considered with respect to the development of this intervention. Namely, only construction workers of companies who committed themselves to the project were involved in step 1-3. As companies volunteered to participate in the project, it is plausible that these companies are early adopters[44] when it comes to health and safety. Workers of these companies have probably more sympathy towards the programme and therefore a higher compliance is expected. Furthermore, due to time constraints, it was impossible to perform a full pilot of the intervention (i.e. including the six months program). Instead of a full pilot, new materials like the Rest-Break tool were piloted with the construction workers in step 4 of IM and adjusted to their needs.

In conclusion, using IM and involving all stakeholders in the development of a worksite prevention programme showed to be useful in the construction industry. By applying IM, the intervention is not only tailored to the needs of the target population but also to the abilities and opportunities of the implementers. Therefore, a positive attitude and commitment was obtained among all stakeholders. Moreover, the present study also gives insight in the current theoretical and empirical knowledge in the field of improving the work ability of older workers in the construction industry. An RCT is the next step that will be taken with great confidence in the design of the intervention at the worksite.

References

1. Roelen CA, Schreuder KJ, Koopmans PC, Groothoff JW. Perceived job demands relate to self-reported health complaints*. Occup Med (Lond)* 2008;58(1):58-63.
2. Aittomäki A, Lahelma E, Rahkonen O, Leino-Arjas P, Martikainen P. The contribution of musculoskeletal disorders and physical workload to socioeconomic inequalities in health*. Eur J Public Health* 2007;17(2):145-50.
3. De Zwart BCH, Frings-Dresen MH, Van Duivenbooden JC. Senior workers in the Dutch construction industry: a search for age-related work and health issues*. Exp Aging Res* 1999;25(4):385-91.
4. Peterson JS, Zwerling C. Comparison of health outcomes among older construction and blue-collar employees in the United States*. Am J Ind Med* 1998;34(3):280-7.
5. Arbouw. De bouwnijverheid: arbeid, gezondheid en veiligheid in 2008 [The construction industry; work, health and safety]*.* Harderwijk: Arbouw; 2009.
6. Holmström E, Engholm G. Musculoskeletal disorders in relation to age and occupation in Swedish construction workers. *Am J Ind Med* 2003;44(4):377-84.
7. De Zwart BC, Broersen JP, Frings-Dresen MH, Van Dijk FJ. Musculoskeletal complaints in The Netherlands in relation to age, gender and physically demanding work*. Int Arch Occup Environ Health* 1997;70(5):352-60.
8. Seitsamo J, Klockars M. Aging and changes in health*. Scand J Work Environ Health* 1997;23(Suppl 1):27-35.
9. Beereboom HJA, Blomsma G, Corten IW, Muchall S. De bouwarbeidsmarkt in de periode 2005–2010 [The labour market of the construction industry in the period 2005–2010]. Amsterdam; 2005.
10. Sijpersma R. De oudere werknemer in de bouw. [The older worker in the construction industry]. Amsterdam; 2003.
11. Van Duivenbooden C. Ageing and employability in construction industry: The Dutch approach. Paper presented at the XXIX International Symposium of the ISSA on Prevention in the Construction Industry; Brussels; 2009.
12. Alavinia SM, Van Duivenbooden C, Burdorf A. Influence of work-related factors and individual characteristics on work ability among Dutch construction workers*. Scand J Work Environ Health* 2007;33(5):351-7.
13. De Zwart BCH, Frings-Dresen M, Van Duivenbooden C. Gezondheid en loopbaanverwachting van oudere werknemers in de bouw [Health and career expectations of older construction workers]*. Tijdschrift Voor Gezondheidswetenschappen* 2001;79(4):239-44.
14. Van den Berg TI, Elders LA, De Zwart BC, Burdorf A. The effects of work-related and individual factors on the Work Ability Index: a systematic review*. Occup Environ Med* 2009;66(4):211-20.
15. Gould R, Ilmarinen J, Järvisalo J, Koskinen S. Dimension of work ability: results of the Health 2000 Survey. Helsinki: Finnish Institute of Occupational Health; 2008.
16. Ilmarinen JE. Aging workers*. Occup Environ Med* 2001;58(8):546-52.
17. Ilmarinen J. Ageing workers in the European Union: status and promotion of work ability, employability and employment. Helsinki; Finnish Institute of Occupational Health, Ministry of Social Affairs and Health, Ministry of Labour; 1999.
18. Van der Molen HF, Grouwstra R, Kuijer PP, Sluiter JK, Frings-Dresen MH. Efficacy of adjusting working height and mechanizing of transport on physical work demands and local discomfort in construction work. *Ergonomics* 2004;47(7):772-83.
19. Luijsterburg PA, Bongers PM, De Vroome EM. A new bricklayers' method for use in the construction industry*. Scand J Work Environ Health* 2005;31(5):394-400.
20. Groeneveld IF, Proper KI, Van der Beek AJ, Van Duivenbooden C, Van Mechelen W. Design of a RCT evaluating the (cost-)effectiveness of a lifestyle intervention for male construction workers at risk for cardiovascular disease: the health under construction study*. BMC Public Health* 2008;8:1: doi:10.1186/1471-2458-8-1
21. Ludewig PM, Borstad JD. Effects of a home exercise programme on shoulder pain and functional status in construction workers*. Occup Environ Med* 2003;60(11):841-9.

22. De Boer AG, Burdorf A, Van Duivenbooden C, Frings-Dresen MH. The effect of individual counselling and education on work ability and disability pension: a prospective intervention study in the construction industry. *Occup Environ Med* 2007;64(12):722-7.
23. Green LW, Kreuter M. Health promotion planning: an educational and ecological approach. New York: McGraw-Hill; 1999.
24. Tannahill A. Health promotion: the Tannahill model revisited. *Public Health* 2009;123(5):396-9.
25. Tannahill A. What is health promotion? *Health Educ J* 1985;44(4):167-8.
26. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach. San Francisco: Jossey-Bass; 2006.
27. World Health Organization (WHO). Aging and Working Capacity. Report of a WHO study group. Geneva: WHO; 1993. Technical Report Series, No. 835.
28. Morgan DL, Kreuger RA. The focus group kit: volume 1-6. California: SAGE publications inc.; 1997.
29. Corbin J, Strauss A. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. California: Sage Publications; 1998.
30. Boeije HR. Analyseren in kwalitatief onderzoek [Analysis in qualitative research]. The Hague: Boom Onderwijs; 2005.
31. Tuomi K, Huuhtanen P, Nykyri E, Ilmarinen J. Promotion of work ability, the quality of work and retirement. *Occup Med (Lond)* 2001;51(5):318-24.
32. Chang FL, Sun YM, Chuang KH, Hsu DJ. Work fatigue and physiological symptoms in different occupations of high-elevation construction workers. *2009* Appl Ergon;40(4):591-6.
33. Tuomi K, Ilmarinen J, Martikainen R, Aalto L, Klockars M. Aging, work, life-style and work ability among Finnish municipal workers in 1981-1992. *Scand J Work Environ Health* 1997;23(Suppl 1):58-65.
34. Seitsamo J, Ilmarinen J. Life-style, aging and work ability among active Finnish workers in 1981-1992. *Scand J Work Environ Health* 1997;23(Suppl 1):20-6.
35. Arndt V, Rothenbacher D, Brenner H, Fraisse E, Zschenderlein B, Daniel U, et al. Older workers in the construction industry: results of a routine health examination and a five year follow up. *Occup Environ Med* 1996;53(10):686-91.
36. Rothenbacher D, Brenner H, Arndt V, Fraisse E, Zschenderlein B, Fliedner TM. Smoking patterns and mortality attributable to smoking in a cohort of 3528 construction workers. *Eur J Epidemiol* 1996;12(4):335-40.
37. Pohjonen T. Perceived work ability of home care workers in relation to individual and work-related factors in different age groups. *Occup Med (Lond)* 2001;51(3):209-17.
38. De Vries H, Dijkstra M, Kuhlman P. Self-efficacy: the third factor besides attitude and subjective norm as a predictor of behavioural intentions. *Health Educ Res* 1988;3(3):273-82.
39. Kok G, De Vries H, Mudde AN, Strecher VJ. Planned health education and the role of self-efficacy: Dutch research. *Health Educ Res* 1991;6(2):231-8.
40. Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med* 1999;29(6):563-70.
41. McEachan RR, Lawton RJ, Jackson C, Conner M, Lunt J. Evidence, theory and context: using intervention mapping to develop a worksite physical activity intervention. *BMC Public Health* 2008;8:326.
42. Singh AS, Chin A Paw MJ, Kremers SP, Visscher TL, Brug J, Van Mechelen W. Design of the Dutch Obesity Intervention in Teenagers (NRG-DOiT): systematic development, implementation and evaluation of a school-based intervention aimed at the prevention of excessive weight gain in adolescents. *BMC Public Health* 2006;16(6):doi:10.1186/1471-2458-6-304.
43. Kwak L, Kremers SP, Werkman A, Visscher TL, Van Baak MA, Brug J. The NHF-NRG In Balance-project: the application of Intervention Mapping in the development, implementation and evaluation of weight gain prevention at the worksite. *Obes Rev* 2007;8(4):347-61.
44. Rogers EM. Lessons for guidelines from the diffusion of innovations. *Jt Comm J Qual Improv.* 1995;21(7):324-8.

Chapter 5

A worksite prevention program for construction workers: design of a randomized controlled trial

Karen M. Oude Hengel, Catelijne I. Joling, Karen I. Proper,
Birgitte M. Blatter, Paulien M. Bongers

BMC Public Health. 2010 doi:10.1186/1471-2458-10-336

Abstract

Background: A worksite prevention programme was developed to promote the work ability of construction workers and thereby prolong a healthy working life. The objective of this paper is to present the design of a randomised controlled trial evaluating the effectiveness of that intervention programme compared with usual care for construction workers.

Methods: The study is designed as a randomised controlled trial with a follow-up of one year. Employees eligible for this study are construction workers performing actual construction work. The worksite intervention will be compared with usual care. This intervention was developed by using the Intervention Mapping approach and consists of the following components: (1) two individual training sessions of a physical therapist to lower the physical workload, (2) a Rest-Break tool to improve the balance between work and recovery, and (3) two empowerment training sessions to increase the influence of the construction workers at the worksite. Outcome measures are assessed at baseline, 3, 6, and 12 months. The primary outcome measures of this study are work ability and health-related quality of life. Secondary outcome measures include need for recovery, musculoskeletal complaints, work engagement and self-efficacy. Cost-effectiveness will be evaluated from the company perspective. Moreover, a process evaluation will be conducted.

Conclusion: The feasibility of the intervention and the study has been enhanced by creating an intervention programme that explicitly appeals to construction workers and will not interfere too much with the on-going construction. The feasibility and effectiveness of this worksite prevention programme will be investigated by means of an effect- and a process evaluation. If proven effective, this worksite prevention programme can be implemented on a larger scale within the construction industry.

Background

In order to face the challenges of the ageing working population and to extend the healthy working lives of the workers, the construction industry in the Netherlands has reason to pay attention to maintaining and promoting work ability.[1,2] Work ability is defined as how well workers can perform their jobs at present and in the near future, and is the result of the interaction between the individuals' capacity and the work demands.[3,4] Work ability is determined by personal factors like health, functional capacity and job satisfaction and occupational factors like physical work demands and the work organization.[4-6]

Because of the high physical workload and the health risks involved[7-10], construction workers run relatively high risks to suffer an impaired work ability.[2,4] To change things for the better, health promoting activities to maintain and improve the work ability seem necessary. Until now, most health promotion programmes in the construction industry have focused on either improving the health of construction workers by means of a lifestyle program[11,12] or on decreasing the work demands by means of ergonomic measures[13,14]. Only one intervention study in the construction industry was found that explicitly aimed to improve the work ability. That single-component intervention consisting of a counselling and education programme for construction workers at risk for disability pension showed a slight but not significant improvement of the work ability.[15]

Based on the fact that work ability is a multidimensional concept, it was hypothesised that a multidimensional intervention approach could potentially be more effective. To our knowledge, such interventions have not yet been undertaken in the construction industry. Therefore, in our study a multidimensional intervention was developed, taking into account the individual factors as well as the work environment, in order to promote the work ability.[16] The intervention was developed by means of the Intervention Mapping approach which is based on theoretical information from literature and practical information from stakeholders.[17] This resulted in an intervention tailored to the needs of the construction workers. This paper presents the design of the worksite prevention programme illustrating the recruitment of the workers, the feasibility of the study, and the attractiveness of the programme for the workers.

Methods

Study design

A Randomised Controlled Trial is performed in order to evaluate the effectiveness of the intervention. This trial is carried out to evaluate whether the worksite prevention programme for construction workers improves construction workers' work ability and their health-related quality of life. Construction workers at the worksites allocated to the intervention group receive the worksite prevention programme during six months; those allocated to the control group receive no intervention (i.e. usual care). Participants are followed for one year. Primary and secondary outcomes are measured at baseline, and 3, 6 and 12 months after baseline measurement. The study protocol was approved by The Medical Ethics Committee of the VU University Medical Center (Amsterdam, The Netherlands).

Study population

The study population consists of construction workers performing actual construction work (i.e., blue-collar workers). These workers are contracted by six companies which are specialized in house-, commercial- or industrial building. The other inclusion criteria were (1) available for the study for the following 12 months, (2) sufficient mastery of the Dutch language and (3) having signed a written informed consent. No exclusion took place based on age or gender.

Recruitment of the study population

In order to successfully accomplish an intervention programme at the worksite, strong support and participation of different company levels (managers, supervisors and workers) was considered essential. At the start of the project, we therefore recruited the top-management of the six companies who committed themselves to the project by signing a letter of intent. Additionally, they agreed that their workers (supervisors and construction workers) were allowed to participate in the programme during working hours. The managers informed all supervisors about the aim of the intervention and the intervention components. Finally, the researchers informed all workers at the worksite about the intervention programme by an oral presentation and by handing out a letter with the content of the programme.

Randomisation

Cluster randomisation took place at the level of department within each company. In order to avoid intervention group contamination, to accommodate a potential work-related intervention, to obtain maximal cooperation of employers and employees, and to enhance participants' compliance, cluster randomisation was considered the best randomisation strategy for this study. The randomisation was performed by a research assistant who had no prior information about the departments. For practical reasons, randomisation was performed before the baseline measurements. Because the intervention takes place at the worksite, the participants, their supervisors and the trainers cannot be blinded to the group assignment.

Intervention

The intervention was developed using the Intervention Mapping approach.[17] Intervention Mapping ensures participation and consultation of all stakeholders (employers, supervisors, workers, health professionals, and providers). The development of the detailed programme plan was based on three key points: (1) feasibility: a programme which could be executed at the worksite, not interfering too much with the on-going construction work; (2) attractiveness for workers: the programme should be geared to the workers' perception of their work environment; and (3) a standardized protocol for a sound scientific evaluation. Based on the first step of Intervention Mapping, two programme objectives were defined: (1) the programme should improve the balance between the physical workload and the need for recovery and (2) the programme should increase the range of influence of construction workers at the worksite. Following the steps of Intervention Mapping, the programme objectives were transformed into an intervention programme of six months. An extensive description of the Intervention Mapping process and the content of the intervention has been described elsewhere.[16] The intervention consists of a physical component and a mental component. At the start of the program, the intervention is introduced to the workers and their supervisors by a 3-minute lasting video showing the content of the intervention and the accompanying components. This video uses the metaphor of a soccer game to introduce the underlying principles of the intervention programme.

The physical component consists of (1) two individual training sessions by a physical therapist and (2) a Rest-Break tool. To reduce the physical workload, the worker receives two training sessions by an occupational physical therapist. During the first training, the therapist assesses work style, working methods, and the balance between physical load and rest breaks, and makes an assessment of the associated health risks. This is done by means of a quick scan questionnaire and a 15-20 minute observation of the worker. Based on the assessment, the therapist gives individual advice on how to reduce the physical workload, focusing on the improvement of the work style, the work methods and/or the rest breaks. At the end of the first training session, the physical therapist writes down a maximum of three recommendations for the worker on a pocket-size card. Before the training session begins, the therapist meets the supervisor of the works, to inform him about the purpose of his visit. After training all participating workers at one site, the physical therapist meets the supervisor in order to discuss the group results. During the second visit, after four months, the therapist discusses the experiences so far and evaluates the impact of the advice of the first training with the worker. If necessary, the physical therapist and the worker adjust the advice. Second, a Rest-Break tool was developed that focuses on fatigue and need for recovery. The aim of the Rest-Break tool is to raise awareness about the importance of reducing fatigue among workers by taking flexible rest breaks and to stimulate to actually take rest breaks in order to reduce fatigue. The Rest-Break tool was set up as a flowchart and consists of four steps: (1) the expectations of the workers about their own fatigue at the end of the working day, (2) short term advice to take mini rest breaks (20-60 seconds) or an additional break of ten minutes, (3) selection of possible causes of fatigue and (4) long term advice about structurally lowering fatigue. The Rest-Break tool is introduced and explained to the workers by the therapist during the first visit. The workers are asked to fill in the tool weekly, alone or with colleagues, and to discuss the results with their supervisor. At the start of the program, the supervisors receive a folder with the Rest-Break tool to hand out to the workers at a fixed time each week. A text message by the mobile phone is sent weekly as a reminder to all supervisors.

For the mental component of the intervention, workers receive two interactive empowerment training sessions. Due to practical reasons, the duration of the training is limited to one hour. The empowerment trainer is present at the worksite before the training to get to an impression of the worksite. The training is aimed at improving the range of influence of the workers at the worksite. The workers are taught how to change their attitude from a passive towards a more proactive attitude by increasing the self-efficacy regarding (1) taking responsibility for their own health, (2) discussing with colleagues about their responsibility for their own behaviour (e.g., taking rest breaks, asking for assistance during lifting tasks) and (3) improving communication with the supervisor. A proactive attitude supposes that workers control and change possible adverse working conditions by themselves. The training consists of five components; (1) an introduction of the concept of self-efficacy within the construction industry, (2) an introduction of the training as part of the program, (3) an explanation about how to change, in general, a passive attitude towards a more proactive and positive attitude, (4) a list of topics (e.g., good teamwork, more communication with supervisor, more rest breaks) workers would like to change during the intervention, and (5) an action plan written down on a poster. The training is tailor-made which means that the five steps are just a rough outline of the training. The therapist meets the supervisor before the training sessions, to inform him about the purpose of his visit and to invite him to (partly) attend the meeting. After four months, during a follow-up meeting, the empowerment trainer and workers discuss, evaluate and reconsider the action plan and results that are already booked.

Figure 1 presents the timeline of the current study including the different intervention components and the measurements. For feasibility reasons, all training sessions are organized within the existing so-called “toolbox education system” in the construction industry. The toolbox education system consists of at least 10 obligatory health and safety training sessions for workers, which have to be organized by employers in the construction industry each year. These training sessions are necessary in the construction industry to obtain an official safety and health certificate.

Co-interventions

It is pointed out to the companies that participation in other intervention studies or programmes aimed at health promotion (e.g. lifestyle programmes, adjustments of the equipment, organizational changes) is not allowed during this study. At 12 months follow-up, managers are asked if any other intervention took place during the period of the current study. Some other health care use, like visiting a physical therapist, is regarded as usual care.

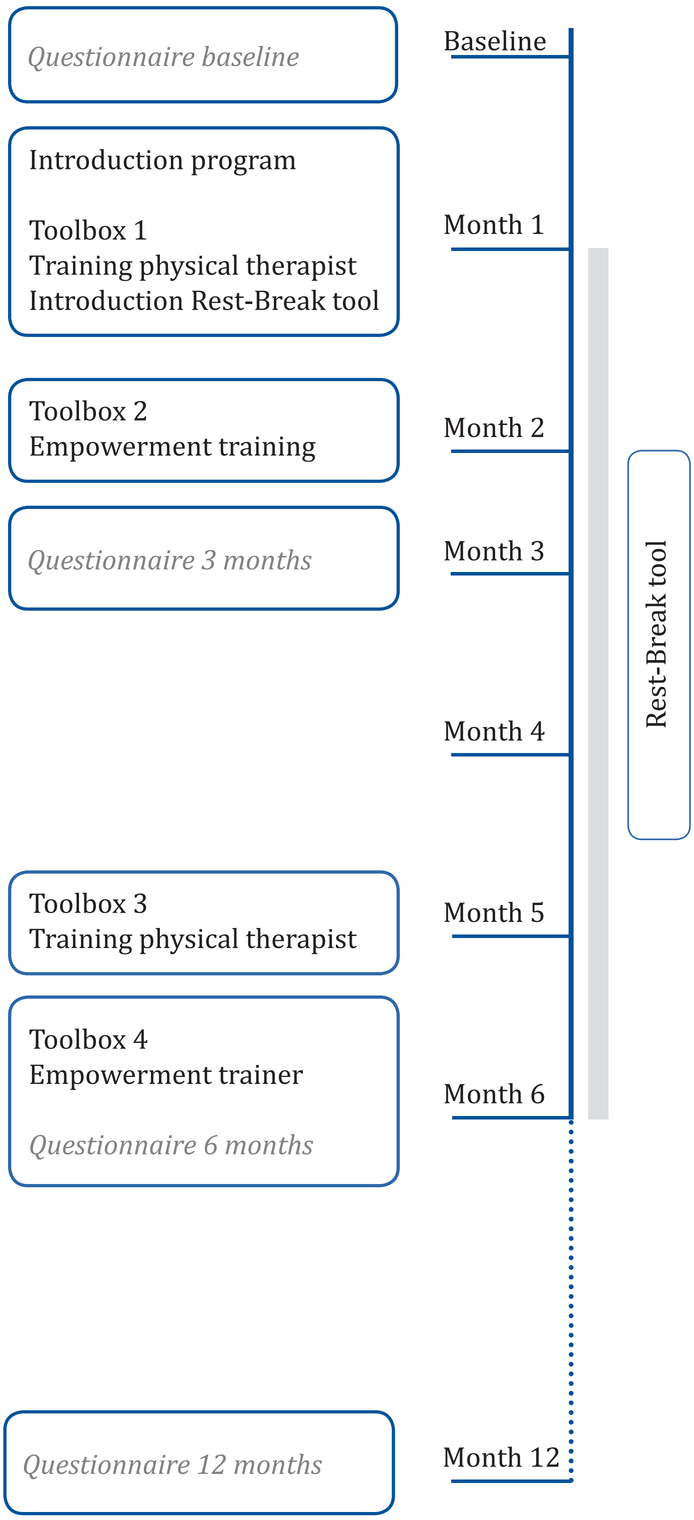

Figure 1. Flow chart of the intervention program

Compliance and loss to follow-up

All participants in this study receive a questionnaire at baseline and a follow-up at 3, 6 and 12 months after baseline measurement. Participants that withdraw from the intervention programme are followed and receive the questionnaire at the given time points. To register the reasons for withdrawal, all participants are asked if they voluntarily want to give their reason(s) for discontinuing the intervention.

To minimise loss-to-follow-up, the researchers distribute and collect the questionnaires at the worksite. In case of absence from work of the participants, the supervisors at the worksite are asked to hand out the questionnaire to the participants later on and to encourage the participants to complete the questionnaire and to send the questionnaire back in a stamped and addressed envelope. If the questionnaire is not received within three weeks, a new questionnaire is sent to the worker.

Incentives

It is well-known that maintaining participants is a difficult process in intervention studies.[18] Therefore, incentives are distributed among the participants to make participation more attractive and to minimise loss to follow-up. After the first empowerment training the participants receive a mug with the study logo. All participants receive playing cards with the study logo after the second questionnaire (at three months follow-up). Moreover, as a reminder of their participation in the project posters are distributed after the first and second empowerment training.

Sample size

The sample size was calculated according to the number of cases needed to identify an effect on health-related quality of life. Because the outcome measure SF-12 has rarely been used in intervention studies among the general population, the SF-36[19,20] was used for the sample size calculation. Calculated effect sizes range (Cohen's D[21]) from 0.58 (which can be considered 'medium' according to effect size conventions) to 0.96 (considered large).[19,22] Because of the cluster randomisation design, a certain loss of efficiency associated with cluster randomisation relative to individual randomisation was taken into account.[23] An effect size of 0.40 was considered to be the lower boundary of a 'medium' effect size.[21] This effect size can be detected with a power of (1-

β) of 0.80 and a two-tailed alpha of 0.05 with two groups of 100. Taking a loss to follow-up of about 10% into account, we need to recruit a total of 220 participants.

Primary outcome measures

Work ability

Work ability is measured with the Work Ability Index.[4] This widely used index measures self-assessed work ability and consists of seven items. For the purpose of this study, only three of the seven items were considered relevant and are thus measured. These three items are: (1) perceived work ability in general, (2) perceived work ability in relation to physical demands and (3) perceived work ability in relation to mental demands. Different studies have shown that the validity and reliability of Work Ability Index are acceptable to good.[24,25]

Health-related quality of life

In this study, health-related quality of life is measured with the SF-12.[26,27] The SF-12 includes items referring to mental health as well as physical health. The following eight dimensions are included: physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health.[28] Different studies have shown that the validity and reliability of the SF-12 are adequate.[27,28]

Secondary outcome measures

Need for recovery

Need for recovery is measured with an existing Dutch questionnaire on the Experience and Evaluation of Work (Dutch abbreviation: VBBA)[29,30], which has shown to be valid and reliable (0.86).[31,32] The scale consists of eleven dichotomous items (yes/no), representing short-term effects of a working day.

Physical workload and musculoskeletal symptoms

Questions about the physical workload are based on the questions used for the Periodical Health Screenings survey in the construction industry. In the Netherlands, this survey is widely used and common among construction workers who participate in the Periodical Health Screening.

Data on musculoskeletal symptoms is assessed by means of the Dutch Musculoskeletal Questionnaire (DMQ).[33,34] In this study, the workers are asked about their symptoms during the last three months and during the past seven days. To provide similarity between the scales, the scale of the seven days period has been adjusted to the two-point scale (yes/no) of the three months.

Psychosocial workload

The psychosocial workload is measured by the Dutch version of the Job Content Questionnaire.[35,36] Two constructs of the psychosocial workload (supervisor support and co-worker support) are selected to be measured. These scales have shown moderate to good reliability (0.65-0.81).[37]

Awareness, attitude, self-efficacy and social norms

Awareness, attitude, self-efficacy and social norms about reducing physical workload, improving recovery and increasing influence at the worksite are measured to provide insight into the working mechanism of the worksite intervention. Questions about these determinants are formulated based on a structure of questions often used in the health promotion research.[38,39]

Work engagement

Work engagement is measured with the 12-item questionnaire Utrecht Work Engagement Scale.[40] This scale consists of three dimensions: vigour, dedication and absorption. The psychometric qualities of this scale have been proven to be good.[41]

The ability and motivation to continue working until the retirement age

Questions about working until the retirement age are assessed by four questions based on the Netherlands Working Conditions Survey.[42] The workers are asked until which age they think they are able and motivated to work. Additionally, they are asked if (physically or mentally) less heavy work can contribute to continue their working life until the age of 65.

Other variables

Socio-demographic and anthropometric data

At baseline, socio-demographic data such as gender, age, level of highest education, working hours per week and anthropometric data such as body height and body weight are assessed.

Process evaluation

Besides the effect evaluation, a process evaluation is conducted based on the six aspects of Steckler and Linnan (2002): context (organizational characteristics that affect the intervention), recruitment (sources and procedures used to recruit companies and construction workers), reach (attendance rates of construction workers), dose delivered (the amount of intervention components actually delivered by the trainers), dose received (the extent to which employees use materials or components recommended by the program) and fidelity (the extent to which the intervention was delivered as planned).[43] In addition, satisfaction (the extent to which the workers were satisfied with the program) is measured. Three of these aspects (context, recruitment and reach) are evaluated by data that are collected in logs since the start of the project in January 2008. Dose delivered and dose received are assessed by checklists completed by the trainers. The remaining aspects, namely fidelity and satisfaction, are obtained by (1) logs from the trainers, (2) questionnaires at three and six months after the start of the intervention, and (3) interviews with supervisors and employees.

Economic evaluation

An economic evaluation will be conducted alongside the trial and include a cost-benefit analysis and a cost-effectiveness analysis. Both analyses will be performed from a company perspective. The time horizon is 12 months, similar to the trial. A cost-benefit analysis will be carried out to compare the intervention costs with the monetary benefits due to productivity loss. A cost-effectiveness analysis will be conducted for the primary outcomes measures (work ability and health-related quality of life). In the cost-effectiveness analyses, all costs (i.e. costs of the intervention and costs due to productivity loss) will be included and will be compared to the effect on health-related quality of life and work ability. Intervention costs include costs for the development of the intervention as well as the implementation of the intervention (e.g., costs of trainings, video, working hours). Productivity loss (i.e. sick leave and productivity) will be measured with the productivity and disease questionnaire (PRODISQ)[44] and the World Health Organization Health and Work Performance Questionnaire (HPQ)[45,46].

Statistical analyses

Analyses regarding the effectiveness of the primary outcomes and secondary outcomes will be performed after three and six months (short term) and 12 months (long term) by means of multilevel analyses. Multilevel analyses take clustering of observations of workers within the same department into account, as well as repeated measurements within one worker.[44] Due to randomisation at the department level, the data will be analysed at three levels: (1) time, (2) worker and (3) department. Both crude and adjusted linear and logistic regression analyses will be performed. The multilevel analyses using the follow-up measurement (i.e. 3 months) as dependent variable will be adjusted for possible confounding factors such as education and working hours. These variables will also be checked for effect modification. The effect of the intervention at six months and 12 months will be analysed using all three follow-up measurements (i.e. 3, 6 and 12 months) and will also be adjusted for possible confounders.[45] Effect modification will also be checked again.

For the cost-benefit analysis, the difference in mean intervention costs between the two study groups will be compared to the difference in mean benefits due to sick leave reduction between the two study groups using bias-corrected and accelerated bootstrapping. Confidence intervals (95%) will then be obtained. For the cost-effectiveness analysis, the difference in mean costs (i.e., intervention costs and reduced benefits due to sick leave) between the two study groups will be compared to the difference in mean effects between the two study groups. Cost-effectiveness ratios will be calculated by dividing the difference between the mean total costs between the two study groups by the difference in the mean effects between the study groups. Confidence intervals (95%) will again be obtained by bias corrected and accelerated bootstrapping. For both outcome measures (i.e. health-related quality of life and work ability), cost-effectiveness ratios will be plotted on a cost-effectiveness plane. Acceptability curves will be calculated, showing the probability that the guideline is cost-effective at a specific ratio. Furthermore, sensitivity analyses will be performed to assess the robustness of the results.

All statistical analyses will be performed according to an intention-to-treat principle. In addition, protocol analyses will be conducted for those groups that actually completed the intervention protocol.

Discussion

This paper presents the design of a randomised controlled trial to investigate the effectiveness of a multi-component worksite prevention programme. The content of the intervention consist of two preventive training sessions of a physical therapist, a Rest-Break tool, and two empowerment training sessions.

To our knowledge, this is the first study that will evaluate a multi-component intervention in the construction industry that targets both the individual capacities as well as the work environment. As work ability is a multidimensional concept, such a worksite prevention programme seems potentially effective in improving the work ability. Moreover, outcome measures (e.g., work ability, health-related quality of life) will be evaluated which might predict a healthier working life among construction workers.

A strength of the current study is that the evaluation of the intervention will not only give insight into the (cost-) effectiveness, but also into the process of the intervention. The process evaluation aims to describe (1) the reach of the program, (2) the initial expectations and satisfaction of the participating construction workers and (3) the intention of participating companies to further implement the intervention programme in the future. Due to time limitations, process evaluations are infrequently conducted in the field of worksite prevention or health promotion and are rarely compared to the outcomes of the study.[43,46] Results of the process evaluation are very relevant as they may provide insight into the working mechanisms of the intervention, and into process factors influencing the outcomes, e.g., was the programme intended as planned, and what was the satisfaction with the different components. Moreover, and even more important, the process evaluation will provide information to improve implementation of the programme in the future.

A limitation of the current study is that intervention consists of several components and that the RCT is two-armed (control versus intervention), which does not allow separate evaluation of each component of the intervention. As a consequence, eventual effectiveness of the programme can only be attributed to the entire programme. However, the process evaluation will focus on the entire programme as well as on the separate components and will therefore qualitatively gain insight into the working mechanisms of the different components of the intervention.

This intervention may benefit workers as well as employers. If the intervention proves to be effective, the construction worker will benefit from this by an improved health and a healthier working environment and, as such, will contribute to the prolongation of their working life. As a consequence, employers may benefit from having healthier workers in terms of a reduced sick leave and a higher productivity. If this programme proves to be cost-effective, the protocol will be made available to all companies in the construction industry as well as for companies in other sectors with high physical work demands.

References

1. Welch LS. Improving work ability in construction workers-let's get to work. *Scand J Work Environ Health* 2009;35(5):321-4.
2. Gould R, Ilmarinen J, Järvisalo J, Koskinen S. Dimension of work ability: results of the Health 2000 Survey. Helsinki: Finnish Institute of Occupational Health; 2008.
3. Ilmarinen J. Work ability, a comprehensive concept for occupational health research and prevention. *Scand J Work Environ Health* 2009;35(1):1-5.
4. Ilmarinen J. Ageing workers in the European Union - Status and promotion of work ability, employability and employment. Helsinki: Finnish Institute of Occupational Health, Ministry of Social Affairs and Health, Ministry of Labour; 1999.
5. Van den Berg TI, Elders LA, De Zwart BC, Burdorf A. The effects of work-related and individual factors on the Work Ability Index: a systematic review. *Occup Environ Med* 2009;66(4):211-20.
6. Alavinia SM, Van Duivenbooden C, Burdorf A. Influence of work-related factors and individual characteristics on work ability among Dutch construction workers. *Scand J Work Environ Health* 2007;33(5):351-7.
7. Roelen CA, Schreuder KJ, Koopmans PC, Groothoff JW. Perceived job demands relate to self-reported health complaints. *Occup Med (Lond)* 2008;58(1):58-63.
8. Aittomäki A, Lahelma E, Rahkonen O, Leino-Arjas P, Martikainen P. The contribution of musculoskeletal disorders and physical workload to socioeconomic inequalities in health. *Eur J Public Health* 2007;17(2):145-50.
9. De Zwart BCH, Frings-Dresen MH, Van Duivenbooden JC. Senior workers in the Dutch construction industry: a search for age-related work and health issues. *Exp Aging Res* 1999;25(4):385-91.
10. Peterson JS, Zwerling C. Comparison of health outcomes among older construction and blue-collar employees in the United States. *Am J Ind Med* 1998;34(3):280-7.
11. Groeneveld IF, Proper KI, Van der Beek AJ, Van Duivenbooden C, Van Mechelen W. Design of a RCT evaluating the (cost-)effectiveness of a lifestyle intervention for male construction workers at risk for cardiovascular disease: the health under construction study. *BMC Public Health* 2008;8:1: doi:10.1186/1471-2458-8-1.
12. Ludewig PM, Borstad JD. Effects of a home exercise programme on shoulder pain and functional status in construction workers. *Occup Environ Med* 2003;60(11):841-9.
13. Van der Molen HF, Kuijer PP, Formanoy M, Bron L, Hoozemans MJ, Visser B, et al. Evaluation of three ergonomic measures on productivity, physical work demands, and workload in gypsum bricklayers. *Am J Ind Med* 2010;53(6):608-14.
14. Luijsterburg PA, Bongers PM, De Vroome EM. A new bricklayers' method for use in the construction industry. *Scand J Work Environ Health* 2005;31(5):394-400.
15. De Boer AG, Burdorf A, Van Duivenbooden C, Frings-Dresen MH. The effect of individual counselling and education on work ability and disability pension: a prospective intervention study in the construction industry. *Occup Environ Med* 2007;64(12):792-7.
16. Oude Hengel KM, Joling CI, Proper KI, Van der Molen HF, Bongers PM. Using intervention mapping to develop a worksite prevention program for construction workers. *Am J Health Promot* 2010;26:e1-e10.
17. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach. San Francisco: Jossey-Bass; 2006.
18. Robroek SJ, van Lenthe FJ, van Empelen P, Burdorf A. Determinants of participation in worksite health promotion programmes: a systematic review. *Int J Behav Nutr Phys Act* 2009;6:26: doi: 10.1186/1479-5868-6-26.
19. Aaronson NK, Muller M, Cohen PD, Essink-Bot ML, Fekkes M, Sanderman R, et al. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations. *J Clin Epidemiol* 1998;51(11):1055-68.
20. Ware JEJ. SF-36 health survey update. *Spine (Phila Pa 1976)* 2000;25(24):3130-9.
21. Cohen J. Statistical Power Analysis for the Behavioral Sciences. New York: Lawrence Erlbaum Associates; 1988.

