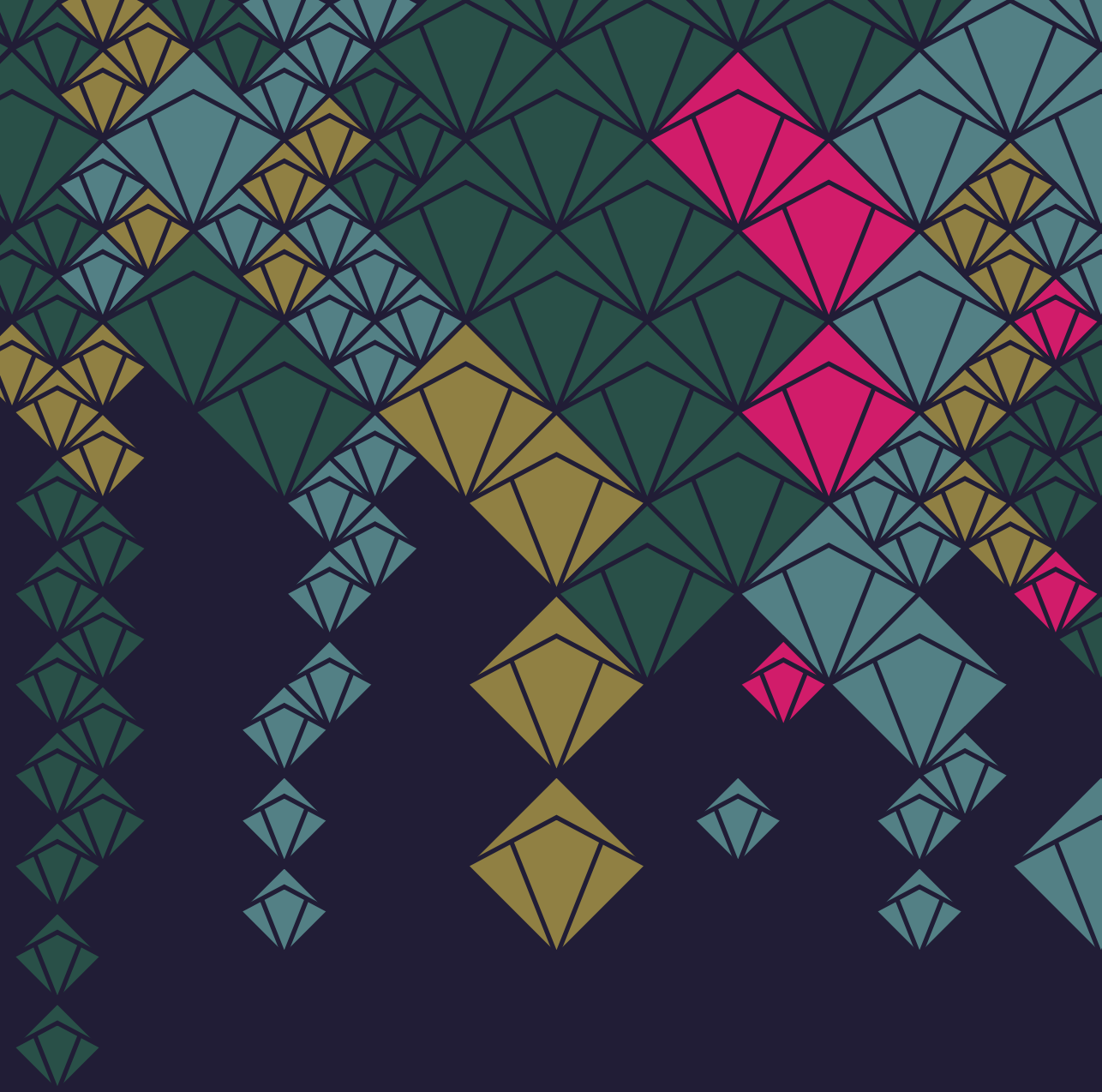
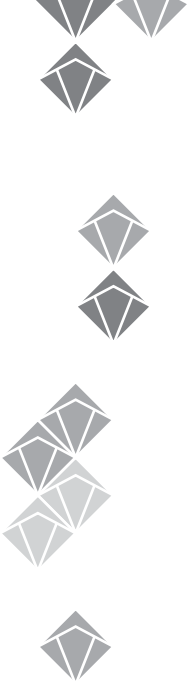


DETERMINANTS OF EXIT FROM PAID EMPLOYMENT

Kerstin Gabriëlle van der Mark - Reeuwijk



DETERMINANTS OF EXIT FROM PAID EMPLOYMENT

DETERMINANTEN VAN UITSTROOM UIT BETAALD WERK

Kerstin Gabriëlle van der Mark - Reeuwijk

ISBN/EAN: 9789462333611

The studies presented in this thesis were financially supported by a grant from the Netherlands Organisation for Health Research and Development (ZonMw) (grant number 208031003) and the Department of Public Health of the Erasmus Medical Center. The financial support by the Department of Public Health, Erasmus Medical Center, Rotterdam, and the Erasmus University Rotterdam for the publication of this thesis is gratefully acknowledged.

Cover design & layout: Moniek van Adrichem; MegaMoniek, Delft, The Netherlands, www.megamoniek.nl

Printing: Gildeprint, Enschede, The Netherlands, www.gildeprint.nl

DETERMINANTS OF EXIT FROM PAID EMPLOYMENT

DETERMINANTEN VAN UITSTROOM UIT BETAALD WERK

Proefschrift

ter verkrijging van de graad van doctor aan de
Erasmus Universiteit Rotterdam
op gezag van de rector magnificus

Prof.dr. H.A.P. Pols

en volgens besluit van het College voor Promoties.

De openbare verdediging zal plaatsvinden op
donderdag 29 september om 13:30 uur

door

Kerstin Gabriëlle van der Mark - Reeuwijk

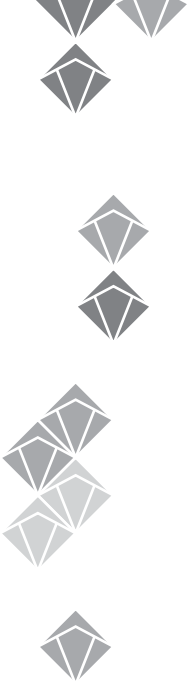
geboren te Hoofddorp

Erasmus University Rotterdam

PROMOTIECOMMISSIE

Promotor	Prof.dr.ir. A. Burdorf
Overige leden	Prof.dr. U. Bültmann
	Dr. R.W. Selles
	Dr. L. Hakkaart-van Roijen
Copromotor	Dr. S.J.W. Robroek

CONTENT



chapter 1

GENERAL INTRODUCTION

BACKGROUND

The current Western society is characterised by an ageing population due to decreasing birth rates and increased longevity [1]. This puts the social security systems under pressure and increases the need for older workers to extend their working life. Recently, many governments in developed countries introduced policies to increase the proportion of older people in paid employment. For example, by minimising the facilities to retire early and by raising the statutory retirement age. Partially as an effect of such interventions, the average retirement age in the Netherlands has gone up from 61 years in 2007 to 64.1 years at the end of 2014 [2]. Still, many workers leave the workforce before the official retirement age. While some people do so via the more voluntary route of early retirement, others exit the workforce via the involuntary routes of disability or unemployment.

In order to prevent early exit from work, increasing attention is paid to sustainable employability, i.e. the opportunity, capability and condition of an employee to work productively with maintenance of health throughout the working life [3]. Insight in modifiable risk factors of premature exit is needed to develop successful interventions aiming to reduce early exit from the workforce and to facilitate sustainable employability.

Determinants of sustainable employability

Sustainable employability is a comprehensive concept and involves a long time span, but until now no single measure is available to determine a worker's sustainable employability. Therefore, various measures are being used to get an indication of sustainable employability. For example, lack of sickness absence, productivity at work, work ability, and labour force participation. Poor health is an important risk factor of early exit from work especially of exit due to disability, but also due to unemployment and early retirement [4]. Further, poor work related factors like low job control and low rewards seem to increase the risk of labour force exit [5]. In a recent paper by Leijten et al, favourable psychosocial work-related factors were found to lower the risk of disability benefit in workers with health problems, indicating the importance of a good work environment in sustainable employment [6]. However, information on how and why certain factors play a role in leaving the workforce is often lacking. This asks for qualitative research to better understand the underlying mechanisms. Furthermore, although lifestyle related factors are well established risk factors for productivity loss at work, sickness absence and reduced work ability [7, 8], there is less insight into the particular role of these factors in different routes of premature exit from paid employment. Gaining more knowledge about the role of these factors may serve as a starting point for developing interventions aiming to reduce premature exit from the workforce.

Work ability

The concept of work ability has been developed as one of the first measures of sustainable employability in order to increase work participation and prolong working life of older Finnish workers [9, 10] and has been adopted in many other countries. It indicates the degree to which a worker, given his/her health, is physically and mentally capable to cope with the demands at work. Work ability is likely to be dynamic throughout people's

working life. One reason for that is ageing which affects the human resources (e.g. health) [1, 11]. The work ability index (WAI) is used to determine individuals' work ability and consists of seven dimensions; an assessment of the current work ability as compared to lifetime best, the physical and psychological demands of an individual in relation to his current work, diagnosed diseases, perceived impairments at work due to diseases, sickness absence in the past 12 months, own prognosis of work ability within 2 years, and current psychological resources [10]. Poor work ability is related to (long-term) sickness absence, a higher risk of disability, and productivity loss at work [12-14]. Also, the WAI is able to discriminate between workers at low and high risk for disability benefit [15, 16]. However, it is not known whether the tool is suitable to screen for future longterm sickness absence. Since workers with multiple episodes of longterm sickness absence are more likely to exit the workforce through disability and unemployment [17-20], it would be helpful to identify high-risk workers before sickness absence occurs.

Competing exit routes out of paid employment

The majority of studies assessing labour force exit have focused on one specific exit route [21-23] or on different routes in a stratified analysis comparing workers within each separate exit route with those who remained in paid employment [5, 24]. However, these approaches ignore that exit routes out of paid employment are to some extent competing processes. For example, leaving paid employment via disability benefit (which requires health problems) often takes place at an earlier age than early retirement, resulting in a healthier selection of workers eligible for early retirement. Furthermore, exit routes may act as communicating vessels whereby social security arrangements and eligibility criteria partly determine via which exit route workers leave paid employment. Therefore, leaving competing exit routes out of the analysis may influence the results and this asks for a different analysis technique.

Health care use

Except for rising costs for benefits and pensions, rising health care use and subsequent cost also puts the social security system under pressure in Western countries [25, 26]. In the Netherlands, health care costs have almost doubled in the past decade. The total health care costs were approximately 74 billion euro in 2007 (for 16 million inhabitants) of which cardiovascular disorders accounted for 9.3%, mental disorders for 9.1% (excluding dementia and mental disabilities), and musculoskeletal disorders for 6.6% [27-29]. Modifiable risk factors for health care use must be identified to target interventions on and keep health care affordable. Besides, participation in society (e.g. via paid employment) after disease or hospital admission is gaining attention in health care. This increases the need for research on the intersection between work and health care. Since the majority of adults are engaged in paid employment it is of particular interest to evaluate how the interplay between work demands and perceived health problems may influence health care use.

OBJECTIVES OF THIS THESIS

Although the average retirement age is rising, still many workers leave the workforce via different pathways before the official retirement age. To facilitate longer working lives, the aim of this thesis is to gain insight into determinants of leaving paid employment, the possibility to identify high risk groups for displacement from work, and the possible consequences of decreased work ability.

The primary objectives of this thesis are:

1. To study determinants of exit from paid employment via disability, unemployment, and early retirement.
2. To explore the predictive value of work ability to identify persons at high risk of long-term sickness absence.
3. To determine the consequences of decreased work ability for health care use.

DATASETS USED IN THIS THESIS

The analyses in this thesis are based on four cohorts:

STREAM. A small sample of the Study on Transitions in Employment, Ability and Motivation (STREAM) cohort was selected for face-to-face interviews to qualitatively investigate reasons for early retirement (chapter 2). STREAM is a 4-year longitudinal study among employed, self-employed, and non-employed persons aged 45 to 64 years at baseline (n=15,118 at baseline) [30]. Only those who recently retired before the statutory retirement age of 65 years or were going to retire early in the next 6 months at the moment they were contacted for the interview, were eligible for the qualitative study. In total 30 persons were interviewed using a comprehensive semi-structured interview guide based on the life course perspective and previously reported determinants of early retirement.

SHARE. Data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) was used to explore competing risk analysis to determine the relation between poor health and exit from paid employment via different exit routes (chapter 4). SHARE started in 2004 aiming to gain insight into ageing and how it affects individuals in the diverse cultural settings of Europe [31-34]. For the study described in chapter 4, four waves of data collection were used representing a 6-year follow-up. Complete data was available for 5,273 persons who were 50 years or older and had not yet reached the country specific retirement age at baseline.

Prevention Compass data. In chapter 5 data collected by NIPED Research Foundation was used to investigate the prognostic value of the WAI for sickness absence of different durations. This longitudinal data with 12 months follow-up was collected among workers in the financial sector and was part of a larger study aiming to gain insight into the impact of a web-based health promotion program on absenteeism. A web based health

questionnaire was used to collect self-reported data on work ability and individual characteristics. Sickness absence was ascertained objectively using the sickness absence register maintained by the occupational health service. Complete information was available for 1,331 participants [35].

Baseline data from 12 Dutch healthcare organisations. This data was available to explore the association between work impairments and reduced work ability on healthcare use within workers with a musculoskeletal, cardiovascular or mental disorder (chapter 6). The collection of data took place via an occupational health organisation using an online questionnaire on health, healthcare use, work ability, and work impairments. Between September 2011 and July 2012 participants were enrolled. Complete data were available for 5,208 workers [36].

OUTLINE OF THIS THESIS

Objective one will be addressed in chapter 2-4. First, non-health related reasons for early retirement will be assessed in a qualitative study to get a more in-depth insight into why and how certain determinants play a role in the transition from work to early retirement (chapter 2). Then, in chapter 3 lifestyle-related factors will be studied as determinants of exit from paid employment via different routes. This will be done in a systematic review with meta-analyses. Last, the relation between health and exit from paid employment is determined with competing risk analysis. With this technique the relation between health and a specific exit route can be estimated more precise (chapter 4).

In chapter 5 the second research question will be answered. Here, we assess the ability of the WAI to discriminate between different durations of sickness absence. This is done to determine whether the WAI score can be used to identify high risk groups for long-term sickness absence.

The third objective of this thesis is discussed in chapter 6, where the role of work ability and work impairments on health care use will be assessed. This will be done in three diseases (i.e. cardiovascular disease, mental disorders, and musculoskeletal disorders) which account for a large amount of health care costs in the Netherlands.