22. Beaton DE, Hogg-Johnson S, Bombardier C. Evaluating changes in health status: reliability and responsiveness of five generic health status measures in workers with musculoskeletal disorders. *J Clin Epidemiol* 1997;50(1):79-93.
23. Simpson JM, Klar N, Donnor A. Accounting for cluster randomization: a review of primary prevention trials, 1990 through 1993. *Am J Public Health* 1995;85(10):1378-83.
24. De Zwart BC, Frings-Dresen MH, Van Duivenbooden JC. Test-retest reliability of the Work Ability Index questionnaire. *Occup Med (Lond)* 2002;52(4):177-81.
25. Eskelinen L, Kohvakka A, Merisalo T, Hurri H, Wagar G.Relationship between the self-assessment and clinical assessment of health status and work ability. *Scand J Work Environ Health* 1991;17(Suppl 1):40-7.
26. Jenkinson C, Layte R. Development and testing of the UK SF-12 (short form health survey). *J Health Serv Res Policy* 1997;2(1):14-8.
27. Ware JJ, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34(3):220-33.
28. Gandek B, Ware JE, Aaronson NK, Apolone G, Bjorner JB, Brazier JE, et al. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. *J Clin Epidemiol* 1998;51(11):1171-8.
29. Sluiter JK, De Croon EM, Meijman TF, Frings-Dresen MH. Need for recovery from work related fatigue and its role in the development and prediction of subjective health complaints. *Occup Environ Med* 2003;60(Suppl 1):i62-70: doi:10.1136/oem.60.suppl_1.i62.
30. Van Veldhoven M, Meijman TF. Het meten van een psychosociale arbeidsbelasting met een vragenlijst: de vragenlijst beleving en beoordeling van de arbeid [The measurement of psychosocial workload with a questionnaire: VBBA]. Amsterdam: NIA; 1994.
31. Van Veldhoven M, Broersen S. Measurement quality and validity of the “need for recovery scale”. *Occup Environ Med* 2003;60:i3-9:doi:10.1136/oem.60.suppl_1.i3.
32. Van Veldhoven M, Meijman TF, Broersen JPJ, Fortuin RJ. Handleiding VBBA [User’s guide VBBA]. Amsterdam: SKB Vragenlijst Services; 2002.
33. Hildebrandt VH, Bongers PM, Van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities. *Ergonomics* 2001;44(12):1038-55.
34. Hildebrandt VH. Prevention of musculoskeletal disorders [Thesis]. Amsterdam: VU University; 2001.
35. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. *J Occup Health Psychol* 1998;3(4):322-55.
36. Karasek RA. Job content questionnaire and user’s guide. Lowell: University of Massachusetts Lowell, Department of Work Environment; 1985.
37. De Jonge J, Reuvers MM, Houtman IL, Bongers PM, Kompier MA. Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes, and sickness absence: baseline results from SMASH. Study on Musculoskeletal Disorders, Absenteeism, Stress, and Health. *J Occup Health Psychol* 2000;5(2):256-68.
38. Brug J, Van Assema P, Lechner L. Gezondheidsvoorlichting en gedragsverandering. Assen: Koninklijke Van Gorcum BV;2007.
39. Bandura A. Guide for constructing self-efficacy scales. Self-Efficacy Beliefs of Adolescents Greenwich: Information Age Publishing; 2006.
40. Schaufeli WB, Bakker AB, Salanova M. The Measurement of Work Engagement With a Short Questionnaire: A Cross-National study. *Educational and Psychological Measurement* 2006;66(4):701-16.
41. Schaufeli W, Bakker A. Utrecht Work Engagement Scale. Utrecht: Occupational Health Psychology Unit; 2003.

42. Koppes L, de Vroome E, Mol M, Van den Bossche S. Nationale enquête arbeidsomstandigheden 2008: Methodologie en globale resultaten [The Netherlands working conditions survey 2008: Methodology and overall results]. Hoofddorp: TNO; 2009.
43. Steckler A, Linnan L. Process Evaluation for Public Health Interventions and Research. San Francisco: Jossey-Bass; 2002.
44. Twisk JWR. Applied Multilevel Analysis. Cambridge: Cambridge University Press; 2006.
45. Twisk JWR. Applied Longitudinal Data Analysis for Epidemiology. Cambridge: Cambridge University Press; 2003.
46. Murta SG, Sanderson K, Oldenburg B. Process evaluation in occupational stress management programs: a systematic review. *Am J Health Promot* 2007;21(4):248-54.

Chapter 6

Meeting the challenges of implementing an intervention to promote work ability and health-related quality of life at construction worksites: a process evaluation

Karen M. Oude Hengel, Birgitte M. Blatter, Henk F. van der Molen, Catelijne I. Joling, Karin I. Proper, Paulien M. Bongers, Allard J. van der Beek

J Occup Environ Med. 2011 53(12):1483-91

Abstract

Objective: To evaluate the process of a prevention programme among construction workers.

Methods: The programme consisted of training sessions of a physical therapist and an empowerment trainer, and a Rest-Break tool. Data on seven process items were collected by means of questionnaires and interviews.

Results: Recruiting construction companies to participate was difficult. The therapists and trainer largely provided the training sessions as intended, but the Rest-Break tool was poorly implemented. Construction workers (n=171) showed high reach (84%), and moderate attendance rates (3 of 4 sessions). 64% of the construction workers recommended the overall programme to colleagues. Company size, economic recession, engagement of the management, and intervention year influenced dose delivered and satisfaction.

Conclusions: The study showed a successful reach, dose and fidelity, and moderate satisfaction. Furthermore, contextual factors played an important role during the implementation.

Introduction

In worksite interventions, randomised controlled trials (RCTs) have been recognised as a standard method to evaluate the effectiveness of outcomes. Despite the fact that RCTs offer the opportunity to control for several factors, such as confounding, selection bias and information bias, there are important factors that cannot be controlled by using this design.[1,2] For instance, the implementation of interventions at the worksite is dependent on the context, such as the social climate at the worksite, and this is nearly impossible to control entirely.[3] Process evaluations have been identified in the literature as an important tool to gain insight into the impact of these factors on the implementation of an intervention.[3,4] However, the number of process evaluations alongside RCTs at the worksite is still limited. An explanation could be that funders are more interested in the outcomes of the intervention in terms of effectiveness.[5]

Nevertheless, process evaluations should be performed more often alongside RCTs in worksite settings as they can facilitate interpretation of study findings by providing more detailed information about the content and degree of the implementation of the intervention.[6] For instance, it could turn out that, in practice, the intervention has not been executed as intended in the protocol (type III error).[7] In that case, process evaluations may help researchers distinguishing between interventions that are not effective because of their predefined intervention protocol and underlying theories, and those that are not implemented adequately.[1,8] Moreover, the information obtained from the process evaluation can be used to further improve decision making about programme modifications.[9] Knowledge about the feasibility and implementation of an intervention also has benefits for other researchers to improve the development and implementation of comparable interventions in worksite settings.

Therefore, a process evaluation was conducted of an intervention programme in the construction industry. In this intervention, a 6-month programme was executed aimed at maintaining and promoting the work ability and health-related quality of life in order to support sustainable employability of construction workers.[10] The intervention protocol consisted of two individual visits of a physical therapist, an instrument to raise awareness of the importance of rest breaks to reduce fatigue, and two empowerment training sessions.[11] Because this intervention was implemented at many construction sites in different companies, a process evaluation is especially necessary as the intervention may be implemented and received differently among these worksites and companies.[6] Thus, the aim of the present study was to evaluate the process of implementing a preventive intervention at different worksites in the construction industry.

Methods

The process evaluation was performed alongside a RCT on the effectiveness of an intervention at construction worksites. The Medical Ethics Committee of the VU University Medical Centre in Amsterdam approved the study and all participants signed informed consent. More detailed information on the methods, randomisation procedure, and outcome measures has been published elsewhere.[11]

Study population

The study population for the process evaluation consisted of construction workers and supervisors working at the allocated intervention worksites, and trainers providing the intervention components. The construction workers were those performing the actual construction work (i.e., blue-collar workers). Supervisors were invited to participate as they had to manage the intervention at the worksite. All trainers (i.e., three physical therapists and one empowerment trainer) participated in the present study.

Intervention

The worksite prevention programme lasted six months and aimed to maintain and promote the work ability and health-related quality of life in order to support sustainable employability of construction workers. Following the Intervention Mapping protocol during the development of the intervention, two programme objectives were defined to improve work ability and health-related quality of life: (1) construction workers had to improve their balance between physical workload and need for recovery, and (2) construction workers had to improve their range of influence at the worksite.[10]

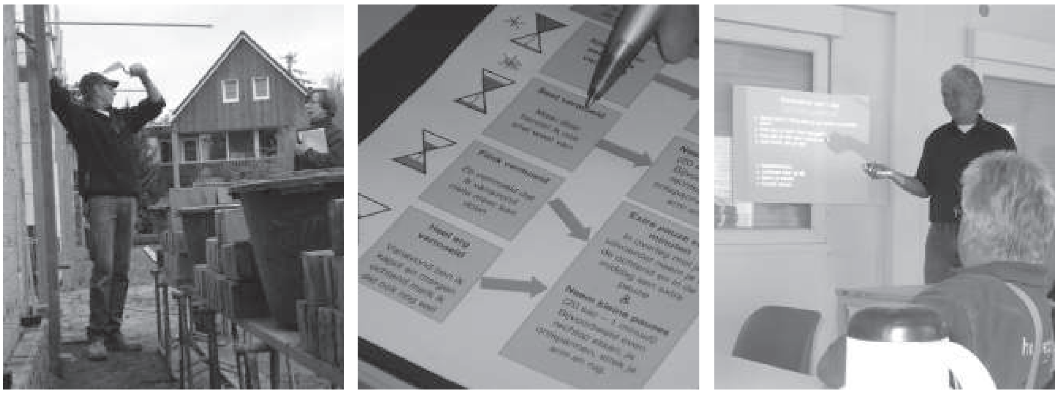

Figure 1. (A) Training session of the physical therapist, (B) Rest-Break tool, (C) Training session of the empowerment trainer

Regarding the first programme objective, the construction workers received two individual training sessions of a physical therapist and a Rest-Break tool. During the first training session of the physical therapist at the worksite, a quick scan questionnaire was followed by a 15-minute observation at the workplace (Figure 1.a). Based on this, three recommendations on how to reduce the physical workload were written down by the physical therapist on a pocket-size card. The recommendations were mainly focused on improvements in working style, work methods and rest breaks. Four months later at the second training session, the experiences so far were discussed and the impact of the advice was evaluated with the worker. The second part of the first programme objective was the introduction of the Rest-Break tool (Figure 1.b). This tool aimed to raise awareness about the importance of reducing fatigue by taking flexible rest breaks, and to stimulate to actually take rest breaks in order to reduce fatigue. The Rest-Break tool is a flowchart and consists of four steps: (1) the expectations of the workers about their fatigue at the end of the working day, (2) short term advice to take mini rest breaks or an additional break of ten minutes, (3) selection of the possible causes of fatigue, and (4) long term advice about structurally lowering fatigue. The workers were asked to fill in the tool weekly, alone or with colleagues, and they discussed the results with their supervisor.

As to the second programme objective, workers as a group received two interactive empowerment training sessions at the worksite to improve their influence at the worksite (Figure 1.c). The first training session consisted of five steps. During these steps, the workers created a list of topics they wanted to change during the intervention period, and they signed an action plan.

Examples of actions they planned to execute during the intervention period were improving the communication with the supervisor, asking for assistance during lifting tasks and taking additional rest breaks. Four months later at the second empowerment training session, the empowerment trainer and workers discussed, evaluated, and reconsidered the action plan as well as the results that were achieved.

To remind the workers during the intervention programme about the content of the program, several incentives were provided, such as a video, poster, and a banner.

Process aspects

Following the recommendation of Steckler and Linnan (2002), seven process aspects were assessed: recruitment, reach, dose delivered, dose received, fidelity, satisfaction, and context.[5,12] These aspects were addressed by combining qualitative and quantitative data at different levels; company level, worksite level, and participant level.

Recruitment

Recruitment refers to the procedures used to approach and attract managers of construction companies to participate. During the recruitment phase, all approached companies, used procedures, and reasons for not participating were registered and collected in logs by the researchers.

Reach

Reach was defined as the number of workers who returned the baseline questionnaire. Reach included the workers allocated to the control group as well as to the intervention group. Reach was expressed by the proportion of workers who returned the baseline questionnaire compared to all workers receiving the baseline questionnaire.

Dose delivered

Dose delivered was defined as the number of intended intervention components that were actually delivered by the trainers. Two visits of a physical therapist including the introduction of the Rest-Break tool and two empowerment trainings sessions should have been provided to each intervention worksite. Data were collected using checklists, which were filled in by the trainers, regarding which worksites they visited. Therefore, dose delivered was expressed as the proportion of worksites that received the components as described in the checklists compared to the number of all intervention worksites.

Dose received

Dose received refers to the proportion of construction workers in the intervention group that participated in the training sessions. Before the start of each training session, all workers had to sign a list to confirm their attendance. These lists were compared to all workers allocated to the intervention group.

Fidelity

Fidelity contains information about the extent to which the trainers delivered the programme according to protocol. The protocol containing information about the content and organization of the training sessions was written together with the physical therapist and empowerment trainer during the development of the intervention. Data were collected using logs of each training session received from the trainers, questionnaires at 3-month and 6-month follow-up, and semi-structured interviews with all trainers and with a sample of workers.

Satisfaction

Satisfaction with the overall content of the programme and the specific programme components was measured using 3-month (for the first training sessions) and 6-month follow-up questionnaires (for the second training sessions and the Rest-Break tool). Satisfaction was measured by using a 10-point scale (very unsatisfied to very satisfied). Moreover, workers were asked if they would recommend the programme or specific components for future implementation (yes/no). In addition to the questionnaires, semi-structured interviews were conducted with workers and supervisors to gain more in-depth insight in their satisfaction with the program, and their recommendations for future implementation. Based on the questionnaires, the average rates of the satisfaction with the intervention and components were categorized into poor (<6), moderate (≥ 6 and <7.5), or good (≥ 7.5).

Context

Contextual factors refer to characteristics that could facilitate or impede the implementation. Four factors (i.e., company size, intervention year, economic recession and engagement of the management) were selected during data collection. These factors were based on the input from the human resource managers of the companies and on discussions within the research team.

First, three companies had a medium company size (20 to 100 employees), whereas the other three companies had a large company size (≥ 100 employees). Second, three of the six companies participated in the development phase and started with the intervention programme in 2009, whereas the other companies started with the intervention in 2010. Third, the economic recession had large consequences for the construction industry in 2009 and 2010 as the working-stock decreased. As a consequence of the economic recession, one company had to lay-off workers and had to keep the remaining workers working part-time during the intervention programme. Fourth, the engagement of the management with the programme was characterized into low, intermediate, and high. Low engagement was defined as commitment of the management, but no further involvement of the management after baseline measurement. Intermediate engagement meant that the management committed themselves to the project and facilitated the implementation of the programme. High engagement meant that the management committed themselves to the project, facilitated the implementation of the programme as well as stimulated workers to participate in the project during the intervention period. The engagement of the management towards the programme was low in two companies, intermediate for three companies, and high for one company.

Data collection of the process aspects

As mentioned briefly in the former paragraph, data for the process evaluation were collected using i) questionnaires at baseline, and at 3-month and 6-month follow-up among construction workers, ii) logs and checklists completed by all trainers after each training session, iii) logs collected by the researchers during the entire project, and iv) semi-structured interviews with workers (n=22), supervisors (n=7), and occupational trainers (n=4).

The questionnaire at baseline was distributed to all construction workers that participated in the intervention. The questionnaires at 3-month and 6-month follow-up were only distributed among the construction workers allocated to the intervention worksites to gain insight in the implementation of the programme and the specific components, and included questions about fidelity, satisfaction and recommendations for future implementation.

Regarding the semi-structured interviews, workers within five companies were recruited based on the number of followed training sessions. Only workers who completed at least three training sessions were selected. Of these workers, a sample was asked to participate in the semi-structured interview based on their opinions about the program; a random sample of those who stated to be dissatisfied with the programme and a random sample of those who were very satisfied with the programme. As none of the workers refused, 22 workers in total participated in the interviews. Second, a random sample of supervisors was asked to participate in this study. Of the eight supervisors approached, one supervisor refused to participate because of time constraints. Third, all trainers participated in the semi-structured interviews. The semi-structured interviews with supervisors and workers were conducted face-to-face at the worksite, whereas the semi-structured interviews with the trainers took place at a location nearby their work. All semi-structured interviews were conducted by independent researchers not involved in the intervention before. With oral permission of the participants, the semi-structured interviews were audio-taped and fully transcribed.

Data analysis

Quantitative data were analysed using descriptive statistics (i.e., percentage, mean and standard deviation). To identify significant differences between attendance rates and recommendations for future implementation for each contextual factor, Pearson Chi-Square tests were performed. To identify significant influence of other variables, Mann–Whitney *U*-tests and Kruskal-Wallis tests were performed for the contextual factors. In all analyses, the Statistical Package of Social Sciences version 17.0 for windows (SPSS Inc. Chicago, Illinois, USA) was used.

All recorded semi-structured interviews were transcribed verbatim. Subsequently, the transcripts were read en reread to become familiar with the text. Next, textual segments were marked with open and axial codes indicating the content of the response. The codes were then grouped in themes related to process variables aspects (e.g., fidelity, satisfaction, and recommendation for future implementation). For all data extracted, a qualitative software programme (Kwalitan, version 5.09) was used to electronically code and manage the data.

Results

Recruitment

In total, 231 companies in the construction industry were approached by phone (Figure 2). Written information was sent to those that were interested (n=171; 76%). Initially, 34 companies that expressed their interest in the project were visited by the principal researcher to explain the development and implementation phase by an oral presentation. Main reasons for these companies not to participate were that they already participated in other health promotion activities, that not all members of the management were in favour of participation, and that there were insecure consequences of the economic recession. After the 34 visits, five companies committed themselves to the development and implementation phase. Two reasons to participate were the consecutive possibilities for companies to exert influence on the content of the programme and the intervention strategy, and the high percentage of sick-leave among their workers. Because of the economic recession, only three companies continued the project in the implementation phase. To reach the desired number of construction workers, three additional companies were invited to participate in the implementation phase by personal contacts of the researchers. Finally, six companies actually participated in the programme.

Reach

The baseline questionnaire was distributed at the worksite to 347 construction workers. The response of the baseline questionnaire between the companies varied from 77% to 100%, and was on average 84%. In total, 293 construction workers responded to the baseline questionnaire. Among them, 171 construction workers were working at the intervention worksites. For the process evaluation, a total of 121 construction workers (71%) responded to the questionnaire at 3-month follow-up, and 114 construction workers (67%) responded to the questionnaire at 6-month follow-up.

Dose delivered

The first training session from the physical therapist, which also included the introduction of the Rest-Break tool, was delivered to 91% of the intervention worksites, and the first empowerment training session was delivered to 90% of the intervention worksites. The second training session of the physical therapist was delivered to 90% of the intervention worksites, and the second empowerment training session was delivered to 95% of the

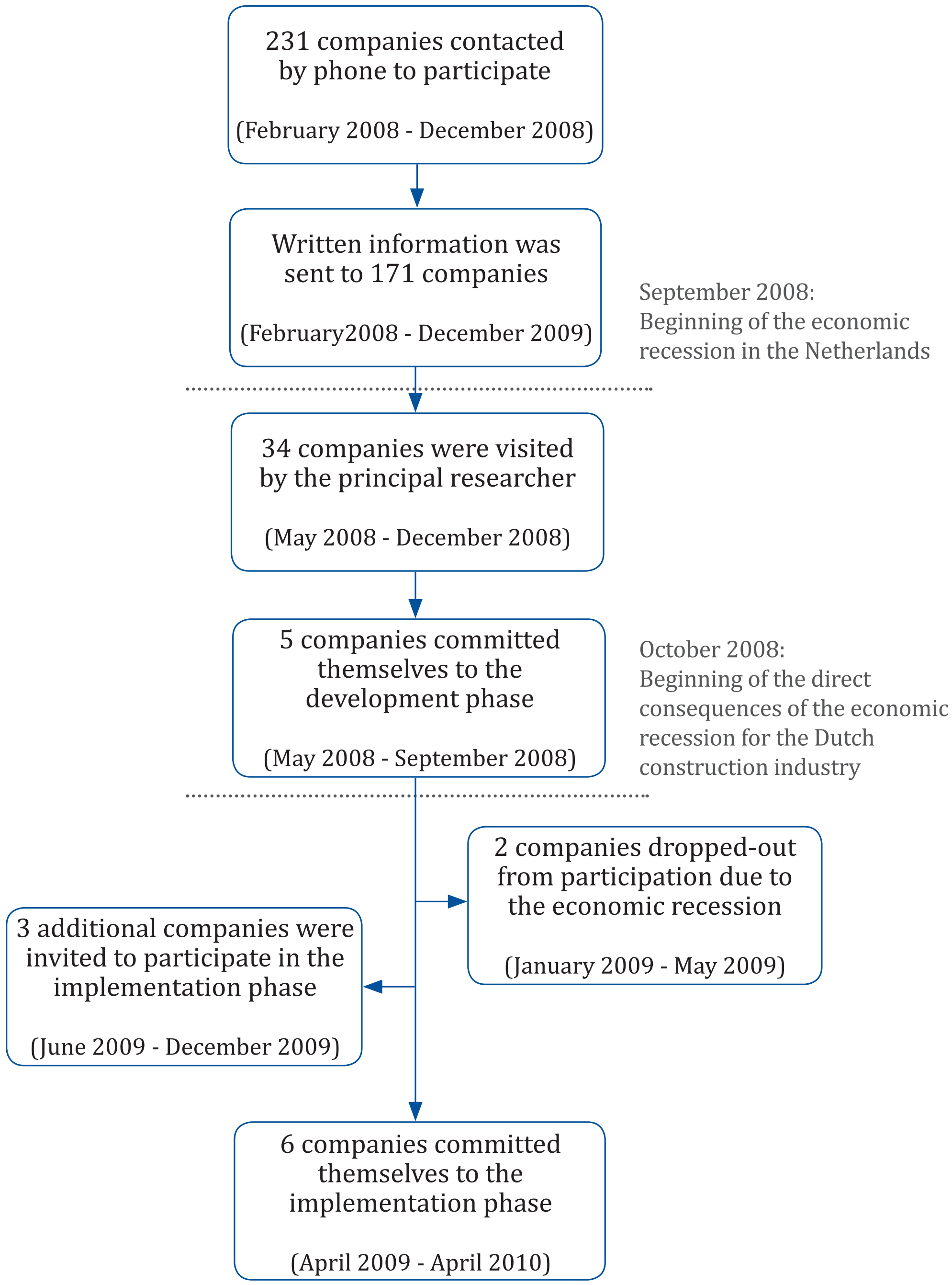

Figure 2. Flow diagram of recruited companies

intervention worksites. In two companies, all training sessions were delivered to all worksites. For two other companies, newly started worksites were not communicated in time, and therefore these worksites were missed. Due to time constraints in two companies, the second training session of the physical therapist was not provided to all workers of some small worksites (≤ 3 construction workers).

Dose received

Based on the checklists of the trainers, the first training session of the physical therapist was follow by 70% (n=120) of the construction workers whereas the first empowerment training session was follow by 67% (n=115) of the workers. The second training session of the physical therapist and empowerment trainer were followed by 59% (n=101) and 62% (n=107) of the workers, respectively. In total, 11% of the workers followed none of the training sessions, whereas 61% of them followed at least three training sessions.

During the intervention period, one company encountered huge consequences of the decreased working-stock due to the economic recession. Just before starting the intervention, this company had to lay-off workers and had to force the other workers to work part-time. Because of the high impact of this on the dose received, these workers (n=50) were excluded. Of the remaining construction workers, the first training session of the physical therapist was followed by 74% (n=90) of them (Table 1). The first empowerment training session was followed by 79% (n=95) of the workers. The second training session of the physical therapist and empowerment trainer was followed by 63% (n=76) and 73% (n=88) of the workers, respectively. In total, 5% of the workers followed none of the training sessions, whereas 70% of them followed at least three training sessions (Table 1).

Fidelity

The physical therapists visited the construction worksites to conduct a quick scan questionnaire and to observe the workers at their workplace individually. In the second training session, the physical therapist reconsidered the advice with the workers. Based on the questionnaires, the main topics that were discussed during the training session were lifting less during the working day (76%), working in right postures (74%), and taking additional rest-breaks during the working day (72%). At some worksites, the training session of the physical therapists deviated from the protocol. First, the workers were in some cases not trained individually. For feasibility reasons, construction workers of very small construction worksites (≤ 3 workers) were gathered to a larger worksite to follow the training session. Besides, some workers asked to be trained together with their colleague, as they always worked as a fixed couple. Second, based on the results of the questionnaires, the majority of the

Table 1. The proportion of workers (% (n)) who received the training sessions in total and for each contextual factor[a]

	Total	Contextual factors						
		Company size		Year		Engagement		
		medium	large	2009	2010	low	medium	high
	n=121	**n=41**	**n=80**	**n=68**	**n=53**	**n=8**	**n=85**	**n=28**
Attendance of the training sessions (%(n))								
The first training session of physical therapist	74% (90)	80% (33)	71% (57)	71% (48)	79% (42)	50% (4)	76% (65)	75% (21)
The first training session of empowerment trainer	79% (95)	80% (33)	78% (62)	69% (47)*	91% (48)*	75% (6)	75% (64)	89% (25)
The second training session of physical therapist	63% (76)	73% (30)	58% (46)	57% (39)	70% (37)	50% (4)	62% (53)	68% (19)
The second training session of empowerment trainer	73% (88)	85% (35)*	66% (53)*	66% (45)	81% (43)	75% (6)	73% (62)	71% (20)
Number of attended training sessions (%(n))								
None	5% (6)	2% (1)	6% (5)	6% (4)**	4% (2)**	13% (1)	5% (4)	4% (1)
1-2 training sessions	25% (30)	22% (9)	26% (21)	34% (23)**	13% (7)**	38% (3)	27% (23)	14% (4)
3-4 training sessions	70% (85)	76% (31)	68% (54)	60% (41)**	83% (44)**	50% (4)	68% (58)	82% (23)

[a] Company B was excluded from analyses (n=50); *p<0.05; ** the proportion of attended training session was higher for workers who started the intervention in 2010 compared to 2009 (p<0.05)

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construction workers (61%) did not receive the advices on a pocket-size card at the end of the first training. The therapists mentioned several reasons for not handing out the cards: (a) two therapists found the card childish, (b) one therapist forgot to bring along the cards for one company, and (c) the workers themselves incidentally found the cards unnecessary. Third, two physical therapists commented on the duration of the training sessions. As workers with musculoskeletal symptoms needed more time than was estimated previously, less time was left for the other workers.

The fidelity of the Rest-Break tool, which was explained and handed-out to all workers during the first training of the physical therapist, was disappointing. The majority of the workers mentioned that the Rest-Break tool was easy to follow and to fill in. Of these workers, only 44% filled in the tool on a weekly basis. None of the interviewed workers discussed the advice with their supervisor, and the majority of them never used the advice in daily practice. The reasons that workers did not follow the advice were that they: 1) already took additional short rest-breaks when needed, 2) were not able to follow the advice from the tool at the worksite, or 3) did not know that the tool was for their own usage.

In general, the empowerment trainer conducted the training sessions according to protocol. The questionnaires (n=71) showed that the training sessions focused mainly on topics such as responsibility for their own health (80%), rest-breaks (73%), celebration of success achievement (73%), and teamwork (72%). The logs showed that working at a small worksite and having no involvement of the supervisors during the training sessions were barriers for conducting the training sessions according to protocol. The empowerment trainer deviated from the protocol in the first step. Because of time constraints during the training session, the protocol described that extra time with the workers beforehand was as a prior condition to get to know the workers and their worksite. However, in contrast to the protocol, the empowerment trainer was never present at the worksite beforehand.

Satisfaction

The construction workers who followed at least one training session rated the satisfaction about the programme as moderate ((6.5±1.2); Table 2). The interviewed workers were satisfied with the programme because

Table 2. Satisfaction with the programme (mean, sd) and recommendation for future implementation (%) among workers in total and for each contextual factor

	N	Total	Contextual factors								
			Company size		Year		Recession		Engagement		
			medium	large	2009	2010	no	yes	low	medium	high
Satisfaction[a] (mean (sd))											
Overall content of the programme	109	6.5 (1.2)	6.6 (1.1)	6.4 (1.2)	6.3 (1.3)	6.6 (1.0)	6.5 (1.2)	6.2 (1.2)	6.2 (1.1)	6.5 (1.3)	6.7 (0.9)
First training session of physical therapist	80	6.6 (1.7)	6.5 (1.3)	6.6 (1.9)	6.3 (2.0)	6.8 (1.3)	6.7 (1.6)	6.1 (2.0)	6.1 (1.9)*	6.4 (1.8)	7.4 (1.0)*
Pocket-size card	48	5.8 (2.1)	5.6 (2.3)	5.9 (2.0)	5.7 (2.3)	6.1 (1.8)	5.8 (2.0)	5.7 (2.5)	5.7 (2.5)	5.6 (2.2)	6.9 (0.7)
Advice from the therapist	80	6.6 (1.7)	6.4 (1.6)	6.7 (1.7)	6.3 (2.0)	6.9 (1.2)	6.6 (1.7)	6.6 (1.7)	6.5 (1.6)	6.3 (1.8)	7.3 (1.2)
Second training session of physical therapist	65	6.6 (1.8)	6.9 (0.9)	6.4 (2.1)	6.4 (1.8)	6.7 (1.7)	6.6 (1.8)	6.4 (1.4)	6.4 (1.3)	6.6 (1.6)	6.7 (2.4)
Rest-Break tool	73	5.3 (2.0)	5.4 (2.0)	5.2 (2.0)	5.5 (2.0)	5.0 (1.9)	5.3 (1.9)	5.2 (1.9)	5.1 (2.1)	5.4 (2.0)	5.2 (1.9)
First training session of empowerment trainer	80	6.2 (1.6)	6.5 (1.5)	6.0 (1.6)	6.1 (1.8)	6.2 (1.4)	6.2 (1.5)	5.7 (2.2)	5.9 (1.8)	6.2 (1.7)	6.2 (1.3)
Action plan	80	6.0 (1.7)	6.2 (2.0)	5.9 (1.5)	5.8 (1.8)	6.2 (1.6)	6.0 (1.6)	5.9 (2.0)	6.0 (1.7)	6.0 (1.9)	6.0 (1.3)
Second training session of empowerment trainer	80	6.2 (1.8)	6.5 (1.9)	6.0 (1.8)	6.0 (1.8)	6.4 (1.7)	6.2 (1.9)	6.4 (1.3)	6.1 (1.7)	6.2 (1.9)	6.3 (1.8)
Recommendation for future implementation[b] (%)											
Overall programme	106	64%	76%	59%	56%	75%	67%	53%	60%	64%	68%
Training sessions of the physical therapist	67	79%	96%*	69%*	69%*	90%*	83%	60%	69%	82%	80%
Rest-Break tool	70	47%	58%	41%	46%	49%	47%	50%	44%	49%	47%
Training sessions of the empowerment trainer	71	62%	70%	57%	49%*	77%*	59%	86%	70%	57%	73%

[a] scale 1-10; with higher scores indicating a higher satisfaction; [b] yes/no; * $p<0.05$

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their company acknowledged the importance of the workers' health, the programme combined different components, and they thought that "the programme may do some good". However, unsatisfied workers commented that the programme was too extensive and impractical. Based on the questionnaires, the programme was recommended by 64% of the workers for future implementation.

Workers were moderately satisfied with the first training session of the physical therapist and the accompanying advice (6.6±1.7 and 6.6±1.7), respectively) and the second training session (6.6±1.8), whereas they were less satisfied with the pocket-size card (5.8±2.1). The interviewed workers mostly liked the practical advice, the personal visits at the worksite, and the increased attention of their company to their physical health. The visit at the worksite and the personality of the physical therapist were mentioned as positive by the supervisors. However, a few workers and supervisors were concerned about the long-term effects of the training sessions. The majority of the workers recommended the programme (79%). For future implementation, the workers and supervisors recommended that the physical therapist should spend more time at the construction site.

As for the Rest-Break tool, the questionnaires as well as the interviews showed that both workers and supervisor were unsatisfied with the tool. Workers rated the tool with a 5.3±2.0 on average. Although the majority of the workers were satisfied about the concept of the tool, some workers experienced difficulties in filling in their weekly status of fatigue on a scale. Negatively judged items were that the advice was often not feasible in daily activities, and workers of large companies became bored with the tool as they had the same work tasks for weeks. The supervisors agreed with these reasons for dissatisfaction. Almost half of the workers (47%) recommended the Rest-Break tool for future implementation. Examples to improve the feasibility of the tool were: lower frequency (e.g., monthly) to fill in the Rest-Break tool, feedback of the Rest-Break tool by the physical therapist, and a tool tailored to different professions.

The first training session of the empowerment trainer and the accompanying action plan were rated as moderate (6.2±1.6 and 6.0±1.7), and the second training session was rated comparable (6.2±1.8). While six out of seven supervisors were dissatisfied with the training sessions, the opinions across the workers differed. Those who were satisfied with the programme mentioned the personality of the trainer, the content of the program, and the action plan as positive. Negatively judged items were stereotyping the construction industry by the trainer, and the infeasibility to implement the solutions. For future implementation, the training sessions were recommended by 62% of the workers. The workers suggested that actual examples from the Dutch construction industry should be provided, and that the training sessions should be available for supervisors and white-collar workers as well.

Context

Regarding the dose received, table 1 showed the associations between each contextual factor and the attendance rates. In general, higher but no significant attendance rates were found among workers working in smaller companies, workers who started with the intervention in 2010, and workers working in companies with an engagement management towards the programme. The number of followed training sessions was significantly higher for workers who started with the intervention in 2010 compared to those who started in 2009. Regarding the satisfaction with the programme and the specific components, in general, a slightly higher but no significant appreciation was found among workers who started the intervention in 2010, who had no direct consequences of the economic recession, and who worked in a company with a high management engagement (Table 2). Regarding future implementation, significant more construction workers of smaller companies recommended the training sessions of the physical therapist compared workers of larger companies. Moreover, significant higher recommendation for future implementation of the trainings sessions of the physical therapist as well as empowerment trainer were found among workers who started in 2010 compared to those who started in 2009.

Discussion

This paper described the process of implementing a worksite prevention programme in the construction industry, using the framework of Steckler and Linnan. The intervention programme faced immense difficulties in recruiting companies, but yielded a high reach among workers of companies that finally participated in the study. The main results indicated that the protocol was largely implemented as intended by the physical therapist and empowerment trainer. However, the Rest-Break tool was not used by the workers as described in the protocol. The satisfaction with the program, the training sessions of the physical therapist as well as the empowerment trainer was moderate, whereas the Rest-Break tool was rated as unsatisfactory. Furthermore, working in a smaller company (< 100 employees), higher management engagement towards the program, and participation in the second year of the intervention positively influenced the implementation of the intervention.

Comparison with other studies

The participation rate among construction companies was extremely low; only 6 of the 234 companies (3%) participated in the implementation of the intervention. An explanation for the low participation could be that the content and requested additional time and costs were unknown during the recruitment phase. Thus, in agreement with previous studies[13,14], time demands and costs were factors playing an important role in decision making to participate in an intervention.

Once companies committed themselves to implementing the intervention, the focus moved towards the recruitment of the workers in these companies. Because participation of blue-collar workers in intervention studies is in general low[15], recruitment strategies were chosen to increase the reach among the workers. One way to stimulate the participation rates in the present study was to involve workers in the development of the intervention using the Intervention Mapping protocol.[4,10] Other strategies to obtain higher participation rates were the commitment of the management[16] and the personal invitation of the researchers at the worksite. These strategies apparently worked well as the participation of workers in the current study (84%) was higher than in most worksite health promotion programmes (10-64%)[17,18].

Concerning the dose delivered of the intervention, almost all worksites (90%-100%) received the training sessions. This is in line with previous studies.[17,19] Also the dose received of the training sessions was satisfactory (61% of the workers followed three or four training sessions), and was in line with other worksite intervention studies.[15,17,19] Explanations for the satisfying attendance rates were that the training sessions were organized at the worksite and within the existing training system in the Dutch construction industry[10], and that the workers participated in company time.[16] Unfortunately, the usage of the Rest-Break tool was unsatisfactory as only half of the workers filled in the tool on a weekly basis.

Regarding the fidelity of the implementation, it should be noticed that implementing an intervention also includes balancing between the interests of the researchers, who want to standardize the components, and the interests of the trainers, who need to adapt the intervention to the local setting.[20,21] Thus, despite the fact that the protocol was developed with the trainers, the physical therapist needed to modify the protocol occasionally when it could not be applied completely. In contrast to the training sessions, the Rest-Break tool was not implemented as intended in the protocol. Although half of the workers filled in the tool on a weekly basis, the majority of them never used the advice in daily practice. The main reason for this was that workers already took additional short rest-breaks when necessary.

The construction workers rated the overall content of the programme as moderate. The interviews showed that workers and supervisors were very positive about the training sessions of the physical therapist. The opinions about the empowerment training session differed among the workers, whereas the opinions about these training sessions were mainly negative among the supervisors. This was surprising as the intervention was developed in collaboration with the workers. However, it might be explained by the fact that the empowerment training aimed to change work on an organizational level, which was new for both supervisors and workers. However, 64% of the workers still recommended the intervention for future implementation. The interviews showed that the satisfaction about the intervention may be improved when the recommendations for modifications of the intervention (e.g., more visits from the physical therapist, availability of the empowerment trainer for the white-collars as well) are followed.

Several contextual factors influenced the implementation of the intervention. Although the consequence of the economic recession was apparent during the entire intervention program, it is unknown how this exactly influenced the results of the present study. It could be hypothesised that construction workers experienced high job insecurity and that they were less able to dedicate themselves to the intervention entirely. Moreover, as one company actually had to lay-off workers and had to force the other workers to work part-time, the economic recession negatively influenced the dose received in the present study. In addition, working for a company of smaller size and with higher management engagement towards the programme were other factors that positively influenced the dose received and satisfaction. A smaller company size[15,16] as well as high engagement of the staff[22,23] were already recognised by previous studies as success factor for participation rate or satisfaction. Also better results for dose received, satisfaction and future recommendations were achieved when implementing the intervention in 2010 compared to 2009.

Based on the results of the different process aspects, the question arises whether the implementation of the intervention failed or succeeded. To indicate the extent to which the intervention has been implemented and received by the construction workers, some process aspects can be used to calculate a composite score.[5] Thus, 293 of the 347 workers approached (84%) agreed to participate in the intervention programme. Because of the high impact of the economic recession on company B, these workers (n=51) were excluded from the process variable dose received. Of the remaining 120 workers in the intervention group, 69 workers (58%) received at least three sessions and rated the programme as moderate to good (score of 6 and higher). Drawing conclusions about the implementation of the programme based on this number is still hard as there is no cut-off point to determine whether implementation was successful or had failed.[5] When analysing the effectiveness of the intervention, per-protocol analysis based on these process outcomes should be performed.

Strengths and weaknesses

First, by following this framework, researchers were forced to write down a process evaluation plan a priori. As a result, all data could be collected from the beginning of the project. Collecting input from all stakeholders about the programme is the second strength of this study. The programme can be modified based on this input and will therefore be feasible for all of them for future implementation. Third, the present study collected both qualitative and quantitative data. Qualitative research is often criticized as it lacks reproducibility, is subjected to researcher bias and lacks generalizability.[24] However, while quantitative data provide an overview on how well the intervention is implemented, qualitative data can complement this in exploring the underlying motives of the findings.[25]

Some methodological limitations should be considered as well. First, socially desirable answers could be expected because the questionnaires were filled in together with colleagues and within the presence of the principal researcher. To be sure to avoid this kind of response bias during the interviews, an independent researcher interviewed the workers individually. Second, we should be aware of selection bias as only construction workers who at least followed three training sessions were interviewed. However, to encounter this bias, workers with a high satisfaction as well as workers with a lower satisfaction towards the overall programme were invited for the interviews. Third, recall bias needs to be taken into account, since the interviews took place three to nine months after the intervention. Therefore, some relevant information for recommendation for future implementation could be missed. Fourth, we did not collect sufficient information about the implementation of the Rest-Break tool. To obtain more detailed information, the usage of the Rest-Break tool should actually have been monitored during the intervention period.

Implications for future research

Based on the findings of the current study, some lessons can be learned for future researchers who are planning to conduct an intervention study at the worksite. First, implementing an intervention at different companies and across different worksites is a dynamic process with many external influences. It is therefore recommended that researchers focus on possible contextual factors, from drawing the protocol until the very end of the intervention. Thereby, researchers should distinguish between factors that are suggestible (e.g., engagement of the management towards the program) and those that are not (e.g., company size) because they both might ask for different strategies to improve the implementation of an intervention. For instance, implementing an intervention in a larger company is more difficult compared to smaller company. As a strategy for implementing an intervention in a larger company, researchers should spend more time on spreading out the information and exact time schedules of the intervention. Moreover, some unexpected factors could also occur during the implementation of the intervention such as the economic crisis. It is important to notice and monitor these factors as it will help researchers how to interpret the effectiveness of the outcomes. The second lesson learned from the present study is the importance of conducting a full pilot. The results showed that implementation was more successful in the second intervention year compared to first intervention year. Due to time constraints, new materials such as the Rest-Break tool were piloted only once, whereas other components were not tested among the target group at all. Hence, initial shortcomings could have been corrected when a full pilot was performed.

Implications for practice

When implementing the intervention at a larger scale in the construction industry, implementers (e.g., trainers, managers of trade unions or companies) should consider some challenges. First, some adaptations on the intervention should be made based. In the current study, the physical therapist needed to proceed pragmatically in situations where the protocol could not be applied completely. Thus, various scenarios that can be encountered in daily practice need to be outlined in the protocol. Besides, more involvement of the supervisor during the empowerment training sessions is recommended. Because the training sessions aim to change work on an organizational level, it is important that supervisors and managers also are in favour of this cultural change. Therefore, providing training sessions for the supervisors and other white-collar workers of the company might be valuable. Moreover, the Rest-Break tool is not usable in the current form because the tool was rated unsatisfactory and the advices were not followed. Thus, more qualitative research (i.e., interviews and focus groups) is needed to explore which solutions might be more appropriate to reduce fatigue. Second, as the results from the present study showed the importance of the contextual factors at construction worksites, it is important to be aware of them for future implementation. For instance, to implement an intervention successfully, it is important that the managers are engaged towards the programme. Implementers should invest more time in convincing less engaged managers about the value of the intervention for their company. The third challenge is to optimize the collaboration within the multidisciplinary team (e.g., physical therapists, empowerment trainer, human resource managers, supervisors and workers). To optimize the cohesion between the training sessions of the physical therapist and empowerment trainers, it is recommend that both trainings sessions will be provided by the same company. Besides, to keep all stakeholders of the company involved in the project, implementers should inform each of them regularly.

Conclusion

The results of the present process evaluation show that (i) the willingness to participate was low among the companies but notably higher among construction workers in the participating companies, (ii) the training sessions were largely implemented according to the protocol, whereas the Rest-Break tool was poorly implemented, (iii) 64% of the workers recommended the intervention for future implementation and the training sessions of the physical therapist were recommended by 79% of them. Furthermore, working in a smaller company (< 100 employees), having a higher management engagement towards the program, experiencing no direct consequences of the economic crisis, and participating in the second year of the intervention were contextual factors that positively influenced the implementation of the intervention.

References

1. Rychetnik L, Frommer M, Hawe P, Shiell A. Criteria for evaluating evidence on public health interventions. *J Epidemiol Community Health* 2002;56(2):119-27.
2. Kristensen TS. Intervention studies in occupational epidemiology. *Occup Environ Med* 2005;62(3):205-10.
3. Glasgow RE, Klesges LM, Dzewaltowski DA, Bull SS, Estabrooks P. The future of health behavior change research: what is needed to improve translation of research into health promotion practice? *Ann Behav Med* 2004;27(1):3-12.
4. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach. San Francisco: Jossey-Bass; 2006.
5. Steckler A, Linnan L. Process Evaluation for Public Health Interventions and Research. San Francisco: Jossey-Bass; 2002.
6. Oakley A, Strange V, Bonell C, Allen E, Stephenson J, RIPPLE Study Team. Process evaluation in randomised controlled trials of complex interventions. *BMJ* 2006;332(7538):413-6.
7. Brownson RC, Fielding JE, Maylahn CM. Evidence-based public health: a fundamental concept for public health practice. *Annu Rev Public Health* 2009;30:175-201.
8. Nielsen K, Fredslund H, Christensen KB, Albertsen K. Succes or failure? Interpreting and understanding the impact of interventions in four similar worksites. *Work & Stress* 2006;20:272-87.
9. Saunders RP, Evans MH, Joshi P. Developing a process-evaluation plan for assessing health promotion program implementation: a how-to guide. *Health Promot Pract* 2005;6(2):134-47.
10. Oude Hengel KM, Joling CI, Proper KI, Van der Molen HF, Bongers PM. Using intervention mapping to develop a worksite prevention program for construction workers. *Am J Health Promot* 2010;26:e1-e10.
11. Oude Hengel KM, Joling CI, Proper KI, Blatter BM, Bongers PM. A worksite prevention program for construction workers: design of a randomized controlled trial. *BMC Public Health* 2010;(10):doi: 10.1186/1471,2458-10-336.
12. Murta SG, Sanderson K, Oldenburg B. Process evaluation in occupational stress management programs: a systematic review. *Am J Health Promot* 2007;21(4):248-54.
13. Cherniack M, Morse T, Henning R, Seidner A, Punnett L. Health promotion site selection blues: barriers to participation and implementation. *J Occup Environ Med* 2010;52(6):626-34.
14. Kidd P, Parshall M, Wojcik S, Struttmann T. Overcoming recruitment challenges in construction safety intervention research. *Am J Ind Med* 2004;45(3):297-304.
15. Glasgow RE, McCaul KD, Fisher KJ. Participation in worksite health promotion: a critique of the literature and recommendations for future practice. *Health Educ Q* 1993;20(3):391-408.
16. Linnan LA, Sorensen G, Colditz G, Klar DN, Emmons KM. Using theory to understand the multiple determinants of low participation in worksite health promotion programs. *Health Educ Behav* 2001;28(5):591-607.
17. Johnson CC, Lai YL, Rice J, Rose D, Webber LS. ACTION live: using process evaluation to describe implementation of a worksite wellness program. *J Occup Environ Med* 2010;52(Suppl 1):S14-21.
18. Robroek SJ, van Lenthe FJ, van Empelen P, Burdorf A. Determinants of participation in worksite health promotion programmes: a systematic review. *Int J Behav Nutr Phys Act* 2009;6:26: doi: 10.1186/1479-5868-6-26.
19. Strijk JE, Proper KI, Van der Beek AJ, Van Mechelen W. A process evaluation of a worksite vitality intervention among ageing hospital workers. *Int J Behav Nutr Phys Act* 2011;10(8):58.
20. Jansen YJ, Bal R, Bruijnzeels M, Foets M, Frenken R, De Bont A. Coping with methodological dilemmas; about establishing the effectiveness of interventions in routine medical practice. *BMC Health Serv Res* 2006;13(6):160: doi:10.1186/1472-6963-6-160.

21. Hawe P, Shiell A, Riley T, Gold L. Methods for exploring implementation variation and local context within a cluster randomised community intervention trial. *J Epidemiol Community Health* 2004;58(9):788-93.
22. Linnan L, Bowling M, Childress J, Lindsay G, Blakey C, Pronk S, et al. Results of the 2004 National Worksite Health Promotion Survey. *Am J Public Health* 2008;98:1503-9.
23. Lassen A, Bruselius-Jensen M, Sommer HM, Thorsen A, Trolle E. Factors influencing participation rates and employees' attitudes toward promoting healthy eating at blue-collar worksites. *Health Educ Res* 2007;22(5):727-36.
24. Mays N, Pope C. Rigour and qualitative research. *BMJ* 1995;311(6997):109-12.
25. Pope C, Mays N. Reaching the parts other methods cannot reach: an introduction to qualitative methods in health and health services research. *BMJ* 1995;311(6996):42-5.

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Chapter 7

Effectiveness of an intervention at construction worksites on work engagement, social support, physical workload, and need for recovery: results from a cluster randomized controlled trial

Karen M. Oude Hengel, Birgitte M. Blatter, Catelijne I. Joling, Allard J. van der Beek, Paulien M. Bongers

BMC Public Health. 2012 doi:10.1186/1471-2458-12-1008

Abstract

Background: To prolong sustainable healthy working lives of construction workers, a worksite prevention programme was developed which aimed to improve the health and work ability of construction workers. The aim of the current study was to investigate the effectiveness of this programme on social support at work, work engagement, physical workload and need for recovery.
Methods: Fifteen departments from six construction companies participated in this cluster randomised controlled trial; 8 departments (n=171 workers) were randomised to an intervention group and 7 departments (n=122 workers) to a control group. The intervention consisted of two individual training sessions of a physical therapist to lower the physical workload, a Rest-Break tool to improve the balance between work and recovery, and two empowerment training sessions to increase the influence of the construction workers at the worksite. Data on work engagement, social support at work, physical workload, and need for recovery were collected at baseline, and at three, six and 12 months after the start of the intervention using questionnaires.
Results: No differences between the intervention and control group were found for work engagement, social support at work, and need for recovery. At 6 months follow-up, the control group reported a small but statistically significant reduction of physical workload.
Conclusion: The intervention neither improved social support nor work engagement, nor was it effective in reducing the physical workload and need for recovery among construction workers.

Background

As in many industrialised countries[1], the Dutch construction industry faces the challenges of a decreasing working population. This development can be explained by the fact that less young workers are entering the construction industry and, at the same time, the baby boom cohort moves towards the retirement age.[2,3] To encounter the expected shortages of workers, construction workers need to work longer and retire later than in previous years.

Policies and intervention programmes are needed in order to support sustainable employability of construction workers. To develop such interventions, insight in the factors influencing the sustainable employability of construction workers is of interest. Previous studies showed that a poor physical health is an important contributor among blue-collar workers to a diminished ability to continue working until the retirement age[4], and to an earlier retirement[5,6]. Also, among construction workers, mental health was associated with a lower ability to continue working.[4] In addition to health, physically heavy work influences whether workers retire or not. A recent study added that psychosocial factors, such as supervisor support and job autonomy play a significant role in the ability and willingness to continue working as well.[4]

Until now, no studies were found on interventions that explicitly aimed to support the sustainable employability among construction workers. Therefore, an intervention programme for construction workers was developed using the intervention mapping approach[7], and taking the multi-factorial concept of sustainable employability into account.[8] The prevention programme consisted of two individual training sessions of a physical therapist aimed at lowering physical workload, an instrument to raise awareness of the importance of taking rest breaks to reduce fatigue (i.e., Rest-Break tool), and two empowerment training sessions to increase the influence of the construction workers at the worksite.[9,10]

In a recent publication, the process of this worksite prevention programme was evaluated.[11] The study yielded that the physical therapists and empowerment trainer largely provided the training sessions as intended, but that the Rest-Break tool was poorly implemented. Moreover, the workers and supervisors were moderately satisfied with the programme. In addition, the study showed that contextual factors, such as engagement of the top-management, the economic recession, and company size, played an important role during the implementation.[11] Since the effectiveness still has to be established, the aim of the present study was to investigate the effectiveness of the worksite prevention programme compared to usual care on social support at work, work engagement, physical workload and need for recovery. In addition, the present study aims to take into account the influence of the process variables and contextual factors on the effectiveness of the intervention.

Methods

Study design and study population

The study was a cluster randomised controlled trial (RCT) conducted at the departments of six construction companies, which were specialized in house, commercial or industrial building. Construction workers of these six companies were allowed to participate in the study. Inclusion criteria at baseline were: (i) construction workers were able to complete questionnaires written in the Dutch language, and (ii) construction workers had signed a written informed consent. The study protocol was approved by The Medical Ethics Committee of the VU University Medical Centre (Amsterdam, The Netherlands). More details on the study design and methods have been described elsewhere.[10]

Intervention

The intervention was developed using the Intervention Mapping approach, meaning that theoretical information from literature was combined with practical information from stakeholders (employers, supervisors, workers, health professionals, and providers).[7,9] By applying the Intervention Mapping approach, the intervention is not only tailored to the construction workers but also to the abilities and opportunities of the implementers.

Following from this, a prevention programme was developed which consisted of a physical and a mental component. Regarding the physical component, the workers received two individual training sessions of a physical therapist and a Rest-Break tool. During the first training session of the physical therapist, a quick scan questionnaire was followed by a 15-minute observation at the workplace. Based on this, three recommendations on how to reduce the physical workload were written down on a pocket-size card. These recommendations were, for instance, focused on improvements in working style, work methods and rest breaks. Four months later, at the second training session, the experiences so far were discussed and the impact of the advice was evaluated. The second part of the physical component was the introduction of the Rest-Break tool that was constructed by the researchers. This tool aimed to raise awareness about the importance of reducing fatigue by taking flexible rest breaks, and to stimulate to actually take rest breaks. The Rest-Break tool is a flowchart and consists of four steps: (i) the expectations of the workers about their fatigue at the end of the working day, (ii) short-term advice to take mini rest breaks or an additional break of ten minutes, (iii) selection of possible causes of fatigue, and (iv) long-term advice about structurally lowering fatigue. The workers were asked to fill in the tool weekly, alone or with colleagues, and to discuss the results with their supervisor.

As to the mental component, workers received two interactive empowerment training sessions to improve their influence at the worksite. Influence at the worksite could be improved by (i) taking responsibility for their own behaviour and health, (ii) discussing with colleagues about this responsibility, and (iii) improving the communication with the supervisor. The first training session consisted of five steps. During these steps, the workers created a list of topics they wanted to change during the intervention period, and they signed an action plan. Four months later, at the second empowerment training session, the empowerment trainer and workers discussed, evaluated, and reconsidered the action plan as well as the results that were achieved. More details on the development and content of the intervention have been described elsewhere.[9]

Workers allocated to the intervention departments received the worksite prevention programme lasting six months, whereas those allocated to the control group received no intervention.

Randomisation, blinding and sample size

Cluster randomisation took place at the level of the department within each company, using a computer-generated random-sequence table. In order to avoid intervention group contamination, to accommodate the worksite intervention, and to enhance participants' compliance, cluster randomisation was considered the best randomisation strategy for this study. The randomisation procedure was performed by a research assistant, who had no prior information about the departments. Obviously, as the intervention took place at the worksite, it was impossible to blind the researchers, the construction workers, their supervisors and the trainers to the allocation. The sample size of workers was calculated according to the number of cases needed to identify an effect on health status which was measured by the SF-12. Health status is one of the other outcome measures of the trial, and will be published in a separate paper. As the SF-12 has rarely been used in intervention studies among the general population, the sample size calculation was based on the SF-36.[12] Based on means and standard deviations of the SF-36 from earlier studies among different groups of workers, we calculated the sample size needed to detect relevant changes in health, reflecting either "somewhat better (or worse)" or "much better (or worse)" health.[12,13] Because of the cluster randomisation design, a certain loss of efficiency associated with cluster randomisation relative to individual randomisation was taken into account.[14] An effect size of 0.40 was considered to be the lower boundary of a 'medium' effect size.[15] This effect size can be detected with a power (1-β) of 0.80 and a two-tailed alpha of 0.05 with two groups of 100. Taking a loss to follow-up of about 10% into account, 220 workers were required at baseline.

Outcome measures

For practical reasons, the baseline measurement took place after randomisation. Responders on the baseline questionnaire received follow-up questionnaires after three, six and 12 months. The present study investigated the effectiveness of social support at work, work engagement, physical workload, and need for recovery.

Social support at work

Social support at work was measured using the Dutch version of the Job Content Questionnaire.[16,17] Co-worker support and supervisory support were measured separately with four items, each on a 4-point rating scale (1=totally disagree; 4=totally agree). These scales have shown moderate to good reliability (Cronbach's alpha between 0.75 and 0.84).[16,17] A total score of social support at work was obtained by adding the scores of co-worker support to those of supervisory support.

Work engagement

Work engagement was measured using a modified version of the Utrecht Work Engagement Scale (UWES-9), which enquires how often the respondents currently experience positive emotions at work.[18] The items were divided into the subscales vigour, dedication, and absorption. In the present study, the items were measured on a 6-point scale ranging from 1 (never) to 6 (always). A total score was obtained by averaging the individual item scores. The psychometric qualities of the UWES-9 have been proven to be acceptable.[19]

Physical workload

Questions about physical workload were measured using three questions (using force, working in awkward postures and repetitive movements) on a 5-point scale ranging from 1 (never) to 5 (always). These questions were derived from the Periodical Health Screenings survey in the construction industry. This survey is widely used and common among Dutch construction workers, most of whom regularly participate in the Periodical Health Screening. A total score of physical workload was calculated by averaging the three items.

Need for recovery

Need for recovery was assessed using an 11-item dichotomized subscale (yes/no) of the VBBA (Dutch questionnaire on Experience and Assessment of Work), which has shown to be valid and reliable (Cronbach's alpha of 0.86).[20,21] This questionnaire assesses short-term health effects that reflect the worker's need for recovery at the end of a regular workday.[21] In the present study, the scale was highly skewed to the right, meaning that the majority of the workers reported no fatigue. However, no cut-off point for the scale existed to classify "cases" with high scores on the scale. Based on a previous study on need for recovery[22], the upper quartile of the score in the study was used to define a contrast between workers with considerable need for recovery from work (upper quartile) versus workers with a lower need for recovery from work (lowest three quartiles).

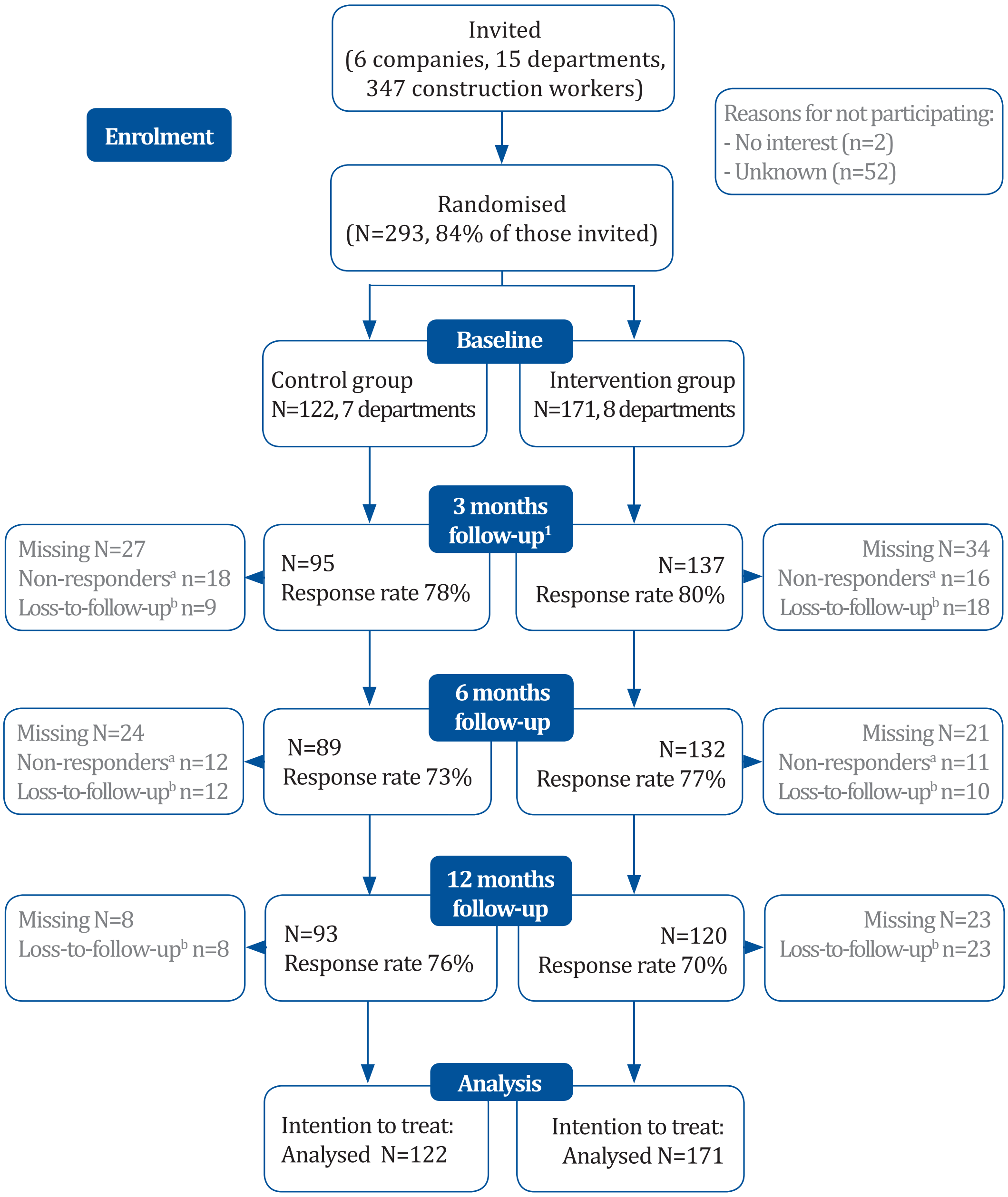
Statistical analyses

All analyses were performed according to the intention-to-treat principle. Baseline characteristics of the workers in the two groups were compared using the unpaired Student t-test and Pearson's chi-square test.

To evaluate the effects of the intervention, multilevel analyses were performed for all outcome variables. Four levels were identified: time (four measurements), worker (n=293), department (n=15), and company (n=6). Linear mixed models were used to evaluate the effects on work engagement, social support and physical workload, and logistic mixed models to evaluate the effects on need for recovery. For each outcome variable, two analyses were performed: 1) crude analysis (i.e. the differences between intervention and control group at three, six and 12 months follow-up, adjusted for corresponding baseline on outcome variable), and 2) adjusted analysis, encompassing the analysis as described above but adjusted for potential confounders. Potential confounders or effect modifiers were measured at baseline (i.e., age, and educational level). Confounding was considered if >10% change occurred in the regression coefficient. Effect modification was considered for age, and educational level measured at baseline, using a p-value <0.1 of the interaction term to indicate effect modification. For all analyses the intervention effect of interest was the interaction between group and measurement time. P-values <0.05 were considered to be statistically significant.

To investigate to what extent the implementation influenced the intervention effect, effect modification was also considered on four factors described in the process evaluation. These factors were company size (medium, large), engagement of the top-management towards the programme (low, medium, high), year of implementing the programme (2008, 2009), and economic recession (company with discharged workers, companies without discharged workers). Furthermore, per-protocol analyses were performed for the number of training sessions that were followed in the intervention group. The linear and logistic regression models were stratified by the number of training sessions followed. The number of training sessions was categorized into three groups; i.e., workers followed none of the training sessions, workers followed one or two training sessions, and workers followed three or four training sessions.

All multilevel statistical analyses were performed using MLwiN version 2.02. All non-multilevel statistical analyses were performed using the Statistical Package of Social Sciences version 17.0 (SPSS Inc, Chicago, IL).



[1] Workers who were loss-to-follow-up due to non-responding were included again in the following measurements. To illustrate; at three months follow-up, 27 workers did not respond to the questionnaires of whom 18 of them were non-responders. At 6 months questionnaire, 103 (95 +18 workers) workers were approached, and 89 workers responded to this questionnaire.
[a] Non-responders was defined as workers that did not complete a particular follow-up measurement
[b] Loss-to-follow up was defined as workers that ended participation in follow-up measurements (i.e., drop outs)

Figure 1. Flow diagram of the participants through the phases of the trial

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Table 1. Baseline characteristics

	Control group		Intervention group	
	n=122		n=171	
Individual characteristics				
Age (yr) [mean (SD)]	44.3	(12.7)	41.8	(12.7)
Gender (male) [n (%)]	120	(98%)	171	(100%)
Education [n (%)]*				
Lower education	103	(84%)*	127	(74%)*
Intermediate/higher education	18	(15%)*	44	(26%)*
Missing	1		1	
Profession				
Bricklayer	16	(13%)	39	(23%)
Carpenter	92	(75%)	116	(68%)
Other	14	(12%)	16	(9%)
Outcomes [mean (SD)]				
Work engagement (range 1-6) ¥	4.3	(0.8)	4.3	(0.8)
Vigour (range 1-6)	4.3	(0.8)	4.4	(0.8)
Absorption (range 1-6)	4.1	(1.0)	4.0	(1.0)
Dedication (range 1-6)	4.6	(0.9)	4.6	(0.9)
Overall social support (range 8-32) ¥	24.0	(3.4)	24.3	(2.5)
Co-worker support (range 4-16)	12.2	(1.7)	12.4	(1.4)
Supervisor support (range 4-16)	11.8	(2.0)	12.0	(1.7)
Physical workload (range 1-5) ¥	2.6	(0.8)	2.6	(0.8)
Elevated need for recovery [n (%)]	29	(24%)	44	(26%)

Abbreviations: yr, years; SD, standard deviation; n, number; * p=0.02; ¥ Higher score means a higher level of work engagement (including vigour, absorption and dedication), social support (including co-worker and supervisor support), and physical workload.

Results

Participants

Figure 1 outlines the complete flow of the participants from the six companies. Those companies were recruited between March 2008 and December 2009. When a company agreed to participate in the program, construction workers of the company were approached to participate at the worksites, and they received the baseline questionnaire. In total, the baseline questionnaire was distributed to 347 construction workers, of whom 84% (n=293) responded. The randomisation procedure allocated 8 departments to the intervention group (n=171) and 7 departments to the control group (n=122). All construction workers were approached for follow-up measurements.

Table 1 presents the baseline characteristics of construction workers in the intervention and control group. No significant differences regarding age, gender, profession, and the outcome measures were found between the two groups. However, construction workers in the intervention group were higher educated compared to the construction workers in the control group. After 12 months, the loss-to-follow-up was 24% in the control group and 30% in the intervention group. The main reasons for loss-to-follow-up were that construction workers were on sick leave during the measurements, the contract of construction workers was (un)voluntary ended, and workers were discharged from the company due to the economic crisis. In addition, non-completers were higher educated than completers.

Intervention effects

The means for social support at work, work engagement, physical workload, and need for recovery in the intervention and control group at baseline, and at three, six and 12 months follow-up are shown in table 2 and table 3. Additionally, the overall effect of the intervention, and the effect at three, six, and 12 months are presented.

No significant intervention effects were found for work engagement and the accompanying subscales (i.e. vigour, dedication, and absorption) at three, six and 12 months. Moreover, the intervention did not result in significant effects on social support at work, neither on social support from colleagues nor on social support from the supervisor. Regarding physical workload, a significant intervention effect was found at 6 months follow-up (β 0.18, 95% CI 0.01; 0.34). This effect indicates that construction workers in the intervention group experienced a slightly higher physical workload at 6 months follow-up compared to the construction workers in the control group. Additionally, no overall effect or an effect at any of the time measurements was found for need for recovery. No significant interactions were found for work-related outcomes with age or educational level, indicating that effect modification did not occur.

Table 2. Intervention effects on social support at work, work engagement, and physical workload between the intervention and control group after three, six and 12 months of follow-up

	Control group		Intervention group			
	mean	(SD)	mean	(SD)	β	(95% CI)‡
Social support at work[1]						
Overall social support (range 8-32)						
Baseline	24.0	(3.4)	24.3	(2.5)		
3-months	24.2	(3.1)	24.2	(2.5)	0.02	(-0.61 0.65)
6-months	24.2	(3.2)	25.5	(2.5)	0.25	(-0.40 0.90)
12-months	24.0	(2.9)	23.9	(2.5)	-0.20	(-0.56 0.45)
overall effect					0.03	(-0.39 0.46)
Co-worker support (range 4-16)						
Baseline	12.2	(1.7)	12.4	(1.4)		
3-months	12.3	(1.5)	12.3	(1.2)	-0.02	(-0.33 0.30)
6-months	12.3	(1.6)	12.3	(1.4)	0.03	(-0.29 0.35)
12-months	12.2	(1.4)	12.2	(1.3)	-0.02	(-0.35 0.30)
overall effect					0.00	(-0.21 0.20)
Supervisor support (range 4-16)						
Baseline	11.8	(2.0)	12.0	(1.7)		
3-months	11.9	(1.9)	11.9	(1.6)	0.07	(-0.34 0.48)
6-months	11.8	(2.0)	12.1	(1.7)	0.27	(-0.15 0.69)
12-months	11.7	(1.8)	11.7	(1.7)	-0.09	(-0.51 0.33)
overall effect					0.09	(-0.18 0.36)
Work Engagement[1]						
Work engagement (range 1-6)						
Baseline	4.3	(0.8)	4.3	(0.8)		
3-months	4.4	(0.8)	4.2	(0.7)	-0.06	(-0.22 0.11)
6-months	4.2	(0.9)	4.3	(0.8)	0.02	(-0.15 0.19)
12-months	4.2	(0.9)	4.3	(0.8)	0.10	(-0.07 0.27)
overall effect					0.02	(-0.12 0.15)
Subscale vigour (range 1-6)						
Baseline	4.3	(0.8)	4.4	(0.8)		
3-months	4.4	(0.8)	4.3	(0.7)	-0.04	(-0.21 0.13)
6-months	4.2	(0.8)	4.3	(0.8)	0.06	(-0.12 0.24)
12-months	4.3	(0.9)	4.4	(0.8)	0.04	(-0.14 0.22)
overall effect					0.02	(-0.19 0.15)
Subscale absorption (range 1-6)						
Baseline	4.1	(1.0)	4.0	(1.0)		
3-months	4.1	(1.0)	3.8	(1.0)	-0.18	(-0.38 0.02)
6-months	4.1	(1.1)	4.0	(1.0)	-0.07	(-2.00 0.52)
12-months	3.9	(1.1)	4.0	(1.0)	-0.01	(-0.22 0.19)
overall effect					-0.09	(-1.64 1.46)
Subscale dedication (range 1-6)						
Baseline	4.6	(0.9)	4.6	(0.9)		
3-months	4.6	(0.9)	4.5	(0.8)	-0.01	(-0.32 0.04)
6-months	4.5	(1.0)	4.5	(0.9)	0.02	(-0.15 0.19)
12-months	4.3	(1.0)	4.5	(0.9)	0.22	(-1.67 2.10)
overall effect					0.07	(-0.08 0.22)

Table 2. Intervention effects on social support at work, work engagement, and physical workload between the intervention and control group after three, six and 12 months of follow-up *(continued)*

	Control group		Intervention group			
	mean	(SD)	mean	(SD)	β	(95% CI)‡
Physical workload[1]						
Baseline	2.6	(0.8)	2.6	(0.8)		
3-months	2.7	(0.8)	2.8	(0.8)	0.09	(-0.08 0.24)
6-months	2.5	(0.7)	2.7	(0.9)	0.18	(0.01 0.34)*
12-months	2.5	(0.8)	2.6	(0.8)	0.04	(-0.13 0.21)
overall effect					0.10	(-0.02 0.21)

‡ Adjusted model corrected for age and education; [1] a positive βèta (β) means a higher work engagement (including vigour, absorption and dedication), higher social support (including co-worker and supervisor support), and higher physical workload in the intervention group compared to the control group.* p<0.05

Implementation of the intervention

The effect sizes were not influenced by the number of followed training session of the workers in the intervention group. Moreover, the effectiveness of the intervention on the outcomes did generally not differ between medium and large companies, between companies with a low, medium, and high engagement of the top-management towards the programme, between companies with and without discharged workers, and between companies that started the intervention in 2008 compared to those that started the intervention on 2009.