REFERENCES

1. Ilmarinen JE. Aging workers. *Occup Environ Med*. 2001;58(8):546-52.
2. Statistics Netherlands. Meer dan de helft van de werknemers bij pensionering 65 jaar of ouder [More than half of the employees retire at 65 years or over]; 2015. Available from: http://www.cbs.nl/nl-NL/menu/themas/arbeid-socialezekerheid/publicaties/artikelen/archief/2015/meer-dan-de-helft-van-de-werknemers-bij-pensionering-65-jaar-of-ouder.htm.
3. van der Klink JJL, Burdorf A, Schaufeli WB, van der Wilt GJ, Zijlstra FRH, Brouwer S, et al. Duurzaam inzetbaar: Werk als waarde. ZonMw; 2010.
4. van Rijn RM, Robroek SJW, Brouwer S, Burdorf A. Influence of poor health on exit from paid employment: a systematic review. *Occup Environ Med*. 2014;71(4):295-301.
5. Robroek SJW, Schuring M, Croezen S, Stattin M, Burdorf A. Poor health, unhealthy behaviors, and unfavorable work characteristics influence pathways of exit from paid employment among older workers in Europe: a four year follow-up study. *Scand J Work Environ Health*. 2013;39(2):125-33.
6. Leijten FRM, de Wind A, van den Heuvel SG, Ybema JF, van der Beek AJ, Robroek SJW, et al. The influence of chronic health problems and work-related factors on loss of paid employment among older workers. *J Epidemiol Community Health*. 2015;69(11):1058-65.
7. van den Berg TIJ, Elders LAM, de Zwart BCH, 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.
8. Robroek SJW, van den Berg,TIJ, Plat JF, Burdorf A. The role of obesity and lifestyle behaviours in a productive workforce. *Occup Environ Med*. 2011;68(2):134-9.
9. Tuomi K, Ilmarinen J, Eskelinen L, Järvinen E, Toikkanen J, Klockars M. Prevalence and incidence rates of diseases and work ability in different work categories of municipal occupations. *Scand J Work Environ Health*. 1991;17(Suppl 1):67-74.
10. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work ability index. 2nd ed. Helsinki: Finnish Institute of Occupational Health; 1998.
11. Ilmarinen J, Tuomi K. Work ability of aging workers. *Scand J Work Environ Health*. 1992;18(Suppl 2):8-10.
12. Alavinia SM, de Boer AGEM, van Duivenbooden JC, Frings-Dresen MHW, Burdorf A. Determinants of work ability and its predictive value for disability. *Occup Med*. 2009;59(1):32-7.
13. Alavinia SM, van den Berg TIJ, van Duivenbooden C, Elders LAM, 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.

14. Alavinia SM, Molenaar D, Burdorf A. Productivity loss in the workforce: associations with health, work demands, and individual characteristics. *Am J Ind Med*. 2009;52(1):49-56.

15. Roelen CAM, van Rhenen W, Groothoff JW, van der Klink JJL, Twisk JWR, Heymans MW. Work ability as prognostic risk marker of disability pension: single-item work ability score versus multi-item work ability index. *Scand J Work Environ Health*. 2014;40:428–31.

16. Bethge M, Gutenbrunner C, Neuderth S. Work Ability Index Predicts Application for Disability Pension After Work-Related Medical Rehabilitation for Chronic Back Pain. *Arch Phys Med Rehabil*. 2013;94(11):2262-8.

17. Alexanderson K, Kivimäki M, Ferrie JE, Westerlund H, Vahtera J, Singh-Manoux A, et al. Diagnosis-specific sick leave as a long-term predictor of disability pension: a 13-year follow-up of the GAZEL cohort study. *J Epidemiol Community Health*. 2012;66(2):155-9.

18. Hultin H, Lindholm C, Moller J. Is there an association between long-term sick leave and disability pension and unemployment beyond the effect of health status? - A cohort study. *PLoS One*. 2012;7(4):e35614.

19. Koopmans PC, Roelen CAM, Groothoff JW. Frequent and long-term absence as a risk factor for work disability and job termination among employees in the private sector. *Occup Environ Med*. 2008;65(7):494-9.

20. Virtanen M, Kivimäki M, Vahtera J, Elovainio M, Sund R, Virtanen P, et al. Sickness absence as a risk factor for job termination, unemployment, and disability pension among temporary and permanent employees. *Occup Environ Med*. 2006;63(3):212-7.

21. Lund T, Csonka A. Risk factors in health, work environment, smoking status, and organizational context for work disability. *Am J Ind Med*. 2003;44(5):492-501.

22. 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.

23. Bültmann U, Christensen KB, Burr H, Lund T, Rugulies R. Severe depressive symptoms as predictor of disability pension: a 10-year follow-up study in Denmark. *Eur J Public Health*. 2008;18(3):232-41.

24. Jensen LD, Ryom PK, Christensen MV, Andersen JH. Differences in risk factors for voluntary early retirement and disability pension: a 15-year follow-up in a cohort of nurses' aides. *BMJ Open*. 2012;2(6):e000991.

25. American Diabetes Association. Economic Costs of Diabetes in the U.S. in 2012. *Diabetes Care*. 2013;36(4):1033-46.

26. Organisation for Economic Co-operation and Development. Total expenditure on health. Health: key tables from OECD; 2014. Available from: http://www.oecd-ilibrary.org/social-issues-migration-health/total-expenditure-on-health-2014-1_hlthxp-total-table-2014-1-en.

27. Slobbe LCJ, Smit JM, Groen J, Poos MJJC, Kommer GJ. Trends in Kosten van Ziekten in Nederland 1999-2010: Kosten per diagnose [Trends in cost of illness in the Netherlands 1999-2010: costs per diagnosis]; 2011. Available from:http://www.kostenvanziekten.nl/kvz2005/cijfers/start-tabellen-grafieken-volgens-zorgrekeningen/Default.aspx?ref=kvz_v2l1b1p4r3c0i0t1j1o6y4a-1g0d254s54z0f0w2.

28. Slobbe LCJ, Smit JM, Groen J, Poos MJJC, Kommer GJ. Trends in kosten van ziekten in Nederland 1999-2010: kosten voor psychische stoornissen [Trends in cost of illness in the Netherlands 1999-2010: costs for mental disorders]; 2011. Available from: http://www.kostenvanziekten.nl/kvz2005/cijfers/start-tabellen-grafieken-volgens-zorgrekeningen/Default.aspx?ref=kvz_v2l1b1p4r3c0i0t1j1o6y4a-1g0d205s54z0f0w2.

29. Slobbe LCJ, Smit JM, Groen J, Poos MJJC, Kommer GJ. Trends in kosten van ziekten in Nederland 1999-2010: Totale kosten [Trends in cost of illness in the Netherlands 1999-2010: Total costs]; 2011. Available from: http://www.kostenvanziekten.nl/kvz2005/cijfers/start-tabellen-grafieken-volgens-zorgrekeningen/Default.aspx?ref=kvz_v2l1b1p4r0c0i0t1j1o6y4a-1g0d254s54z0f0w2.

30. Ybema JF, Geuskens GA, van den Heuvel SG, de Wind A, Leijten FRM, Joling CI, et al. Study on Transitions in Employment, Ability, and Motivation (STREAM): The design of a four-year longitudinal cohort study among 15,118 persons aged 45 to 64 years. *Br J Med Med Res*. 2014;4(6):1383-99.

31. Börsch-Supan A, Hank K, Jürges H. A new comprehensive and international view on ageing: introducing the 'Survey of Health, Ageing and Retirement in Europe'. *Eur J Ageing*. 2005;2:245-5310.1007/s10433-005-0014-9.

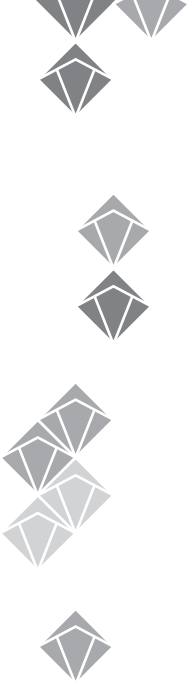
32. Health, Ageing and Retirement in Europe. First results from the Survey of Health, Ageing and Retirement in Europe. Börsch-Supan A, Brugiavini A, Jürges H, Mackenbach J, Siegrist J, Weber G, editors. Mannheim: Mannheim Research Institute for the Exonomics of Aging (MEA); 2005.

33. Börsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbmacher J, Malter F, et al. Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *Int J Epidemiol*. 2013;42(4):992-1001.

34. The Survey of Health, Aging, and Retirement in Europe - Methodology. Börsch-Supan A and Jürges H, editors. Mannheim: Mannheim Research Institute for the Economics of Aging (MEA); 2005.

35. Niessen MAJ, Kraaijenhagen RA, Dijkgraaf MGW, Van Pelt D, Van Kalken CK, Peek N. Impact of a Web-Based Worksite Health Promotion Program on Absenteeism. *J Occup Environ Med*. 2012;54(4):404-8.

36. Reeuwijk KG, Robroek SJW, Hakkaart L, Burdorf A. How Work Impairments and Reduced Work Ability are Associated with Health Care Use in Workers with Musculoskeletal Disorders, Cardiovascular Disorders or Mental Disorders. *J Occup Rehabil*. 2014;24(4):631-9.



Chapter 2

‘ALL THOSE THINGS TOGETHER MADE ME RETIRE’: QUALITATIVE STUDY ON EARLY RETIREMENT AMONG DUTCH EMPLOYEES

BMC PUBLIC HEALTH 2013; 13:516

REEUWIJK KG

DE WIND A

WESTERMAN MJ

YBEMA JF

VAN DER BEEK AJ

GEUSKENS GA

ABSTRACT

Background

Due to the aging of the population and subsequent higher pressure on public finances, there is a need for employees in many European countries to extend their working lives. One way in which this can be achieved is by employees refraining from retiring early. Factors predicting early retirement have been identified in quantitative research, but little is known on why and how these factors influence early retirement. The present qualitative study investigated which non-health related factors influence early retirement, and why and how these factors influence early retirement.

Methods

A qualitative study among 30 Dutch employees (60–64 years) who retired early, i.e. before the age of 65, was performed by means of face-to-face interviews. Participants were selected from the cohort Study on Transitions in Employment, Ability and Motivation (STREAM).

Results

For most employees, a combination of factors played a role in the transition from work to early retirement, and the specific factors involved differed between individuals. Participants reported various factors that pushed towards early retirement ('push factors'), including organizational changes at work, conflicts at work, high work pressure, high physical job demands, and insufficient use of their skills and knowledge by others in the organization. Employees who reported such push factors towards early retirement often felt unable to find another job. Factors attracting towards early retirement ('pull factors') included the wish to do other things outside of work, enjoy life, have more flexibility, spend more time with a spouse or grandchildren, and care for others. In addition, the financial opportunity to retire early played an important role. Factors influenced early retirement via changes in the motivation, ability and opportunity to continue working or retire early.

Conclusion

To support the prolongation of working life, it seems important to improve the fit between the physical and psychosocial job characteristics on the one hand, and the abilities and wishes of the employee on the other hand. Alongside improvements in the work environment that enable and motivate employees to prolong their careers, a continuous dialogue between the employer and employee on the (future) person-job fit and tailored interventions might be helpful.

Key words

Early retirement, Pull factors, Push factors, Qualitative study

BACKGROUND

Similar to other European countries, the average retirement age has increased from 60.9 years in 2001 to 63.1 years in 2011 in the Netherlands [1]. Despite this increase, many workers still retire before the official retirement age of 65 years. Currently, the general population is aging because of decreasing birth rates [2] and increasing longevity [3]. Moreover, the baby boom generation has started to leave work. The increasing ratio of retired persons to the working age population puts pressure on the social security systems in many European countries [4]. For example, in the Netherlands it is estimated that the costs of the General Old Age Pension Act (AOW) will increase from the current 27 billion euros to 47 billion euros in 2040 [5]. Thus, there is a societal need for workers to extend working life.

A transition from work to (non-disability) retirement before the age of 65, i.e. early retirement, can be seen as influenced by so-called push and pull factors [6]. Push factors are defined as negative circumstances that lead to early retirement, such as poor health or lack of job satisfaction [6]. In a recent review of longitudinal studies on determinants of early retirement, poor health and high physical and psychosocial work demands were identified as risk factors for early retirement [7]. These findings from quantitative studies were confirmed in focus groups with employees working in the printing industry [7]. Pull factors are defined as positive factors that attract an individual towards early retirement, such as the desire to spend more time on volunteer work or leisure time activities [6]. In a study conducted among waste collectors and municipal workers, having a partner also increased the likelihood of retiring early [8]. In addition to push and pull factors, the employees' skills and knowledge may influence the transition to early retirement. Provision of and participation in education and training has been associated with a reduced intention to retire early and actual retirement behavior [9,10]. Moreover, in previous research it has been shown that pension systems offering generous early retirement options encourage early departure from the labor market [11]. Hence, health, work-related factors, skills and know- ledge, social factors, and financial factors may influence the transition from work to early retirement.

Despite the current public debate on extending working life, relatively few studies have been performed that explore the factors that influence transitions to early retirement. As a consequence, some push or pull factors may have been overlooked. This is especially true since many of the available studies did not investigate early retirement, but the intention to retire early [7,12,13]. Factors that influence the intention to retire may differ from those that influence actual retirement [14]. In addition, although a variety of factors that predict earl retirement have been identified in quantitative studies, little is known on why these factors push or pull individuals to retire early and how they influence the retirement process. This knowledge may contribute to the development of interventions that aim to prolong working life and thus may contribute solutions to the challenges posed by our aging population. Therefore, the present study aimed to explore reasons for retirement before the age of 65 in Dutch employees. Specifically, we investigated which

non-health related factors influence early retirement, and why and how these factors influence early retirement.

METHODS

Design and study population

The present study was part of a larger qualitative investigation on why persons retire early. The role of health in early retirement was extensively described elsewhere [15].

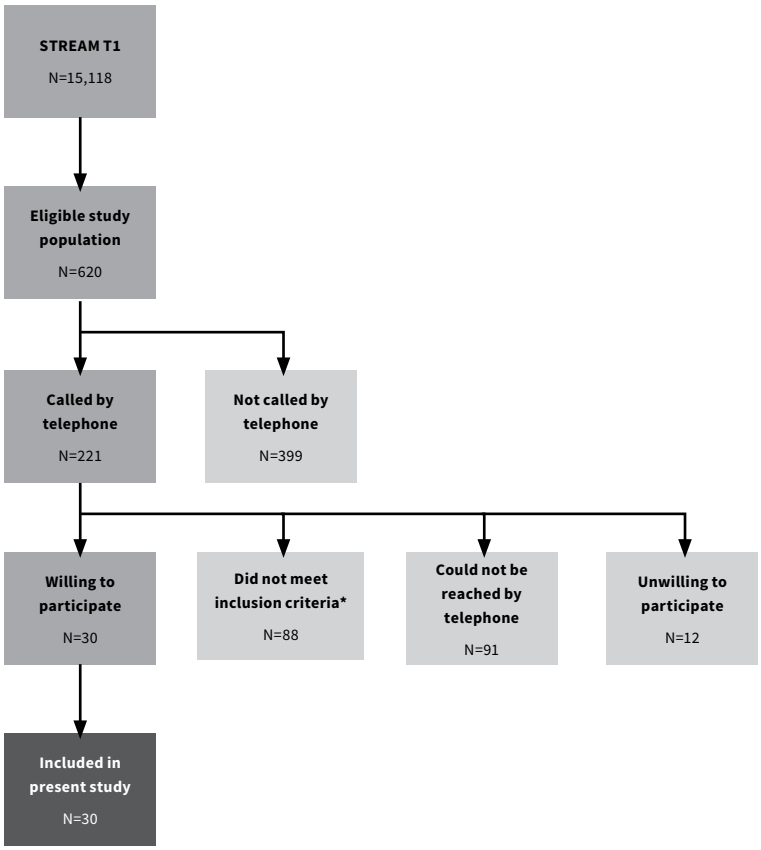
Face-to-face semi-structured interviews with Dutch employees who retired early were conducted. Early retirement referred to retirement before the official retirement age of 65. Persons who left the workforce due to (partially) compensated work disability or unemployment were excluded, since previous research suggests that different factors underlie these transitions out of work [16].