Table 3. Intervention effects on need for recovery between the intervention and control group after three, six and 12 months of follow-up

	Control group	Intervention group		
	%	%	OR	(95% CI) ‡
Elevated need for recovery[1]				
Baseline	24 %	26 %		
3-months	26 %	31 %	1.50	(0.66 3.41)
6-months	25 %	26 %	1.15	(0.48 2.79)
12-months	27 %	26 %	0.88	(0.37 2.11)
overall effect			1.17	(0.66 2.07)

‡ Adjusted model corrected for age and education; [1] An odds ratio (OR) above 1 indicates that workers in the intervention group had on average a higher need for recovery compared to the control group.

Discussion

The present study showed that the prevention programme among construction workers was not effective in improving social support at work and work engagement, nor in reducing physical workload and need for recovery. At 6 months follow-up, the control group reported a small but statistically significant reduction of physical workload.

This study is the first prospective controlled trial aimed to support sustainable employability in the construction industry by means of an intervention consisting of a physical component and mental component. A balance between good health and work was suggested as important to support sustainable employability during the development of the programme[9], as well as by previous studies[4-6]. Until now, most health promotion programmes in the construction industry have focused on either improving the health of construction workers by means of a lifestyle programme[23,24], or on decreasing the work demands by means of ergonomic measures[25].

Both the intervention and control group did not show any significant differences for social support at work and work engagement. Despite the fact that psychosocial factors have been recognised as factors associated with musculoskeletal symptoms[26,27] and short-term sickness absence[27], intervention studies among blue-collar workers did not focus on the psychosocial aspects of work yet. Regarding physical workload, the present study showed no overall intervention effect. However, the intervention group reported a significant higher physical workload at 6 months follow-up. It should be noticed that this adverse effect in absolute numbers was very small. A previous review recommended that an education programme or involvement of workers combined with ergonomic measures might be more promising to reduce workload.[28] Also, no intervention effect was found on decreasing the elevated need for recovery among the construction workers.

Strengths of the study include the cluster RCT design, and the high participation rate among the workers. Although participation of blue-collar workers in intervention studies is usually low[29], 84% of the construction workers approached in the present study was willing to participate in the intervention. These strengths improve the generalizability of the study findings towards workers in the construction industry. Randomisation at department level is another strength that minimised possible contamination between the construction workers from the intervention group and control group. Avoiding contamination is especially important in this industry where workers are working at worksites that are temporary and mobile.

Some methodological considerations deserve attention as well. First, the study design was two-armed (control versus intervention), which does not allow a separate evaluation of the individual components of the prevention programme. As a consequence, the (in-)effectiveness of the programme can only be attributed to the entire programme. Second, the sample size calculation was based on a change in health status. The sample size might therefore be too small to detect a significant change in outcomes measures. To illustrate, another study calculated that almost 250 workers were needed in each group to find an effect on work engagement.[30] However, while providing sufficient statistical power would have diminished the confidence intervals, these smaller confidence intervals would still not have led to statistically significant intervention effects as the mean scores between the intervention and control group are quite similar for most outcomes (Table 2 and Table 3). Third, data were obtained solely from questionnaires. As a result, all data were self-reported, inducing a potential risk of bias due to socially desirable answers. Fourth, participation in the programme was voluntary, and bias due to non-response could therefore not be ruled out in intervention studies. However, the participation of workers was very high (84%), indicating that selection bias due to non-response was minimal in the current study. Fifth, the loss-to-follow-up was higher than expected due to the economic crisis and health-related absenteeism of the workers. As a consequence of the economic recession, one company was forced to lay-off workers, and to offer the remaining workers a temporary part-time job during the intervention programme. Participants who were lost-to-follow up were higher educated. However, as no other differences between completers and non-completers were found, we assume the bias due to selective loss-to-follow-up was limited.

Based on the results obtained from the present RCT, it can be concluded that no intervention effects on any of the outcomes were found. Possible reasons for ineffectiveness can be distinguished into programme failure and theory failure.[31] Programme failure indicates that a poorly implemented intervention resulted in no improvement on the study outcomes. Theory failure implicates that an intervention has been perfectly implemented, but did not lead to improvement on the study outcomes. Both types of failure have taken place in the present study.

Some clear signs of programme failure were detected in the intervention. First, the effectiveness might be dimmed by the moderate compliance. Although the training sessions were incorporated into the existing health and safety programme of the Dutch construction industry, 39% of the construction workers followed less than three training sessions. In addition, construction workers who followed the training sessions of the physical therapist were satisfied about the personal contact and individual advices. However, their opinion about the training sessions of the empowerment trainer varied. This might be explained by the fact that the empowerment training sessions aimed to change work on an organization level, which was new for both supervisors and workers. The moderate compliance and lower satisfaction towards the training session of the empowerment trainer might have dimmed the effectiveness of the intervention. However, the per-protocol analyses on the number of training sessions showed no differences between workers with low or high compliance. Additionally, the Rest Break Tool was filled in by less than half of the construction workers.[11] Therefore, it is plausible that outcomes closely related to the Rest-Break tool such as need for recovery showed no differences between the intervention and control group. Second, the intervention could be less effective because the rationale behind the intervention was not perfectly implemented by the trainers.[11] For instance, the physical therapist did not deliver all training sessions individually, and the empowerment trainer did not always involve the supervisor in the training sessions. Third, the intervention could be less effective due to the economic climate. During the worldwide crisis, companies and their workers might feel obliged to only focus on activities that are obviously and directly contributing to the productivity at the worksites, and not on prevention programmes. Moreover, construction workers may not have entirely committed themselves to the prevention programme if they face the fear of losing their jobs at the same time.[32]

Although the lack of effect can be caused by programme failure, the question arises whether the intervention would be effective if the compliance was optimal, and all trainers delivered the training as intended. Because no improvements on the outcomes were detected at all, it is plausible that the rationale behind the intervention is not entirely correct. First, construction workers showed low interest in the application of this tool as they experienced difficulties filling in their weekly status of fatigue, and they mentioned that the advice was not always feasible in daily practices. As frequency and duration of rest breaks are recorded in policies at worksite or company level, involvement of supervisors and middle-management is essential to take additional rest breaks, and consequently reduce fatigue. Second, the construction workers in the present study mentioned that involvement of the supervisors and management could be valuable in the empowerment training sessions as well.[11] In addition to the rest breaks, achieving a change in topics such as more communication at the worksite, and asking for assistance lies not only within the power of the workers, but relies also on the decision of supervisor and middle-management (e.g., organizational level). Therefore, a more shared responsibility between construction workers, supervisors and middle-management is needed to integrate social support, work engagement and rest breaks more deeply in the work culture of the companies. Although the supervisors were invited to attend the empowerment training sessions, they were mostly not attending these meetings. In addition to the involvement of supervisors and middle-management, a change in topics as described in the empowerment sessions was also difficult to achieve at the worksite because of the economic recession. For instance, workers might have been hindered to take additional rest breaks at a time when job security was threatened by the economic recession, whereas supervisors might have been less willing to accept the additional rest breaks during these times.

In conclusion, the prevention programme was not effective with regard to work engagement, social support at work, physical jobs demands, and need for recovery. Moreover, the effectiveness of the intervention was not influenced by number of training sessions followed, company size, economic recession, engagement of the top-management towards the programme, and intervention year.

References

1. Eurostat. Europe in Figures; Eurostat yearbook 2011, chapter 5 labour market. Lyxembourg: Eurostat European Commission; 2011.
2. Beereboom HJA, Blomsma G, Corten IW, Muchall S. De bouwarbeidsmarkt in de periode 2005–2010 [The labour market of the construction industry in the period 2005–2010]. Amsterdam; 2005.
3. Sijpersma R. De oudere werknemer in de bouw. [The older worker in the construction industry]. Amsterdam; 2003.
4. Oude Hengel KM, Blatter BM, Geuskens GA, Koppes LLJ, Bongers PM. Factors associated with the ability and willingness to continue working until the age of 65 in construction workers*. Int Arch Occup Environ Health* 2012; 85(7):783-90.
5. Szubert Z, Sobala W. Current determinants of early retirement among blue collar workers in Poland*. Int J Occup Med Environ Health* 2005;18(2):177-84.
6. Lund T, Iversen L, Poulsen KB. Work environment factors, health, lifestyle and marital status as predictors of job change and early retirement in physically heavy occupations*. Am J Ind Med* 2001;40(2):161-9.
7. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach. San Francisco: Jossey-Bass; 2006.
8. Shacklock K, Brunetto Y. A model of older workers' intentions to continue working. *Personnel Review* 2011;40(2):252-74.
9. Oude Hengel KM, Joling CI, Proper KI, Van der Molen HF, Bongers PM. Using intervention mapping to develop a worksite prevention program for construction workers*. Am J Health Promot* 2010;26:e1-e10.
10. Oude Hengel KM, Joling CI, Proper KI, Blatter BM, Bongers PM. A worksite prevention program for construction workers: design of a randomized controlled trial*. BMC Public Health* 2010;(10):doi: 10.1186/1471,2458-10-336.
11. Oude Hengel KM, Blatter BM, Van der Molen HF, Joling CI, Proper KI, Bongers PM, et al. Meeting the challenges of implementing an intervention to promote work ability and health-related quality of life at construction worksites: a process evaluation*. J Occup Environ Med* 2011;53(12):1483-91.
12. Aaronson NK, Muller M, Cohen PD, Essink-Bot ML, Fekkes M, Sanderman R, et al. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations*. J Clin Epidemiol* 1998;51(11):1055-68.
13. Beaton DE, Hogg-Johnson S, Bombardier C. Evaluating changes in health status: reliability and responsiveness of five generic health status measures in workers with musculoskeletal disorders*. J Clin Epidemiol* 1997;50(1):79-93.
14. Simpson JM, Klar N, Donnor A. Accounting for cluster randomization: a review of primary prevention trials, 1990 through 1993. *Am J Public Health* 1995; 85(10):1378–1383.
15. Cohen J: Statistical Power Analysis for the Behavioral Sciences. New York: Lawrence Erlbaum Associates; 1988.
16. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics*. J Occup Health Psychol* 1998;3(4):322-55.
17. Karasek RA. Job content questionnaire and user's guide. Lowell: University of Massachusetts Lowell, Department of Work Environment; 1985.
18. Schaufeli WB, Bakker AB, Salanova M. The Measurement of Work Engagement With a Short Questionnaire: A Cross-National study*. Educational and Psychological Measurement* 2006;66(4):701-16.
19. Schaufeli W, Bakker A. Utrecht Work Engagement Scale. Utrecht: Occupational Health Psychology Unit; 2003.
20. Van Veldhoven M, Broersen S. Measurement quality and validity of the "need for recovery scale"*. Occup Environ Med* 2003;60:i3-9: doi:10.1136/oem.60.suppl_1.i3.
21. Van Veldhoven M, Meijman TF, Broersen JPJ, Fortuin RJ. Handleiding VBBA [User's guide VBBA]. Amsterdam: SKB Vragenlijst Services; 2002.

22. Van Amelsvoort LG, Jansen NW, Swaen GM, Van den Brandt PA, Kant I. Direction of shift rotation among three-shift workers in relation to psychological health and work-family conflict. *Scand J Work Environ Health* 2004;30(2):149-56.
23. Groeneveld IF, Proper KI, Van der Beek AJ, Van Mechelen W. Sustained body weight reduction by an individual-based lifestyle intervention for workers in the construction industry at risk for cardiovascular disease: results of a randomized controlled trial. *Prev Med* 2010;51(3-4):240-6.
24. Ludewig PM, Borstad JD. Effects of a home exercise programme on shoulder pain and functional status in construction workers. *Occup Environ Med* 2003;60(11):841-9.
25. Luijsterburg PA, Bongers PM, de Vroome EM. A new bricklayers' method for use in the construction industry. *Scand J Work Environ Health* 2005;31(5):394-400.
26. IJzelenberg W, Molenaar D, Burdorf A. Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence. *Scand J Work Environ Health* 2004;30(1):56-63.
27. Morken T, Riise T, Moen B, Hauge SH, Holien S, Langedrag A, et al. Low back pain and widespread pain predict sickness absence among industrial workers. *BMC Musculoskelet Disord* 2003;4:21: doi:10.1186/1471-2474-4-21.
28. Van der Molen HF, Sluiter JK, Hulshof CT, Vink P, Frings-Dresen MH. Effectiveness of measures and implementation strategies in reducing physical work demands due to manual handling at work. *Scand J Work Environ Health* 2005;31(Suppl 2):75-87.
29. Glasgow RE, McCaul KD, Fisher KJ. Participation in worksite health promotion: a critique of the literature and recommendations for future practice. *Health Educ Q* 1993;20(3):391-408.
30. Van Berkel J, Proper KI, Boot CR, Bongers PM, Van der Beek AJ. Mindful "Vitality in Practice": an intervention to improve the work engagement and energy balance among workers; the development and design of the randomised controlled trial. *BMC Public Health* 2011;11:doi: 10.1186/1471-2458-11-736.
31. Kristensen TS. Intervention studies in occupational epidemiology. *Occup Environ Med* 2005;62(3):205-10.
32. Hodgins M, Battel-Kirk B, Asgeirsdottir AG. Building capacity in workplace health promotion: the case of the Healthy Together e-learning project. *Glob Health Promot* 2010;17(1):60-8.

Chapter 8

The effectiveness of a prevention programme at construction worksites on work ability, health and sick leave: results from a cluster randomised controlled trial

Karen M. Oude Hengel, Birgitte M. Blatter, Henk F. van der Molen,
Paulien M. Bongers, Allard J. van der Beek

Under Review

Abstract

Objective: To investigate the effectiveness of a prevention programme at construction worksites on work ability, health and sick leave.

Methods: A total of 15 departments (n=297 workers) from six construction companies participated in this cluster randomized controlled trial, and were randomly allocated to the intervention group (eight departments; n=171 workers) or control group (seven departments; n=122 workers). The intervention consisted of two individual training sessions with a physical therapist to lower the physical workload, a Rest-Break tool to improve the balance between work and recovery, and two empowerment training sessions to increase influence at the worksite. Data on work ability, physical and mental health status, and musculoskeletal symptoms were collected at baseline, and at three, six and 12 months follow-up. Sick leave data were obtained from the companies.

Results: Overall, no differences in work ability (β 0.02, 95% confidence interval (CI) -0.34;0.37) and physical and mental health status (β -0.04, 95% CI -1.43;1.35 and β 0.80 95% CI -1.43;1.35, respectively) were found between the intervention and control group. The intervention showed an overall decline in musculoskeletal symptoms (ranging from odds ratio [OR] 0.68, 95% CI 0.34;1.33 to OR 0.86, 95% CI 0.47;1.57) and long-term sick leave (OR 0.44, 95% CI -0.34;0.37) among construction workers. Both reductions were not statistically significant.

Conclusion: The prevention programme seems to result in a beneficial but not statistically significant decline in the prevalence of musculoskeletal symptoms and long-term sick leave among construction workers, but showed no effects with regard to work ability, physical health and mental health.

Introduction

In the next decades, a shortage of workers is expected in the Dutch construction industry due to a delay of young workers entering the labour force.[1] In addition, many workers are expected to leave the labour force before their official retirement age.[2] The age of retirement among Dutch construction workers has been strongly influenced by collective agreements, which offer the opportunity of retiring at the age of 62, instead of the official retirement age of 65. In order to face the challenges of the expected shortages, it is considered necessary that construction workers extend their working life until their official retirement age. However, due to their physical workload, construction workers run an increased risk for sick leave[3] and disability pension[4]. Thus, retaining the labour force in the construction industry is not only a matter of rising the retirement age in the collective agreements, but also a matter of improving the ability and intention of workers to remain in the labour force. [5]

To support sustainable employability of construction workers, policies and intervention programmes focusing on work ability and health seem useful. Focusing on these factors could be beneficial as they are major contributors of sustainable employability. Previous studies showed that blue collar workers with a poor work ability were at an increased risk for early retirement[6], and poor work ability predicted long-term sick leave[3,4,6] and disability pensions[4,7]. Regarding health, a poor physical and mental health status were associated with a diminished ability to continue working until the age of 65[8], whereas studies also found an association between physical health and early retirement[9] and disability pensions[9,10].

To date, only one study for construction workers at risk for early retirement and disability pensions was found that aimed to improve work ability.[11] This six-month counselling and education programme showed no significant differences on work ability or disability pensions. The authors hypothesized that a more comprehensive intervention starting at an earlier stage in the working lives of construction workers could potentially be more effective.

Therefore, a comprehensive prevention programme was developed using the Intervention Mapping approach, meaning that theoretical information from the literature was combined with practical information from stakeholders.[12,13]

Following from this, a prevention programme was developed consisting of three components in order to improve the health and work ability of the construction workers. First, construction workers run an increased risk for musculoskeletal symptoms[14,15], lower work ability[16] and sick leave[3] because of the high physical job demands such as awkward postures and repetitive movements placed on them[17]. In order to lower physical work demands, and to prevent musculoskeletal symptoms and work ability, the first intervention component consisted of two individual visits of the physical therapist at the worksite. Second, as a consequence of the high physical work demands, older construction workers experienced more fatigue and a higher need for recovery after work.[18]. Therefore, the second intervention component, a Rest-Break tool, was introduced to improve the balance between the physical workload and need for recovery during and after work. Third, literature and focus groups showed that more job control, job satisfaction and social support from management at construction worksites might improve work ability[16] and reduce sick leave.[3] Two group empowerment training sessions were therefore organized as the third intervention component in order to achieve a cultural change at the worksites.

In a recent publication, the process of this worksite prevention programme was evaluated.[19] However, the effectiveness of the prevention programme still has to be established. Thus, the aim of the present study was to evaluate if this worksite prevention programme for construction workers could improve their work ability and health, and reduce sick leave.

Methods

Study design and population

The study was a cluster randomized controlled trial (RCT) at department level conducted at the departments of six construction companies, which were specialized in house, commercial or industrial building. All workers of these companies performing actual construction work were allowed to participate in the study. Inclusion criteria at baseline were: (i) construction workers were able to complete questionnaires written in the Dutch language, and (ii) construction workers had signed a written informed consent. No exclusion took place based on age or gender. The study protocol was approved by the Medical Ethics Committee of the VU University Medical Center (Amsterdam, The Netherlands). More details on the study design and methods have been described elsewhere.[13]

Randomisation, blinding and sample size

Cluster randomization took place at the department level within each company. In order to avoid intervention group contamination, to accommodate this worksite program, to obtain maximal cooperation of employers and employees, and to enhance participants' compliance, cluster randomization was considered the best randomization strategy for this study. Clusters were departments between 12 and 123 construction workers within each company in the Netherlands. In each company, the departments were randomly assigned to the worksite prevention programme or to the control group (i.e., no intervention). The randomization procedure was performed by a research assistant who had no prior information about the departments. Because the intervention took place at the worksite, the construction workers, their supervisors and the trainers could not be blinded to the allocation. The sample size was calculated based on the number of cases needed to identify an effect on health status. Because the outcome measure SF-12 has rarely been used in intervention studies among the general population, the SF-36 was used for the sample size calculation.[20,21] Previous studies presented effect sizes ranging from 0.58 to 0.96.[22] Because of the cluster randomization design, a certain loss of efficiency associated with cluster randomization relative to individual randomization was taken into account.[23] Therefore, an effect size of 0.40 was considered to be the lower boundary of a medium effect size.[24] This effect size can be detected with two groups of 100 (with a power of 80% and a two-tailed significance level of 5%). Taking a loss to follow-up of about 10% into account, 220 construction workers were needed at baseline.

Intervention

The intervention was developed according to the Intervention Mapping protocol[25], a six-step protocol that facilitates a stepwise process for theory- and evidence-based development of health promotion programmes.[12] The six-month prevention programme consisted of a physical component and a mental component.

The physical component comprised of two individual training sessions of approximately 30 minutes by a physical therapist and a Rest-Break tool. During the first physical therapist's training session at the worksite, a quick scan questionnaire was followed by a 15-minute observation at the workplace. Based on this, a maximum of three individual advices on how to reduce physical workload (e.g., improvements in work technique, work methods and/or rest breaks) were written down on a pocket-size card. During the second training session, which took place after four months, the physical therapist discussed the workers' experiences so far and evaluated the impact of the advice with the worker. Next, the Rest-Break tool was introduced by the physical therapist to raise awareness about the importance of reducing fatigue by taking flexible rest breaks, and to stimulate actually taking rest breaks in order to reduce fatigue. The Rest-Break tool is a flowchart and consists of four steps; (i) the expectations of the workers about their fatigue at the end of the working day; (ii) short-term advice to take mini rest breaks or an additional break of 10 minutes;, (iii) selection of the possible causes of fatigue; and (iv) long-term advice about structurally lowering fatigue. The workers were asked to fill in the tool on a weekly basis, alone or with colleagues, and to discuss the results with their supervisor.

For the mental component, the construction workers received two interactive empowerment training sessions of approximately one hour in the construction trailer at the worksite. The training sessions aimed to improve construction workers' influence at the worksite regarding; (i) taking responsibility for their own health;, (ii) discussing with colleagues the responsibility for their own behaviour (e.g., taking rest breaks, asking for assistance during physically demanding work tasks);, and (iii) improving communication with the supervisor. The first training session consisted of five steps, in which the workers created a list of topics they wanted to change during the intervention period. Finally, they signed an action plan. After four months, during a follow-up meeting, the empowerment trainer and workers discussed and reconsidered the action plan as well as the results that were achieved. More details on the development and content of the intervention have been described elsewhere.[13]

Outcome measures

The present study investigated the effectiveness of the intervention concerning work ability, health (i.e., mental and physical health status, and the occurrence of musculoskeletal symptoms), and sick leave. Other outcome measures that were assessed but not presented in this paper included the following short-term outcomes: work engagement, physical workload, need for recovery, and social support. The baseline measurement took place before randomization, and follow-up measurements were performed at three, six, and 12 months after baseline. Sick leave data were gathered from continuous registration systems of the companies after 12-month follow-up.

Work ability

Work ability was measured using the Work Ability Index (WAI), which originally consists of seven items.[26] Different studies have shown that the reliability and validity of WAI are acceptable to good.[27,28] Because subitems of the WAI could also be used as a simple indicator for assessing the status and progress of work ability[29,30], two of the seven items were assessed in the present study: current work ability (one question), and work ability in relation to physical and mental job demands (two questions). A total score of the WAI (range 2-20) was obtained by adding the weight scores of these individual items.[31]

Health

Health status was assessed using the Short-Form Health Survey (SF-12).[32,33] This measure provided two weighted scores assessing physical health status and mental health status.[34]. Different studies among general populations (respondents of 15 years and older) have shown that the reliability and validity of the SF-12 are adequate.[33,35] The mean physical and mental health status of the general population are 50, with a standard deviation of 10.[35] A higher score means a better physical or mental health. Musculoskeletal symptoms were measured using the Dutch Musculoskeletal Questionnaire (DMQ).[36,37] The workers were asked to rate the occurrence of pain or discomfort in the neck, shoulders, upper and lower back, elbows, wrists/hands, hips/thighs, knees and ankles/feet during the previous seven days using a four-point scale (never, sometimes, frequent, and prolonged). These regions were grouped into four larger body regions: back (upper and lower back), neck/shoulders, upper extremities (elbows and wrist/hands), and lower extremities (hips/thighs, knees and ankles/feet). For each of the body region, workers who answered 'frequent' or 'prolonged' on one or more of the questions were classified as having musculoskeletal symptoms, whereas the others were classified as having no musculoskeletal symptoms.

Sick leave

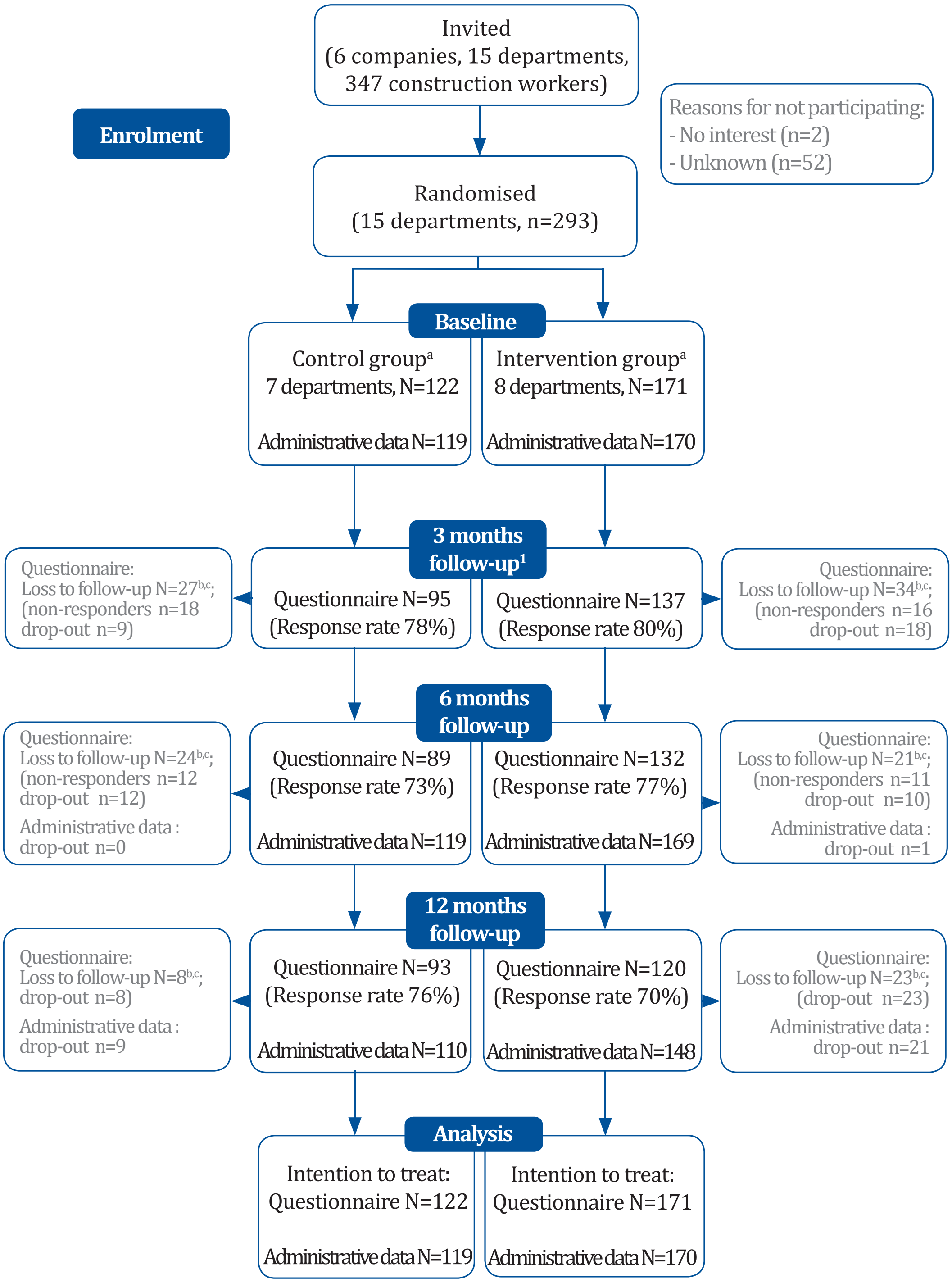
Sick leave data were obtained from databases of the six participating companies. For the analyses, sick leave data from three periods of six months were used: prior to the intervention, during the intervention, and after the intervention. Sick leave was defined as the total number of working days during the six month period of concern in which the workers were on sick leave. Because of the skewed distributions, sick leave was dichotomized into 6-month prevalence of no or short-term sick leave (0-5 days), and the 6-month prevalence of long-term sick leave (≥ 6 days).

Statistical analyses

All analyses were performed according to the intention-to-treat principle. Baseline differences between the intervention and control group were checked using the unpaired Student *t*-test (continuous variables) and Pearson's chi-square test (dichotomous variables).

To evaluate the effects of the intervention, multilevel analyses were performed for all outcome variables. Multilevel analyses were more suitable than standard regression analyses due to the dependency of observations (clustering of workers within departments, and repeated measurements within one worker) and unbalanced data (participants were not equally divided among departments).[38] Four levels were identified: time (four measurements), worker (n=293), department (n=15), and company (n=6). Linear mixed models were used to evaluate the effects on work ability, mental health and physical health, and logistic mixed models to evaluate the effects on musculoskeletal symptoms and sick leave. For each outcome variable, two analyses were performed. A crude analysis was performed to determine the differences between the intervention and control group at three, six and 12 months of follow-up, adjusted for the corresponding baseline outcome variable. Next, an adjusted analysis was performed encompassing the analysis as described earlier, but adjusted for potential confounders (i.e., age and educational level (i.e., primary school, lower and intermediate secondary education versus higher secondary education intermediate vocational and university)). Confounding was considered if > 10% change occurred in the regression coefficient. Effect modification was considered for age and educational level. A *p*-value <0.05 of the interaction term was used to indicate effect modification. For all analyses the intervention effect of interest was the interaction between group and measurement time. The measure of intervention effect was expressed by betas (β) and the 95% confidence interval for the linear regression analyses and odds ratios (OR) and the 95% confidence interval for the logistic regression analyses.

All nonmultilevel statistical analyses were performed using the Statistical Package of Social Sciences version 17.0 (SPSS Inc, Chicago, IL). The multilevel statistical analyses were performed using MLwiN version 2.24.



[a] Sick leave data were not available for four workers (3 in control group, and 1 in intervention group).
[b] Workers who were loss-to-follow- up due to non-responding were again included in the following measurements.
[c] Drop-out was defined as workers that ended participation in follow-up measurements.

Figure 1. Flow diagram of the participants through the phases of the trial

Results

Participants flow

After recruitment, 37 companies expressed an interest in the intervention programme. Finally, six companies actually participated in the program, and the departments within each company were randomized to either the intervention or control group. The randomization procedure allocated eight departments to the intervention group (n=171) and seven departments to the control group (n=122; Figure 1). All construction workers in the intervention group were working in departments which were specialized in house- and utility building. Three of these departments consisted largely of carpenters whereas the other departments consisted of carpenters, bricklayers, tilers and plasterers. Regarding the control group, one department was specialized in renovation and maintenance whereas the other departments focused on house- and utility building. In two departments, the majority of workers were carpenters, whereas the professions varied in the other departments.

The baseline questionnaire was distributed to 347 construction workers, of whom 293 (84%) responded. After 12 months, 29 workers of the control group (24%) and 51 workers of the intervention group (30%) were lost-to-follow-up. These subjects were significantly lower educated. The main reasons for loss-to-follow-up were that construction workers were on sick leave, the (un)voluntary ending of the contract, and workers were discharged due to the economic crisis.

Baseline characteristics

The baseline characteristics of construction workers in the intervention and control group are presented in table 1. No significant differences regarding age, gender, profession, work ability, physical health, and the occurrence of musculoskeletal symptoms were found between the two groups. However, construction workers in the intervention group were higher educated, and showed a slightly higher mental health status compared to the construction workers in the control group.

Table 1. Baseline characteristics

	Intervention group		Control group	
	n=171		n=122	
Individual characteristics				
Age (yr) [mean (SD)]	41.8	(12.7)	44.3	(12.7)
Gender (male) (% [n])	100%	(171)	98%	(120)
Education (% [n])				
Lower education	74%	(127)*	84%	(103)*
Intermediate/higher education	26%	(44)*	15%	(18)*
Missing		(1)		(1)
Profession				
Bricklayer	23%	(39)	23%	(39)
Carpenter	68%	(116)	68%	(116)
Other	9%	(16)	9%	(16)
Outcomes				
Work Ability [mean (SD)] ¥	15.8	(2.2)	15.8	(2.2)
Health status [mean (SD)] ¥				
Physical health status	50.2	(8.2)	49.4	(8.9)
Mental health status	55.0	(5.5)*	53.4	(7.7)*
Musculoskeletal symptoms in the past 7 days				
Back [n (%)]	34	(20%)	29	(24%)
Neck/shoulder [n (%)]	23	(13%)	15	(13%)
Upper extremities [n (%)]	21	(12%)	16	(13%)
Lower extremities [n (%)]	32	(19%)	22	(19%)
Sick leave (6 months prior to the intervention)				
Mean (SD)	6.8	(15.9)	6.4	(19.8)
Median (number of sick leave days)	0		0	
Number of sick leave days in the 6 months prior to baseline [n (%)]				
- no or short-term sick leave (0-5 days; n (%)]	128	(75%)	99	(83%)
- long term sick leave (≥ 6 days; [n (%)]	42	(25%)	20	(17%)

Abbreviations: yr, years; SD, standard deviation; n, number; * $p<0.05$, indicating a significant differences between the intervention and control group at baseline; ¥ Higher score indicates a higher physical and mental health score, and a better work ability.

Work ability

Table 2 presents the means for work ability at baseline and at three, six and 12 months follow-up per study group, as well as the results of the multilevel linear regression analyses. No overall intervention effect or an effect at any of the time measurements was found.

Health

The intervention did not result in significant effects on physical health status, nor on mental health status (Table 2). Construction workers in the intervention group reported, in general, fewer symptoms of the back, neck/shoulders, upper extremities and lower extremities at three, six and 12-month follow-up compared to the construction workers in the control group (Table 3). However, neither the overall intervention effects nor the effects on any of the time measurements were statistically significant.

Sick leave

Table 3 shows the values for sick leave at baseline, and at six- and 12-month follow-up, as well as the effectiveness of the intervention on sick leave. For the overall effect and both follow-up periods, the 6-month prevalence of long-term sick leave was lower in the intervention group compared to the control group. However, this was not statistically significant.

Table 2. Intervention effects (β (95% CI)) on work ability, physical and mental health status between the intervention and control group after three, six and 12 months of follow-up

	Intervention group		Control group			
	n	mean (SD)	n	mean (SD)	β	(95% CI)‡
Work Ability[1]						
Baseline	170	15.8 (2.2)	121	15.4 (2.5)		
3-months	134	15.7 (1.8)	92	15.4 (2.2)	0.15	(-0.31 0.62)
6-months	131	15.4 (2.4)	88	15.3 (2.2)	-0.26	(-0.73 0.22)
12-months	115	15.5 (2.1)	89	15.1 (2.3)	0.15	(-0.34 0.63)
overall effect					0.02	(-0.34 0.37)
Health status[1]						
Physical health status (PCS)						
Baseline	155	50.2 (8.2)	112	49.4 (8.9)		
3-months	121	51.4 (7.1)	85	50.7 (7.5)	0.04	(-1.77 1.85)
6-months	113	50.1 (7.9)	78	50.0 (8.9)	-0.39	(-2.30 1.51)
12-months	104	49.8 (8.4)	80	49.2 (8.1)	0.28	(-1.65 2.20)
overall effect					-0.04	(-1.43 1.35)
Mental health status (PCS)						
Baseline	155	55.0 (5.5)	112	53.4 (7.7)		
3-months	121	54.6 (4.9)	85	53.2 (7.0)	0.63	(-1.07 2.33)
6-months	113	54.1 (7.2)	78	53.5 (5.8)	0.12	(-1.65 1.89)
12-months	104	54.5 (5.3)	80	52.6 (7.5)	1.71	(-0.08 3.49)
overall effect					0.80	(-0.51 2.11)

‡ Adjusted model corrected for age and education; [1] a positive βèta (β) means higher work ability, physical and mental health status in the intervention group compared to the control group.