Participants were selected from the Study on Transitions in Employment, Ability and Motivation (STREAM). The aim of this prospective cohort study is to identify under which circumstances persons aged 45 to 64 years prolong their working life, while maintaining good health and good work productivity [17]. Persons were eligible for the present study if (a) they had given permission in the STREAM 2010 questionnaire to be contacted for additional research, (b) had a paid job as an employee at the time of STREAM 2010, (c) had retired before the age of 65 in the last 12 months in 2011, or were going to retire early in the next six months and already formally arranged this with their employer when contacted about the inter- view, and (d) were aged 58 to 64 years at the time of the interview.

To ensure heterogeneity in the study population, participants were purposefully selected [18] based on age, educational level, and their intention to retire assessed in the STREAM 2010 questionnaire. We selected on age, since different reasons might underlie retirement in those who retired at a relatively young age (e.g. 59 years) compared to those who retired at a higher age (e.g. 64 years). Similarly, educational differences in reasons of early retirement may exist, e.g. due to exposure to different physical and psychosocial working conditions. The intention to retire was assessed with one question in the STREAM 2010 questionnaire, i.e. 'Are you planning to stop working in the next 12 months?'. This item could be answered on a 5-point Likert scale ranging from 'certainly not' to 'certainly'. Persons who answered 'maybe', 'probably' or 'certainly' were eligible for the present study. We selected purposefully on the intention to retire to assure that both persons in which longstanding processes and persons in which more sudden events influenced early retirement were included.

In total 620 of the 15,118 persons included in STREAM gave permission to be contacted for additional research, were employed in 2010, and were aged 58 to 64 at the time of the interview (Figure 1). After purposeful sampling on age, education level, and intention to retire in 2010, 221 persons were contacted by telephone between July 2011 and October 2011 to check whether they met the inclusion criteria. The aim and content of the interview

study was explained and their willingness to participate in a face-to-face interview was checked. Eighty-eight persons did not meet the selection criteria. They had either not retired yet, or retired early due to compensated work disability. In total 91 persons could not be reached by telephone. These persons were called at least once again after one or two weeks, but could still not be reached. Twelve persons were unwilling to participate. Reasons were personal circumstances (N=4), no time (N=2), unwillingness to talk about work history and early retirement (N=2), and miscellaneous reasons (N=4). Participants were enrolled in the present study by clusters of two to six persons at the same time. In total 30 persons who were eligible and gave permission for an interview were included.



**i.e. did not retire yet, retirement due to compensate work disability*

Figure 1. Study population.

Interview guide

Prior to the beginning of the study, a comprehensive semi-structured interview guide was created based on the life course perspective [19] and determinants of early retirement according to the literature (appendix 1). The life course perspective considers transitions from work to retirement as a part of the life course. The processes leading to the transition are influenced by someone's individual history and characteristics, and the context of the transition. The life course perspective has previously been used to understand how persons experience (the transition to) retirement [19]. According to the literature, transitions towards early retirement may be influenced by determinants in the following domains: health, work-related factors, skills and knowledge, social factors, and financial factors [6-11]. The interview guide was tested by means of three role plays of the interviewer with other researchers involved in this study. Subsequently, more examples of in-depth follow-up questions were include in the interview guide.

Interview procedure

The interviews were carried out by the second author (AdW). The interviewer was familiar with interview techniques, such as clarification, paraphrasing, and summarizing. During most of the interviews, a second interviewer was present who took notes (KR or DR). The interviewers did not have a prior relationship with any of the participants. The interviews were carried out in participants' homes throughout The Netherlands, except for one person, who, upon request, was interviewed at work. Interviews were digitally recorded. All participants agreed to this procedure.

Before the start of the interview, the interviewer introduced herself, and again explained the aim and content of the interview and subsequent study. Anonymity and confidentiality were assured. Hereafter, open-ended questions were postulated, pertaining to six topics (appendix 1). The first part was aimed at getting acquainted with the interviewee and focused on the personal and home situation. The second part was about the person's work history and job-job transitions. Together with the participant, the interviewer created a timeline of the interviewee's work history and other important (positive or negative) events, such as education, marriage, divorce, birth, death of family or friends, and periods of illness. The third part focused on the reasons why an interviewee had retired early, or had made arrangements to do so. Understanding of these reasons was gained through in-depth follow-up questions. The fourth part focused on the timing of the transition from work to early retirement. The fifth part focused on circumstances under which the interviewee would have prolonged his or her working life. The sixth part of the interview concentrated on satisfaction with the transition from work to early retirement. In addition, participants described how they perceived their life in the coming years.

On average interviews lasted 80 min (range: 40–156 min). During 9 interviews non-participants were present (spouse (N=7), spouse and daughter (N=1), and granddaughter (N=1)). In one interview the spouse helped the respondent come up with ideas about what was asked. In two interviews the spouse interfered substantially. Issues brought up by these spouses were interpreted with caution in the analysis.

Analysis

Analysis of the interviews took place in four steps and in Dutch. First, the interviews were transcribed verbatim. All interviews were listened to at least twice and com- pared with the transcriptions to check accuracy. Second, 10 interviews were independently summarized using transcriptions and field notes, and were open-coded by AdW and KR. The aim of this step was to understand why and how the transition from work to early retirement had taken place for these persons. Afterwards, AdW and KR discussed summaries, timelines, and codes extensively until consensus was reached about the factors involved in early retirement, and why and how these factors influenced early retirement. If AdW and KR could not reach consensus by comparing their arguments, a third person was consulted and decisive (MW or GG). In the third step, the remaining 20 interviews were summarized, and open-coded by either AdW or KR. Summaries and coded interviews were cross-checked, and AdW and KR regularly met to discuss findings. During these meetings, data saturation was monitored. No new information on reasons of early retirement was derived from the last cluster of five interviews, i.e. from interview 26 to 30. In the fourth step the aim was to investigate how and why the transition to early retirement had taken place in more detail. KR extracted the part in all interview transcriptions in which the transition to early retirement was addressed, and open coded these parts in more detail. These detailed codes were discussed with AdW, and clustered deductively into coding families according to the domains identified in the literature (i.e. health, work-related factors, skills and knowledge, social factors and financial factors) [20]. If codes did not fit into these existing coding families, new coding families were defined, i.e. inductive coding [20].

Parallel to the four steps described above, AdW and KR regularly met to compare interviews on a thematic level. Leading questions during these discussions were: (a) what similarities can be identified between interviewees' experiences?, and (b) why did certain processes take place in some persons, but not in others? To enhance robustness of the findings, main results were also discussed with other project members (MW and GG). In order to manage the data of the interviews, the computer package for qualitative analysis Atlas.ti 6.1.17 [21] was used.

Ethical considerations

The Medical Ethics Committee of the VU University Medical Center Amsterdam declared that no ethical approval was needed to conduct this study. Informed con- sent was obtained verbally from all participants during the telephone conversation in which persons were invited for the interview.

RESULTS

Characteristics of the study population are reported in Table 1. The participants' jobs before retirement varied and included both blue and white collar jobs, such as mechanic, manager, and teacher. Different reasons for early retirement were reported, namely factors that pushed employees out of work to early retirement, factors that pulled employees towards early retirement, and financial factors. An overview of these factors is presented in Figure 2. In most persons an interplay of factors played a role.

Table 1. Characteristics of the study population

Characteristic		**Total sample (N=30)**
Women	N (%)	6 (20%)
Age (years)	Median (range)	62 (60–64)
Retirement age (years)	Median (range)	61 (60–64)
Education level		
Low	N (%)	12 (40%)
Moderate	N (%)	4 (13%)
High	N (%)	14 (47%)

N = number of participants.

Factors that pushed towards early retirement

Work

Work-related factors were frequently described as a reason for early retirement (Figure 2). Changes in the work organization, e.g. restructuring, often preceded early retirement. One man (64), who worked in the welfare sector, reported that after recurrent restructuring, the department he worked for closed down. He felt that due to his age, he would be unable to find a new job. He had been rejected one year earlier for another position ("*But yeah, then they want some young person").* In his view, due to this lack of opportunities, retirement was unavoidable. When he was asked why he had retired before the age of 65, he answered:

> *"Well, there was no perspective anymore. As of July 1st the department I worked in was closed."*

Another man (61), who worked as a mechanic, reported that when enterprise restructuring occurred, his employer played a substantial role in his early retirement process. His employer decided not to fire him, but to offer an early retirement arrangement:

"Last year I was almost fired due to a reorganization but then administration said […] as of next year he can already retire early, and receive his pension, firing him will take a few months anyways so we might as well just keep him. Well that's what they did then."

In addition to large organizational changes, continuous changes in the way work needed to be done was reported as a reason for early retirement. Employees became tired of continuous changes in work tasks and the need for these changes was not always fully understood. This decreased their motivation to continue working.

Conflicts at work were mentioned as a reason to leave the workforce before the age of 65 as well. A woman (64), who had an administrative job, described that she did not enjoy her work as much as she had before when a conflict with her colleagues arose. She explained:

"Couldn't get on that well with my colleagues. Or they couldn't get on with me […] sometimes it clashed […] that was very unpleasant, no, not nice at all."

Furthermore, high work pressure and physically demanding work were reported as push factors for early retirement, because they reduced the ability to continue working until an older age in a particular job. A technician (60), who worked offshore in engine rooms of freighters and oil rigs around the world, explained that the physical burden of his job did not allow him to continue working until the age of 65. Although he was given the opportunity to get an office job as a clerk, he was not willing to perform this type of work. He was offered a favorable financial arrangement by his employer and retired early. He argued:

"When I was around 40 I already noticed […] the first of the wear and tear. And then you think, guys, I won't make it to 65."

Skills and knowledge

Factors related to skills and knowledge were mentioned as push factors towards early retirement. Some employees were not willing to invest in their careers any- more, and, for example, retired early before they had to take a new course or training. Others described that they were dissatisfied with the limited use of their skills and knowledge, which decreased their motivation to work for the company, and pushed them out of the workforce. A man (64) who worked in the welfare sector argued that he had a lot of knowledge that, he felt, was not sufficiently used by his supervisors:

"I had a lot more knowledge than others […], so from their point of view […] I would have said: make use of that. I was actually 'used' way too little […], and that of course also gives a certain negative feeling […], and then you give up earlier."

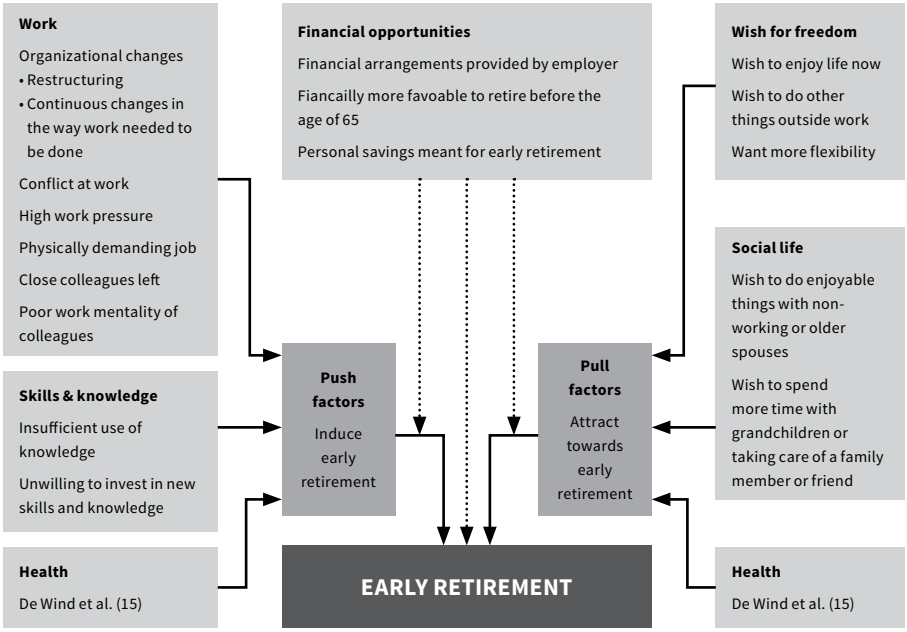


Figure 2. Factors involved in early retirement.

Factors that pulled towards early retirement

Desire for freedom

Many respondents described that they wished to do other things outside of work, wanted to enjoy life, or looked forward to more flexibility in their life. As these wishes gained importance, respondents became less motivated to continue working and were more attracted to early retirement. A woman (60) who worked as a physical therapist explained:

> *"And also enjoying yourself. I think that with physical therapy work you are really inflexible, […] for people with office jobs […] with nice weather they can say I'm taking the afternoon off, going to the beach, well we couldn't do that because you were fully booked and the following week as well. So I think it's really restricting."*

A 62 year old economics teacher said:

> *"I think that after working for 40 years it's now time for other things. And aside from that I wanted something else, I wanted to be more flexible with my time."*

Importance of family and friends

Respondents mentioned that as they got older, spending time with family or friends became more important to them. An older or non-working spouse often pulled the employee towards early retirement, since respondents wished to spend more time together. A woman (60), who worked in the health care sector her whole career, emphasized:

"The fact that (my partner) is 10 years older than I am is decisive for my stopping work at an earlier age […], if I want to do fun things, then I shouldn't keep working until I'm 65."

Some persons were attracted to early retirement because they wished to take care of a partner, family member (e.g. grandchild), or friend. A primary school teacher (female, 61) described:

"And by now I have grandchildren. That is also one of the reasons that I stopped a little sooner, because I'm going to be babysitting soon."