Table 3. Intervention effects (β (95% CI)) on musculoskeletal symptoms and sick leave between the intervention and control group

	Intervention group		Control group			
	n	%	n	%	OR	(95% CI)‡
Musculoskeletal symptoms[1,2]						
Back symptoms						
Baseline	34	20 %	29	24 %		
3-months	20	14 %	16	17 %	0.82	(0.34 1.98)
6-months	18	14 %	15	17 %	0.99	(0.39 2.52)
12-months	19	16 %	20	22%	0.83	(0.35 1.98)
overall effect					0.86	(0.47 1.57)
Neck/shoulders symptoms						
Baseline	23	13 %	15	13 %		
3-months	13	9 %	17	18 %	0.39	(0.15 1.03)
6-months	15	12 %	9	10 %	1.24	(0.42 3.62)
12-months	14	12 %	13	14 %	0.72	(0.26 1.95)
overall effect					0.68	(0.34 1.33)
Symptoms in the upper extremities						
Baseline	21	12 %	16	13 %		
3-months	15	11 %	11	12 %	0.92	(0.34 2.47)
6-months	19	15 %	17	19 %	0.86	(0.35 2.13)
12-months	12	10 %	15	17 %	0.59	(0.22 1.58)
overall effect					0.79	(0.42 1.51)
Symptoms in the lower extremities						
Baseline	32	19 %	22	19 %		
3-months	14	10 %	21	22 %	0.43	(0.18 1.02)
6-months	24	19 %	20	23 %	0.89	(0.40 2.02)
12-months	22	18 %	19	21 %	0.97	(0.43 2.20)
overall effect					0.75	(0.43 1.31)
Sick leave[1]						
Baseline	170		119			
no or short-term sick leave	128	75%	99	83%		
long term sick leave (≥ 6 days)	42	25%	20	17%		
6-months	169		119		0.49	(0.17 1.20)
no or short-term sick leave	139	82%	90	76%		
long term sick leave (≥ 6 days)	30	18%	29	24%		
12-months	148		111		0.40	(0.15 1.57)
no or short-term sick leave	169	76%	78	70%		
long term sick leave (≥ 6 days)	63	24%	33	30%		
Overall effect					0.44	(0.13 1.26)

‡ Adjusted model corrected for age and education;[1] an odds ratio (OR) below 1 indicates that the prevalence of musculoskeletal symptoms and sick leave is lower in the intervention group compared to the control group;[2] Number of construction workers that were included for musculoskeletal symptoms. At baseline: intervention group n=171 and control group n=119; 3 months follow-up: intervention group n=137 and control group n=95; 6months follow-up: intervention group n=130 and control group n=89; 12 months follow-up: intervention group n=120 workers and control group n=91 workers.

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Discussion

The preventive intervention in the current study was not effective in improving work ability, physical and mental health status. However, the intervention showed a decline in the prevalence of musculoskeletal symptoms and long-term sick leave among construction workers, although neither was statistically significant.

To our knowledge, this is the first study that evaluated an intervention in the construction industry that targeted both physical and psychosocial factors. These factors were described as important to prevent quitting labour force participation by the construction workers in the development of the intervention[12], and by previous researchers.[9,39] Until now, most health promotion programmes in the construction industry have focused on physical factors by improving the physical health of construction workers through a lifestyle program.[40-42], or by decreasing the physical work demands by means of ergonomic measures[43].

By performing the intervention in a cluster RCT according to corresponding quality standards[44], strengths of the present study include randomization, the control group, and the intention-to-treat principle. This standardized design reduced the effects of the interference of other initiatives at the companies during the intervention, and allows for an interpretation of the effects of this prevention program. Moreover, the randomisation at department level minimized the risk of contamination. Avoiding contamination is especially important in the construction industry, where workers are working at worksites that are temporary and mobile. Additionally, the generalizability of the study findings towards construction workers is strengthened by the fact that the current study population consisted of construction workers with different professions from all over the Netherlands and of all ages. Lastly, sick leave data were gathered from the continuous registration systems, which eliminated information or recall bias, and limited loss-to-follow up.

Some limitations deserve attention as well. First, most data were obtained from questionnaires collected at the worksite. As a result, data were self-reported inducing a potential risk of bias due to socially desirable answers. The second concern is the limited statistical power. We chose to base the power calculation on the number of cases needed to identify an effect on mental and physical health status, and not on the other outcome measures. Additionally, the loss-to-follow-up was higher than expected due to the economic crisis (i.e., workers in one company were laid-off or worked part-time) and because workers were on sick-leave during the measurements. It should be noted that, even without the economic crisis, the loss-to-follow-up of 10% in the sample size calculation appeared to be an underestimation. Third, a relative high rate of data was missing for the physical and mental health score because workers did not complete all 12 items of the questionnaire.

In accordance with previous studies on work ability[11,45,46] and mental and physical health status[47], the intervention in the current study showed no improvements on these outcomes. The lack of statistically significant results in the present study is in line with the findings of the short-term outcomes (i.e., social support, need for recovery, work engagement, and physical workload) which were also not statistically significant in favour of the intervention group (data not shown).

First, the lack of impact on work ability might be explained by the broad concept of work ability as defined in the present study, including several individual characteristics and work-related factors.[48] Even though the current intervention incorporated the physical and psychosocial factors into an intervention tailored to the construction workers[13], the dose (i.e., four training sessions and Rest-Break tool) might be insufficient to result in an effect on work ability and health. This is especially true when taking into account the moderate compliance to the intervention.[19] Of all workers in the intervention group, 61% of them followed at least three of the four training sessions and the majority of the workers did not fill in the tool on a weekly basis. Moreover, it would be of interest to know which parts of the empowerment training sessions were applied to actually change the workers' behaviour or not as this could explain the lack of effect. Unfortunately, because of the rapidly changing worksites, we were unable to detect which actions were taken as a result of the empowerment training sessions. Second, the lack of impact of the intervention on work ability and health status may be due to the fact that we studied a relatively healthy group of workers. At baseline, the mean scores of work ability, physical and mental health status of the construction workers could be considered as good.[49,50] Thus, by enrolling these workers, it was more difficult to detect an intervention effect on both primary outcomes. Moreover, physical and mental health status were measured using the SF-12, which is more commonly used among patient populations. To date, we found no other intervention studies among workers including this outcome measure. Probably, this outcome is insufficiently sensitive to change within workers.

While no effects were found for physical health status, the preventive intervention showed a slight, but not significant, decline in musculoskeletal symptoms in favour of the intervention group. Both outcomes distinctively assessed the physical status of the construction workers, but concerned different aspects (i.e., daily limitations in physical functioning versus musculoskeletal symptoms). Several intervention studies were found for workers with physically demanding jobs which implemented an integrated approach of several components (e.g., group training session, individual education, and exercises) and investigated the effects on musculoskeletal symptoms.[45.47.51] All these studies failed to show a significant intervention effect on musculoskeletal symptoms as well. While a review showed no evidence of advice and devices to prevent back pain[52] , the present study showed that individual advice about working techniques at the worksite is promising to prevent musculoskeletal symptom (i.e., neck pain and lower extremities). It could be argued that the present study provided insufficient dose regarding the training sessions of the physical therapists, which led to non-significant improvements on the outcomes. In order to achieve a behavioural change with regard to working techniques and rest breaks, and consequently a decline in the prevalence of musculoskeletal symptoms, it could be hypothesized that a longer duration or a higher frequency of the training sessions from the physical therapist are needed.

With regard to sick leave, a favourable decline on the prevalence of long-term sick leave at six- and 12- month follow-up was found in favour of the intervention group. As expected, the power of the study population was insufficient to detect a statistically significant effect on sick leave. At the start of the project, a power analysis was based on finding an effect on health status, which was our primary outcome measure. Sick leave data have a skewed distribution and a large standard deviation. As a consequence a large sample size is needed which is not often feasible in studies such as randomized controlled trials. The beneficial decline in the present study was not in accordance with other intervention programmes among blue collar workers[45.53.54], which revealed no differences on sick leave at all. It is hypothesized that the reduction in long-term sick leave could be attributed to the beneficial decline in musculoskeletal symptoms in the intervention group. Unfortunately, data from the personnel administration of the six participating companies did not include sick leave diagnoses, which hampered the interpretation of the sick leave data in the present study.

Although construction worksites are temporary and mobile, the current study illustrated the feasibility of a preventive intervention at these worksites. However, the worksite intervention consisting of individual training sessions with a physical therapist, the use of a Rest-Break tool, and two empowerment training sessions did not results in improvements on the primary outcomes (work ability, physical and mental health). Therefore, the intervention should not be implemented directly on a larger scale in the Dutch construction industry. Considering the moderate to high satisfaction of the workers towards the training sessions with the physical therapist[19] and the slight decline in the prevalence of musculoskeletal symptoms, these training sessions seems promising and ask for more research. It is recommended that further studies investigate if a longer duration or a higher frequency will lead to a significant decline in the prevalence of musculoskeletal symptoms and long-term sick leave. More research is also needed to identify factors to keep construction workers healthy in the future and to prevent early retirement. Based on these factors, it might be possible that more comprehensive actions are needed to promote work ability and health, including organizational and environmental interventions. Additionally, the intervention addressed the individual level of the construction workers. As postponing early retirement could be facilitated by increasing social support from colleagues and supportive leadership[55], future interventions should put more emphasis on a comprehensive multidisciplinary approach by actively involving supervisors and managers.

Concluding remarks

As a shortage of construction workers is expected in the next decades, effective intervention programmes are needed to promote a healthy working life and to prevent early retirement. The results of the prevention worksite programme in this study showed no effects on work ability, physical and mental health status. The effectiveness with respect to the prevalence of musculoskeletal symptoms and long-term sick leave was in favour of the intervention group, although the differences between the two groups were not statistically significant.

References

1. Beereboom HJA, Blomsma G, Corten IW, Muchall S. De bouwarbeidsmarkt in de periode 2005–2010 [The labour market of the construction industry in the period 2005–2010]. Amsterdam; 2005.
2. Sijpersma R. De oudere werknemer in de bouw. [The older worker in the construction industry]. Amsterdam; 2003.
3. Alavinia SM, van den Berg TI, Van Duivenbooden C, Elders LA, Burdorf A. Impact of work-related factors, lifestyle, and work ability on sickness absence among Dutch construction workers*. Scand J Work Environ Health* 2009;35(5):325-33.
4. Alavinia SM, de Boer AG, Van Duivenbooden JC, Frings-Dresen MH, Burdorf A. Determinants of work ability and its predictive value for disability*. Occup Med (Lond)* 2009;59(1):32-7.
5. Ybema JF, Geuskens GA, Oude Hengel KM. Oudere werknemers en langer doorwerken [Older employees and prolonging working life]. Hoofddorp: TNO; 2010.
6. Sell L. Predicting long-term sickness absence and early retirement pension from self-reported work ability*. Int Arch Occup Environ Health* 2009;82(9):1133-8.
7. Liira J, Matikainen E, Leino-Arjas P, Malmivaara A, Mutanen P, Rytkönen H, et al. Work ability of middle-aged Finnish construction workers – a follow-up study in 1991–1995*. Int J Ind Erg* 2000;25(5):477-81.
8. Oude Hengel KM, Blatter BM, Geuskens GA, Koppes LLJ, Bongers PM. Factors associated with the ability and willingness to continue working until the age of 65 in construction workers*. Int Arch Occup Environ Health* 2012; 85(7):783-90.
9. Lund T, Iversen L, Poulsen KB. Work environment factors, health, lifestyle and marital status as predictors of job change and early retirement in physically heavy occupations*. Am J Ind Med* 2001;40(2):161-9.
10. Brenner H, Ahern W. Sickness absence and early retirement on health grounds in the construction industry in Ireland*. Occup Environ Med* 2000;57(9):615-20.
11. De Boer AG, Burdorf A, Van Duivenbooden C, Frings-Dresen MH. The effect of individual counselling and education on work ability and disability pension: a prospective intervention study in the construction industry*. Occup Environ Med* 2007;64(12):722-7.
12. Oude Hengel KM, Joling CI, Proper KI, Van der Molen HF, Bongers PM. Using intervention mapping to develop a worksite prevention program for construction workers*. Am J Health Promot* 2010;26:e1-e10.
13. Oude Hengel KM, Joling CI, Proper KI, Blatter BM, Bongers PM. A worksite prevention program for construction workers: design of a randomized controlled trial*. BMC Public Health* 2010;(10):doi: 10.1186/1471,2458-10-336.
14. Boschman JS, Van der Molen HF, Sluiter JK, Frings-Dresen MH. Musculoskeletal disorders among construction workers: A one-year follow-up study. *BMC Musculoskelet Disord.* 2012;(13):doi:10.1186/1471-2474-13-196.
15. Stocks SJ, Turner S, McNamee R, Carder M, Hussey L, Agius RM. Occupation and work-related ill-health in UK construction workers. *Occup Med (Lond)* 2011;61(6):407-15.
16. Alavinia SM, Van Duivenbooden C, Burdorf A. Influence of work-related factors and individual characteristics on work ability among dutch construction workers. *Scand J Work Environ Health* 2007;33(5):351-7.
17. Boschman JS, Van der Molen HF, Sluiter JK, Frings-Dresen MH. Occupational demands and health effects for bricklayers and construction supervisors: A systematic review. *Am J Ind Med* 2011;54(1):55-77.
18. De Zwart BCH, Frings-Dresen MH, Van Duivenbooden JC. Senior workers in the Dutch construction industry: A search for age-related work and health issues. *Exp Aging Res* 1999;25(4):385-91.

19. Oude Hengel KM, Blatter BM, Van der Molen HF, Joling CI, Proper KI, Bongers PM, et al. Meeting the challenges of implementing an intervention to promote work ability and health-related quality of life at construction worksites: a process evaluation. *J Occup Environ Med* 2011;53(12):1483-91.
20. Ware JEJ. SF-36 health survey update. *Spine (Phila Pa 1976)* 2000;25(24):3130-9.
21. Aaronson NK, Muller M, Cohen PD, Essink-Bot ML, Fekkes M, Sanderman R, et al. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations. *J Clin Epidemiol* 1998;51(11):1055-68.
22. Beaton DE, Hogg-Johnson S, Bombardier C. Evaluating changes in health status: reliability and responsiveness of five generic health status measures in workers with musculoskeletal disorders. *J Clin Epidemiol* 1997;50(1):79-93.
23. Simpson JM, Klar N, Donnor A. Accounting for cluster randomization: a review of primary prevention trials, 1990 through 1993. *Am J Public Health* 1995;85(10):1378-83.
24. Cohen J. Statistical Power Analysis for the Behavioral Sciences. Hillsdale: Lawrence Erlbaum Associates; 1988.
25. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach. San Francisco: Jossey-Bass; 2006.
26. Ilmarinen J. Ageing workers in the European Union - Status and promotion of work ability, employability and employment. Helsinki: Finnish Institute of Occupational Health, Ministry of Social Affairs and Health, Ministry of Labour; 1999.
27. De Zwart BC, Frings-Dresen MH, Van Duivenbooden JC. Test-retest reliability of the Work Ability Index questionnaire. *Occup Med (Lond)* 2002;52(4):177-81.
28. Eskelinen L, Kohvakka A, Merisalo T, Hurri H, Wagar G. Relationship between the self-assessment and clinical assessment of health status and work ability. *Scand J Work Environ Health* 1991;17(Suppl 1):40-7.
29. Ahlstrom L, Grimby-Ekman A, Hagberg M, Dellve L. The work ability index and single-item question: associations with sick leave, symptoms, and health--a prospective study of women on long-term sick leave. *Scand J Work Environ Health* 2010;36(5):404-12.
30. Torgén M. Experiences of WAI in a random sample of the Swedish working population. *International Congress Series* 2005;1280:328-32.
31. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work ability index. Helsinki: Finnish Institute of Occupational Health; 1998.
32. Jenkinson C, Layte R. Development and testing of the UK SF-12 (short form health survey). *J Health Serv Res Policy* 1997;2(1):14-8.
33. Ware JJ, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34(3):220-33.
34. Saris-Baglama RN, Dewey CJ, Chisholm GB, Plumb E, King J, Kosinski M, et al. QualityMetric Health Outcomes Scoring Software 3.0: User's Guide. Lincoln: QualityMetric Incorporated; 2009.
35. Gandek B, Ware JE, Aaronson NK, Apolone G, Bjorner JB, Brazier JE, et al. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. *J Clin Epidemiol* 1998;51(11):1171-8.
36. Hildebrandt VH. Prevention of musculoskeletal disorders [Thesis]. Amsterdam: VU University; 2001.
37. Hildebrandt VH, Bongers PM, Van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities. *Ergonomics* 2001;44(12):1038-55.
38. Twisk JWR. *Applied Multilevel Analysis.* Cambridge: Cambridge University Press; 2006.
39. Szubert Z, Sobala W. Current determinants of early retirement among blue collar workers in Poland. *Int J Occup Med Environ Health* 2005;18(2):177-84.

40. Gram B, Holtermann A, Søgaard K, Sjøgaard G. Effect of individualized worksite exercise training on aerobic capacity and muscle strength among construction workers - a randomized controlled intervention study. *Scand J Work Environ Health* 2011; 38(5):467-75.
41. Groeneveld IF, Proper KI, van der Beek AJ, Hildebrandt VH, Van Mechelen W. Short and long term effects of a lifestyle intervention for construction workers at risk for cardiovascular disease: a randomized controlled trial. *BMC Public Health* 2011;11:836: doi:10.1186/1471-2458-11-836.
42. Ludewig PM, Borstad JD. Effects of a home exercise programme on shoulder pain and functional status in construction workers. *Occup Environ Med* 2003;60(11):841-9.
43. Luijsterburg PA, Bongers PM, De Vroome EM. A new bricklayers' method for use in the construction industry. *Scand J Work Environ Health* 2005;31(5):394-400.
44. Ivers NM, Taljaard M, Dixon S, Bennett C, McRae A, Taleban J, et al. Impact of CONSORT extension for cluster randomised trials on quality of reporting and study methodology: review of random sample of 300 trials, 2000-8. *BMJ* 2011;343: doi: 10.1136/bmj.d5886.
45. Jørgensen MB, Faber A, Hansen JV, Holtermann A, Søgaard K. Effects on musculoskeletal pain, work ability and sickness absence in a 1-year randomised controlled trial among cleaners. *BMC Public Health* 2011;11:840: doi:10.1186/1471-2458-11-840.
46. Nurminen E, Malmivaara A, Ilmarinen J, Ylostalo P, Mutanen P, Ahonen G, et al. Effectiveness of a worksite exercise program with respect to perceived work ability and sick leaves among women with physical work. *Scand J Work Environ Health* 2002;28(2):85-93.
47. IJzelenberg H, Meerding WJ, Burdorf A. Effectiveness of a back pain prevention program: a cluster randomized controlled trial in an occupational setting. *Spine (Phila Pa 1976)* 2007;32(7):711-9.
48. Ilmarinen J. Work ability, a comprehensive concept for occupational health research and prevention. *Scand J Work Environ Health* 2009;35(1):1-5.
49. Gould R, Ilmarinen J, Järvisalo J, Koskinen S. Dimension of work ability: results of the Health 2000 Survey. Helsinki: Finnish Institute of Occupational Health; 2008.
50. Welch LS, Haile E, Boden LI, Hunting KL. Impact of musculoskeletal and medical conditions on disability retirement-a longitudinal study among construction roofers. *Am J Ind Med* 2010;53(6):552-60.
51. Haukka E, Leino-Arjas P, Viikari-Juntura E, Takala EP, Malmivaara A, Hopsu L, et al. A randomised controlled trial on whether a participatory ergonomics intervention could prevent musculoskeletal disorders. *Occup Environ Med* 2008;65(12):849-56.
52. Verbeek J, Martimo KP, Karppinen J, Kuijer PP, Takala EP, Viikari-Juntura E. Manual material handling advice and assistive devices for preventing and treating back pain in workers: a Cochrane Systematic Review. *Occup Environ Med* 2012;69(1):79-80.
53. Haukka E, Leino-Arjas P, Viikari-Juntura E, Takala EP, Malmivaara A, Hopsu L, et al. A randomised controlled trial on whether a participatory ergonomics intervention could prevent musculoskeletal disorders. *Occup Environ Med* 2008;65(12):849-56.
54. IJzelenberg W, Molenaar D, Burdorf A. Different risk factors for musculoskeletal complaints and musculoskeletal sickness absence. *Scand J Work Environ Health* 2004;30(1):56-63.
55. Van den Berg TI, Elders LA, Burdorf A. Influence of health and work on early retirement. *J Occup Environ Med* 2010;52(6):576-83.

Chapter 9

Prevention programme at construction worksites aimed at improving health and work ability is cost-saving to the employer: results from a cluster RCT

Karen M. Oude Hengel, Judith E. Bosmans, Johanna M. van Dongen, Paulien M. Bongers, Allard J. van der Beek, Birgitte M. Blatter

Under Review

9

Abstract

Background: To analyse the cost-effectiveness and financial return of an intervention from an employer's perspective.

Methods: Two hundred ninety-three workers of 15 departments were randomised to the intervention (n=8) or control group (n=7). Data on work ability and health were collected using questionnaires. Sick leave data were obtained from the companies. Both the cost-effectiveness analyses and return on investment analyses were performed from the employer's perspective.

Results: After 12 months, the absenteeism costs were significantly lower in the intervention group compared to the control group. No significant differences in effects were observed after 12 months, meaning that the intervention was not cost-effective in comparison with the control group. The net-benefit was 641, and the intervention generated a positive financial return to the employer.

Conclusion: The intervention in the present study was cost-saving to the employer due to less sickness absenteeism; for each €1 invested in the intervention group €6.4 was gained.

Introduction

As in many industries in Western countries, the working population in the Dutch construction industry is rapidly decreasing and ageing.1,2 These demographic changes have serious economic consequences as a shrinking labour force will have to pay for the national pensions of an increasing number of people who are retired. Thus, both government and construction companies face the challenge of keeping both young and old construction workers on their job for a longer period. In order to keep the working lives of construction workers healthy and productive, worksites are increasingly becoming the focus of health promotion programmes.[3]

As employers are the ones eventually investing in such health promotion programmes, they have a growing interest in the economic evaluations of these programmes.[4,5] Results of economic evaluations can play an important role in the decision whether or not to invest in worksite health promotion programmes, as they provide a systemic comparison of both the effects and costs of the alternatives (e.g., health promotion programmes and usual care).[6] Specifically, employers need to gain insight into the potential effects in terms of improved health of their workers compared to their additional investments in order to decide whether the implementation is worthwhile for their company (i.e., cost-effectiveness analyses (CEA)).[7]This information is becoming even more important when taking into account the limited resources of companies, such as time, facilities and money.[8] Also, employers increasingly ask whether these programmes generate a positive financial return to the company.[9] This can be determined with a return on investment analysis (i.e., ROI analysis), in which programme costs are compared to its financial benefits.[10]

Until now, two studies have been conducted evaluating the cost-effectiveness and/or financial return of a worksite health promotion programme aimed at blue-collar workers using a randomised controlled trial (RCT).[11,12] Both studies evaluated the cost-effectiveness of the programme from a societal perspective, whereas Groeneveld et al. (2011) also analysed the net-benefit from that of an employer. Although a societal perspective is mostly advocated for economic evaluations (i.e., all costs and effects are included in the analyses irrespective of who pays for them or benefits from them)[8], interpreting these results may be difficult for various decisions makers. In the case of worksite health promotion programmes, the adoption of the employer's perspective (e.g., only costs relevant to the employer are considered) is more appropriate since the final decision about whether or not to invest in such programmes are made by the management of companies.

Therefore, an economic evaluation from an employer's perspective was conducted of an intervention programme in the construction industry in comparison with control. This 6-month intervention aimed to maintain and promote work ability and health in order to support sustainable employability of construction workers.[13] The present study aims to evaluate both the cost-effectiveness and financial return of an intervention programme in the construction industry versus no intervention.

Methods

Study design and population

An economic evaluation alongside a cluster-randomised controlled trial (RCT) was conducted at all departments of six construction companies, which specialize in house, commercial or industrial building. All workers of these companies who perform actual construction work were invited to participate in the study. Inclusion criteria were: (1) construction workers were able to complete questionnaires written in the Dutch language, and (2) construction workers provided written informed consent. The study protocol was approved by the Medical Ethics Committee of the VU University Medical Center (Amsterdam, The Netherlands). More details on the study have been described elsewhere.[14]

Randomisation, blinding and sample size calculation

Cluster randomisation took place at the department level within each company. The randomisation procedure was performed by an independent research assistant, who had no prior information about the departments to ensure concealment of treatment allocation. As the intervention took place at the worksite, the construction workers, their supervisors and trainers could not be blinded to the allocation.

The sample size was calculated based on the number of cases needed to identify an effect on health status. In the present study, health status was measured by the SF-12. However, as this outcome has rarely been used among the working population, the SF-36 was used for the sample size calculation. Effect sizes of the SF-36 varied between 0.58 and 0.96. Because of the cluster randomisation design, an effect size of 0.40 was considered to be the lower boundary of a medium effect size. This effect size can be detected with two groups of 100 (with a power of 80% and a two-tailed significance level of 5%). Taking a loss to follow-up of about 10% into account, 220 construction workers were needed at baseline.

Intervention and control condition

The six-month intervention consisted of two individual training sessions with a physical therapist to reduce physical workload, an instrument to raise awareness of the importance of rest breaks to reduce fatigue (Rest-Break tool), and two empowerment training sessions to improve the range of influence at the worksite. The four training sessions took place at the worksite within the existing so-called "toolbox education system". The toolbox education system consists of at least 10 obligatory health and safety training sessions for workers, which have to be organized by employers in the construction industry each year. These training sessions are necessary in the construction industry to obtain an official health and safety certificate.

Both training sessions with the physical therapist lasted approximately 30 minutes per worker. During the first training session, a quick scan questionnaire was administered and followed by a 15-minute observation at the worksite. Based on this, a maximum of three individual recommendations on how to reduce ones physical workload were written down on a pocket-sized card. During the second training session, which took place after four months, the physical therapist discussed the workers' experiences so far and evaluated the impact of the advice. The Rest-Break tool was introduced to raise awareness about the importance of reducing fatigue by taking flexible rest breaks, and to stimulate workers to actually take them. The Rest-Break tool is a flowchart and consists of four steps: (1) the workers' expectations about their fatigue at the end of a working day, (2) short-term advice to take mini rest breaks or an additional break of 10 minutes, (3) selection of the possible causes of fatigue, and (4) long-term advice about how to structurally lower fatigue. The workers were asked to fill in the tool on a weekly basis and to discuss the results with their supervisor. The two group training sessions with the empowerment trainer were organized at the worksite. The sessions were aimed at improving construction workers' influence at the worksite by (1) taking responsibility for their own health, (2) discussing the responsibility for their own behaviour (e.g., taking rest breaks, asking for assistance) with colleagues, and (3) improving communication with their supervisor. During the first training session, workers created a list of topics (e.g., more communication with supervisor, celebration of achieved goals, and less need for recovery) they wanted to change during the intervention period. Finally, they signed an action plan. After four months, the empowerment trainer and workers discussed, and reconsidered the action plan as well as the results that were achieved. More details on the development and content of the intervention have been described elsewhere.[13] The control group received no intervention at all, besides the regularly obliged training sessions for the Health and Safety certificate.

Effect measures

Primary outcomes in this study were work ability, physical and mental health, and the prevalence of musculoskeletal symptoms. Baseline measurements took place before randomisation. Follow-up measurements were performed at three, six, and 12 months after baseline.

Work ability was measured using the Work Ability Index (WAI), which originally consisted of seven concepts.[15] Because sub-concepts can also be used as a simple indicator for assessing the status of work ability[16,17], only two concepts were used in the present study: current work ability (one question), and work ability in relation to job demands (physical and mental job demands by two questions). A total score of the WAI was obtained by adding the weight scores of these individual concepts.[18]

Physical and mental health were assessed using the Short-Form Health Survey (SF-12).[19,20] The SF-12 provided two separate weighted scores for physical and mental health.[21]

The prevalence of musculoskeletal symptoms was measured using the Dutch Musculoskeletal Questionnaire (DMQ), in which workers were asked to rate the occurrence of pain or discomfort in the neck, shoulders, upper and lower back, elbows, wrists/hands, hips/thighs, knees, and ankles/feet during the previous seven days using a four-point scale (never, sometimes, frequent, and prolonged).[22] These regions were grouped into four larger body regions; back (upper and lower back), neck/shoulders, upper extremities (elbows and wrist/hands), and lower extremities (hips/thighs, knees and ankles/feet). For each of the body regions, workers who answered 'frequent' or 'prolonged' on one or more of the questions were classified as having musculoskeletal symptoms in that specific body region, whereas the others were classified as having no musculoskeletal symptoms in that specific body region.

Costs

The economic evaluation was conducted from the employer's perspective. This means that only costs relevant for the companies were considered; notably costs of the intervention, and costs due to productivity losses of the workers.

Intervention costs were valued using the market prices that the six companies have to pay for the intervention. Intervention costs included the costs related to the training sessions with the physical therapist and empowerment trainer (including travel time, training time, and their materials), and material costs (i.e., Rest-Break tool, posters, and pocket-sized advisory cards). The costs of the trainers were based on the commercial rates of the trainers themselves. Material costs were estimated using invoices.

Costs due to paid time of the workers to participate in the intervention program were not included because (i) the training sessions were organized within the existing education system, meaning that companies have to organize at least 10 obligatory health and safety training sessions at the work site for workers to obtain an official health and safety certificate, and (ii) construction workers in the control group received these training sessions as well, but with other topics and purposes.

Costs of productivity losses were divided into costs due to sickness absenteeism and costs due to presenteeism (i.e., lost performance while at work). Currently, no consensus exists regarding the best method to measure and value presenteeism in economic evaluations.[23] Therefore, the main analyses consisted of sickness absenteeism costs only, while presenteeism costs were added to sickness absenteeism costs in one of the sensitivity analyses. Sickness absenteeism data were gathered from continuous registration systems of the six participating companies. Gross annual salaries of participants were estimated using the average annual salaries of construction workers, which were divided into seven age categories (Economic Institute of the Dutch construction industry, personal communication). Labour costs associated with one hour of sickness absenteeism were calculated by dividing these gross annual salaries including holiday allowances and premiums by the average number of annual working hours for construction workers. Using the Human Capital Approach (HCA)[8], absenteeism costs were estimated by multiplying the total number of sickness absenteeism hours during follow-up by the hourly labour costs. Presenteeism (i.e. reduced productivity while at work)[24] was assessed at baseline, three, six and 12-month follow-up using an item of the World Health Organization and Work Performance Questionnaire (WHO-HPQ).[25] Workers were asked to rate their overall work performance during the previous four weeks on an 11-point scale, ranging from "worst performance" (0) to "best performance" (10). Assuming linearity, the average work performance of the participants during the follow-up period was calculated. As presenteeism is conceptualized in the WHO-HPQ as a measure of actual performance in relation to "best performance" (10)[25,26], a worker's average level of presenteeism during follow-up (Presenteeism Score) was calculated using the following formula: presenteeism score= (10 – work performance)/10. Using the HCA, presenteeism was valued by multiplying a worker's presenteeism score by the number of working hours in the previous follow-up period (working hours minus leave), and multiplying this with the hourly labour cost. Prices were adjusted for the year 2009, as this was the year in which most data were collected. Discounting of costs and effects was not necessary, as the follow-up period of the trial was 12 months.

Statistical analyses

Cost-effectiveness analyses and cost-benefit analyses were performed from the employer's perspective. Cost-effectiveness is defined as the relationship between nonmonetary health-outcomes (i.e., health, work ability and musculoskeletal symptoms) as a result of the intervention and the monetary value of resources (i.e., intervention costs and sickness absence costs) used during implementation. Cost-benefit is defined as the relationship between costs of the intervention (i.e., intervention costs), and monetary benefits produced by the intervention (i.e., sickness absence costs).[6,8]

Analyses were performed according to the intention-to-treat principle (i.e., analyses of the trial were based on the initial group assignment). Baseline differences between the intervention and control group were checked using the unpaired Student t-test (continuous variables), and Pearson's chi-square test (dichotomous variables).

Multiple imputation using Fully Conditional Specification and Predictive Mean Matching was used to impute missing cost and effect data.[27] An imputation model containing important demographic and prognostic variables was specified to create 30 complete data sets. Effects and costs from the 30 complete data sets were pooled using Rubin's rules.[28]

Linear regression analyses (i.e., on work ability, physical and mental health as effect measure) and logistic regression analyses (i.e., on musculoskeletal symptoms) were used to compare the effects between the intervention and control group, while adjusting for baseline values. Mean costs differences between the intervention and control group were calculated. To estimate uncertainty bootstrapping with 5000 replications was employed. The Approximate Bootstrap Confidence algorithm (ABC) was used to estimate 95% confidence intervals (CIs) around the cost differences.

To provide a summary measure of the incremental comparison of costs and effects, incremental cost-effectiveness ratios (ICERs) were estimated by dividing the differences in costs over 12 months between the intervention and control group by the difference in effects at 12 months. Bootstrapped incremental cost-effects pairs, were plotted on cost-effectiveness planes (CE-planes) to graphically illustrate the uncertainty surrounding the ICERs.[29] CE-planes consist of four quadrants. Each quadrant has a different implication for the decision maker. If an ICER is located in the South-East quadrant (i.e., less expensive and more effective), the intervention can be regarded cost-effective. If an ICER is located in the North-West quadrant (i.e., less effective and more expensive), the intervention cannot be regarded as cost-effective. When ICERs are located either in the North-East quadrant (i.e., more effective and more expensive) or the South-West quadrant (i.e., less effective and less expensive), the choice depends on the so-called "willingness-to-pay". That is, the amount of money decision makers are willing to pay for an additional unit of effect.

For the cost-benefit analyses, costs were defined as the intervention costs and benefits as the difference in monetized productivity loss (i.e., absenteeism costs) between the control group and intervention group during follow-up, with positive benefits indicating reduced spending. Using these costs and benefits, three outcomes were calculated; (1) Net Benefit (NB), (2) Benefit Cost Ratio (BCR), and (3) Return on investment (ROI).[30] The NB was calculated by subtracting the intervention costs from the benefits. BCR was calculated by dividing the benefits by the costs, and the ROI by dividing the NB by the costs, and expressed as a percentage. To quantify uncertainty, 95%CIs around the NB were estimated by means of ABC intervals. Financial returns are positive if the following criteria are met: NB>0, BCR>1, and ROI>0.

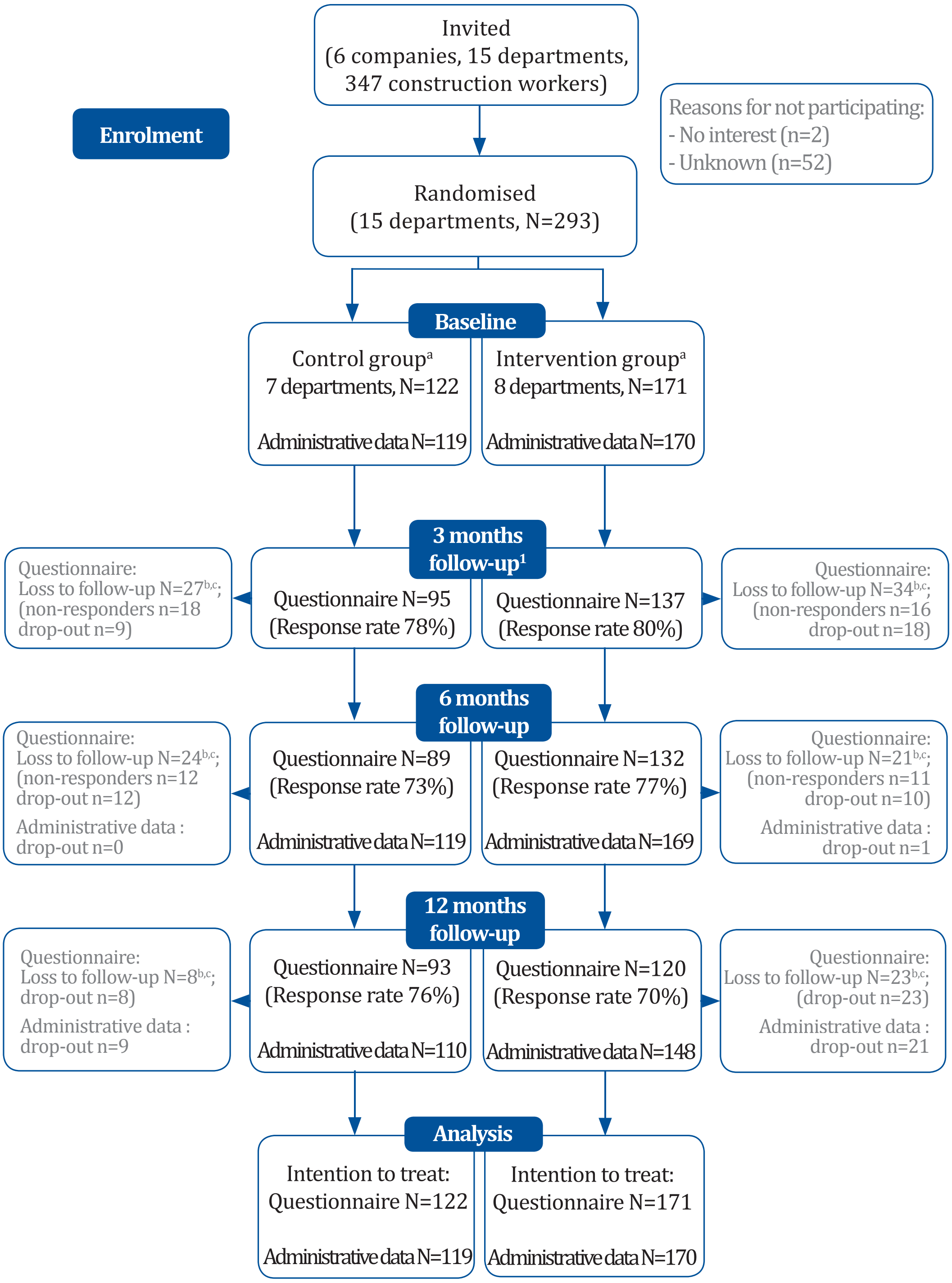
To assess the robustness of the study results, three sensitivity analyses were performed. First, analyses were conducted in which presenteeism costs were also included. Second, analyses were conducted using complete cases only. Third, analyses were performed according to the per-protocol principle; that is only workers in the intervention group who followed three or four training sessions were included in the analyses.

The statistical programme R, v2.14.0 was used to estimate the cost-effectiveness planes, and ABC intervals. All other statistical analyses were performed using PASW version 18.0 (SPSS Inc, Chicago, IL). Statistical significance was set at $p<0.05$.

Results

Participants

A total of 15 departments from six construction companies participated in the study. After randomisation, eight departments were allocated to the intervention group (n=171) and seven departments to the control group (n=122; Figure 1). At baseline, workers in the intervention group were higher educated, and had a slightly better mental health compared to workers in the control group (Table 1). Complete follow-up data were obtained from 165 workers (65%) on the effect measures and from 259 workers (88%) on the cost measures. Workers with complete follow-up data reported significantly higher work ability at baseline than workers with incomplete follow-up data (15.9 versus 15.3, respectively).



[a] Sick leave data were not available for four workers (3 in control group, and 1 in intervention group).
[b] Workers who were loss-to-follow- up due to non-responding were again included in the following measurements.
[c] Drop-out was defined as workers that ended participation in follow-up measurements.

Figure 1. Flow diagram of the participants through the phases of the trial

Table 1. Baseline characteristics of the study population

	Control group		Intervention group	
	n=122		n=171	
Individual characteristics				
Age (yr) [mean (SD)]	44.3	(12.7)	41.8	(12.7)
Gender (male) (% [n])	98%	(120)	100%	(171)
Education (% [n])				
Lower education	84%	(103)*	74%	(127)*
Intermediate/higher education	15%	(18)*	26%	(44)*
Missing		(1)		(1)
Profession				
Bricklayer	13%	(16)	23%	(39)
Carpenter	75%	(92)	68%	(116)
Other	12%	(14)	9%	(16)
Outcomes [mean (SD)]				
Work Ability [mean (SD)] ¥	15.6	(2.2)	15.8	(2.0)
Health status [mean (SD)] ¥				
Physical health status	49.4	(8.9)	50.2	(8.2)
Mental health status	53.4	(7.7)*	55.0	(5.5)*
Musculoskeletal symptoms in the past 7 days				
Back [n (%)]	29	(24%)	34	(20%)
Neck/shoulder [n (%)]	15	(13%)	23	(13%)
Upper extremities [n (%)]	16	(13%)	21	(12%)
Lower extremities [n (%)]	22	(19%)	32	(19%)

Abbreviations: yr, years; SD, standard deviation; n, number; * p<0.05, indicating a significant differences between the intervention and control group at baseline; ¥ Higher score indicates a better work ability and a higher physical and mental health score.

Effectiveness

At 12-month follow-up, work ability and physical health decreased slightly in the intervention group compared to the control group, whereas mental health showed a small increase in the intervention group (Table 2). Regarding musculoskeletal symptoms, fewer intervention group workers reported musculoskeletal symptoms for the four body regions compared to their control group counterparts (Table 2). However, none of these differences were significant.

Costs

Mean intervention costs were €118 per construction worker. During follow-up, sickness absenteeism costs were significantly lower in the intervention group compared to the control group (€-760; 95% CI: -1497; -156). Due to the lower sickness absenteeism costs, total costs (i.e., intervention costs and sickness absenteeism costs) were significantly lower in the intervention group compared to the control group (€-641; 95% CI: -1391; -48).

Cost-effectiveness analyses

The ICER for work ability was €5.243, implying that the employer saved €5.234 per one-point decline in work ability in the intervention group in comparison with the control group (Table 3). ICERs for physical and mental health were 798 and -642, respectively. This means that the employer's saving per one-point decline in physical health was €798, whereas a one-point improvement in mental health saved the employer €642 in the intervention group in comparison with the control group. For musculoskeletal symptoms, ICERs

Table 2. Pooled effects and costs, and differences in mean effects and costs at baseline and 12 months follow-up between the intervention and control group

	Control group				Intervention group					
	Baseline		Follow-up		Baseline		Follow-up		Differences[1]	
Pooled Effects										
	Mean	*(SEM)*	*Mean*	*(SEM)*	*Mean*	*(SEM)*	*Mean*	*(SEM)*	*Mean*	*(95% CI)*
Work Ability	15.4	(0.23)	15.1	(0.25)	15.8	(0.15)	15.3	(0.22)	-0.12	(-0,79; 0,54)
Physical health	49.4	(0.82)	48.9	(0.87)	50.2	(0.64)	48.9	(0.77)	-0.80	(-3.22; 1.61)
Mental health	53.4	(0.71)	51.8	(0.92)	55.0	(0.44)	54.2	(0.52)	1.00	(-1.15; 3.15)
	%	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*(95% CI)*
Musculoskeletal symptoms										
Back	24%	29	22%	27	20%	34	19%	32	-0.03	(-0.13; 0.07)
Neck/Shoulder	13%	15	17%	23	13%	23	12%	21	-0.05	(-0.14; 0.05)
Upper extremities	13%	16	17%	20	12%	21	11%	19	-0.05	(-0,15; 0.04)
Lower extremities	19%	22	22%	32	19%	32	20%	35	-0.01	(-0,13; 0.10)
Pooled Costs (€)										
	Mean	*(SEM)*	*Mean*	*(SEM)*	*Mean*	*(SEM)*	*Mean*	*(SEM)*	*Mean*	*(95% CI)*
Absenteeism costs	-	-	1727	(306)	-	-	968	(146)	-760	(-1497;-156)
Intervention costs	-	-			-	-	118		118	
Total costs	-	-	1727	(306)	-	-	1086	(146)	-641	(-1391; -48)

Abbreviations: n: number; SEM: standard error of the mean CI: confidence intervals. [1] Mean differences between intervention group and control group at twelve months, adjusted for baseline values and age

Table 3. Results of the cost-effectiveness analyses on work ability, physical and mental health between the intervention and control group after 12 months of follow up

Analysis	Sample size		Outcome	ΔC		ΔE		ICER	Distribution CE-plane (%)			
	Co	Int		€	(95% CI)	Points	(95% CI)		NE[1]	SE[2]	SW[3]	NW[4]
Main analysis												
Imputed data set	122	171	Work ability	-641	(-1391; -48)	-0.12	(-0.79; 0.54)	5243	1.3	35.3	62.4	1.0
	122	171	Physical health	-641	(-1391; -48)	-0.80	(-3.22; 1.61)	798	0.8	25.3	72.5	1.4
	122	171	Mental health	-641	(-1391; -48)	1.00	(-1.15; 3.15)	-642	1.7	80.4	17.6	0.5
Sensitivity analysis												
Complete cases	72	93	Work ability	-136	(-1101; 462)	-0.27	(-1.07; 0.53)	578	15.3	13.1	49.3	22.2
	72	93	Physical health	-136	(-1101; 462)	-0.52	(-3.09; 2.06)	280	17.7	18.4	43.5	20.4
	72	93	Mental health	-136	(-1101; 462)	1.54	(-0.60; 3.69)	-93	33.5	56.6	5.5	4.5
Per-protocol	122	104	Work ability	-641	(-1411; 24)	-0.25	(-1.01; 0.51)	2573	1.2	24.7	71.8	2.3
	122	104	Physical health	-641	(-1411; 24)	-0.22	(-3.01; 2.57)	2948	1.7	42.6	53.8	1.8
	122	104	Mental health	-641	(-1411; 24)	0.81	(-1.49; 3.12)	-788	2.5	73.7	22.8	1.0
Including presenteeism	122	171	Work ability	-1179	(-2370; -82)	-0.12	(-0.79; 0.54)	9635	0.8	35.9	62.2	1.1
	122	171	Physical health	-1179	(-2370; -82)	-0.80	(-3.22; 1.61)	1466	0.5	25.7	72.4	1.4
	122	171	Mental health	-1179	(-2370; -82)	1.00	(-1.15; 3.15)	-1180	1.3	80.5	17.5	0.6

Abbreviations: C: costs; CI: confidence intervals; E; effects; ICER: incremental cost-effectiveness ratio, CE-plane: cost-effectiveness plane; SA: sensitivity analysis;
[1] refers to the northeast quadrant of the CE-plane, indicating that the intervention is more effective and more costly compared to the control group;
[2] refers to the southeast quadrant of the CE-plane, indicating that the intervention is more ffective and less costly compared to the control group;
[3] refers to the northwest quadrant of the CE-plane, indicating that the intervention is less effective and more costly compared to the control group;
[4] refers to the southwest quadrant of the CE-plane, indicating that the intervention is less effective and less costly compared to the control group.
Note: costs are expresses in 2009 Euros.

Table 4. Results of the cost-effectiveness analyses on musculoskeletal symptoms between the intervention and control group after 12 months of follow-up

Analysis	Sample size		Outcome	ΔC		ΔE		ICER	Distribution CE-plane (%)			
	Co	Int		€	(95% CI)	%	(95% CI)		NE[1]	SE[2]	SW[3]	NW[4]
Main analysis												
Imputed data set	122	171	Back	-641	(-1391; -48	-0.03	(-0.14; 0.07)	20319	1.5	70.6	27.2	0.8
	122	171	Neck/shoulders	-641	(-1391; -48	-0.05	(-0.13; 0.04)	13868	1.7	81.8	16.0	0.6
	122	171	Upper extremities	-641	(-1391; -48	-0.05	(-0.14; 0.04)	12113	1.8	85.2	12.6	0.4
	122	171	Lower extremities	-641	(-1391; -48	-0.01	(-0.13; 0.10)	59716	1.1	55.8	42.0	1.2
Sensitivity analyses												
Complete cases	72	93	Back	-136	(-1101; 462)	-0.04	(-0.16; 0.08)	3480	10.5	14.6	48.0	27.0
	72	93	Neck/shoulders	-136	(-1101; 462)	-0.03	(-0.12; 0.07)	5220	12.0	16.4	44.7	26.3
	72	93	Upper extremities	-136	(-1101; 462)	-0.07	(-0.17; 0.04)	2088	4.8	5.5	56.8	32.8
	72	93	Lower extremities	-136	(-1101; 462)	-0.02	(-0.15; 0.10)	6463	13.9	22.9	40.3	22.9
Per-protocol	122	104	Back	-641	(-1411; 24)	0.00	(-0.11; 0.11)	-976306	1.5	47.4	48.9	1.9
	122	104	Neck/shoulders	-641	(-1411; 24)	-0.05	(-0.15; 0.07)	12631	2.9	82.3	14.1	0.7
	122	104	Upper extremities	-641	(-1411; 24)	-0.03	(-0.13; 0.07)	19431	2.1	72.5	24.0	1.5
	122	104	Lower extremities	-641	(-1411; 24)	0.00	(-0.12; 0.13)	-595950	1.5	46.9	49.6	2.0
Including presenteeism	122	171	Back	-1179	(-2370; -82)	-0.03	(-0.14; 0.07)	79302	0.9	59.9	38.2	1.0
	122	171	Neck/shoulders	-1179	(-2370; -82)	-0.04	(-0.13; 0.04)	24002	1.5	84.1	13.9	0.4
	122	171	Upper extremities	-1179	(-2370; -82)	-0.05	(-0.14; 0.04)	23375	1.5	84.7	13.4	0.4
	122	171	Lower extremities	-1179	(-2370; -82)	-0.01	(-0.13; 0.10)	110135	0.8	55.9	42.3	1.0

Abbreviations: C: costs; CI: confidence intervals; E; effects; ICER: incremental cost-effectiveness ratio, CE-plane: cost-effectiveness plane; SA: sensitivity analysis
[1] refers to the northeast quadrant of the CE-plane, indicating that the intervention is more effective and more costly compared to the control group;
[2] refers to the southeast quadrant of the CE-plane, indicating that the intervention is more effective and less costly compared to the control group;
[3] refers to the northwest quadrant of the CE-plane, indicating that the intervention is less effective and more costly compared to the control group;
[4] refers to the southwest quadrant of the CE-plane, indicating that the intervention is less effective and less costly compared to the control group;
Note: costs are expressed in 2009 Euros

ranged between 12.133 (upper extremities) and 59.716 (lower extremities; Table 4). These ICERs indicate that the employer will save €12.133 to €59.716 per 1% reduction in the prevalence of musculoskeletal symptoms. Uncertainty around the ICERs is presented by the distribution of the cost-effect pairs among the four quadrants (Tables 3 and 4). For work ability and physical health, the majority of all outcomes, most cost-effect pairs are located in the South-West quadrant, indicating that the intervention is less effective and less expensive. Regarding mental health and musculoskeletal symptoms, the cost-effect pairs are mainly located in the South-East quadrant, indicating the intervention is less expensive and more effective. As the CE-planes were quite similar for all outcomes, only those for work ability and mental health are presented (Figure 2).

Financial return

The ROI analyses indicated that the investment needed for the intervention was €118 and the savings were €760 in absenteeism costs per worker (i.e., a reduction of 8.5 sickness absenteeism days in the intervention group compared to the control group) resulting in a positive net benefit of €641 (95%CI 48;1391; Table 5). Furthermore, for each €1 invested, €6.4 was gained (BCR: 6.4) and a 544% profit was made (ROI: 544%). Therefore, the intervention can be regarded as cost-saving to the employer.

Figure 2. Cost-effectiveness planes for work ability (A) and mental health (B) of the intervention group compared to the control group.

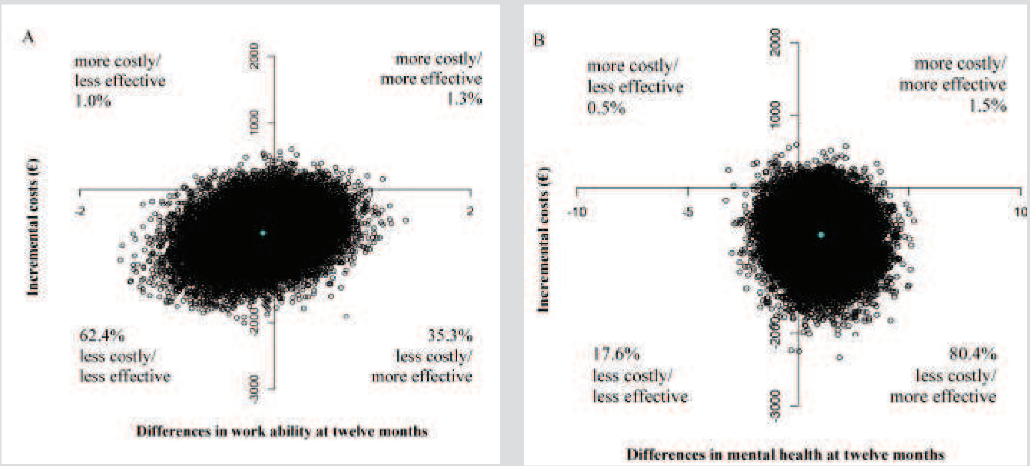


Table 5. Intervention costs, benefits (95% CI), net benefit (NB, (95% CI)), benefit cost ratio (BCR), and return on investment (ROI (%)) per worker

Analysis	Sample size		Costs[1]	Benefits						Financial Return			
	Co	Int		Absenteeism		Presenteeism		Total		NB		BCR	ROI
Main analysis													
Imputed datasets	122	171	118	760	(156;1497)	-	-	760	(156;1497)	641	(48; 1391)	6.4	543
Sensitivity analyses													
Complete cases	72	93	118	254	(- 486; 989)	-	-	254	(- 486; 989)	136	(-462;1101)	2.2	115
Per-protocol	122	104	118	760	(74; 1510)	-	-	760	(74; 1510)	641	(-24;1411)	6.4	543
Including presenteeism	122	171	118	760	(156;1497)	537	(-315; 1429)	1297	(1095;1470)	1179	(82; 2370)	11.0	999

Abbreviations: C: control; I: intervention; CI: confidence intervals; NB: net benefit; BCR: benefit cost ratio; ROI: return on investment; SA: sensitivity analysis.
[1]Costs are those costs that were related to the intervention.

9

Sensitivity analyses

Cost-effectiveness analyses

The results on the cost-effectiveness of the intervention in the sensitivity analyses are presented in tables 3 and 4. No differences were found in effects between the main analyses and the sensitivity analyses. For the per-protocol analyses, results were similar to those of the main analyses, but the cost difference between the two groups was no longer statistically significant. Results of the complete-cases analysis also deviated from the main analyses as the cost difference between the two groups was no longer statistically significant (−€136 (95%CI -462;1101)). If presenteeism costs were included, total costs remained significantly lower in the intervention group compared to the control group (€ -1179 (95%CI (-2370;-82)).

Financial return

The results of the sensitivity analyses on the financial return are presented in Table 5. If the analyses were restricted to the per-protocol analyses (i.e., workers in the intervention group who followed at least three training sessions), the results (NB, BCR, and ROI) remained quite similar to the main analyses. Only the NB (€641 (95%CI -24;1411) was no longer statistically significant. For the complete-cases analysis, the intervention was no longer statistically significantly cost-saving (NB: €254 (95%CI -486;989); BCR: 2.2, and ROI: 115). If presenteeism costs were included (€537 (95%CI -315;1429), the intervention remained cost-saving to the employer (NB: €1179 (95%CI 82;2370), BCR: 11 and ROI:999).

Discussion

This study evaluated the cost-effectiveness and financial return of a preventive programme delivered at construction worksites. The results showed that the intervention was cost-saving to the employer, due to reduced sickness absenteeism costs in the intervention group compared with the control group. Specifically, for each €1 invested in the intervention group, €6.4 was gained. However, the intervention cannot be regarded as cost-effective in terms of work ability, physical and mental health, and musculoskeletal symptoms, because the intervention was ineffective for these outcomes in comparison.

An important strength of this study was the pragmatic cluster randomised design. This enabled us to study the cost-effectiveness and financial return of this worksite prevention programme under real conditions and allowed us to prospectively collect all relevant cost and effect data.[31] Additionally, randomisation was performed at the department level to minimise the risk of contamination. Avoiding contamination is especially important in the construction industry where workers are working at worksites that are temporary and mobile. Another strength is that sickness absence data were retrieved from continuous sickness absence registration systems of the six participating companies, which eliminated information or recall bias, and limited loss-to-follow-up.

Some methodological limitations deserve attention as well. First, the clustering of construction workers within the departments was ignored in the analyses. Economic evaluations of cluster randomised controlled trials require methods that address clustering in both the effects and costs, and adjust for covariates.[32] However, methods are not yet fully developed nor does consensus exist about the best method to do so.[33] A second limitation concerns the high loss to follow-up on the outcomes. Complete follow-up data at 12 months (effect measures and cost data) were derived from 128 workers (44%). To account for this, missing data were imputed using the 'fully conditional specification and predictive mean matching', which is acknowledged as a better way to deal with missing data than complete-cases analyses.[34] Third, the measurement of presenteeism costs is another limitation. Although presenteeism costs are increasingly being recognised by employers as an important part of productivity-related costs, universal agreement about the most appropriate method for measuring or monetizing them does not exist.[35,36] Moreover, presenteeism was measured by one single question that covered only the past four weeks, and needed to be extrapolated to the next measurement. Therefore, presenteeism costs were only included in the sensitivity analyses. Fourth, costs indirectly related to the intervention and employer's costs were not included in the present study. Regarding the intervention costs, time spent for discussions about the results of the Rest-Break tool between the workers and supervisors, and the time spent for additional rest breaks are examples of indirect intervention costs. As it is unknown to what extent these discussions and additional rest-breaks took place, these indirect costs were not included in the current economic evaluation. Regarding the financial consequences for the employers, costs such as, turnover, disability management and workers' compensation costs were not measured in the current study. This should be taken into account when interpreting the present findings.

Comparing our results to those of other studies is hampered by the lack of studies evaluating the financial return and cost-effectiveness of similar interventions from an employer's perspective. Until now, most studies among blue-collar workers evaluated the economic impact of worksite health promotion programme from a societal perspective[11,12], were not aimed at primary prevention[37], or were not based on a (randomised) controlled trial[37]. The comparison is also hampered by the fact that policies regarding employee medical costs may differ between countries. To illustrate this, in the United States, employers bear a large part of the medical costs of their employees whereas in the Netherlands (which has a dual-payer system) these accrue to health insurance companies and the government. Hence, the results of the current economic evaluation are mainly of interest for countries with comparable policies.

Remarkably, the results of the present study showed that the employer financially benefits from the intervention (i.e., positive financial return), although the intervention did not improve the work ability or health of the construction workers. The positive financial return was the result of a relatively large difference in sickness absenteeism costs in the intervention group compared to the control group. Several reasons might explain the present finding of a positive financial return in comparison to an absence of effectiveness on any of the outcome measures. The absence of statistically significant differences was in line with the findings for these outcomes at three and six months follow-up (data not shown). First, the baseline scores for work ability and health status were relatively good, indicating that the potential of the intervention for further improvement on these outcome measures is relatively weak (i.e., ceiling effect). Second, the study design was two-armed, which complicated the clarifications of the pathways between the different programme components and the achieved reduction in costs (i.e., black box). A theoretical framework was defined in the development phase of the intervention in which the pathways between an intervention action and an expected change in an outcome measure were described.[13] For example, we supposed that increasing awareness would lead to a higher intention to take more rest breaks (lower need for recovery) and, thus, to a change in working techniques (lower physical workload). As a result, a decline in musculoskeletal symptoms and sickness absenteeism was expected. However, as no change in need for recovery and physical workload were found (data not shown), it could be hypothesised that other pathways clarify the reduction in musculoskeletal symptoms and sickness absence. Other factors, such as improved job control or less manual material handling, which were not measured in the present study might have explained the reduction of sickness absence in the intervention group. Third, lower absenteeism cost might be explained by other health complaints than musculoskeletal symptoms and health status as measured in the present study. Unfortunately, because of confidentiality, companies were not allowed to provide causes of sickness absence in detail. Therefore, no additional analyses could be performed on other health outcomes. Finally, it cannot be ruled out that the cost difference is based on coincidence.[38]

Based on the key findings of the present study, the question arises whether or not to advice employers to implement the intervention in the construction industry. Because most of the ICERs were located in the South-West quadrant, decisions makers themselves need to decide whether the investment in the intervention is worthwhile compared to no intervention for their company. From our point of view, although this study showed some promising results with respect to the financial impact of the intervention to the employer, it is, for several reasons, not recommended yet to implement the current intervention directly on a large scale. First, the prime objective of worksite interventions is to enhance the expected health-related welfare of individuals in the workplace. As the workers' effort, commitment and participation in the current program did not improve their health, the purpose of these training sessions in term of an improved health were not achieved in the current intervention. As the workers' effort, commitment and participation in the current programme did not improve their health, the purpose of these training sessions in term of an improved health were not achieved in the current intervention. This indicates that more research is needed on programs that have benefits for both employer and workers. Second, the sensitivity analyses showed some confusing results. When the analyses were restricted to complete cases only, sickness absenteeism costs were no longer in favour of the intervention group. This may be due to the complete-cases being unrepresentative of the whole study population in term of absenteeism costs. Therefore, it could be hypothesized that the missing completely at-random assumption (i.e., missing data do neither depend on the unobserved nor the observed data) was not met. This assumption is required for complete-case analyses to provide valid and unbiased results.[39] In addition, when per-protocol analyses were performed, no differences in costs and effects were found compared to the main analyses. The lack of impact of the intervention may be due to the fact that a relatively healthy group of construction workers were included in the trial. Third, it should be noticed that, although economic evaluations are useful for companies to decide whether or not to implement an intervention on a wider scale, other benefits, such as an improved company image and workers' commitment to the company, that are difficult to measure and value should be weighted in the decision as well. Because of the reasons mentioned earlier, employers and policy makers should interpret the results of the current study with caution.

Some lessons can be learned from the current study for future researchers who are planning to conduct an economic evaluation from an employers' perspective. First, to support stakeholders (employers, business managers) in deciding which intervention is a worthwhile investment or not, researchers should emphasize more the quality of economic evaluations from an employers' perspective. Following the present study, high quality studies should include a detailed description of the target population and intervention, an explicit statement for the narrowed perspective, and sensitivity analyses.[37] Second, we handled missing data by using multiple imputations. As minimising missing data is important in economic evaluations, researchers should also put as much effort as possible in collecting complete datasets. Future researchers should also explore optimal resources for collecting questionnaires and other data to minimise the amount of missing data in RCTs.[40] Third, presenting the financial return in terms of the NB, BCR, as well as the ROI is recommended as the NB is well known to policy-makers and economists whereas business managers prefer the BCR and ROI.[10] Also, this way of presenting the financial return makes the results easier to interpret and compare for all stakeholders.

Conclusion

The intervention in the present study was cost-saving to the employer due to a reduction in sick leave days. Specifically, for each €1 invested in the intervention group, €6.4 was gained. However, the intervention was not cost-effective in comparison with the control group in terms of work ability, physical and mental health, and musculoskeletal symptoms, due to a lack of effect on these outcomes by the intervention. Despite promising results with respect to the financial return, implementing the intervention in the current form at a larger scale in the Dutch construction industry is not recommended yet.

References

1. Beereboom HJA, Blomsma G, Corten IW, Muchall S. De bouwarbeidsmarkt in de periode 2005–2010 [The labour market of the construction industry in the period 2005–2010]. Amsterdam; 2005.
2. Eurostat. Europe in Figures; Eurostat yearbook 2011, chapter 5 labour market. Lyxembourg: Eurostat European Commission; 2011.
3. Hulshof C, Frings-Dresen MH. International OH systemas. Part 2: occupational health delivery in the Netherlands. *Occupational Health at Work* 2010;6(5):19-23.
4. Burdorf A. Economic evaluation in occupational health - its goals, challenges, and opportunities. *Scand J Work Environ Health* 2007;33(3):161-4.
5. Leigh JP. Expanding research on the economics of occupational health. *Scand J Work Environ Health* 2006;32(1):1-4.
6. Tompa E, Culyer AJ, Dolinschi R. Economic Evaluation of Interventions for Occupational Health and Safety: Developing Good Practice New York: Oxford University Press; 2008.
7. Goetzel RZ, Ozminkowski RJ. The health and cost benefits of work site health-promotion programs. *Annu Rev Public Health* 2008;29:303-23.
8. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ. Methods for the Economic Evaluation of Health Care Programmes. 3rd edition ed. New York: Oxford University Press; 2005.
9. Cavallo D. Using Return on Investment Analysis to Evaluate Health Promotion Programs: Challenges and Opportunities. *Health Promot Econ Issue Briefs* 2006;1(1):1-4.
10. Van Dongen JM, Proper KI, Van Wier MF, Van der Beek AJ, Bongers PM, Van Mechelen W, et al. Systematic review on the financial return of worksite health promotion programmes aimed at improving nutrition and/or increasing physical activity. *Obes Rev* 2011;12(12):1031-49.
11. Groeneveld IF, Van Wier MF, Proper KI, Bosmans JE, Van Mechelen W, Van der Beek AJ. Cost-effectiveness and cost-benefit of a lifestyle intervention for workers in the construction industry at risk for cardiovascular disease. *J Occup Environ Med* 2011;53(6):610-7.
12. IJzelenberg H, Meerding WJ, Burdorf A. Effectiveness of a back pain prevention program: a cluster randomized controlled trial in an occupational setting. *Spine (Phila Pa 1976)* 2007;32(7):711-9.
13. Oude Hengel KM, Joling CI, Proper KI, Van der Molen HF, Bongers PM. Using intervention mapping to develop a worksite prevention program for construction workers. *Am J Health Promot* 2010;26:e1-e10.
14. Oude Hengel KM, Joling CI, Proper KI, Blatter BM, Bongers PM. A worksite prevention program for construction workers: design of a randomized controlled trial. *BMC Public Health* 2010;(10):doi: 10.1186/1471,2458-10-336.
15. Ilmarinen J. Ageing workers in the European Union - Status and promotion of work ability, employability and employment. Helsinki: Finnish Institute of Occupational Health, Ministry of Social Affairs and Health, Ministry of Labour; 1999.
16. Ahlstrom L, Grimby-Ekman A, Hagberg M, Dellve L. The work ability index and single-item question: associations with sick leave, symptoms, and health--a prospective study of women on long-term sick leave. *Scand J Work Environ Health* 2010;36(5):404-12.
17. Torgén M. Experiences of WAI in a random sample of the Swedish working population. *International Congress Series* 2005;1280:328-32.
18. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work ability index. Helsinki: Finnish Institute of Occupational Health; 1998.
19. Jenkinson C, Layte R. Development and testing of the UK SF-12 (short form health survey). *J Health Serv Res Policy* 1997;2(1):14-8.
20. Ware JJ, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996;34(3):220-33.

21. Saris-Baglama RN, Dewey CJ, Chisholm GB, Plumb E, King J, Kosinski M, et al. QualityMetric Health Outcomes Scoring Software 3.0: User's Guide. Lincoln: QualityMetric Incorporated; 2009.
22. Hildebrandt VH, Bongers PM, Van Dijk FJ, Kemper HC, Dul J. Dutch Musculoskeletal Questionnaire: description and basic qualities. *Ergonomics* 2001;44(12):1038-55.
23. Uegaki K, De Bruijne MC, Anema JR, Van der Beek AJ, Van Tulder MW, Van Mechelen W. Consensus-based findings and recommendations for estimating the costs of health-related productivity loss from a company's perspective. *Scand J Work Environ Health* 2007;33(2):122-30.
24. Prasad M, Wahlqvist P, Shikiar R, Shih YC. A review of self-report instruments measuring health-related work productivity: a patient-reported outcomes perspective. *Pharmacoeconomics* 2004;22(4):225-44.
25. Kessler R, Petukhova M, McInnes K, Üstün TB. Content and scoring rules for the WHO HPQ absenteeism and presenteeism questions. Harvard Medical School; Accessed May 15, 2012.
26. Kessler RC, Barber C, Beck A, Berglund P, Cleary PD, McKenas D, et al. The World Health Organization Health and Work Performance Questionnaire (HPQ). *J Occup Environ Med* 2003;45(2):156-74.
27. Azur MJ, Stuart EA, Frangakis C, Leaf PJ. Multiple imputation by chained equations: what is it and how does it work? *Int J Methods Psychiatr Res* 2011;20(1):40-9.
28. Rubin DB. Multiple imputation for nonresponse in surveys. New York: J. Wiley & Sons; 1987.
29. Black WC. The CE plane: A graphic representation of cost-effectiveness. *Med Decis Making* 1990; 10(3):212-214.
30. Stone PW. Return-on-investment models. *Appl Nurs Res* 2005;18(3):186-9.
31. Petrou S, Gray A. Economic evaluation alongside randomised controlled trials: design, conduct, analysis, and reporting. *BMJ* 2011;342:doi:10.1136/bmj.d1548.
32. Gomes M, Grieve R, Nixon R, Edmunds WJ. Statistical methods for cost-effectiveness analyses that use data from cluster randomized trials: a systematic review and checklist for critical appraisal. *Med Decis Making* 2012;32(1):209-20.
33. Gomes M, Ng ES, Grieve R, Nixon R, Carpenter J, Thompson SG. Developing appropriate methods for cost-effectiveness analysis of cluster randomized trials. *Med Decis Making* 2012;32(2):350-61.
34. Marshall A, Billingham LJ, Bryan S. Can we afford to ignore missing data in cost-effectiveness analyses? *Eur J Health Econ* 2009;10(1):1-3.
35. Cancelliere C, Cassidy JD, Ammendolia C, Cote P. Are workplace health promotion programs effective at improving presenteeism in workers? A systematic review and best evidence synthesis of the literature. *BMC Public Health* 2011;11:395: doi:10.1186/1471-2458-11-395.
36. Schultz AB, Chen CY, Edington DW. The cost and impact of health conditions on presenteeism to employers: a review of the literature. *Pharmacoeconomics* 2009;27(5):365-78.
37. Uegaki K, De Bruijne MC, Lambeek L, Anema JR, Van der Beek AJ, Van Mechelen W, et al. Economic evaluations of occupational health interventions from a corporate perspective - a systematic review of methodological quality. *Scand J Work Environ Health* 2010;36(4):273-88.
38. Alavinia SM, van den Berg TI, van Duivenbooden C, Elders LA, Burdorf A. Impact of work-related factors, lifestyle, and work ability on sickness absence among Dutch construction workers. *Scand J Work Environ Health* 2009;35(5):325-33.
39. Burton A, Billingham LJ, Bryan S. Cost-effectiveness in clinical trials: Using multiple imputation to deal with incomplete cost data. *Clin Trials* 2007;4(2):154-161.
40. Noble SM, Hollingworth W, Tilling K. Missing data in trial-based cost-effectiveness analysis: the current state of play. *Health Econ* 2012;21(2):187-200.

Chapter 10

General discussion

10

Sustainable employability is one of the major challenges for industrialised countries over the coming decades. Because of a shrinking and ageing working population, it is important that more workers prolong their working life in a healthy and productive way.[1] The challenge to extend working lives is the most eminent in industries with high physical work demands. Workers with physically demanding jobs run an increased risk of a lower health status[2] and lower work ability[3]. Moreover, blue-collar workers report a lower ability and willingness to continue working until the age of 65 than do white-collar workers.[4] Currently, these workers are retiring far below the official retirement age. Prolonging working lives is not only a matter of raising the retirement age in collective agreements, but also a matter of improving the ability and the willingness of workers to continue working until the retirement age. Therefore, policies and intervention programmes are needed for blue-collar workers to promote their health and work ability, and thereby prolong a healthy and productive working life.

The main objectives of this thesis are to identify factors that influence the ability and the willingness to continue working until the age of 65 years in the general population of employees aged 45-64 years and in the specific population of construction workers, and to develop and evaluate a tailored prevention programme to promote the work ability and health of construction workers. This chapter presents the main findings in light of these objectives, discusses research issues, and presents recommendations and opportunities for future directions in research and practice.

Overview of the findings

Factors influencing the ability and the willingness to continue working

According to previous studies on actual early retirement[5,6], and on the ability and willingness to continue working[7], health played an important role in prolonging working lives among older employees (Chapter 2). Specifically, emotional exhaustion predicted a lower likelihood to be able and willing to continue working until the age of 65, whereas a work handicap was negatively related to the ability to continue working. Moreover, lower support from the supervisor and emotional demands were negatively related to the ability to continue working, whereas inappropriate behaviour by colleagues/supervisor predicted a lower likelihood to be willing to do so. In line with a previous study[7], older employees with high physical demands were less often able to continue working until the age of 65.

While physical job demands also played a significant role in a lower ability to continue working in construction workers, these demands were also associated with a lower willingness to continue working in these workers as well (Chapter 3). Moreover, several psychosocial work factors, such as lower supervisor support and lower skill discretion, were associated with a lower ability and willingness to continue working. In contrast, lower social support from colleagues was associated with a higher willingness to continue working. The role of physical job demands is in line with previous studies investigating early retirement among blue-collar workers, whereas these studies showed different results on the influence of psychosocial factors.[5,8,9] Additionally, health was an important factor associated with a lower ability and willingness to continue working in construction workers. In particular, the occurrence of musculoskeletal symptoms was associated with both a lower ability and willingness to continue working, whereas emotional exhaustion was only associated with a lower ability to continue working.

In conclusion, poor health was related to a lower ability and willingness to continue working until the age of 65 among older employees in general and among construction workers. In addition, physical and psychosocial job demands were related to a lower ability in both groups, whereas these demands were only associated with a lower willingness to continue working in construction workers. Relatively few work-related factors predicted the willingness to continue working in older employees.