Financial factors

In addition to the 'push' and 'pull' factors towards early retirement described above, financial factors influenced early retirement (Figure 2). Most employees had the opportunity to opt for early retirement schemes (e.g. financial arrangements provided by the employer or sector, flexible early retirement schemes), which made early retirement accessible. Others saved money to facilitate an early exit from working life. In some persons, financial opportunities to retire early became important in the context of other push and pull factors, whereas financial opportunities played a more direct role for others. In all cases, the financial opportunity to retire early was essential in the final decision to leave the workforce before the age of 65. Some described that they had known for years at what age they would qualify for early retirement arrangements and changed their mindset accordingly. A man (60), who worked in the police force, explained:

"I knew during my contract time that I could retire at 60 […] then it turned into 62, but if you participated in the life-course savings scheme you could do it early."

A trouble-shooter in machine construction (61) who enjoyed his job, described his financial opportunity to retire as follows:

"The Social Benefit taxes that I paid, that bag of money was laying there. I can use that and if I don't, then at 65 it's gone […] that money that I saved […] all those years, someone else will use it. And then I say, no that is my money, I'm using it."

DISCUSSION

For most employees, a combination of factors played a role in the process towards early retirement, although the specific factors involved differed between individuals. Push factors towards early retirement included, among others, organizational changes at work, conflicts at work, high work pressure, high physical job demands, and dis- satisfaction with the limited use of one's particular skills and knowledge. Pull factors towards early retirement included the wish to do other things outside of work, enjoy life, have more flexibility, spend more time with a spouse or grandchildren, and care for others. In addition, the financial opportunity to retire early played an important role for all respondents.

Our findings on the influence of work-related factors, the wish to do other things outside of work, and financial factors are in line with previous qualitative and quantitative studies on early retirement [7,12]. The present study also identified an additional factor, namely insufficient use of older workers' skills and knowledge. Moreover, the present study provided new insights into how and why different factors influenced early retirement. Push factors towards early retirement seemed to cause early retirement via a decrease in motivation, ability, and opportunity to continue working. For example, insufficient use of skills and knowledge decreased a per- son's motivation to continue working and physically demanding work reduced an employee's ability to continue working until the age of 65. Our results suggest that employees who felt unable to find a new job due to their age when confronted with a push factor experienced a reduced opportunity to continue working, and as a con- sequence, retired early. In line with this, earlier studies have shown that age discrimination impacts the opportunity for older workers to remain in or re-enter the workforce [22]. Pull factors towards early retirement, such as spending more time with a significant other, mainly influenced early retirement via an increased motivation to retire early. Moreover, financial factors, such as favorable retirement schemes, importantly influenced the opportunity to retire before the age of 65.

In line with previous research [23], the process to- wards early retirement appeared to be multi-factorial and was frequently not determined by one single factor. This suggests that interventions and policies should not focus on one factor but integrate measures on a combination of relevant factors. When ranking the relative importance of factors involved in the early retirement process, financial factors appeared to be most important and were often a precondition for early retirement. Push and pull factors seemed of equal importance for early retirement in our study population. We recommend that future quantitative research investigates the relative importance of factors involved in early retirement in different groups of workers to shed more light on the potential of interventions.

Since different factors played a role for different persons, it seems that especially interventions tailored to the individual and the specific working conditions may support the prolongation of working life. Work-related interventions can address both push and pull factors, though the intervention potential may differ between these factors. Push factors towards early retirement can be targeted directly, whereas pull factors relate to private life, and hence, can only be accommodated. With respect to push factors,

work-related interventions could include measures that improve working conditions such as work pressure, social climate and use of individual's knowledge. The impact of organizational and task-related changes on early retirement stresses the importance of a working environment that supports maintaining a high employability and flexibility throughout employees' careers. With respect to pull factors, work-related interventions are recommended to include measures that match working conditions with factors pulling individuals to- wards early retirement [24,25]. Flexible working hours could for example fit with the wish to spend more time with a spouse or take care of others and maintain a satisfactory work-life balance. To ensure a good fit between the demands of the job and the ability and wishes of the employee, a dialogue between employers and employees may be helpful from an early phase in the career onwards. Due to the aging of the population and changes in retirement scheme regulations, early retirement schemes will become financially less favorable in the Netherlands in the near future. As a consequence, the opportunities to leave the workforce early will decrease. Most participants in this study still had the opportunity to opt for favorable retirement schemes, and it would be interesting in future research to explore whether reasons for early retirement will shift when these arrangements become less accessible. It could be hypothesized that push factors towards early retirement will gain importance relative to pull factors such as the wish to do other things outside of work. However, in the present study, employees who could financially afford to retire early in order to focus on other aspects of life experienced this as a positive outcome. Besides, it could be hypothesized that some employees may leave the work force via different pathways in the future, e.g. unemployment. These potential consequences further necessitate improvements in the working environment including flexible working arrangements, policies supporting employability (e.g. skills), and improvements in labor market opportunities for older persons. Another area that could be further researched is on how to balance the societal need to prolong working life due to the aging of the population and the older worker's preferred work-life balance. This is especially important because satisfaction with the job relates to health and well-being [26]. Future research on early retirement also needs to take the employers perspective into account; employers may, for example, be confronted with costs associated with the loss of older skilled workers and recruitment of new workers, but also with costs associated with retention of older workers.

The qualitative character of the present study was considered a strength, since it allowed us to gain insight into how various factors led to early retirement. This method also allowed respondents to report important factors that were not yet identified in the literature and played a role in their retirement process. Another strength of the current study was the study population, since only employees who had retired early, or already formally arranged with their employer to do so within six months, were included. Hence, actual early retirement was explored rather than the intention to retire early.

The present study also has some limitations. Firstly, in qualitative studies the researcher is an important instrument in data collection and analysis [27], which may have influenced the findings. Therefore, analysis of the interviews was predominantly done by two persons. Moreover, to ensure robustness of findings, members of the project team discussed data quality and results. Secondly, during the interviews, persons looked back at their

transition from work to early retirement. There is a risk of recall bias and transformation of the 'real' story, since persons may not remember facts correctly or may be influenced by psychological processes, such as cognitive dissonance. The interviewer used in-depth follow-up questions to validate interviewees' answers. Moreover, to prevent biased results we checked for inconsistencies in the stories and interpreted these parts with caution. Thirdly, during some interviews a spouse, daughter, or granddaughter was present. This may have influenced the participants' answers. To limit bias, issues brought up by non-participants were interpreted with caution in the analysis. Fourthly, in the present study, differences between subgroups, e.g. gender and educational level, could not be investigated. Fifthly, it should be acknowledged that country specific pension systems may influence both the accessibility and factors involved in early retirement. This might limit the generalizability of (some of) our findings to other (non-European) countries. Finally, before retirement, some persons had expected to miss pleasant aspects of working life including social contacts with colleagues, day rhythm, and appreciation (i.e. pull factors towards work). This made the decision to retire early tough. However, we were unable to identify reasons to *continue* working life, since we did not include employees who stayed in the workforce until the age of 65 years in the present study.

CONCLUSION

In conclusion, this study found that the process towards early retirement is multi-factorial. Apart from financial incentives, the prolongation of working life may be supported by improving the fit between the physical and psychosocial job characteristics on the one hand and the abilities and wishes of employees on the other hand. Work-related interventions that enable and motivate employees to prolong their careers may include measures that reduce physical and psychosocial load, support employees in coping with organizational changes and maintain employability, support the use of older workers' skills and knowledge, and offer the opportunity to perform activities outside of work (e.g. flexible working hours). Tailored interventions seem especially important, since a different combination of factors resulted in early retirement for different persons. Therefore, a continuous dialogue between employers and employees on the (future) person-job fit and tailored interventions might be helpful in promoting prolonged working lives for older employees.

REFERENCES

1. Statline: *From work to retirement; persons of 55 years and older*; 2012 [http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=80396NED&D1=1,9&D2=0&D3=0&D4=0&D5=1&D6=0-1,3-6,9-12,14,17-20&D7=0&D8=3,6-11&HD=120111-1606&HDR=G4,G3,G2,G1,G6,T,G7&STB=G5]

2. Statline: *Population; key figures*; 2011 [http://statline.cbs.nl/StatWeb/ publication /?VW=T&DM=SLNL&PA=37296ned&D1=a&D2=0,10,20,30,40,50,(l-1)-l&HD=120124-1109&HDR=G1&STB=T]

3. Poos MJJC: Does the life expectancy increase or decrease? In *National Public Health Compass.* Bilthoven: RIVM; 2011 [http://www.nationaalkompas.nl/gezondheid-en-ziekte/sterfte-levensverwachting-en-daly-s/ levensverwachting/trend/#.TwFwzbvgLok.email]

4. Ilmarinen JE: Aging workers. *Occup Environ Med.* 2001;58:546–52.

5. Ministery of Social Affairs and Employment: *Facts & Figures elaboration pension agreement*; 2011 [http://www.rijksoverheid.nl/documenten-en- publicaties/ circulaires/2011/06/10/facts-figures-uitwerking-pensioenakkoord. html]

6. Shultz KS, Morton KR, Weckerle JR: The influence of push and pull factors on voluntary and involuntary early retirees' retirement decision and adjustment. *J Voc Beh.* 1998;53:45–57.

7. Van den Berg TIJ, Elders LAM, Burdorf A: Influence of health and work on early retirement. *J Occup Environ Med.* 2010;52:576–83.

8. 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;40:161–9.

9. Damman M, Henkens K, Kalmijn M: The impact of midlife educational, work, health, and family experiences on men's early retiremen. *J Gerontol Ser B Psychol Sci Soc Sci.* 2011;66(5):617–27.

10. Herrbach O, Mignonac K, Vandenberghe C, Negrini A: Organizational commitment, and voluntary early retirement among late-career managers. *Hum Resour Manage.* 2009:48(6):895–915.

11. Fischer JAV, Sousa-Poza A: *The institutional determinants of early retirement in Europe.* St. Gallen: Department of Economics, University of St. Gallen; 2006.

12. Proper KI, Deeg DJH, Van der Beek AJ: Challenges at work and financial rewards to stimulate longer workforce participation. *Hum Resour Health.* 2009;7:70.

13. Siegrist J, Wahrendorf M, Von Dem Knesebeck O, Jürges H, Börsch-Supan A: Quality of work, well-being, and intended early retirement of older employees - baseline results from the SHARE study. *Eur J Public Health.* 2006;17(1):62-8.

14. 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.

15. De Wind A, Geuskens GA, Reeuwijk KG, Westerman MJ, Ybema JF, Burdorf A, Bongers P, Van der Beek AJ: Pathways through which health influence early retirement: a qualitative study. *BMC Public Health.* 2013;13:292.

16. Van den Berg TIJ, 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.

17. Ybema JF, Geuskens G, Van den Heuvel S: *Study on transition in employment, ability and motivation (STREAM). Methodology and first results.* Hoofddorp: TNO; 2011.

18. Patton MQ: *Qualitative research & evaluation methods.* 3rd edition. Newbury Park, California: Sage Publications; 2002:230–43.

19. Wang M: Profiling retirees in retirement transition and adjustment process: examining the longitudinal change patterns of retirees' psychological well-being. *J Appl Psychol.* 2007;92:455–74.

20. Braun V, Clarke V: Using thematic analysis in psychology. *Qual Res Psychol* 2006, 3:77-101.

21. ATLAS.ti GmbH: *[software package]. Version 6.1.17.* Berlin: ATLAS.ti Scientific Software Development GmbH; 2010.

22. Ghosheh NS Jr, Lee S, McCann D: *Conditions of work and employment for older workers in industrialized countries: Understanding the issues. Conditions of Work and Employment Series (no. 15).* Genevia: International Labour office; 2006.

23. Soderhamn O, Skisland A, Herrman M: Self-care and anticipated transition into retirement and later life in a Nordic welfare context. *J Multidiscip Healthc.* 2011;4:273–9.

24. Schaufeli W: Sustainability from a psychological perspective: a matter of 'fit'. In *Best before: about the urgency of sustainable employability in the Netherlands.* Schouten & Nelissen. Zaltbommel: Uitgeverij Thema; 2011.

25. Edwards JR, Cable DM, Williamson IO, Schurer Lambert L, Shipp AJ: The phenomenology of fit: linking the person and environment to the subjective experience of person-environment fit. *J Appl Psychol.* 2006;91(4):802–27.

26. Faragher EB, Cass M, Cooper CL: The relationship between job satisfaction and health: a meta-analysis. *Occup Environ Med.* 2005;62(2):105–12.

27. Pope C, Ziebland S, May N: Qualitative research in health care: analyzing qualitative data. *BMJ.* 2000;320:114-6.

APPENDIX

Interview guide

I. Background information

1. To get to know you a little bit better, I would like you to tell me something about yourself…
    - What is your home situation like?
    - What kind of family do you come from?

II. Work history

2. Could you describe what types of jobs you have had in the past?

Draw, with the interviewee, his/her career history on a timeline.

If respondent mentions different jobs:

3. What was the reason for the job change?
    - Why?
    - Since when?
    - What triggered this?
    - How did this happen?
4. For what reasons did you work in this job for x years?

If respondent mentions one job

5. For what reasons did you work in this job for x years?
6. Did you work part-time or fulltime?
7. What is your educational background? Do you have any diplomas?
8. Could you mention something about your home situation during your career?
9. Did you participate in any activities outside of work, such as hobbies, volunteer work, or taking care of others?
    - How important were those activities to you?
10. How important was work to you?
11. Did this change throughout the years?
    - Why?

- Since when?

12. Could you describe your most recent job?

III. Reasons for retiring early

13. What were reasons for you to retire early?

If someone mentions (changes in) health (examples):

What kind of health problems did you have?

- Since when?
- For what reason didn't you continue working with the health problems?

If someone mentions (changes in) work stress or work- related tasks (examples):

Why did your work become more stressful?

- Since when?
- Why was that?

How did you experience it when teams were combined?

- Why was that?

How did you experience it when you got a new team leader?

- Why was that?

If someone mentions (changes in) how their skills and knowledge matched with the job demands (examples):

How did you experience it when you could not keep up with new developments?

- Since when?
- Why was that?

If someone mentions (changes in) the social situation (examples):

How did you experience it when your partner stopped working?

- Why was that?

How did you experience it when you became a grand- mother/grandfather?

- Why was that?

If someone mentions (changes in) financial situation (examples):

How did you experience it that you were financially able to stop working sooner?

- Why was that?
- How were you able to?

How did you experience it that you were offered an appealing financial incentive from your employer?

- Why was that?

If someone mentions (changes in) the ability to work (examples):

Why were you no longer able to work?

- Since when?
- Why weren't you able to work anymore since then?

If someone mentions (changes in) their motivation to work (examples):

Why did your motivation to work change?

Why did your work become less/more important to you?

- Since when?
- Why did your motivation to work change at that moment?

Why were you no longer satisfied at work?

- Since when?
- Why were you no longer satisfied at work at that moment?

If someone mentions (changes in) their opportunity to work (examples):

Why was there no longer an opportunity for you to work?

- Since when?
- Why did you perceive a decrease in the opportunity to continue working?

14. You mentioned several reasons why you retired early.

The interviewer summarizes these reasons.

- Is this correct?
- Are there any other important reasons for which you retired early?

15. What were the most important reasons for you to retire early?

16. From the literature we know that aside from …, and …, other factors can also play a role in early retirement decisions.

Fill in blanks on the basis of the interview.

If health was not mentioned:

For example, health. If you look back, did health play a role in your early retirement?

If work-related factors were not mentioned:

For example, work-related factors. If you look back, did work-related factors play a role in your early retirement?

If skills and knowledge were not mentioned:

For example, skills and knowledge. If you look back, did skills and knowledge play a role in your early retirement?

If social factors were not mentioned:

For example, social factors. If you look back, did social factors play a role in your early retirement?

If financial factors were not mentioned:

For example, financial factors. If you look back, did financial factors play a role in your early retirement?

If ability was not mentioned:

For example, sometimes people are no longer able to work. If you look back, did this play a role in your early retirement?

If motivation was not mentioned:

For example, sometimes people are no longer motivated to continue working, or they no longer want to continue working. If you look back, did this play a role in your early retirement?

If opportunity was not mentioned:

For example, sometimes people no longer had the opportunity to continue working. If you look back, did this play a role in your early retirement?

IV. Timing of the transition

If someone retired early within the past 12 months:

17. On xx-xx-xxxx you retired early. Why did you retire at that moment specifically?

- Why not sooner?
- Why not later?

18. Why did the factors that you mentioned before lead to your retiring at that moment?

OR You mentioned that x, x, and x played a role in your retiring early. Did something change in those factors that led you to retire on xx-xx-xxxx?

19. After you decided to retire early, you still worked x months. What kind of expectations did you have of those last x months?

20. To what extent were those expectations of the last × months accurate?

If someone will retire early within the next 6 months:

21. On xx-xx-xxxx you are going to retire early. Why are you retiring on that moment specifically?
    - Why not sooner?
    - Why not later?

22. When did you and your employer discuss your retiring early?

23. Could you explain how that went?
    - Who initiated the process?
    - Why was the process initiated?
    - How long did this take?

24. Why did you then decide that you would keep working x months?
    - Why not longer?
    - Why not shorter?

V. Circumstances under which one would have continued working

25. If you could have decided yourself, would you have retired early on xx-xx-xxxx, or would you have worked longer or shorter?
    - Why?

26. Did it feel like it was your own decision to retire early?
    - Why?

27. Are there any circumstances under which you would have continued working? Under which circumstances would you have continued working?

If someone mentions circumstances:

28. Why would you have worked longer under those circumstances?

If someone doesn't mention circumstances

29. Why did you not want to/could you not continue working?

If someone mentions multiple circumstances (question 3):

30. You mentioned various circumstances under which you would have continued working. *The interviewer summarizes these.* Is that correct?
    - Which circumstances were most important?

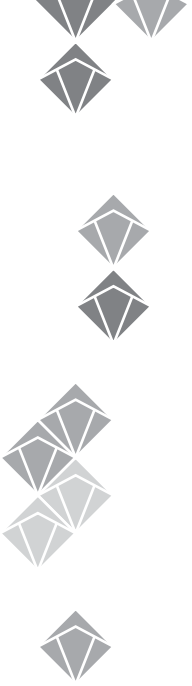
VI. Current situation and future

If someone retired early within the past 12 months:

31. You have now been retired for x months. How do you feel about it?
32. What were your expectations about early retirement?
33. To what extent does your early retirement compare to these expectations?
34. Now I have another very open question to conclude with. How do you feel about the future?
    - Do you see this as a positive thing?
    - Do you have plans for the future?

If someone will retire early within the next 6 months:

35. In x months you will retire early. What are your expectations about these upcoming months?
36. Soon you will retire early. What are your expectations about early retirement?
37. Now I have another very open question to conclude with. How do you feel about the future?
    - Do you see this as a positive thing?
    - Do you have plans for the future?



chapter 3

THE CONTRIBUTION OF OVERWEIGHT, OBESITY, AND LACK OF PHYSICAL ACTIVITY TO EXIT FROM PAID EMPLOYMENT: A META-ANALYSIS

SCANDINAVIAN JOURNAL OF WORK, ENVIRONMENT & HEALTH 2013; 39(3):233-40

ROBROEK SJW

REEUWIJK KG

HILLIER FC

BAMBRA CL

VAN RIJN RM

BURDORF A

ABSTRACT

Objectives

The objective of this review was to analyze systematically the association between overweight, obesity, and lack of physical activity (PA) and exit from paid employment through disability pension, unemployment, and early retirement. We also aimed to identify the influence of study population and study design on the magnitude of this association.

Methods

We searched PubMed and Embase for English language, longitudinal, quantitative studies that described the relationship between overweight, obesity, or lack of PA and exit from work. A short checklist was used to assess the internal and external validity of the studies. We first estimated the pooled effects using a random effects model and then analyzed the influence of study and population characteristics on associations by stratified meta-analyses.

Results

In total, 28 out of 1097 publications met the inclusion criteria. Obese [relative risk (RR)=1.53] and, to a lesser extent, overweight (RR=1.16) individuals had an increased likelihood of exit from paid employment through disability pension, but were not at statistically significant increased risk for unemployment or early retirement. Of 17 associations between a lack of PA and disability pension, 8 were statistically significant; this was also the case for 2 of 3 for unemployment. No associations were statistically significant for early retirement.

Conclusions

Obesity is a risk factor for exit from paid employment through disability pension. There are also indications that a lack of PA is related to an increased risk of disability pension and unemployment. To protect workers against premature exit from paid employment, long-term interventions to prevent overweight and obesity and promote PA in the working population should be considered for implementation.

Key words

Disability pension; early retirement; systematic review; unemployment

BACKGROUND

Life expectancy is steadily increasing in developed countries. Governments are seeking to increase the proportion of elderly persons in paid employment by both extending working life through a higher official retirement age and preventing premature exit from paid employment. Therefore, many policies and programs are introduced to improve sustainable employability. In order to develop successful interventions to reduce premature exit from paid employment, insights into important modifiable risk factors for exit from paid employment are needed. From previous studies it is known that poor health is an important determinant of exit from paid employment, particularly due to disability pension [1]. Furthermore, poor health has also been found to increase the likelihood of labor force exit into unemployment and early retirement [1]. However, less is known about the role of important modifiable behavioral and social risk factors for poor health, especially lack of physical activity (PA) and obesity, in displacement from the labor force through disability pension, unemployment, and early retirement. Recent studies have shown that a lack of PA and obesity are important risk factors for productivity loss at work [2], sickness absence [2], and reduced work ability [3]. Numerous health promotion programs for healthier lifestyle have been offered to employees. These programs are also often evaluated in terms of health and productivity. In recent years, several systematic reviews have been conducted that corroborate the influence of lifestyle-related factors, mainly obesity, on productivity loss at work [4–6], and sickness absence [5–8]. However, there is less insight into the particular role of these factors on different routes of premature exit from paid employment.

A systematic review of 16 cross-sectional and longitudinal studies reported that a higher body mass index (BMI) was significantly associated with disability pension [9]. The potential contribution of overweight, obesity, and lack of PA to unemployment and early retirement is less well known.

In order to understand and quantify the importance of these factors on different labor market exit pathways, the literature needs to be synthesized. Hence, we conducted a systematic review and meta-analysis. The aims were to (i) describe the influence of overweight, obesity, and lack of PA on exit from paid employment through disability pension, unemployment, and early retirement, and (ii) identify the influence of study population and study design on the magnitude of this association.

METHODS

Identification of the studies

Relevant articles were identified by means of a computerized search in the bibliographic databases PubMed, Embase, and Web of Science up to 31 December 2012. The search terms were related to (i) a lack of PA or over- weight/obesity, (ii) early retirement or unemployment or disability pension, and (iii) a longitudinal design. The detailed search

for each bibliographic database can be found in appendix A. To be included, articles had to meet the following criteria: (i) describe the relationship between overweight, obesity, or lack of PA and exit from paid employment through early retirement, unemployment, or disability pension; (ii) study this relationship in a longitudinal design; (iii) express the strength of the relation in a quantitative measure or provide sufficient information to calculate a quantitative measure and corresponding confidence interval; and (iv) be written in English. Studies on specific patient populations were excluded from this review.

Selection

The first author performed the literature search and selected titles and abstracts. A broad selection of studies was used so that we could include studies in the screening that did not primarily focus on the risk factors overweight, obesity, or lack of PA, but rather included these factors as confounding factors. Subsequently, the second author selected the fulltext articles to be included in the meta-analysis. In case of doubt, the first author was consulted. Figure 1 shows the flow of the articles throughout the inclusion process. Based on title and abstract, 990 of 1097 articles (90%) were discarded because 818 abstracts (75%) did not describe exit from paid employment as an outcome, 156 abstracts (14%) did not study the role of lifestyle-related factors on exit from paid employment, and 16 abstracts (1%) did not describe a longitudinal study. In total, 107 articles were retrieved for full review of which 79 were excluded (74%) for various reasons (see figure 1). In case of duplicate use of data sets, the study providing the most complete information was chosen. Finally, 28 articles (3%) met our inclusion criteria.

Data extraction

The first author extracted information on population characteristics (sex, age, country of study), study characteristics (number of participants, length of follow-up), occurrence of exit from paid employment and the magnitude of the association with corresponding confidence intervals. When more associations were presented within a study, the maximal adjusted association was chosen.

Quality evaluation

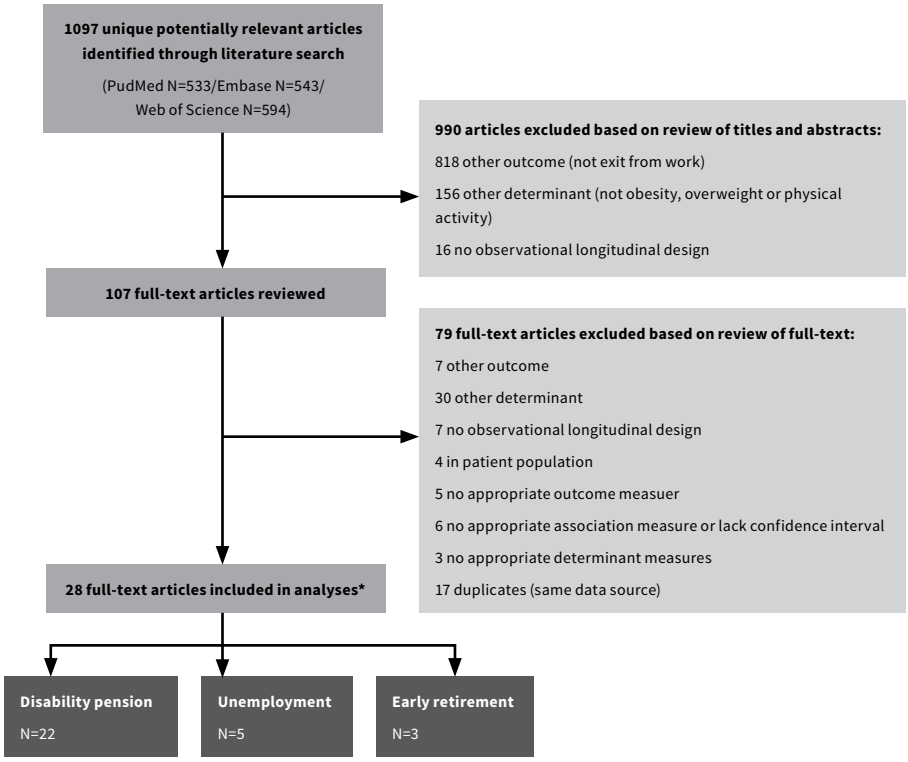
The methodological quality was assessed according to an abbreviated version of the Methodological Evaluation of Observational Research checklist [10]. Criteria for quality assessment in this systematic review addressed four items on internal (response, subject flow) and external validity (adjustment for confounding factors, loss to follow-up), whereby each criterion was scored as 1 (sufficiently met), 0 (insufficiently met or lack of essential information). The contrast in measurements is restricted to objective or subjective measurement of determinants and outcomes since all included studies derived comparable information. Therefore, no additional information concerning measurement quality will be presented. The detailed information on quality aspects is presented in appendix B.

Data synthesis and data analysis

The first step in the meta-analysis was to estimate the pooled effects using an excel spread sheet for pooling of relative risks [11]. Due to observed heterogeneity (heterogeneity

statistics I2 >50% for disability pension) between studies, a random effects model was used in the meta-analysis on reported hazard ratios (HR), odds ratios (OR), and relative risks (RR). These measures of association were used interchangeably and interpreted as an expression of RR. Random-effects meta-analysis assumes that there are real differences between individual studies regarding the magnitude of the association between health determinants and exit from paid employment. It considers both between- and within-study variability [12].

The standard definitions for obesity (BMI≥30 kg/m2) and overweight (25≤BMI<30 kg/m2) will be used. For those studies that used other definitions [13, 14], BMI>27.5 kg/m2 was considered as obesity, and BMI>22.5 kg/m2 was considered to reflect overweight. In case BMI was presented as a continuous variable [15, 16], it was transformed to the corresponding categories with the assumption of a constant risk increment [17]. Subsequently, the influence of study and population characteristics on associations between obesity and overweight with exit from paid employment was analyzed by a stratified meta-analysis.



One study included unemployment, early retirement, and disability pension as outcome measures [Robroek et al [18]]

Figure 1. Flow chart describing the article search process.

RESULTS

In total, 28 longitudinal studies described the influence of BMI or lack of PA on disability pension (N=22), unemployment (N=5), or early retirement (N=3). One study provided associations with disability pension, unemployment, and early retirement [18]. The study sizes varied between N=781 [19] and N=1191027 [20] and the median follow-up time was 10 years with a range of 2.5 [21] to 38 [20] years. Several studies presented more than one risk estimate, either through stratification (i.e., gender), several cut-offs for the determinants, or numerous outcome measures. Therefore, the sum of associations presented for disability pension (obesity: N=29, overweight: N=23, lack of PA: N=17), early retirement (obesity: N=6, overweight: N=6, lack of PA: N=3), and unemployment (obesity: N=3, overweight: N=6, lack of PA: N=2) was >28 (appendix C). Because of the few studies investigating the associations with early retirement or unemployment, the stratified meta-analysis of population and study characteristics is restricted to studies evaluating disability pension outcomes only. No pooled estimates were calculated for lack of PA due to the large variety in definitions and cut-off points used.