Development of a prevention programme to prolong a healthy working life

Following the principles of the Intervention Mapping protocol[10], an intervention at construction worksites was developed in which evidence from the literature was systematically combined with data from stakeholders (i.e., construction workers, managers, trainers, and researchers; Chapter 4). The first step in the Intervention Mapping protocol resulted in two programme objectives for the intervention: (i) construction workers improve their balance between physical workload and need for recovery, and (ii) construction workers improve their range of influence at the worksite. For each programme objective, intervention materials were developed and combined into a prevention programme for construction workers. In the end, the intervention programme consisted of the following components: two individual training sessions at the worksite performed by a physical therapist, a Rest-Break tool to raise awareness about reducing fatigue by taking flexible rest breaks, and two interactive group training sessions by an empowerment trainer. The programme was delivered at the worksite during working hours, and within the existing education system in the Dutch construction industry. This prevention programme was evaluated in a cluster randomised controlled trial (RCT) among construction workers (n=293) employed at six construction companies (Chapter 5).

Evaluation of the programme at construction worksites

The prevention programme was largely implemented as intended, and most construction workers were willing to participate in the prevention programme in general and in the specific training sessions (Chapter 6). The satisfaction of the construction workers towards these training sessions was moderate. The Rest-Break tool was, however, highly criticised and not used by the workers. Yet, 64% of the workers recommended the overall programme for future implementation; the training sessions of the physical therapists were even recommended by 79% of them. Furthermore, contextual factors influenced the implementation of the intervention. More specifically, working in a smaller company (<100 employees), experiencing no direct consequences of the economic crisis and having a higher management engagement towards the programme positively influenced several aspects of the implementation process.

Despite the fact that the construction workers were rather positive about the intervention, the prevention programme neither improved social support and work engagement, nor reduced the physical workload and need for recovery among construction workers in the intervention group (Chapter 7). In addition, work ability and health status were not affected by the intervention either (Chapter 8). Yet, a statistically non-significant trend was found in the reduction of the prevalence of musculoskeletal symptoms and long-term sick leave in favour of the intervention group. As no significant effects were found for work ability and health, the intervention cannot be regarded as cost-effective from an employer's perspective. However, it appeared that the intervention was cost-saving for the employer due to a reduction in sick leave days. Specifically, for each euro invested in the intervention group, €6.4 was gained (Chapter 9).

Issues in the research context

In this paragraph, I will interpret the results found in this thesis in the light of methodological issues, programme failure and theory failure. First, I will discuss the general methodological issues in relation to the included surveys to measure the ability and willingness to continue working (Chapters 2 and 3), the study population, the study design, and the outcome measures of the trial (Chapters 4-9). Second, the causes for the lack of significant effects of the prevention programme will be explained by programme failure and theory failure.

Methodological issues

Measurement of the surveys

The factors influencing the ability and willingness to continue working until the age of 65 were investigated using two surveys, one among older employees in a longitudinal design (the Netherlands Working Conditions Cohort Survey), and one among construction workers in a cross-sectional study (the Netherlands Working Conditions Survey). Both surveys are unique as they are large and representative of the Dutch employee population. As participation in both surveys was voluntary, bias due to non-response could not be ruled out in either study. In the Netherlands, the response to surveys is usually low, and the response at baseline of about 32% was considered to be satisfactory. Because no information was available on the non-respondents, I do not know whether selective non-response influenced the findings. Bias due to selective loss to follow-up is a larger issue than selection bias due to non-response in longitudinal studies. In the current study, persons lost to follow-up in the longitudinal study were less often able to continue working until the age of 65. Therefore, it is assumed that a relatively large number of these workers stopped working during the follow-up period. Although this may have resulted in an underestimation of the number of employees being unable to continue working, it remains unclear to what extent selective response influenced the findings.

The second methodological issue of both surveys concerns the measurement of the ability and willingness to continue working. Both concepts were measured using single-item questions, and one could question the reliability of these items. A previous report among older employees, in which the same group of workers was described as in Chapter 2, showed that the willingness and ability to continue working until the age of 65 were predictive for early retirement.[11] However, it needs to be argued whether this relation will remain for younger workers as well. Younger workers may be less aware of the possibilities and capabilities needed to prolong their working life since the retirement age is a long-term issue for them.

Study population

The target population in the intervention proposal consisted of construction workers aged 45 and older. However, the participatory approach during the Intervention Mapping protocol led to new insights regarding the target population (Chapter 4). It was not only the workers and human resource managers who mentioned age-discrimination as an important obstacle for successful implementation; the researchers themselves also came to an advancing insight that prolonging healthy and productive working lives needs to start as early as possible. In addition, as the programme aimed to target the work environment, the trainers were concerned that including only older workers would hinder implementation (Chapter 4). Taking the opinions of all stakeholders into account, workers of all ages were invited to participate in the programme. However, as only older workers participated in the focus groups during the development phase, the question remains to what extent the intervention fits the younger workers as well. In my opinion, including younger workers in the development phase may have led to other designed intervention materials rather than to other programme objectives. This is in line with the results, which showed no differences between the two age groups in the different aspects of the process evaluation (Chapter 6), nor was an effect modification found for age in any of the outcomes (Chapters 7 and 8).

With regard to the recruitment of companies and workers, the research team faced immense difficulties in recruiting companies, as only six of the 234 approached companies committed themselves to the programme (Chapter 6). In line with previous studies[12,13], the unknown content and requested additional time and costs were reasons for the low interest of directors and management of the companies to participate. This was particularly the case for construction companies who were aware of their insecure situation in times of financial recession. Those six companies that finally volunteered to participate in this trial could be considered as early adopters when it comes to health and safety.[14] Consequently, workers at these companies probably have more understanding of the importance of health and safety issues, and might have more sympathy towards the programme, which led to the high willingness among the workers to participate in the trial (84%). This reach is higher than has generally been found in interventions among blue-collar workers.[15,16] The attendance rate of the workers that followed at least three training sessions (61%) was in line with other worksite programmes.[15,17,18] The high reach and attendance rates confirmed the value of the recruitment and implementation strategy for workers as presented in this thesis. A recruitment strategy should include the involvement of the workers during the development phase[10], commitment from management[19], and a personal invitation. Implementing the intervention at worksites during working hours[19], and within the existing education system are key elements for future implementation strategies. However, the low reach among companies suggests that different recruitment strategies are needed for them. A higher reach among companies could be obtained by recruiting companies through their sector organisation, and providing them with the preconditions in terms of time and costs (e.g., number of hours spent during working time, and intervention costs).

Study design

For evaluation purposes, a randomised controlled trial is a strong and transparent prospective research design as it offers the opportunity to control for several factors, such as confounding and selection bias. To minimise contamination among construction workers who are working at worksites that are temporary and mobile, cluster randomisation is recommended. Cluster randomisation in the current trial took place at the level of departments within companies instead of the company level. Randomisation at department level appeared of significance as the consequences of the financial recession were different across the participating construction companies. By clustering workers at department level within each company, the results presented in this thesis are not distorted by company factors such as economic status. To correct for the clustering within the dependency of observations (clustering of workers within departments and companies, and repeated measurements within one worker), multilevel analyses were used in the effectiveness studies (Chapter 7 and 8). Clustering of observations was, however, ignored in the analyses of the economic evaluation. Methods that address clustering in both effects and costs, and are adjusted for covariates are not yet fully developed nor does consensus exist about the best method.[20] Nevertheless, leaving clustering out of the economic evaluation did not change our conclusion as the results in Chapter 8 (with clustering) and 9 (without clustering) were both statistically non-significant.

Outcome measures

Work ability and health status were selected as primary outcomes since both are contributors to sustainable employability. To measure these outcomes, standardised international questionnaires were used. The Work Ability Index (WAI)[21] is the most widely used questionnaire to measure the concept of work ability, and has been developed to monitor work ability at working population level[3]. Health status was measured using the short-term SF-12, which is a shortened version of the SF-36, and has been recommended to be of value in a setting where a short general health measure is required[22], and within patient populations[23]. It was unknown whether both questionnaires (i.e., WAI and SF-12) were adequate to measure changes over time within working populations. In line with previous intervention studies among blue-collar workers including work ability[24-26], and mental and physical health status[27], the current trial did not detect statistically significant changes (Chapter 8). A reason for this ineffectiveness may be that the mean scores of work ability, and physical and mental health were already good at baseline, implying that a relatively healthy group of workers was included in the current trial (i.e., ceiling effect). Therefore, I hypothesise that both primary outcome measures might be insufficiently sensitive to change among a group of relatively healthy workers within a follow-up period of 12 months.

The second methodological concern is to what extent productivity loss was measured and valued in a reliable and valid way (Chapter 9). Productivity loss at work was defined as sickness absence and presenteeism (i.e., being present at work but working at a reduced capacity due to sickness; Chapter 9). Data on sickness absence of the construction workers were obtained from the registration systems of the companies, meaning that information and recall bias were eliminated. However, how presenteeism should be measured and monetised in a valid and reliable way is still an ongoing discussion.[28-30] In the current trial, presenteeism was measured subjectively with a single question[31,32] in which the work performance of the previous four weeks was examined at baseline, and at three, six and 12 months follow-up. A recent review, however, recommends a shorter recall period (i.e., one week) because a longer period reduces accuracy.[33] According to this recommendation, more frequent follow-ups are needed, but this gain in accuracy should outweigh the increase in participant burden. Although it is not recommended to increase the frequency of follow-ups, the one-week recall period might still be recommended because of the higher accuracy. Not only measuring presenteeism, but also monetising presenteeism varies widely.[28,34] For example, studies differ with regard to taking compensation mechanisms into account or not. To illustrate this, if a worker has a reduced capacity, it might be that the remaining workers sacrifice their rest breaks or work harder, or that employers cancel non-urgent work, or replace a sick worker. Compensation mechanisms were not taken into account in the current economic evaluation. As no consensus exists about presenteeism[34,35], presenteeism costs were only included in one sensitivity analyses in the current trial. However, as both costs (i.e., absenteeism and presenteeism) are important in terms of benefits for the employer, it is necessary to reach consensus and to include them in the main analyses in future research.

Programme and theory failure

Besides methodological issues, the small and non-significant effects of the prevention programme need to be further discussed in light of possible programme and theory failure.[36] Programme failure indicates that a poorly implemented intervention resulted in no improvement in the study outcomes, whereas theory failure implies that the rationale behind the intervention was not entirely correct.

Programme failure may be indicated by three factors. Firstly, not all of physical therapist's training sessions were delivered individually because this was not always feasible within the dynamic setting of construction worksites[37]. This means that the rationale behind the intervention protocol was not entirely followed by the trainers. Secondly, even though the training sessions were incorporated into an existing education system and implemented during working hours at the worksite, 39% of the workers still attended less than three training sessions (Chapter 6). This moderate compliance might have dimmed the effectiveness of the intervention. However, the per-protocol analyses on the number of training sessions showed no differences between workers with low or high compliance (Chapter 7). Thirdly, it could be hypothesised that the intervention was less effective because of the financial recession. Companies and their workers might have felt obliged to only focus on activities that obviously and directly contribute to their productivity. Moreover, the workers may not have committed themselves to the programme when they faced the fear of losing their jobs at the same time. The implementation of the intervention was indeed hampered by the financial recession, as this negatively influenced the dose delivered and the satisfaction of the workers towards the programme (Chapter 6).

Besides the programme failure, several signs of theory failure were also detected. First, the number of training sessions (i.e., four) might be too small to have significant effects. Possibly, a longzer duration or higher frequency of the training sessions from the physical therapists is needed in order to achieve a behavioural change with regard to working techniques, and consequently a decline in musculoskeletal symptoms. The workers themselves also mentioned that a higher frequency would be valuable to achieve long-term effects in reducing physical workload and the prevalence of musculoskeletal symptoms (Chapter 6). Regarding the training sessions by the empowerment trainer, a higher frequency of these sessions would probably not lead to favourable effects. During the sessions, the responsibilities for specific issues, such as social support, communication and work engagement, were addressed at the individual level. However, involvement of supervisors and management might be valuable to achieve a change at organisational level, and needs therefore to be incorporated in the topics discussed in the empowerment training sessions. Furthermore, even though fatigue is a risk factor for reduced employability among construction workers, they showed little interest in the application of the Rest-Break tool to improve their need for recovery. Workers experienced difficulties filling in their weekly fatigue status, and they mentioned that the advice was not always feasible in daily practice. As the frequency and duration of rest breaks are recorded in policies at worksite or company level, involvement of supervisors and management is essential. Therefore, more qualitative research by means of interviews with workers, supervisors and management is needed to explore which solutions might be more appropriate to reduce fatigue.

Thus, besides the earlier mentioned methodological issues such as the insensitivity of the outcome measures, the absence of effects on the primary and secondary outcomes of the interventions need to be explained by programme failure as well as theory failure as both have taken place in the present intervention study.

Implications for research

The current thesis contributes to the knowledge about determinants of sustainable employability, and interventions to support sustainable employability among construction workers. In the following paragraphs, I will discuss where more knowledge is needed and which future directions in research should be taken.

More insight into the ability, willingness and opportunity to continue working

While the current thesis has gained relevant knowledge on the ability and willingness to continue working in the current profession until the age of 65, a broader view is also needed when following the definition of sustainable employability.[38] In short, sustainable employability is defined as workers having the capabilities, the opportunities, and the necessary conditions that allow them to achieve valuable work function in current and future work.[38] This definition implies that workers might need to change job or profession to extend their working career. Thus, in addition to the current questions that were asked in our survey and longitudinal study, future epidemiological research should also focus on workers' ability and willingness to remain in the labour force, even when this asks for a career transition.

Additionally, the current thesis has contributed valuable knowledge about the impact of health and physical and psychosocial work-related factors on the ability and willingness to continue working until the age of 65. Besides these factors, more longitudinal studies are needed to gain insight into the influence of other factors as well. First, researchers should shift their focus towards promoting factors. While cross-sectional and qualitative studies on early retirement and work disability pensions among blue-collar workers have mainly focused on risk factors[8,9,39], it is plausible that promoting factors, such as an appropriate effort-reward balance and challenging work[40,41], will facilitate the ability and the willingness to continue working. Second, financial factors, such as financial stimuli[40] and the financial situation of a worker[41], might influence whether workers retire or not. Moreover, previous qualitative and cross-sectional studies showed that social factors, such as support from the partner[41], and other factors, such as lifestyle aspects[42] and subjective life-expectancy[43], also played a role in extending working lives. Third, according to the definition of sustainable employability[38], it is also recommended to include factors about the working career, such as to what extent a worker's knowledge and capacities fit the current job, and the willingness for a career transition. This supplementary knowledge from longitudinal studies will contribute to the development of policies and intervention programmes to prolong workers' working lives in a healthy and productive way.

Finally, in addition to the ability and willingness to continue working until the retirement age, the workers must also have the opportunity to actually extend their working lives. Therefore, it is interesting to know which determinants at the organisational level play a role in the opportunity to continue working (e.g., the company). A Dutch report showed that dissatisfaction about older employees and stereotyping these workers impede sustainable employability.[44] Scientific research is needed to determine which specific factors (e.g., company characteristics and policies) play a role in the opportunity to continue working, and whether these factors differ among industries and target populations. Insight into these factors is important to develop policies and intervention programmes at the organisational level.

Implications for future evaluations of interventions at worksites

Conventionally, the scientific success or failure of an intervention is mainly derived from the effects on health and productivity-related outcomes within an RCT. Following this, the current prevention programme has failed as it showed no significant positive effects on either primary or secondary outcomes. At the same time, the workers mentioned that they were moderately satisfied with the overall programme, and the financial return was positive for employers. This raises the question as to whether the intervention was indeed not proven to be effective or that the success or failure of the intervention could not be concluded on the predetermined outcomes alone. In other words, simply focusing on the effects of primary outcomes such as health and productivity may be inappropriate in RCTs when it comes to interventions implemented at worksites, which are complex and continuously changing.

In case of interventions at individual level, RCTs are considered as the most robust research design for establishing a cause-effect relationship between an intervention and an outcome, while controlling for all biases and confounders.[45] Because individual randomisation is often either not possible or inappropriate in worksite interventions, randomisation of groups might be preferred (i.e., cluster RCT). However, as the number of clusters is often limited, controlling for all factors and conditions of dynamic worksites between the intervention and control groups is almost impossible.[46] This is even more the case in the construction industry where worksites are temporary and mobile, meaning that workers move from one worksite to another bringing ideas, knowledge and experiences from the previous worksite[47]. To anticipate this, the so-called 'pragmatic trial' has been developed which allows variations of the intervention to be incorporated at different worksites.[48] This has already been used to some extent in the current thesis as the intervention slightly differed among the construction worksites. Following this line of reasoning, as interventions at different worksites are never exact copies of the original prescribed intervention in pragmatic trials[49], a detailed reporting of the process is essential[50]. A process evaluation is helpful to determine which part of the intervention is effective for whom and under which circumstances.[51] The current thesis described the process of the intervention, and linked this to the outcomes.[52] However, even more in-depth process evaluations are needed in which all key actors at individual and organisational level are involved. Additionally, a qualitative approach in these evaluations is valuable to provide an insight into the underlying thoughts and attitudes of the participants, and to describe and analyse the context. Hence, in interpreting the success or failure of future worksite interventions, process evaluations including a qualitative approach and economic evaluations from the employer's perspective need to be considered in addition to effect evaluations.

These comprehensive threefold evaluations are costly and time-consuming. Researchers have therefore to consider whether evaluation by the most rigid and robust design, such as an (cluster) RCT, is appropriate for newly designed interventions. In my opinion, new interventions definitely need to be tested and evaluated in an experimental setting. Within this experimental setting, a full pilot can be conducted in which not only can initial shortcomings in materials and tools be corrected, but also the feasibility of the intervention can be improved by gaining an insight into the context and culture of the target population.

If the worksite intervention has potential in the experimental setting, then it can still be evaluated in a more robust research design. As described previously, controlling for all factors and conditions at worksites is difficult within a cluster RCT. Therefore, researchers have to search for additional approaches to evaluate worksite interventions. First, alternative approaches that retain some elements of randomisation have already received increased attention in occupational health settings in recent years. One example of these quasi-experimental designs is the stepped-wedge design in which the intervention is sequentially rolled out to all clusters.[53,54] Additionally, I would suggest that the interventions are qualitatively evaluated in each cluster. By doing this, the intervention can be adjusted on the lessons learned, and an improved intervention can be implemented in the next cluster. Second, another example of an alternative approach is found in the econometric domain, in which models estimate the effectiveness of an intervention using observational data.[55,56] This modelling technique allows researchers to adjust for differences in covariates, and thereby eliminating biases.[57] For example, data from a cohort of workers within occupational health services can be collected in which participation in prevention programmes is recorded. Based on the cohort data and the workers' participation rates, an econometric model estimates the average causal effect of the intervention on the workers who received the programme compared to those who did not receive the intervention. It should be noticed that large numbers of workers are needed for these econometric models to eliminate indication bias. Nevertheless, these two examples showed that promising additional approaches are available, but researchers need to accept these new designs, and have to learn how to apply them for their purposes.

Implications for practice: towards healthy prolonged working lives for physically demanding jobs

During the course of this thesis, sustainable employability has been gaining an increasingly prominent place in political and public debates. At the start of this project in 2008, a Dutch commission had already advised the government to raise the retirement age in order to increase labour force participation.[58] During the years spent preparing this thesis, the majority of the political parties in the Netherlands realised that keeping workers employed for a longer period is essential from an economic point of view. However, their opinions differed on when and to what level the retirement age should be increased.

In the end, the Dutch government decided to raise the retirement age to counteract the expected shrinking working population in the near future. In July 2012, members of the Senate approved the bill to raise the retirement age stepwise from 65 in 2012 to 67 in 2023. During the political and public debates, a recurring concern was raised as to how workers in physically demanding jobs can extend their working life in a healthy and productive way. As described in Chapter 1, blue-collar workers nowadays leave the labour force at the age of 62, which is long before their official retirement age.[59]

Based on the current thesis, new scientific knowledge can be added to support sustainable employability among workers with physically demanding jobs, and in particular among construction workers. In the following paragraphs, I will discuss which future directions in practice are needed in order to keep workers with physically demanding jobs healthy and productive during their working career.

Key role for employers to promote (sustainable) employability

Even though policymakers raised the retirement age to finance the longer lives of all citizens, workers and employers are ultimately responsible for putting this into practice. While construction workers need to be able and willing to extend their working careers, whether they get the opportunity mainly depends on the employer's decisions. Nowadays, a slight positive tendency is noticeable in construction workers' ability and willingness to continue working[4], and in their actual retirement age (from 60.5 years in 2002 to 62.2 years in 2011)[59] due to amendments to the law and growing attention in the media. However, even though employers admit that enabling workers to continue working is important from a societal perspective, the majority of them are not convinced of the importance of keeping older construction workers within their own organisation.[60]

First, the negative attitudes of employers towards sustainable employability within their own organisation could be explained by the severe economic recession and accompanying increased unemployment of construction workers. As a consequence, construction companies are less concerned with long-term issues such as the shift in the workforce.[60] Second, employers generalise older workers as being more loyal, experienced and committed to their company than younger workers, but also as less skilled and having lower mental and physical capacities.[61,62] Stereotyping older construction workers in this way could give rise to age discrimination.[62] Third, employers' reluctance to support later retirement could also be explained by the fear that the increasing gap between productivity and labour costs of an ageing workforce is a burden for their company.[63,64] Even though it is expected that the productivity of an ageing workforce only slightly decreases, the increase in labour costs (i.e., high salaries) eventually leads to a growing productivity-labour costs gap.[60]

As employers play a key role in bridging the gap between the aims at the political level and the actual retirement age of workers, informing and convincing employers to let workers extend their working career is essential. Additionally, employers need to design policies and actions that enhance sustainable employability. Based on the current thesis, I suggest that these policies should not only focus on older workers, but should be designed for all workers at the worksite in order to limit age discrimination. These policies and actions to keep construction workers healthy and productive during their working career need to focus on reducing the physical and psychosocial workload (e.g., reducing physical workload, improving the range of influence and the social climate) or on improving the capacity of the workers (e.g., reducing fatigue) as described in the current thesis. Additionally, investing in human capital through lifelong learning during the whole working career seems necessary. By means of formal training programmes and informal ways, such as social media and platforms, construction workers learn to adjust their competences, skills and knowledge to the current and future work situation in order to improve their productivity and quality of work. Besides, these policies and actions are not only needed to prevent older construction workers from leaving the labour market early, but also to attract students to start their working careers in these jobs.

Embedding psychosocial factors into traditional OSH policies

Currently, occupational safety and health (OSH) policies in the construction industry are still primarily aimed at topics such as physical workload and safety. Of course, reducing physical workload is important as workers with high physical work demands are well documented to be at an increased risk of an impaired work ability[65], musculoskeletal symptoms[66,67], and sickness absence[68,69]. Improving safety is incorporated in the current policies because poor safety and associated (non-)fatal injuries are, in addition to the human suffering, a financial burden for construction companies.[70,71]

While these traditional OSH policies in the construction industry focus on preventing risks, they also need to pay attention to other topics when focusing on sustainable employability. The current thesis has shown that psychosocial factors (e.g. skill discretion and low supervisor support) are related to the ability and willingness to continue working. Additionally, during the focus groups, construction workers mentioned that time pressure and low social support from the supervisor hampered work ability and sustainable employability. Thus, in order to keep workers healthy and productive in the construction industry, psychosocial factors need to be incorporated in OSH policies at both sector and corporate level.

Embedding psychosocial factors in OSH policies at sector level is relatively easy to realise within the existing procedures and guidelines. Nowadays, psychosocial factors, such as time pressure and job control, are minimally incorporated in the periodic health examinations, which are obligatory offered to all Dutch construction workers. Not only should better constructs be added to these examinations, but sector organisations, the Health and Safety Institute (in Dutch: Arbouw), and occupational health services also need to offer preventive actions. Additionally, Occupational Health and Safety Catalogues (in Dutch: Arbocatalogi) and the Safety, Health and Environment Checklist Contracts (in Dutch: VCA aannemers checklist) should pay attention to psychosocial factors.

At corporate level, employers have to realise that psychosocial factors are of importance, in particular due to the changing building processes. Building processes are more often outsourced towards subcontractors and self-employed workers. These processes lead to an increased need for communication, higher work pace, and lower job autonomy among construction workers in paid employment. However, embedding psychosocial factors into OSH policies at the corporate level is difficult. First, the Health and Safety Institute, sector organisations and trade unions have to make sure that employers and their workers are well informed about the role of physical and psychosocial factors in sustainable employability. This may be achieved within the existing education system in the construction industry. This education system consists of at least 10 health and safety training sessions at the worksite for workers, which have to be organised yearly by construction companies to obtain an official Health and Safety Certificate.

Currently, training sessions that focus on psychosocial factors are not yet provided, which underlines the need for developing these training sessions. However, as the culture at construction worksites could be characterised as conservative and macho, the current intervention has already shown that it is quite difficult to interest workers in relatively new topics such as communication, social climate and need for recovery in the traditional style of the training sessions (e.g., factsheets, and oral presentation). Therefore, sector organisations, the Health and Safety Institute and companies have to search for other ways of incorporating these topics in the training sessions. An example is the use of new training techniques such as gamification in which game techniques and mechanics are used to enhance non-game contexts, and serious gaming in which a virtual reality environment is created. To illustrate this, a virtual worksite with contractors, supervisors and workers might be helpful in training workers in skills such as opening a discussion on psychosocial factors.[72] These kinds of technique might also be powerful in encouraging workers to link psychosocial and physical work demands with long-term issues such as sustainable employability. Other relatively new technologies, such as smartphones and accompanying applications, might be useful in training sessions as well as for monitoring the behaviour of construction workers and supervisors, and for providing information and feedback.

Future directions for prevention programmes in the construction industry

Even though the prevention programme in this thesis showed promising results regarding the satisfaction and recommendation rates of the construction workers and the financial impact for the employer, I would not suggest implementing the programme at construction worksites because the programme did not enhance the health and work ability of the construction workers. Based on the findings and the lessons learned, I would like to propose directions for future prevention programmes in the construction industry.

The ineffectiveness of the prevention programme described in the current thesis is in line with other high-quality studies on primary prevention that did not show significant effects on subjective health outcomes either.[27,73-75] This raises the question as to whether primary prevention programmes are necessary for whole populations including those workers who are completely healthy. In my opinion, future prevention programmes should shift their focus from primary prevention for all workers towards aiming at specific target populations who are at a higher risk of reduced employability. Nowadays, the obligatorily offered periodic medical examination in the construction industry is already in use as a starting point to select individuals at risk. Construction workers are currently offered programmes if the results of this examination show that they are, for instance, at high risk of being overweight or cardiovascular diseases.[76] Additional to these health-related individual programmes, there seems to be a need for prevention programmes that take into account the socio-ecological approach of sustainable employability. This approach considers the complex interplay between workers, work environment and social elements[77], and asks therefore for programmes at department or company level. Companies need first to gain an insight into the sustainable employability within their organisation. Nowadays, a general needs assessment already exists in the Netherlands that provides companies with indicators on how to improve the sustainable employability of their workers.[78] However, more tailored needs assessments are required for specific industries such as the construction industry. Because companies and construction workers are familiar with the periodic medical examination, I believe this examination should have the ability to serve as a needs assessment for sustainable employability in the construction industry. For that purpose, an adjusted version of the examination is needed in which a broader range of constructs will be assessed, such as physical and psychosocial work demands, but also the opportunities, capacities, motivation and ability to continue working. In the case of a potential risk factor for sustainable employability, companies are offered directions for interventions policies to reduce this specific risk factor. Based on the group results of the periodic medical examination, it might be that one company is recommended to implement one supplementary training session, whereas another company needs to implement several complementary sub-programmes or change its policies. In short, a more tailored approach is recommended in which companies employing workers at risk of a reduced employability can form a comprehensive multi-component prevention programme based on the company's specific risk factors.

General conclusion

Prevention of emotional exhaustion and promotion of a healthy social work climate may support both the willingness and ability to continue working until the age of 65 in older workers. Both, the ability and the willingness to continue working until the retirement age are important predictors for the choice of workers to retire or not. Among construction workers, poor health, high physical job demands, and high psychosocial job demands play a role in their ability and willingness to continue working until the retirement age.

The development of a prevention programme by using the Intervention Mapping approach revealed that interventions should not only focus on reduction of physical workload but should also assist construction workers in their attempts to exert influence at worksites. We did not succeed in incorporating this notion into an intervention that was effective. The prevention programme neither improved work ability, health status, social support, and work engagement, nor reduced the physical workload and need for recovery among construction workers in the intervention group. Yet, a statistically non-significant trend was found in the reduction of the prevalence of musculoskeletal symptoms and long-term sick leave in favour of the intervention group. Additionally, the finding that a non-significant reduction in sick leave resulted in a positive financial impact for the employer is intriguing. This, in combination with the fact that the construction workers were rather positive about the intervention, indicates that interventions focusing on physical and psychosocial work factors still have potential in the future.

References

1. Ilmarinen J. The ageing workforce; challenges for occupational health*. Occup Med (Lond)* 2006;56(6):362-4.
2. Karpansalo M, Manninen P, Kauhanen J, Lakka TA, Salonen JT. Perceived health as a predictor of early retirement*. Scand J Work Environ Health* 2004;30(4):287-92.
3. Gould R, Ilmarinen J, Järvisalo J, Koskinen S. Dimension of work ability: results of the Health 2000 Survey. Helsinki: Finnish Institute of Occupational Health; 2008.
4. Koppes LLJ, De Vroome EMM, Mol MEM, Janssen BJM, Van den Bossche SNJ. Nationale Enquête Arbeidsomstandigheden 2010: Methodologie en globale resultaten [The Netherlands working conditions survey 2010: Methodology and overall results]. Hoofddorp: TNO; 2011.
5. Van den Berg TI, Elders LA, Burdorf A. Influence of health and work on early retirement*. J Occup Environ Med* 2010;52(6):576-83.
6. Olesen SC, Butterworth P, Rodgers B. Is poor mental health a risk factor for retirement? Findings from a longitudinal population survey*. Soc Psychiatry Psychiatr Epidemiol* 2012;47(5):735-44.
7. Nilsson K, Hydbom AR, Rylander L. Factors influencing the decision to extend working life or retire*. Scand J Work Environ Health* 2011;37(6):473-80.
8. Szubert Z, Sobala W. Current determinants of early retirement among blue collar workers in Poland*. Int J Occup Med Environ Health* 2005;18(2):177-84.
9. Lund T, Iversen L, Poulsen KB. Work environment factors, health, lifestyle and marital status as predictors of job change and early retirement in physically heavy occupations*. Am J Ind Med* 2001;40(2):161-9.
10. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach. San Francisco: Jossey-Bass; 2006.
11. Ybema JF, Geuskens GA, Oude Hengel KM. Oudere werknemers en langer doorwerken [Older employees and prolonging working life]. Hoofddorp:TNO; 2010.
12. Cherniack M, Morse T, Henning R, Seidner A, Punnett L. Health promotion site selection blues: barriers to participation and implementation*. J Occup Environ Med* 2010;52(6):626-34.
13. Kidd P, Parshall M, Wojcik S, Struttmann T. Overcoming recruitment challenges in construction safety intervention research*. Am J Ind Med* 2004;45(3):297-304.
14. Rogers EM. Lessons for guidelines from the diffusion of innovations*. Jt Comm J Qual Improv.* 1995; 21(7):324-8.
15. Glasgow RE, McCaul KD, Fisher KJ. Participation in worksite health promotion: a critique of the literature and recommendations for future practice*. Health Educ Q* 1993;20(3):391-408.
16. Robroek SJ, van Lenthe FJ, van Empelen P, Burdorf A. Determinants of participation in worksite health promotion programmes: a systematic review*. Int J Behav Nutr Phys Act* 2009;6:26: doi: 10.1186/1479-5868-6-26.
17. Johnson CC, Lai YL, Rice J, Rose D, Webber LS. ACTION live: using process evaluation to describe implementation of a worksite wellness program*. J Occup Environ Med* 2010;52(Suppl 1):S14-21.
18. Strijk JE, Proper KI, Van der Beek AJ, Van Mechelen W. A process evaluation of a worksite vitality intervention among ageing hospital workers. *Int J Behav Nutr Phys Act* 2011;10(8):58.
19. Linnan LA, Sorensen G, Colditz G, Klar DN, Emmons KM. Using theory to understand the multiple determinants of low participation in worksite health promotion programs. *Health Educ Behav* 2001;28(5):591-607.
20. Gomes M, Grieve R, Nixon R, Edmunds WJ. Statistical methods for cost-effectiveness analyses that use data from cluster randomized trials: a systematic review and checklist for critical appraisal*. Med Decis Making* 2012;32(1):209-20.
21. Ilmarinen J. Ageing workers in the European Union - Status and promotion of work ability, employability and employment. Helsinki: Finnish Institute of Occupational Health, Ministry of Social Affairs and Health, Ministry of Labour; 1999.

22. Jenkinson C, Layte R. Development and testing of the UK SF-12 (short form health survey). *J Health Serv Res Policy* 1997;2(1):14-8.
23. Jenkinson C, Layte R, Jenkinson D, Lawrence K, Petersen S, Paice C, et al. A shorter form health survey: can the SF-12 replicate results from the SF-36 in longitudinal studies?. *J Public Health Med* 1997;19(2):179-86.
24. Jørgensen MB, Faber A, Hansen JV, Holtermann A, Søgaard K. Effects on musculoskeletal pain, work ability and sickness absence in a 1-year randomised controlled trial among cleaners. *BMC Public Health* 2011;11:840.
25. De Boer AG, Burdorf A, Van Duivenbooden C, Frings-Dresen MH. The effect of individual counselling and education on work ability and disability pension: a prospective intervention study in the construction industry. *Occup Environ Med* 2007;64(12):722-7.
26. Nurminen E, Malmivaara A, Ilmarinen J, Ylöstalo P, Mutanen P, Ahonen G, et al. Effectiveness of a worksite exercise program with respect to perceived work ability and sick leaves among women with physical work. *Scand J Work Environ Health* 2002;28(2):85-93.
27. IJzelenberg H, Meerding WJ, Burdorf A. Effectiveness of a back pain prevention program: a cluster randomized controlled trial in an occupational setting. *Spine (Phila Pa 1976)* 2007;32(7):711-9.
28. Uegaki K, De Bruijne MC, Van der Beek AJ, Van Mechelen W, Van Tulder MW. Economic evaluations of occupational health interventions from a company's perspective: a systematic review of methods to estimate the cost of health-related productivity loss. *J Occup Rehabil* 2011;21(1):90-9.
29. Burdorf A. Economic evaluation in occupational health-its goals, challenges, and opportunities. *Scand J Work Environ Health* 2007;33(3):161-4.
30. Goetzel RZ, Long SR, Ozminkowski RJ, Hawkins K, Wang S, Lynch W. Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting U.S. employers. *J Occup Environ Med* 2004;46(4):398-412.
31. Kessler R, Petukhova M, McInnes K, Üstün TB. Content and scoring rules for the WHO HPQ absenteeism and presenteeism questions.Boston: Harvard Medical School; Accessed 2012.
32. Kessler RC, Barber C, Beck A, Berglund P, Cleary PD, McKenas D, et al. The World Health Organization Health and Work Performance Questionnaire (HPQ). *J Occup Environ Med* 2003;45(2):156-74.
33. Zhang W, Bansback N, Anis AH. Measuring and valuing productivity loss due to poor health: A critical review. *Soc Sci Med* 2011;72(2):185-92.
34. Uegaki K, De Bruijne MC, Anema JR, Van der Beek AJ, Van Tulder MW, Van Mechelen W. Consensus-based findings and recommendations for estimating the costs of health-related productivity loss from a company's perspective. *Scand J Work Environ Health* 2007;33(2):122-30.
35. Koopmanschap M, Burdorf A, Jacob K, Meerding WJ, Brouwer W, Severens H. Measuring productivity changes in economic evaluation: setting the research agenda. *Pharmacoeconomics* 2005;23(1):47-54.
36. Kristensen TS. Intervention studies in occupational epidemiology. *Occup Environ Med* 2005;62(3):205-10.
37. Hawe P, Shiell A, Riley T, Gold L. Methods for exploring implementation variation and local context within a cluster randomised community intervention trial. *J Epidemiol Community Health* 2004;58(9):788-93.
38. Van der Klink JJL, Brouwer S, Bültmann U, Burdorf L, Schaufeli WB, Van der Wilt GJ, et al. Duurzaam inzetbaar: Een werkdefinitie. [Sustainable employability: a working definition]. 's Gravenhage: ZonMw; 2010.
39. Alavinia SM, De Boer AG, Van Duivenbooden JC, Frings-Dresen MH, Burdorf A. Determinants of work ability and its predictive value for disability. *Occup Med (Lond)* 2009;59(1):32-7.
40. Proper KI, Deeg DJ, van der Beek AJ. Challenges at work and financial rewards to stimulate longer workforce participation. *Hum Resour Health* 2009;7:70:doi:10.1186/1478-4491-7-70.