Disability pension

Fifteen [13, 15, 16, 18, 20–30] and 17 studies [13, 15, 16, 18, 20, 21, 23–33] investigated the influence of overweight (23 associations) and obesity (29 associations) on the risk of disability pension, respectively (see figure 2). In 15 of 23 associations, overweight was a statistically significant risk factor with an overall estimate across all 23 associations of RR=1.16 [95% confidence interval (95% CI) 1.08–1.24]. In 20 of 29 associations, obesity was also a statistically significant risk factor with a higher pooled estimate across 29 associations of RR=1.53 (95% CI 1.35– 1.72). The stratified meta-analysis shows stronger associations for obesity in Scandinavian (RR=1.57, 95% CI 1.39–1.78) than non-Scandinavian studies (RR=1.21, 95% CI 0.81–1.81). There were no differences in associations between studies performed among women (RR=1.53, 95% CI 1.27–1.86) or men (RR=1.56, 95% CI 1.29–1.87). Studies with a longer follow-up time showed slightly higher RR (follow- up period ≥10 years: RR=1.57, 95% CI 1.36–1.81; follow-up period <10 years: RR=1.44, 95% CI 1.32– 1.58). The more recently a study was published, the more likely they reported a lower association estimate (published in/after 2002: RR=1.44, 95% CI 1.25–1.66; published before 2002: RR=1.85, 95% CI 1.51–2.26). Concerning quality characteristics, there were no major differences in risk estimates between studies with a response level < or >30% or studies that did or did not adjust for other lifestyle factors. Studies with objective information (RR=1.67, 95% CI 1.44–1.94) on obesity were more likely to report a stronger association estimate than those based on self- reported information (RR=1.30, 95% CI 1.19–1.43). Studies lacking information about the flow of subjects were, although not statistically significant, more likely to report a stronger association between obesity and disability pension (RR=1.64, 95% CI 1.35–1.99 versus RR=1.46, 95% CI 1.24–1.71).

Ten studies (13, 16, 18, 22, 24, 31, 34–37) investigated the influence of lack of PA during leisure time on the risk of disability pension, presenting 17 associations (figure 5). In 8 of these associations, lack of PA was a statistically significant risk factor for disability

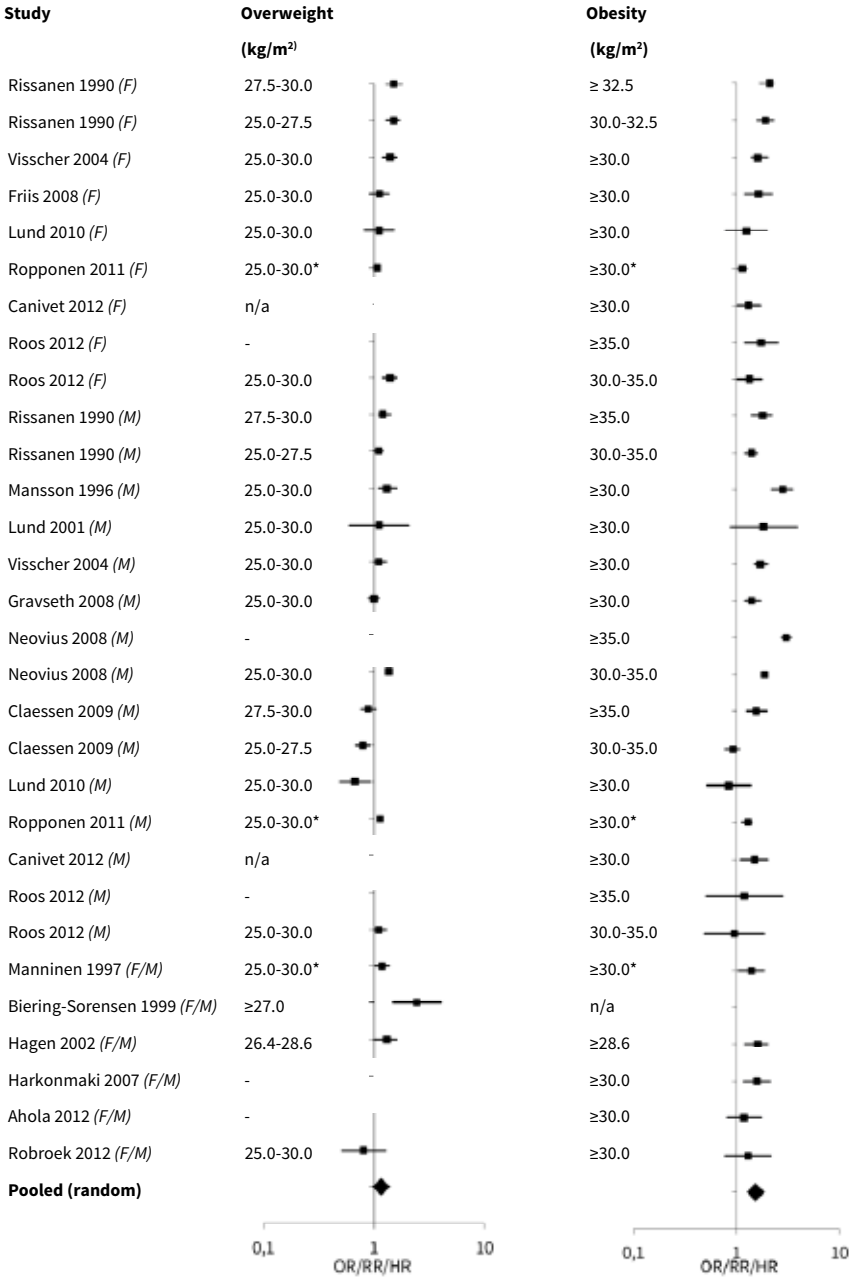
pension. With the exception of one study [24], all presented a RR>1 for the association between lack of PA and disability pension.

Unemployment

Four [14, 18, 38, 39] and two studies [18, 38] investigated the influence of overweight (6 associations, none statistically significant) and obesity (3 associations, 1 statistically significant) on unemployment, respectively (see figure 3). After pooling, no statistically significant associations were found between obesity (pooled RR=1.20, 95% CI 0.64–2.25) or overweight (pooled RR=1.02, 95% CI 0.90–1.16, figure 3) and unemployment. Two studies [18, 19] investigated the influence of lack of PA during leisure time on unemployment presenting three associations (figure 5). Two of these associations presented a statistically significant increased risk of lack of PA on unemployment (figure 5).

Early retirement

Three studies [18, 40, 41] investigated the influence of overweight or obesity on early retirement presenting six associations (see figure 4). One of these associations presented an increased risk of early retirement among obese individuals, but no statistically significant association was found when all six studies were pooled (pooled RR=1.07, 95% CI 0.95–1.20, figure 4). Two of six associations presented a statistically significant increased risk of early retirement among overweight individuals, but again no statistically significant association was found when all the studies were pooled (pooled RR=1.08, 95% CI 0.95–1.23, figure 4). The two studies investigating the association between lack of PA and early retirement reported no statistically significant increased risk of early retirement [18, 40].



** BMI as a continuous variable was transformed to the corresponding categories, with the assumption of a constant risk increment.*

Figure 2. Association between obesity, overweight and disability pension. Body mass index as a continuous variable was transformed to the corresponding categories with the assumption of a constant risk increment.

Study	Overweight (kg/m$^{2)}$	Obesity (kg/m^2)
Laitinen 2002 *(F)*	≥23.8 *(age 14)*	n/a
Jusot 2008 *(F)*	25.0-30.0	≥30.0
Laitinen 2002 *(M)*	≥23.7 *(age 14)*	n/a
Jusot 2008 *(M)*	25.0-30.0	≥30.0
Virtanen 2012 *(F/M)*	≥25.0	n/a
Robroek 2012 *(F/M)*	25.0-30.0	≥30.0
Pooled (random)		

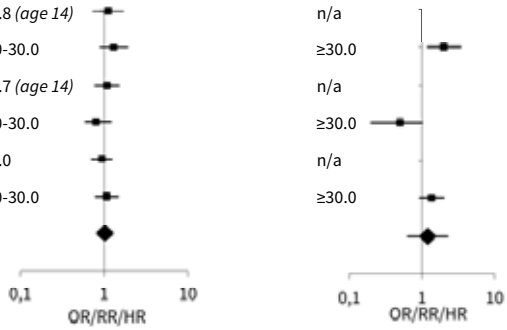


Figure 3. Association between obesity, overweight, and unemployment.

Study	Overweight (kg/m$^{2)}$	Obesity (kg/m^2)
Friis 2007 *(F)*	25.0-30.0	≥30.0
Houston 2008 *(F, White)*	25.0-30.0	≥30.0
Houston 2008 *(F, Afr-Am)*	25.0-30.0	≥30.0
Houston 2008 *(M, White)*	25.0-30.0	≥30.0
Houston 2008 *(M, Afr-Am)*	25.0-30.0	≥30.0
Robroek 2012 *(F/M)*	25.0-30.0	≥30.0
Pooled (random)		

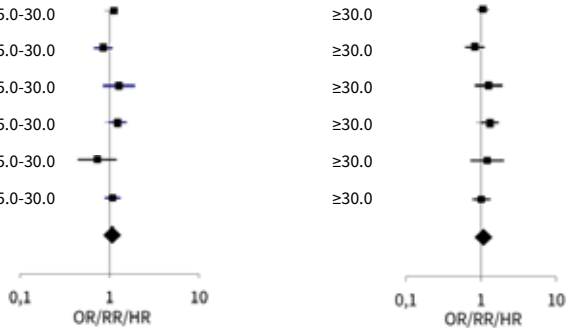


Figure 4. Association between obesity, overweight, and early retirement .

Study	Lack of PA
Disability pension	
Krokstad 2002 *(F)*	< 1x/week
Friis 2008 *(F)*	little/sedentary
Ropponen 2011 *(F)*	continuous
Lahti 2012 *(F)*	inactive
Krause 1997 *(M)*	lowest 25%
Krokstad 2002 *(M)*	< 1x/week
Ropponen 2011 *(M)*	continuous
Lahti 2012 *(M)*	inactive
Biering-Sorensen 1999 *(F/M)*	never
Hagen 2002 *(F/M)*	lowest 0-10%
Hagen 2002 *(F/M)*	lowest 10-25%
Hagen 2002 *(F/M)*	lowest 25-50%
Suominen 2005 *(F/M)*	0x/month
Suominen 2005 *(F/M)*	1x/month
Suominen 2005 *(F/M)*	2-3x/month
Ahola 2011 *(F/M)*	< weekly
Robroek 2012 *(F/M)*	< 1x / week
Unemployment	
Liira 1999 *(M, farming)*	<1x / week
Liira 1999 *(M, construction)*	<1x / week
Robroek 2012 *(F/M)*	<1x / week
Early retirement	
Friis 2007 *(F)*	little/sedentary
Robroek 2012 *(F/M)*	<1x / week

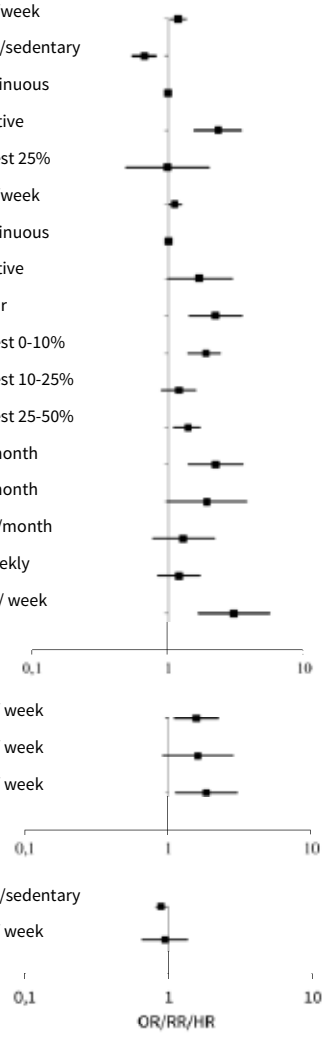


Figure 5. Association between lack of physical activity and disability pension, unemployment and early retirement.

DISCUSSION

This meta-analysis provides insight into the role of overweight, obesity, and lack of PA during leisure time on premature exit from paid employment. Obese – and to a lesser extent overweight – workers had an increased likelihood of exit from paid employment through dis- ability pension among both men and women, but obesity was not a risk factor for unemployment or early retirement. Workers with lack of PA had an increased risk of disability pension and unemployment, but not of early retirement.

The finding that obesity, and to a smaller extent overweight, are related to future disability pension confirms the results of a previous systematic review on eight longitudinal studies [9]. The majority of the studies included in the current review consistently reported a statistically significant association between obesity and disability pension in spite of different definitions for both risk factor and outcome. Interestingly, in several studies, a lack of PA during leisure time was also a significant risk factor for disability pension. However, the available evidence in longitudinal studies suggests that obesity is more important than PA for sustained employability. Since the majority of the studies did not report information concerning the underlying reason for disability pension, we were not able to disentangle whether the relation between obesity and lack of PA with disability pension is mediated by specific diseases. The increased risk of disability pension among obese workers is in line with the findings of recent studies on the relation between obesity on one hand and productivity loss at work and sick leave on the other hand [4–8, 42]. The results imply that the increasing prevalence of obesity in most Western countries is a concern with regard to work participation and sustainable employability. A healthy lifestyle and body weight are important for a productive workforce.

Three studies were included that reported on the association between obesity and unemployment and early retirement. The pooled estimate was weak and non-significant, suggesting that obesity plays a minor role in displacement from the labor market through both pathways. In general, these pathways are to a lesser extent driven by health problems [1]. Other financial or social factors might play a more important role in these pathways of exit from work than might be the case when leaving the labor market through a specific healthrelated pathway such as disability pension [43]. Few studies investigated the relationship between a lack of PA and exit from work. Only two studies evaluated the role of lack of PA on early retirement and unemployment. For both disability pension and unemployment, several studies found lack of PA to be a risk factor. Other lifestyle-related factors, such as smoking or an unhealthy diet, were not evaluated in this meta-analysis. Several studies have shown that such lifestyle factors, particularly smoking, may play a role in premature exit from paid employment, especially through disability pension [18, 38]. Promoting a healthy lifestyle might thus be a way to prevent workers from leaving the workforce too early. Interventions could range from organizational workplace changes that enhance the ability of employees to engage in PA [e.g., flexible working conditions [44]] to workplace health promotion and onsite PA and healthy eating initiatives [45]. Most intervention studies on workplace health programs have follow-up periods of at best 24 months, which is far too short to demonstrate a noticeable impact on work participation.

In order to gain more insight into the role of lifestyle on sustained labor participation, studies with repeated measurements during longer follow-up periods are needed.

Socioeconomic status is a potential confounder for the relation between lifestyle-related factors and exit from work. From previous studies, it is known that an unhealthy lifestyle and obesity are more prevalent among individuals in lower socioeconomic groups [46]. Furthermore, individuals with a lower education or in a lower occupational class are more likely to leave the labor force due to disability pension, unemployment, or early retirement [1, 47]. However, in the stratified meta-analysis no systematic lower risk of exit from paid employment was observed between studies adjusting for socioeconomic status, educational level, or job type and studies that did not adjust for these factors. A potential explanation might be that the response in questionnaire surveys is typically higher among higher educated employees and, thus, study populations reflect better higher-educated populations.

A strength of this systematic review is the availability of various studies on disability pension, which supported an informative meta-analysis. In contrast, only few studies evaluated the role of obesity and lack of PA on early retirement and unemployment. There are also some limitations in this systematic review. First, the literature search was limited to three electronic databases and English publications. Therefore, it is possible that we still missed some useful studies. Second, there is substantial variation among studies concerning definitions for determinants (particularly for lack of PA) and out- comes, the follow-up period, and the study populations. With the exception of three studies [18, 21, 33], all used register-based outcome data. We found that the method of measurement of determinant (self-report or objective measurement) did influence the pooled estimate. Studies based on objective information to define BMI were more likely to find a stronger association with disability pension. A possible explanation might be that weight is underreported in studies using self-reported information. Since the heterogeneity in definitions was limited, we decided to pool the studies investigating overweight and/ or obesity in spite of heterogeneity. Third, the majority of studies are from Scandinavian countries, hampering the generalizability of findings to other countries. The stratified meta-analysis shows stronger associations between obesity and the risk of disability pension among obese individuals in Scandinavian compared with non-Scandinavian countries. This prompts a need for studies in other countries to corroborate or refute the association between obesity and disability pension. Last, although publication bias cannot be ruled out, there was no relation between the magnitude of risk estimates and their standard errors. After summarizing the literature, it can be concluded that obesity is a risk factor for exit from paid employment through disability pension, but there is no evidence of a relationship with other routes of exit from work. There are also indications that a lack of PA during lei- sure time was related to an increased risk of disability pension and unemployment. Although our meta-analysis is unable to identify the mechanisms through which obesity, overweight, and lack of PA contribute to labor market exit, it strongly suggests that – in order to maintain a productive and healthy workforce and protect workers against premature exit from paid employment – the implementation of long-term interventions and policies to promote PA and prevent overweight and obesity be considered.

REFERENCES

1. Schuring M, Robroek SJ, Otten FW, Arts CH, Burdorf A. The effect of ill health and socioeconomic status on labor force exit and re-employment: a prospective study with ten years follow-up in the Netherlands. Scand J Work Environ Health. 2013;39(2):134–143.
2. Robroek SJ, van den Berg TI, Plat JF, Burdorf A. The role of obesity and lifestyle behaviours in a productive workforce. Occup Environ Med. 2011;68(2):134–9.
3. 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.
4. Brown HE, Gilson ND, Burton NW, Brown WJ. Does physical activity impact on presenteeism and other indicators of workplace well-being? Sports Med. 2011;41(3):24962.
5. Schmier JK, Jones ML, Halpern MT. Cost of obesity in the workplace. Scand J Work Environ Health. 2006;32(1):5–11.
6. Trogdon JG, Finkelstein EA, Hylands T, Dellea PS, Kamal-Bahl SJ. Indirect costs of obesity: a review of the current literature. Obes Rev. 2008;9(5):489–500.
7. Neovius K, Johansson K, Kark M, Neovius M. Obesity status and sick leave: a systematic review. Obes Rev. 2009;10(1):17–27.
8. van Duijvenbode DC, Hoozemans MJ, van Poppel MN, Proper KI. The relationship between overweight and obesity, and sick leave: a systematic review. Int J Obes (Lond). 2009;33(8):807–16.
9. Neovius K, Johansson K, Rossner S, Neovius M. Disability pension, employment and obesity status: a systematic review. Obes Rev. 2008;9(6):572–81.
10. Shamliyan TA, Kane RL, Ansari MT, Raman G, Berkman ND, Grant M, et al. Development quality criteria to evaluate nontherapeutic studies of incidence, prevalence, or risk factors of chronic diseases: pilot study of new checklists. J Clin Epidemiol. 2011;64(6):637–57.
11. Fleiss JL. The statistical basis of meta-analysis. Stat Methods Med Res. 1993;2(2):121–45.
12. Higgins J, Green S. Cochrane handbook for systematic reviews of interventions version 5. 1. 0 [Updated March 2011]. The Cochrane Collaboration, 2011. Available from www. cochrane-handbook.org.
13. Hagen KB, Tambs K, Bjerkedal T. A prospective cohort study of risk factors for disability retirement because of back pain in the general working population. Spine (Phila Pa 1976). 2002;27(16):1790–6.

14. Laitinen J, Power C, Ek E, Sovio U, Jarvelin MR. Unemployment and obesity among young adults in a northern Finland 1966 birth cohort. Int J Obes Relat Metab Disord. 2002;26(10):1329–38.

15. Manninen P, Heliovaara M, Riihimaki H, Makela P. Does psychological distress predict disability? Int J Epidemiol. 1997;26(5):1063–70.

16. Ropponen A, Silventoinen K, Svedberg P, Alexanderson K, Koskenvuo K, HuunanSeppala A, et al. Health-related risk factors for disability pensions due to musculoskeletal diagnoses: a 30-year Finnish twin cohort study. Scand J Public Health. 2011;39(8):839–48.

17. Cao Y, Ma J. Body mass index, prostate cancer-specific mortality, and biochemical recurrence: a systematic review and meta-analysis. Cancer Prev Res. 2011;4:486–501.

18. Robroek SJ, Schuring M, Croezen S, Stattin M, Burdorf A. Poor health, unhealthy behaviors, and unfavorable work characteristics influence pathways of exit from paid employment among older workers in Europe: a four year follow-up study. Scand J Work Environ Health. 2013;39(3):125–133.

19. Liira J, Leino-Arjas P. Predictors and consequences of unemployment in construction and forest work during a 5-year follow-up. Scand J Work Environ Health. 1999;25(1):42–9.

20. Neovius M, Kark M, Rasmussen F. Association between obesity status in young adulthood and disability pension. Int J Obes (Lond). 2008;32(8):1319–26.

21. 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.

22. Biering-Sorensen F, Lund J, Hoydalsmo OJ, Darre EM, Deis A, Kryger P, et al. Risk indicators of disability pension. A 15 year follow-up study. Dan Med Bull. 1999;46(3):258–62.

23. Claessen H, Arndt V, Drath C, Brenner H. Overweight, obesity and risk of work disability: a cohort study of construction workers in Germany. Occup Environ Med. 2009;66(6):402–9.

24. Friis K, Ekholm O, Hundrup YA. The relationship between lifestyle, working environment, socio-demographic factors and expulsion from the labour market due to disability pension among nurses. Scand J Caring Sci. 2008;22(2):241–8.

25. Gravseth HM, Bjerkedal T, Irgens LM, Aalen OO, Selmer R, Kristensen P. Influence of physical, mental and intellectual development on disability in young Norwegian men. Eur J Public Health. 2008;18(6):650–5.

26. und T, Labriola M, Feveile H, Christensen KB. The fraction of disability pensions attributable to smoking and obesity. Results from a 15-year follow-up study. J Public Health. 2010;18(3):251–4.

27. Mansson NO, Eriksson KF, Israelsson B, Ranstam J, Melander A, Rastam L. Body mass index and disability pension in middle-aged men--non-linear relations. Int J Epidemiol. 1996;25(1):80–5.

28. Rissanen A, Heliovaara M, Knekt P, Reunanen A, Aromaa A, Maatela J. Risk of disability and mortality due to overweight in a Finnish population. BMJ. 1990;301(6756):835–7.

29. Roos E, Laaksonen M, Rahkonen O, Lahelma E, Lallukka T. Relative weight and disability retirement: a prospective cohort study. Scand J Work Environ Health. 2013;39(3):259-67

30. Visscher TL, Rissanen A, Seidell JC, Heliovaara M, Knekt P, Reunanen A, et al. Obesity and unhealthy life- years in adult Finns: an empirical approach. Arch Intern Med. 2004;164(13):1413–20.

31. Ahola K, Virtanen M, Honkonen T, Isometsa E, Aromaa A, Lonnqvist J. Common mental disorders and subsequent work disability: A population-based Health 2000 Study. J Affect Disord. 2011;134(1 3):365–72.

32. Canivet C, Choi B, Karasek R, Moghaddassi M, Staland-Nyman C, Ostergren PO. Can high psychological job demands, low decision latitude, and high job strain predict disability pensions? A 12-year follow-up of middle-aged Swedish workers. Int Arch Occup Environ Health. 2013;86(3):307-19

33. Harkonmaki K, Korkeila K, Vahtera J, Kivimaki M, Suominen S, Sillanmaki L, et al. Childhood adversities as a predictor of disability retirement. J Epidemiol Community Health. 2007;61(6):479–84.

34. Krause N, Lynch J, Kaplan GA, Cohen RD, Goldberg DE, Salonen JT. Predictors of disability retirement. Scand J Work Environ Health. 1997;23(6):403–13.

35. Krokstad S, Johnsen R, Westin S. Social determinants of disability pension: a 10-year follow-up of 62 000 people in a Norwegian county population. Int J Epidemiol. 2002;31(6):1183–91 .

36. Lahti J, Rahkonen O, Lahelma E, Laaksonen M. Leisure-time Physical Activity and Disability Retirement: A Prospective Cohort Study. J Phys Act Health. 2013;10(5):669-75

37. Suominen S, Gould R, Ahvenainen J, Vahtera J, Uutela A, Koskenvuo M. Sense of coherence and disability pensions. A nationwide, register based prospective population study of 2196 adult Finns. J Epidemiol Community Health. 2005;59(6):455–9.

38. Jusot F, Khlat M, Rochereau T, Serme C. Job loss from poor health, smoking and obesity: a national prospective survey in France. J Epidemiol Community Health. 2008;62(4):332-7

39. Virtanen P, Janlert U, Hammarstrom A. Health status and health behaviour as predictors of the occurrence of unemployment and prolonged unemployment. Public Health. 2013;127(1):46–52.

40. Friis K, Ekholm O, Hundrup YA, Obel EB, Gronbaek M. Influence of health, lifestyle, working conditions, and sociodemography on early retirement among nurses: the Danish Nurse Cohort Study. Scand J Public Health. 2007;35(1):23–30.

41. Houston DK, Cai J, Stevens J. Overweight and obesity in young and middle age and early retirement: the ARIC study. Obesity (Silver Spring). 2009;17(1):143–9.

42. Schultz AB, Edington DW. Employee health and presenteeism: a systematic review. J Occup Rehabil. 2007;17(3):547–79.

43. 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.

44. Joyce K, Pabayo R, Critchley JA, Bambra C. Flexible working conditions and their effects on employee health and wellbeing. Cochrane Database Syst Rev. 2010(2):CD008009.

45. Dugdill L, Brettle A, Hulme C, McCluskey S, Long AF. A review of effectiveness of workplace health promotion interventions on physical activity and what works in motivating and changing employees health behaviour. Project Report. London: National Institute for Health and Clinical Excellence; 2007.

46. Mackenbach JP, Stirbu I, Roskam AJ, Schaap MM, Menvielle G, Leinsalu M, et al. Socioeconomic inequalities in health in 22 European countries. N Engl J Med. 2008;358(23):2468–81.

47. Leinonen T, Pietilainen O, Laaksonen M, Rahkonen O, Lahelma E, Martikainen P. Occupational social class and disability retirement among municipal employees--the contribution of health behaviors and working conditions. Scand J Work Environ Health. 2011;37(6):464–72.

APPENDIX

A1 Search strategy PubMed

	PubMed (up to Dec 31, 2012)
#1 PHYSICAL ACTIVITY "physical activity" [All Fields] OR "physical activities" [All Fields] OR "physical fitness" [All Fields] OR exercise [All Fields] OR sport [All Fields] OR fitness [All Fields] OR lifestyle [All Fields] OR "health behaviour" [All Fields] OR "health behavior" [All Fields] OR "physical tinactivity" [All Fields]	468 717
#2 OBESITY overweight [All Fields] OR "over weight" [All Fields] OR "body weight" [MeSH] OR "body weight" [All Fields] OR "waist circumference" [All Fields] OR "skinfold thickness" [All Fields] OR "fat percentage" [All Fields] OR "waist-hip ratio" [All Fields] OR "hip circumference" OR obesity [All Fields] OR "obese" [All Fields] OR "body mass index" [All Fields] OR bmi [All Fields] OR weight [All fields]	1 140 831
(#1 OR #2)	1 521 639
#3 EARLY RETIREMENT early-retirement [All Fields]	677
#4 UNEMPLOYMENT unemployment [All Fields] OR "unemployed" [All Fields]	12 233
#5 DISABILITY PENSION disability pension[All Fields] OR work-disability [All Fields] OR "disability retirement" [All Fields] OR work ability [All Fields]	2 668
(#3 OR #4 OR #5)	15 276
(#1 OR #2) AND (#3 OR #4 OR #5)	1 932

#6 LONGITUDINAL DESIGN ("cohort studies"[MeSH Terms] OR "cohort studies"[All Fields] OR "cohort study"[All Fields]) OR ("longitudinal studies"[MeSH Terms] OR "longitudinal studies"[All Fields] OR "longitudinal study"[All Fields] OR longitudinally [All Fields]) OR ("prospective studies"[MeSH Terms] OR "prospective studies"[All Fields]) OR "prospective study"[All Fields]) OR (prognosis [MeSH:NoExp]) OR ("follow-up studies"[MeSH Terms] OR "follow-up studies"[All Fields] OR "follow up study"[All Fields] OR "follow-up"[All Fields])OR ("retrospective studies"[MeSH Terms] OR "retrospective studies"[All Fields] OR "retrospective study"[All Fields]) NOT ((randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized[tiab] OR placebo[ti] OR clinical trials as topic [MeSH:noexp] OR trial[ti]))	1 589 995
(#1 OR #2) AND (#3 OR #4 OR #5) AND #6	571
Filter on Language	533

A2 Search strategy Embase

	Embase (up to Dec 31, 2012)
#1 PHYSICAL ACTIVITY ('physical activity'/de OR 'physical activity':de,ti,ab OR 'physical activities'/de OR 'physical fitness'/de OR 'exercise':de,ti,ab OR 'exercise'/de OR 'sport'/de OR 'sport':de,ti,ab OR 'fitness'/de OR 'fitness':de,ti,ab OR 'lifestyle'/de OR 'lifestyle':de,ti,ab OR 'health behavior':de,ti,ab OR 'health behaviour':de,ti,ab OR 'physical inactivity'/de OR 'physical inactivity':de,ti,ab)	559 636
#2 OBESITY 'overweight'/exp OR 'overweight' OR 'body weight'/de OR 'body weight':de,ti,ab OR 'waist circumference'/de OR 'skinfold thickness'/de OR 'waist hip ratio'/exp OR 'hip circumference'/exp OR 'waist hip ratio' OR 'obesity'/exp OR 'obese' OR 'body mass'/exp OR 'body mass index' OR 'bmi' OR 'weight'	1 373 732
(#1 OR #2)	1 818 084
#3 EARLY RETIREMENT 'early-retirement'	920
#4 UNEMPLOYMENT 'Unemployment'/exp OR 'unemployment':ti,ab,de OR 'unemployed'	15 331