41. Henkens K, Van Dalen H, Van Solinge H. De vervagende grens tussen werk en pensioen. Over doorwerken, doorstarten en herintreders [The fading border between employment and retirement. About continuing to work and re-entering employment]. The Hague: NIDI; 2009.
42. Alavinia SM, Burdorf A. Unemployment and retirement and ill-health: a cross-sectional analysis across European countries. *Int Arch Occup Environ Health* 2008;82(1):39-45.
43. Van Solinge H, Henkens K. Living longer, working longer? The impact of subjective life expectancy on retirement intentions and behaviour. *Eur J Public Health* 2010;20(1):47-51.
44. Brouwer S, De Lange A, Van der Mei S, Wessels M, Koolhaas W, Bültmann U, et al. Duurzame inzetbaarheid van de oudere werknemer: stand van zaken [Sustainable employability of the older worker: state of the art]. Groningen: Universitair Medisch Centrum Groningen; 2012.
45. Patsopoulos NA. A pragmatic view on pragmatic trials. *Dialogues Clin Neurosci* 2011;13(2):217-24.
46. Cox T, Karanika M, Griffiths A, Houdmont J. Evaluating organizational-level work stress interventions: Beyond traditional methods. *Work & Stress* 2007;21(4):348-62.
47. Nielsen KM, Taris TW, Cox T. The future of organizational interventions: addressing the challenges of today's organizations. *Work & Stress* 2010;24(3):219-33.
48. Macpherson H. Pragmatic clinical trials. *Complement Ther Med* 2004;12(2-3):136-40.
49. Kok MO, Vaandrager L, Bal R, Schuit J. Practitioner opinions on health promotion interventions that work: opening the 'black box' of a linear evidence-based approach. *Soc Sci Med* 2012;74(5):715-23.
50. Murta SG, Sanderson K, Oldenburg B. Process evaluation in occupational stress management programs: a systematic review. *Am J Health Promot* 2007;21(4):248-54.
51. Egan M, Bambra C, Petticrew M, Whitehead M. Reviewing evidence on complex social interventions: appraising implementation in systematic reviews of the health effects of organisational-level workplace interventions. *J Epidemiol Community Health* 2009;63(1):4-11.
52. Oude Hengel KM, Blatter BM, Van der Molen HF, Joling CI, Proper KI, Bongers PM, et al. Meeting the challenges of implementing an intervention to promote work ability and health-related quality of life at construction worksites: a process evaluation. *J Occup Environ Med* 2011;53(12):1483-91.
53. Handley MA, Schillinger D, Shiboski S. Quasi-experimental designs in practice-based research settings: design and implementation considerations. *J Am Board Fam Med* 2011;24(5):589-96.
54. Mdege ND, Man MS, Taylor Nee Brown CA, Torgerson DJ. Systematic review of stepped wedge cluster randomized trials shows that design is particularly used to evaluate interventions during routine implementation. *J Clin Epidemiol* 2011;64(9):936-48.
55. Hogan JW, Lancaster T. Instrumental variables and inverse probability weighting for causal inference from longitudinal observational studies. *Stat Methods Med Res* 2004;13(1):17-48.
56. Robins JM, Hernan MA, Brumback B. Marginal structural models and causal inference in epidemiology. *Epidemiology* 2000;11(5):550-60.
57. Hirano K, Imbens GW, Ridder G. Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score. *Econometrica* 2003;71(4):1161-89.
58. Commissie Arbeidsparticipatie. Naar een toekomst die werkt [Towards a workable future]. Rotterdam: Ministerie van Sociale Zaken en Werkgelegenheid; 2008.
59. CBS. Pensioenleeftijd werknemers ruim 63 jaar. [Retirement age of employees over 63 years].2012. Available at: http://www.cbs.nl/nl-NL/menu/themas/gezondheid-welzijn/publicaties/artikelen /archief/2012/2012-3557-wm.htm.

60. Van Dalen HP, Henkens CJIM, Conen WS, Schippers J. Dilemma's rond langer doorwerken: Europese werkgevers aan het woord [Dilemmas of prolonging working life: the view of European employers]. Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen (KNAW); 2012.
61. Van Dalen HP, Henkens K, Schippers J. Productivity of older workers: perceptions of employers and employees. *Popul Dev Rev* 2010;36(2):309-30.
62. OECD. Live longer, work longer. Paris: OECDPublishing; 2006.
63. Van Dalen HP, Henkens CJIM, Henderikse W, Schippers J. Do European employers support later retirement? *International Journal of Manpower* 2010;31(3):360-73.
64. Conen W, Van Dalen H, Henkens K. Ageing and Employers' perceptions of labour costs and productivity: a survey among European employers. *Netspar Discussion Paper* 2012; No. 02/2012-013.
65. Van den Berg TI, Elders LA, De Zwart BC, Burdorf A. The effects of work-related and individual factors on the Work Ability Index: a systematic review. *Occup Environ Med* 2009;66(4):211-20.
66. Boschman JS, Van der Molen HF, Sluiter JK, Frings-Dresen MH. Occupational demands and health effects for bricklayers and construction supervisors: A systematic review. *Am J Ind Med* 2011;54(1):55-77.
67. Andersen JH, Haahr JP, Frost P. Risk factors for more severe regional musculoskeletal symptoms: a two-year prospective study of a general working population. *Arthritis Rheum* 2007;56(4):1355-64.
68. Alavinia SM, van den Berg TI, van Duivenbooden C, Elders LA, Burdorf A. Impact of work-related factors, lifestyle, and work ability on sickness absence among Dutch construction workers. *Scand J Work Environ Health* 2009;35(5):325-33.
69. Lund T, Labriola M, Christensen KB, Bültmann U, Villadsen E. Physical work environment risk factors for long term sickness absence: prospective findings among a cohort of 5357 employees in Denmark. *BMJ* 2006;332(7539):449-52.
70. Leigh JP, Marcin JP. Workers' compensation benefits and shifting costs for occupational injury and illness. *J Occup Environ Med* 2012;54(4):445-50.
71. Lipscomb HJ, Glazner JE, Bondy J, Guarini K, Lezotte D. Injuries from slips and trips in construction. *Appl Ergon* 2006;37(3):267-74.
72. Squire J. Harnessing the power of games in education. *Insight* 2003;3:5-33.
73. Strijk JE, Proper KI, Van Mechelen W, Van der Beek AJ. A worksite vitality intervention for older hospital workers to improve vitality, work engagement, productivity and sick leave: results of a randomized controlled trial. *Scand J Work Environ Health* 2012; doi: 10.5271/sjweh.3311.
74. Robroek SJ, Polinder S, Bredt FJ, Burdorf A. Cost-effectiveness of a long-term Internet-delivered worksite health promotion programme on physical activity and nutrition: a cluster randomized controlled trial. *Health Educ Res* 2012;27(3):399-410.
75. Driessen MT, Proper KI, Anema JR, Knol DL, Bongers PM, Van der Beek AJ. The effectiveness of participatory ergonomics to prevent low-back and neck pain; results of a cluster randomized controlled trial. *Scand J Work Environ Health* 2011;37(5):383-93.
76. Groeneveld IF, Proper KI, Van der Beek AJ, Van Mechelen W. Sustained body weight reduction by an individual-based lifestyle intervention for workers in the construction industry at risk for cardiovascular disease: results of a randomized controlled trial. *Prev Med* 2010;51(3-4):240-6.
77. Golden SD, Earp JA. Social ecological approaches to individuals and their contexts: twenty years of health education & behavior health promotion interventions. *Health Educ Behav* 2012;39(3):364-72.
78. Vos FSM, Wevers CWJ, Lindeboom D, Geuskens G, Koppes l, Luijters K, et al. Nationaal Inzetbaarheidsplan: instrumenten en verantwoording [National Employability Plan: instruments and accountability]. Hoofddorp: TNO; 2011.

Summary

Sustainable employability is one of the major challenges for industrialised countries in the next decades. Because of the shrinking and ageing working population, it is important that more workers prolong their working life in a healthy and productive way. The challenge to prolong healthy and productive working lives is the most eminent in industries with high physical workload. Because workers with physically demanding jobs run an increased risk for a lower work ability and poor health, many of them are currently retiring at a younger age than the official retirement age. Moreover, these workers report that they are less able and less willing to continue working until their official retirement age compared to other workers. Thus, in order to support sustainable employability among workers with physically demanding jobs, there is a need to develop policies and intervention programmes to promote their work ability and health **(Chapter 1)**.

The main objectives of this thesis were (i) to identify factors that influence the ability and the willingness to continue working until the age of 65 years in the general population of employees aged 45-64 years and in the specific population of construction workers, and (ii) to develop and (iii) to evaluate a tailored prevention programme to promote the work ability and health of construction workers. The first objective was addressed in Chapter 2 and 3, the second objective was addressed in Chapters 4 and 5, and the third objective was addressed in Chapters 6 to 9. In Chapter 10, the results of this thesis were summarized and discussed.

Factors to continue working until the age of 65

Chapter 2 describes a longitudinal study with one year follow-up, in which 4.937 workers aged 45-63 included in the Netherlands Working Conditions Cohort Study were studied to investigate which factors influenced the ability and willingness to continue working until the age of 65. This study showed that older workers and men were more often able and willing to continue working until the age of 65. Moreover, workers with emotional exhaustion were less often able and willing to continue working until the retirement age, whereas a work handicap was related to a lower ability to continue working until the age of 65. In addition, using force, emotional demands, a lack of social support from the supervisor and having a work handicap also predicted that workers felt less often able to continue working, whereas

inappropriate behaviour by colleagues or supervisor predicted more often a lower willingness to continue working until the age of 65.

Chapter 3 describes a cross-sectional study on the factors associated with the ability and willingness to continue working until the age of 65 in Dutch construction workers. For this study, 5.610 construction workers of the Netherlands Working Conditions Survey were included. This study showed that older construction workers were more often able but less willing to continue working until the age of 65. Besides, the occurrence of musculoskeletal symptoms was associated with both a lower ability and willingness to continue working, whereas emotional exhaustion was only associated with lower ability to continue working. In addition to physical job demands (i.e., using force and working in awkward postures), several psychosocial factors played a significant role in both the ability and willingness to continue working in construction workers. Specifically, lower supervisor support and lower skill discretion were associated with both a lower ability and willingness to continue working. In addition, dangerous work, occasionally using force, working in awkward postures, and lack of job autonomy were associated with a lower ability to continue working, whereas working overtime was associated with a higher ability.

Development of a prevention programme to prolong a healthy working life

The structured development of an intervention to promote the health and work ability of construction workers is outlined in **Chapter 4**. The intervention was developed by using the Intervention Mapping protocol, in which evidence from the literature was combined with qualitative data from stakeholders (i.e., older construction workers, managers, providers, and researchers). According to the principles of the Intervention Mapping protocol, the first step resulted in two program objectives: (i) construction workers improve the balance between physical workload and recovery, (ii) and construction workers improve their range of influence at the worksite. For each programme objective, materials were developed and combined into one prevention programme lasting six months. Finally, the intervention programme consisted of the following components: two individual visits at the worksite from a physical therapist, a Rest-Break tool to raise awareness about reducing fatigue by taking flexible rest breaks, and two interactive group sessions from an empowerment trainer. Following the Intervention

Mapping protocol resulted in an intervention that was not only tailored to the construction workers' needs and desires, but also to the abilities and opportunities of employers and programme implementers.

Chapter 5 presents the design of a cluster-randomised controlled trial, in which a process, effect and economic evaluation of the worksite prevention programme took place. The study included 293 construction workers from six construction companies in the Netherlands. Measurements took place at baseline, and at three, six and 12-month follow-up. Outcome measures were work ability, health (i.e., physical and mental health status, and musculoskeletal symptoms), work engagement, physical workload, need for recovery, social support, and sick leave. Sick leave data were acquired from continuous registration systems of the companies after follow-up.

Evaluation of the prevention programme among construction workers

Chapter 6 describes the implementation process and feasibility of the prevention programme at construction worksites. Although the research team faced immense difficulties in recruiting companies, the reach among workers of companies that finally participated was high (84%). Because the training sessions of the intervention were held at the worksite, 61% of the construction workers followed at least three out of four training sessions. The main reason for not attending the training sessions was the high impact of the financial crisis for one company, which had to lay-off workers and had to force the remaining workers to work part-time. The Rest-Break tool was hardly used by the workers. Main reasons for the lack of interest in the tool were that workers already took short-rest breaks at the worksite or that they were not able to follow the advice from the tool in practice. Regarding the satisfaction of the construction workers, the study showed a varying satisfaction towards the programme: workers were moderately satisfied with the training sessions of the physical therapist and empowerment trainer, whereas they rated the Rest-Break tool as unsatisfactory. Overall, 64% of the construction workers recommended the intervention to their colleagues. The training sessions of the physical therapist were recommended by 76% of the construction workers. Finally, contextual factors, such as working in a smaller company (< 100 employees) and higher management engagement towards the program, positively influenced the implementation of the intervention.

Chapters 7 and 8 present the effect evaluation of the prevention programme within a cluster-randomised controlled trial. A total of 15 departments from six companies participated in the trial; eight departments (n=171) were randomised to an intervention group and seven departments (n=122) to a control group. After 12 months, the loss-to-follow-up was 24% in the control group (n=29) and 30% in the invention group (n=51). **Chapter 7** concludes that the intervention neither improved social support nor work engagement, nor was effective in reducing the physical workload and need for recovery among construction workers. Even an adverse effect was found for physical workload at 6 months of follow-up. in which the intervention group reported a small but significant increase in physical workload compared to the control group. The results were neither influenced by the number of followed training sessions of the workers nor by the contextual factors as described in Chapter 6. Furthermore, no differences between the intervention and control group were found for work ability, physical and mental health (**Chapter 8**). Although the intervention showed a beneficial decline in the 6-month prevalence of musculoskeletal symptoms and long-term sick leave among construction workers in the intervention group, both reductions were not statistically significant at any of the measurements.

An economic evaluation from an employer's perspective in terms of a cost-effectiveness and financial return is described in **Chapter 9**. Data on work ability and health were collected at baseline, and at three, six and 12 months of follow-up by questionnaires. Costs due to sick leave were collected and calculated after 12 months of follow-up, whereas intervention costs were valued using the market prices that the six companies had to pay for the intervention. For the economic evaluation, missing data were imputed using multiple imputation. The prevention programme resulted, as described in Chapter 8, in non-significant effects on health and work ability, but significantly lower costs due to reduced sick leave. Due to a lack of effect on the primary outcomes and confusing results from the sensitivity analyses, we need to conclude that the intervention was not cost-effective compared to the control group. The financial return was estimated using a return- on-investment analysis. This analysis showed that the intervention was cost-saving for the employers due to reduced sick leave costs in the intervention group. Specifically, for each €1 invested in the intervention group, €6.4 was gained by the company.

Chapter 10, the general discussion, started with presenting the main findings in the light of the study objective, followed by methodological issues that should be acknowledged when interpreting the findings. Recommendations for future researchers and implications for practice were addressed in this Chapter. The general conclusion of objective one was that prevention of emotional exhaustion and promotion of a healthy social work climate may support both the willingness and ability to continue working until the age of 65 in older workers. Among construction workers, not only a poor health and high physical workload but also high psychosocial job demands play a role in their ability and willingness to continue working until the retirement age. The overall conclusion of the prevention programme, in which both physical and psychosocial factors were addressed, is that it neither improved work ability, health status, social support, and work engagement, nor reduced the physical workload and need for recovery among construction workers in the intervention group. However, the statistically non-significant reductions of the prevalence of musculoskeletal symptoms and sick leave and the finding that the non-significant reduction in sick leave resulted in a positive financial impact for the employer is intriguing. This, in combination with the fact that the construction workers were rather positive about the overall intervention, indicates that interventions focusing on physical *and* psychosocial work factors still have potential in the future.

Samenvatting

Het verhogen van duurzame inzetbaarheid van de beroepsbevolking is een van de grootste uitdagingen voor de geïndustrialiseerde landen in de komende decennia. Omdat de beroepsbevolking krimpt en vergrijst is het belangrijk om meer werknemers vitaal en productief voor het bedrijfsleven te behouden. De uitdaging om werknemers aan het werk te houden is het grootst voor de sectoren waar de fysieke belasting hoog is. Werknemers in deze sectoren hebben een verhoogd risico op een verminderde gezondheid en werkvermogen, waardoor zij tot op heden eerder met pensioen gaan dan hun officiële pensioengerechtigde leeftijd (65 jaar). Deze werknemers geven dan ook vaker dan werknemers in andere sectoren aan niet door te kunnen en willen werken tot de leeftijd van 65 jaar. Om duurzame inzetbaarheid bij werknemers met fysiek zwaar werk te bevorderen zijn beleid en interventieprogramma's nodig die zich richten op het werkvermogen en de gezondheid van de werknemers.

De belangrijkste doelstellingen van dit proefschrift zijn (i) het identificeren van factoren die het kunnen en willen doorwerken tot 65 beïnvloeden bij oudere werknemers in de beroepsbevolking en bij werknemers in de bouwnijverheid, en (ii) het ontwikkelen en (iii) het evalueren van een preventieprogramma om het werkvermogen en de gezondheid van werknemers in de bouwnijverheid te bevorderen. De eerste doelstelling wordt beschreven in hoofdstukken 2 en 3, de tweede doelstelling in hoofdstukken 4 en 5, en de derde in de hoofdstukken 6 tot en met 9. In hoofdstuk 10 zijn de bevindingen samengevat en bediscussieerd.

Factoren die kunnen en willen doorwerken tot 65 beïnvloeden

Hoofdstuk 2 beschrijft een longitudinale studie met één jaar follow-up, waarbij 4.937 werknemers in de leeftijd van 45 tot 63 jaar uit het Nederlandse Enquête Arbeidsomstandigheden Cohort onderzoek zijn geïncludeerd. Het doel van deze studie was om te onderzoeken welke factoren het kunnen en willen doorwerken tot 65 voorspellen. Allereerst rapporteerden oudere werknemers (55 jaar en ouder) en mannen vaker door te kunnen en willen werken tot 65. Werknemers met burn-out klachten gaven minder vaak aan tot de pensioengerechtigde leeftijd te kunnen en te willen werken, terwijl een arbeidshandicap alleen negatief gerelateerd was aan het kunnen doorwerken. Ook werknemers die fysieke kracht gebruiken tijdens het werk, een hoge emotionele werkbelasting hebben, of weinig steun van de leidinggevende ervaren, gaven minder vaak aan door te kunnen werken tot 65. Tenslotte gaven werknemers die ongewenst gedrag van collega's en/of leidinggevende rapporteerden, vaker aan niet door te willen werken tot de pensioengerechtigde leeftijd.

Hoofdstuk 3 beschrijft een cross-sectioneel onderzoek naar de factoren die samenhangen met het kunnen en willen doorwerken tot 65 bij werknemers in de bouwnijverheid. Voor deze studie zijn gegevens van 5.610 werknemers in de bouwnijverheid uit de Nederlandse Enquête Arbeidsomstandigheden geïncludeerd. Uit deze studie blijkt dat oudere werknemers in de bouwnijverheid weliswaar vaker denken door te kunnen werken tot de pensioengerechtigde leeftijd dan jongere werknemers, maar dat minder vaak willen dan jongere werknemers. Daarbij gaven werknemers met bewegingsapparaatklachten minder vaak aan door te kunnen en te willen doorwerken tot hun pensioengerechtigde leeftijd, terwijl werknemers met burn-out klachten minder vaak aangaven door te kunnen werken. Verder hing zowel een hoge fysieke werkbelasting als psychosociale werkbelasting negatief samen met zowel kunnen als willen doorwerken tot de pensioenleeftijd. In het bijzonder gaven werknemers met een lage sociale steun van de leidinggevende en met weinig taakvariatie minder vaak aan door te kunnen en te willen werken. Tenslotte gaven werknemers met gevaarlijk werk of lage autonomie op het werk minder vaak aan door te kunnen werken tot hun pensioenleeftijd, terwijl werknemers met overwerk aangaven door te kunnen werken.

Ontwikkeling van een preventie programma voor bouwplaatspersoneel

De systematische ontwikkeling van een interventie om de gezondheid en het werkvermogen van werknemers in de bouw te bevorderen, is beschreven in **Hoofdstuk 4**. De interventie is ontwikkeld met behulp van het Intervention Mapping protocol, waarbij kennis uit de literatuur is gecombineerd met kwalitatieve gegevens uit focusgroepen (oudere werknemers in de bouwnijverheid, human resource managers, trainers en onderzoekers). De eerste stap in het Intervention Mapping protocol resulteerde in twee doelen voor het preventieprogramma: (i) werknemers in de bouw verbeteren hun balans tussen de fysieke belasting en herstel, en (ii) werknemers in de bouwnijverheid vergroten hun invloedssfeer op de bouwplaats. Voor elk doel van het programma zijn materialen ontwikkeld en samengevoegd tot een preventieprogramma van zes maanden. Dit preventieprogramma bestond uit twee individuele werkplekbezoeken van een fysiotherapeut, een Werk-Pauze tool om het bewustzijn voor het nemen van flexibelere pauzes te vergroten en zo vermoeidheid te verminderen, en twee interactieve groepsessies van een empowerment trainer om inzicht te krijgen op de invloedssfeer. Door het volgen van het Intervention Mapping protocol is het preventieprogramma uiteindelijk niet alleen afgestemd op behoeftes van het bouwplaatspersoneel, maar ook aangepast aan de mogelijkheden van de werkgevers en trainers om daarmee de haalbaarheid van de interventie te vergroten.

Het doel van **hoofdstuk 5** is het presenteren van het cluster-gerandomiseerde, gecontroleerde onderzoek, waarbinnen een proces-, effectiviteits- en economische evaluatie van de interventie zijn uitgevoerd. Aan het onderzoek namen uiteindelijk 293 werknemers deel, van zes bouwbedrijven in Nederland. Vragenlijsten zijn afgenomen bij aanvang van de interventie en vervolgens na drie, zes en twaalf maanden. Uitkomstmaten waren werkvermogen, gezondheid (fysieke en mentale gezondheid, en bewegingsapparaatklachten), bevlogenheid, fysieke belasting, herstelbehoefte, sociale steun van leidinggevende/collega's en ziekteverzuim. Ziekteverzuimgegevens zijn verkregen via de databestanden van de zes bouwbedrijven.

Evaluatie van het preventieprogramma in de bouwnijverheid

Hoofdstuk 6 gaat over de mate waarin het preventieprogramma is geïmplementeerd en uitgevoerd zoals gepland en de mate waarin werknemers het programma hebben gevolgd en gewaardeerd (procesevaluatie). Hoewel het werven van bouwbedrijven in eerste instantie zeer moeizaam verliep, was de bereidheid tot deelname aan het programma onder werknemers van de zes bouwbedrijven hoog (84 procent). Omdat de trainingen zijn gehouden op de werkplek, volgden 61 procent van de werknemers gedurende het programma minimaal drie van de vier bijeenkomsten. De impact van de financiële crisis voor één bouwbedrijf was de belangrijkste reden waardoor werknemers de trainingen niet konden volgen. Dit bouwbedrijf was genoodzaakt om werknemers te ontslaan en de resterende werknemers in deeltijd aan het werk te houden. De Werk-Pauze tool werd niet of nauwelijks gebruikt door de werknemers. De geringe belangstelling voor deze tool kwam doordat werknemers al regelmatig korte rustpauzes namen op de bouwplaats of dat ze het juist lastig vonden om het advies daadwerkelijk op te volgen. Verder waren de meningen over het preventieprogramma verdeeld. De werknemers waren redelijk tevreden over de bijeenkomsten van de fysiotherapeut en de empowerment trainer, maar ze waren minder tevreden over de Werk-Pauze tool. Toch zou 64 procent van de werknemers het programma aanbevelen aan collega's in de bouwnijverheid. De individuele werkplekbezoeken van de fysiotherapeut werd door 76 procent van de deelnemers aanbevolen. Tenslotte, beïnvloedden het werken in een kleiner bedrijf (<100 werknemers) en de betrokkenheid van het hogere management ten aanzien van het programma de uitvoering van de interventie positief.

Hoofdstukken 7 en 8 beschrijven de effectevaluatie van het preventieprogramma binnen een cluster gerandomiseerd gecontroleerd onderzoek. In totaal werden 15 afdelingen van zes bouwbedrijven gerandomiseerd; 8 afdelingen met 171 werknemers werden gerandomiseerd in de interventiegroep en 7 afdelingen met 122 werknemers in de controle groep. Na 12 maanden was 24 procent van de deelnemers in de controlegroep (n=29) en 30 procent van de deelnemers in de interventiegroep (n=51) uitgevallen. **Hoofdstuk 7** laat zien dat de interventie niet effectief was in het verbeteren van de sociale steun op de werkplek en bevlogenheid, noch in het verminderen van de fysieke belasting en herstelbehoefte. Er werd na zes maanden zelfs een tegengesteld effect voor fysieke belasting waargenomen, waar bij de interventiegroep een kleine maar significante toename van de fysieke belasting rapporteerde in vergelijking met de controlegroep. Verder werden de resultaten niet beïnvloed door het aantal gevolgde trainingen, noch door de contextuele factoren zoals beschreven in hoofdstuk 6. Bovendien werden geen verschillen tussen de interventie- en controlegroep gevonden voor werkvermogen, fysieke en mentale gezondheid (**hoofdstuk 8**). Daarentegen liet de interventie wel een afname zien in zowel de prevalentie van bewegingsapparaatklachten als in lange termijn ziekteverzuim bij werknemers in de interventiegroep, maar deze afname was niet statistisch significant.

In **hoofdstuk 9** is de kosteneffectiviteit en de return-on-investment van de interventie vanuit bedrijfsperspectief beschreven. Gegevens over werkvermogen en gezondheid werden verzameld na de nulmeting en na 12 maanden door middel van vragenlijsten. Gegevens over ziekteverzuimkosten werden verzameld en berekend na 12 maanden, terwijl de interventiekosten werden gewaardeerd op de marktprijzen die de zes deelnemende bedrijven hadden moeten betalen voor de interventie. Voor de economische evaluatie werden ontbrekende gegevens geïmputeerd met behulp van multipele imputatie. Het preventieprogramma resulteerde, zoals eerder beschreven in hoofdstuk 8, in niet-significante effecten voor werkvermogen en gezondheid maar significant lagere kosten als gevolg van minder ziekteverzuim. Door de afwezigheid van een effect op de primaire effectmaten moeten we concluderen dat de interventie niet kosteneffectief was in vergelijking met de controlegroep. Het financiële rendement voor de bedrijven werd geschat met behulp van een return-on-investment analyse. Deze analyse toonde aan dat de interventie kostenbesparend was voor de werkgever als gevolg van verminderde ziekteverzuimkosten in de interventiegroep in vergelijking met de controlegroep. Iedere euro die de werkgever investeerde in het programma leverde uiteindelijk € 6,40 op.

In **hoofdstuk 10**, de algemene discussie, zijn de resultaten uit het proefschrift samengevat, gevolgd door enkele methodologische kanttekeningen die nodig zijn voor het interpreteren van de resultaten. Aanbevelingen voor toekomstig onderzoek en implicaties voor de praktijk worden tevens besproken in dit hoofdstuk. De conclusie die getrokken kan worden is dat preventie van burn-out en het bevorderen van een sociaal werkklimaat nodig zijn bij oudere werknemers om door te kunnen en te willen werken tot 65 jaar. Niet alleen een slechtere gezondheid en een hogere fysieke werkbelasting, maar ook de psychosociale werkbelasting speelt een rol bij het kunnen en willen doorwerken tot de pensioenleeftijd bij bouwvakkers. De algemene conclusie van het preventieprogramma gericht op zowel de fysieke als psychosociale werkbelasting is dat het programma niet het werkvermogen, de fysieke en mentale gezondheid, de sociale steun en de bevlogenheid van de deelnemers in de interventiegroep verbeterde, noch de fysieke werkbelasting en herstelbehoefte verminderde. Echter, de statistisch niet-significante afnames van de prevalentie van bewegingsapparaatklachten en ziekteverzuim en het feit dat het programma winstgevend is voor werkgevers is intrigerend. Dit, in combinatie met het feit dat de werknemers in de bouwnijverheid redelijk positief gestemd waren over de interventie, geeft aan dat interventies gericht op fysieke en psychosociale factoren potentie hebben om duurzame inzetbaarheid te bevorderen bij werknemers in de bouwnijverheid.

About the author

Karen Oude Hengel was born on October 11th 1981 in Chertsey, United Kingdom. After completing secondary school (Gymnasium) at Sancta Maria in Haarlem in 1999, she started Industrial Design Engineering at The Hague University of Applied Sciences in The Hague. After she graduated as a Bachelor of Engineering in 2003, she started studying at the Faculty of Human Movement Sciences at the VU University in Amsterdam in 2004. She did her six-month research internship at the Harvard School of Public Health in Boston, USA, where she performed a study on the effects of different computer mice on wrist posture and muscle activity. After she graduated cum laude as a Master of Science with a specialisation in Ergonomics in 2007, she started to work for the Netherlands Organisation for Applied Scientific Research (TNO) as a junior researcher. Karen was involved in many projects, but the main areas concerned sustainable employability, worksite interventions, and physical workload. Within her position as junior researcher, she started her PhD-project on sustainable employability in the construction industry, of which the results are presented in this thesis. In 2010, Karen completed her master's degree in Epidemiology after following the Postgraduate Epidemiology Program at the VU University Medical Center in Amsterdam. Currently, she continued to work as a Research Scientist at the department Work, Health and Care of TNO.

Contact:
karen.oudehengel@tno.nl
karenoudehengel@hotmail.com

List of Publications

International publications

Oude Hengel KM, Blatter BM, Joling CI, Van der Beek AJ, Bongers PM. Effectiveness of an intervention at construction worksites on work engagement, social support, physical workload, and need for recovery: results from a cluster randomized controlled trial. BMC Public Health. 2012; doi:10.1186/1471-2458-12-1008.

Geuskens GA, Oude Hengel KM, Koppes LL, Ybema JF Predictors of the willingness and the ability to continue working until the age of 65 years. J Occup Environ Med. 2012; 54(5):572-8.

Oude Hengel KM, Blatter BM, Geuskens GA, Koppes LLJ, Bongers PM: Factors associated with the ability and willingness to continue working until the age of 65 in construction workers. Int Arch Occup Environ Health. 2011; 85(7):783-90.

Oude Hengel KM, Blatter BM, Van der Molen HF, Joling CI, Proper KI, Bongers PM, Van der Beek AJ. Meeting the challenges of implementing an intervention to promote work ability and health-related quality of life at construction worksites: a process evaluation. J Occup Environ Med. 2011; 53(12):1483-91.

Oude Hengel KM, Joling CI, Proper KI, van der Molen HF, Bongers PM. Intervention Mapping as a framework for developing an intervention at the worksite for older construction workers. Am J Health Promot. 2011; 26(1):e1-10.

Oude Hengel KM, Visser B, Sluiter JK. The prevalence and incidence of musculoskeletal symptoms among hospital physicians: a systematic review. Int Arch Occup Environ Health. 2011; 84(2):115-119.

Oude Hengel KM, Joling CI, Proper KI, Blatter BM, Bongers PM. A worksite prevention program for construction workers: design of a randomized controlled trial. BMC Public Health. 2010; 10(1):336.

Houwink A, Oude Hengel KM, Odell D, Dennerlein JT. Providing training enhances the biomechanical improvements of an alternative computer mouse design. Hum Factors. 2009; 51(1):46-55.

Oude Hengel KM, Houwink A, Odell D, van Dieën JH, Dennerlein JT. Smaller external notebook mice have different effects on posture and muscle activity. Clin Biomech. 2008; 23(6):727-34.

Oude Hengel KM, Blatter BM, Van der Molen HF, Bongers PM, Van der Beek AJ. The effectiveness of a prevention programme at construction worksites on work ability, health and sick leave: results from a cluster randomised controlled trial. (Under review)

Oude Hengel KM, Bosmans JE, Van Dongen JM, Bongers PM, Van der Beek AJ, Blatter BM. Prevention program at construction worksites aimed at improving health and work ability is cost-saving to the employer: results from a cluster RCT. (Under review)

Viester L, Verhagen EALM, Oude Hengel KM, Koppes LLJ, Van der Beek AJ, Bongers PM. The relation between body mass index and musculoskeletal symptoms in the working population. (Under review)

Dutch publications

Bakhuys-Roozeboom M, Oude Hengel K, Van der Klauw M, De Weerd M, Stam C, Nijman S, Venema A. Sectorprofielen Arbeidsongevallen, bijlage bij de monitor Arbeidsongevallen 2009. TNO. 2011.

Schelvis R, Oude Hengel K**.** Fruit is gezond, maar leg het in een fruitschaal. Hoe kan Intervention Mapping bijdragen aan de ontwikkeling van gezondheidsinterventies in organisaties? GIDS. 2011.

Schulten B, den Broeder-Ooijevaar E, Van Selm H, de Lange J, Oude Hengel K, Van der Borgt J, Warning J, Oosterveer M. Visiedocument safety 'Safety binnen de Nederlandse onderhoudsmarkt in 2020. Nederlands Focal Point. 2011.

Ybema JF, Geuskens G, Oude Hengel K. Oudere werknemers en langer doorwerken, secundaire analyses van de NEA, het NEA-cohortonderzoek en de WEA. TNO. 2009.

International presentations

Oude Hengel KM, Bosmans J, Van der Beek AJ, Bongers PM, Blatter BM. An economic evaluation of a worksite intervention to promote work ability and health-related quality of life in the construction industry. 30th International Commission on Occupational Health (ICOH), Cancun, 2012.

Oude Hengel KM, De Lange J. High impact campaigning. Oral presentation. Kick-off European campaign, European Agency for Safety and Health at Work, Bilbao, 2012.

Oude Hengel KM, De Lange J. Successful campaigning. Oral presentation. European Summit, European Agency for Safety and Health at Work, Bilbao, 2011.

Oude Hengel KM, Blatter BM, Geuskens GA, Koppes LLJ, Bongers PM. Factors associated with the ability and willingness to continue working in construction workers. Oral presentation. The 22nd International Conference on Epidemiology in Occupational Health (EPICOH), Oxford, 2011.

Oude Hengel KM, Joling CI, Proper KI, Bongers PM. A health promotion program at the workplace for construction workers: a feasibility evaluation within a randomized controlled trial. Oral presentation, Seventh International Scientific Conference on Prevention of Work-Related Musculoskeletal Disorders (PREMUS), Angers, 2010.

Geuskens GA, Oude Hengel KM, Ybema JF. Predictors of the motivation and the ability to continue working in older employees: A Dutch prospective cohort study. Oral Presentation, ICOH-WOPS international conference on psychosocial factors at work, Amsterdam, 2010.

Oude Hengel KM, Joling CI, Proper KI, Van der Molen HF, Bongers PM. Using intervention mapping to develop a health promotion program for older construction workers. Oral presentation, 29th International Congress on Occupational Health (ICOH), Cape Town, 2009.

Oude Hengel KM, Houwink A, Odell D, Dennerlein J. Do smaller external notebook mice have different effects on posture and muscle activity than desktop mice? Poster presentation, Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS), Boston, 2007.

Houwink A, Oude Hengel KM, Odell D, Dennerlein J. Providing ergonomic instructions enhances the biomechanical improvements of an alternative computer mouse design. Poster presentation, Sixth International Scientific Conference on Prevention of Work-related Musculoskeletal Disorders (PREMUS), Boston, 2007.