#5 DISABILITY PENSION 'Disability pension' OR 'work disability'/exp OR 'work disability' OR 'disability retirement' OR 'work ability':ti,ab	5 608
(#3 OR #4 OR #5)	21 329
(#1 OR #2) AND (#3 OR #4 OR #5)	2 496
#6 DESIGN 'cohort analysis'/exp OR 'cohort analysis':ti,ab OR 'cohort studies':ti,ab,de OR 'cohort study':ti,ab,de OR 'longitudinal'/syn OR 'longitudinally':ti,ab,de OR 'prospective study'/exp OR 'prospective study':ti,ab OR 'prospective studies':ti,ab,de OR 'prognosis' OR 'follow up'/exp OR 'follow up':ti,ab OR 'restrospective study'/exp OR 'retrospective study':ti,ab OR 'retrospective studies':ti,ab,de NOT ('randomized controlled trial'/exp OR 'controlled clinical trial'/exp OR 'randomized':ti,ab OR 'placebo':ti,ab OR 'clinical trial (topic)'/exp OR 'trial':ti)	1 719 140
(#1 OR #2) AND (#3 OR #4 OR #5) AND #6	598
Filter on Language	543

A3 Search strategy Web of Science

	Web of Science (up to Dec 31, 2012)
#1 PHYSICAL ACTIVITY TS=((physical activity) OR (physical activities) OR (physical fitness) OR exercise OR sport OR fitness OR lifestyle OR (health behaviour) OR (health behavior) OR (physical inactivity)) AND Document Types=(Article)	373 562
#2 OBESITY TS=(overweight OR (over weight) OR (body weight) OR (waist circumference) OR (skinfold thickness) OR (fat percentage) OR (waist-hip ratio) OR (hip circumference) OR obesity OR obese OR (body mass index) OR (bmi) OR (weight)) AND Document Types=(Article)	765 846
(#1 OR #2)	1 080 413
#3 EARLY RETIREMENT (TS=early-retirement) AND Document Types=(Article)	845
#4 UNEMPLOYMENT (TS=((unemployment) OR (unemployed))) AND Document Types=(Article)	21 652
#5 DISABILITY PENSION (TS=((disability-pension) OR work-disability OR (disability-retirement) OR (work-ability))) AND Document Types=(Article)	2 266
(#3 OR #4 OR #5)	24 378
(#1 OR #2) AND (#3 OR #4 OR #5)	1 978
#6 LONGITUDINAL DESIGN (TS=((cohort studies) OR (cohort study) OR (longitudinal studies) OR (longitudinal study) OR longitudinally OR (prospective studies) OR (prospective study) OR (prognosis) OR (follow-up studies) OR (follow up study) OR (follow-up) OR (retrospective studies) OR (retrospective study) NOT ((randomized controlled trial) OR (controlled clinical trial) OR (randomized) OR placebo OR (clinical trials as topic) OR (trial)))) AND Document Types=(Article)	978 774
(#1 OR #2) AND (#3 OR #4 OR #5) AND #6	624
Filter on Language	594

B Overview of included studies and quality assessment.

[0=does not meet criterion or insufficient information in article, 1=meets criterion; SES=socioeconomic status]

Author (year)	Determinant			Outcome			Q1 Insight in subject flow	Q2 >30% response	Q3 Adjusted for confounders			Q4 <loss to 30% follow-up
	Obesity	Over-weight	Lack of PA	Disability Pension	Unem-ployment	Early retirement			Any	SES	Life-style	
Ahola et al, 2011 [31]	Objective		Subjective	Self-report			1	1	1	1	1	1
Biering-Sorensen et al, 1999 [22]		Objective	Self-report	Register			1	1	1	0	1	1
Canivet et al, 2012 [32]	Objective			Register			0	1	1	1	1	1
Claessens et al, 2009 [23]	Objective	Objective		Register			1	1	1	0	1	1
Friis et al, 2007 [40]	Self-report	Self-report	Self-report			Register	0	1	1	1	1	1
Friis et al, 2008 [24]	Self-report	Self-report	Self-report	Register			0	1	1	1	1	1
Gravseth et al, 2008 [25]	Objective	Objective		Register			1	1	1	1	0	1
Hagen et al, 2002 [13]	Objective	Objective	Self-report	Register			1	1	1	1	0	1
Harkonmaki et al, 2007 [33]	Self-report			Self-report			1	0	1	1	1	1
Houston et al, 2008 [41]	Objective	Objective				Self-report	1	0	1	1	1	0
Jusot et al, 2008 [38]	Self-report	Self-report			Self-report		0	1	1	1	0	0
Krause et al, 1997 [34]			Self-report	Self-report			0	1	1	0	0	1
Krokstad et al, 2002 [35]			Self-report	Register			0	1	1	1	1	1
Lahti et al, 2012 [36]			Self-report	Register			0	1	1	1	1	1
Laitinen et al, 2002 [14]	Self-report	Self-report			Register		1	1	1	1	1	1
Liira et al, 1999 [19]			Self-report		Self-report		0	1	1	0	0	1
Lund et al, 2001 [21]	Self-report	Self-report		Self-report			1	1	1	1	1	1
Lund et al, 2010 [26]	Self-report	Self-report		Register			1	1	1	0	0	1

CONTINUED

Author (year)	Determinant			Outcome			Q1 Insight in subject flow	Q2 >30% response	Q3 Adjusted for confounders			Q4 <loss to 30% follow-up
	Obesity	Over-weight	Lack of PA	Disability Pension	Unem-ployment	Early retirement			Any	SES	Life-style	
Manninen et al, 1997 [15]	Self-report	Self-report		Register			0	1	1	0	1	1
Mansson et al, 1996 [27]	Objective			Register			0	1	1	0	1	1
Neovius et al, 2008 [20]	Objective	Objective		Register			1	1	1	1	0	1
Rissanen et al, 1990 [28]	Objective	Objective		Register			0	0	1	1	1	1
Robroek et al, 2012 [18]	Self-report	Self-report	Self-report	Self-report	Self-report	Self-report	1	1	1	1	1	1
Roos et al, 2012 [29]	Self-report	Self-report		Register			1	0	1	0	0	1
Ropponen et al, 2011 [16]	Self-report	Self-report	Self-report	Register			0	0	1	1	1	1
Suominen et al, 2005 [37]			Self-report	Register			0	1	0	0	0	1
Visscher et al, 2004 [30]	Objective	Objective		Register			1	1	1	1	1	1
Virtanen et al, 2012 [39]		Self-report			Self-report		0	0	1	1	0	1

C1: Included studies presenting the association between overweight, obesity and/or lack of physical activity and disability pension.

[BL=baseline; BMI=body mass index; F=female; FU=follow-up; HR=hazard ratio; M=male; OR=odds ratio; PA=physical activity; RR=relative risk.]

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
			Overweight/Obesity				
Canivet et al 2012 [32] Sweden	N=6540 Employees ? (45-65 years) 49% male (N=3181) 51% female (N=3359)	13-year FU BL: 1992-94	BMI (kg/m2), Objective 2 categories: <30.0 / ≥30.0	Register-based	F ≥30.0: n=351 (10.4%) M, ≥30.0: n=344 (10.8%)	F: N=664 (19.8%) M: N=460 (14.5%)	HR adjusted for age BMI≥30.0: F: 1.6 (1.3-2.0) M: 1.7 (1.3-2.2)
Claessen et al 2009 [23] Germany	N=16875 Employees (construct-ion) 41.9 (25-59 years) 100% male	10.8-year FU BL: 1986-92	BMI (kg/m2), Objective 7 categories: <20.0 / 20.0-22.4 / 22.5-24.9 / 25.0-27.4 / 27.5-29.9 / 30.0-34.9 / ≥35.0	Register-based	25.0-27.4: N=4871 27.5-29.9: N=3260 30.0-34.9: N=2221 ≥35.0: N=343	N=3064	HR adjusted for age/nationality/ smoke/alcohol < 20: n/a 20.0-22.4: reference 22.5-24.9: n/a 25.0-27.4: 0.79 (0.69-0.92) 27.5-29.9: 0.89 (0.76-1.03) 30.0-34.9: 0.92 (0.78-1.07) ≥35:1.56 (1.25-1.96)
Gravseth et al 2008 [25] Norway	N=302330 General population (military service conscription) 18/19 year 100% male	36-year FU BL: 1967-76	BMI (kg/m2), Objective 4 categories: <18.5 / 18.5-24.9 / 25-29.9/ ≥30.0	Register-based	≥30: N=7403	N=3651 (1.2%)	HR adjusted for age, birth order, birth weight, childhood disease benefit, maternal marital status, maternal and paternal disability, parental education, intellectual performance, mental function conscript, height conscript, education <18.5: n/a 18.5-24.9: reference 25.0-29.9: 1.0 (0.9-1.1) ≥30: 1.4 (1.2-1.7)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Harkon-mäki et al 2007 [33] Finland	N=8817 General population ? (40-54 year) 42% male (N=3668) 58% female (N=5149)	5-year FU BL: 1998	BMI (kg/m2), Self-report 2 categories: <30.0 / ≥30.0	Self-report	≥30.0: N=1078 (12.3%)	N=318 (3.6%)	OR adjusted for age, gender, childhood adversities, smoking, alcohol, depression, SES, medication. ≥30.0: 1.58 (1.18-2.12)
Lund et al 2001 [21] Denmark	N=2618 Employees (waste collectors, municipal workers) 44.3 year (?) at follow-up 100% male	2.5-year FU BL: 1994	BMI (kg/m2), Self-report 4 categories: <20.0 / 20.0-24.9 / 25.0-29.9 / ≥30.0	Self-report Disability pension and long-term sick leave (>2 months)	25.0-29.9: N=936 ≥30.0: N=293	N=67 (2.6%)	OR adjusted for age, occupational group, health, skill discretion, smoking <20.0: n/a 20.0-24.9: reference 25.0-29.9: 1.11 (0.60-2.04) ≥30.0: 1.83 (0.87-3.85)
Lund et al 2010 [26] Norway/ Denmark	N=8287 Employees ? (18-59 years) 51% male (N=4203) 49% female (N=4084)	15-year FU BL: '90/'95/'00	BMI (kg/m2), Self-report 4 categories: <18.5 / 18.5-24.9 / 25.0-29.9 / ≥30.0	Register-based	Risk time 25.0-29.9 F: 9738.40 M: 21230.87 ≥30.0: F: 2446.77 M: 4123.42	F: n=262 (6.4%) M: n=184 (4.4%)	HR adjusted for age, work environment and general health <18.5: n/a 18.5-24.9: reference 25.0-29.9: F: 1.11 (0.82-1.50) M: 0.67 (0.49-0.93) ≥30.0 F: 1.25 (0.79 -1.97) M: 0.84 (0.52-1.37)
Manninen et al 1997 [15] Finland	N=8655 Employees (farmers) ? (18-64 years) 52% male (N=4537) 48% female (N=4118)	10 year FU BL: 1979-80	BMI (kg/m2), Self-report continuous	Register-based	n/a	n=1004 (11.6%)	RR adjusted for gender, age, smoking, psychological distress 1.08 (1.01-1.15)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Månsson et al 1996 [27] Sweden	N=5926 General population 48.1 (47-49 years) 100% male	±11-year FU BL: 1974-78	BMI (kg/m2), Objective 4 categories: <18.5 / 18.5-24.9 / 25-29.9 / ≥30	Register-based	25-29.9: N=2237 (37.7%) ≥30: N=433 (7.3%)	N=849 (14.3%)	RR adjusted for smoking: <18.5: n/a 18.5-24.9: reference 25-29.9: 1.3 (1.1-1.6) ≥30: 2.8 (2.2-3.5)
Neovius et al 2008 [20] Sweden	N=1191027 General population (military service conscription) ? (17-20 years) 100% male	38-year FU BL: 1969-94	BMI (kg/m2), Objective 5 categories: <18.5 / 18.5-24.9 / 25.0-29.9 / 30.0-34.9 / ≥35	Register-based	25.0-29.9: N=101 332 (8.5%) 30.0-34.9: N=15 974 (1.3%) ≥35: N=3117 (0.3%)	N=60024	HR adjusted for year of conscription testing, SEP, municipality, age at testing, testing center, and year of testing, muscular strength <18.5: n/a 18.5-24.9: reference 25.0-29.9: 1.36 (1.32-1.40) 30.0-34.9: 1.87 (1.76-1.99) ≥35: 3.04 (2.72-3.40)
Rissanen et al 1990 [28] Finland	N=31129 Employees ? (25-64 years) 61% male (N=19076) 39% female (N=12053)	10 year FU BL: 1966-72	BMI (kg/m2), Objective 6 categories: <22.5 / 22.5- 24.9 / 25.0-27.4 / 27.5-29.9 / 30.0-32.4 / ≥32.5	Register-based	25.0-27.4: F: N=2584 M: N=5359 27.5-29.9: F: N=1683 M: N=2839 30.0-32.4: F: N=995 M: N=1065 ≥32.5: F: N=778 M: N=419	N=4706	RR adjusted for age, geographical region, smoking, and occupation <22.5: reference 22.5- 24.9: n/a 25.0-27.4: F: 1.5 (1.3-1.7) M: 1.1 (1.0-1.2) 27.5-29.9: F: 1.5 (1.3-1.8) M: 1.2 (1.1-1.4) 30.0-32.4: F: 1.9 (1.6-2.3) M: 1.4 (1.2-1.6) ≥32.5: F: 2.1 (1.7-2.3) M: 1.8 (1.4-2.2)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Roos et al 2012 [29] Finland	N=6542 Employees 49.5 (45-60 year) 22% male (N=1141) 78% female (N=5131)	7.8 year FU BL: 2000-02	BMI (kg/m2), Self-report 5 categories: <20.0 / 20.0-24.9 / 25-29.9 / 30-34.9 / ≥35	Register-based	25-29.9: F: N=1638 (32%) M: N=643 (46%) 30-34.9 F: N=570 (11%) M: N=165 (12%) ≥35 F: N=177 (3%) M: N=52 (4%)	n/a	HR adjusted for age, diagnosed diseases, physical and mental functioning, working conditions 20.0-24.9: reference 25.0-29.9: F: 1.02 (0.82-1.27) M: 1.45 (0.92-2.30) 30.0-34.9: F: 1.33 (1.02-1.74) M: 0.95 (0.49-1.84) ≥35: F: 1.73 (1.20-2.49) M: 1.19 (0.51-2.78)
Visscher et al. 2004 [30] Nether-lands/ Finland	N=17 235 General population ? (20-64 year) 30% men (N=2437) 70% women (N=5565)	15 year FU BL: 1973-77	BMI (kg/m2), Objective 4 categories: <18.5 / 18.5-24.9 / 25-29.9 / ≥30	Register-based	25-29.9: M: N=3467 (38.9%) F: N=2426 (29.1%) ≥30: M: N=192 (7.4%) F: N=976 (15.6%)	F: N=859 M: N=262	RR adjusted for age, education, geographic region, alcohol use <18.5: n/a 18.5-24.9: reference 25-29.9: F: 1.4 (1.2-1.6) M: 1.1 (1.0-1.3) ≥30: F: 1.6 (1.4-2.0) M: 1.7 (1.5-2.0)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
			Overweight/obesity, lack of PA				
Ahola et al 2011 [31] Finland	N=3164 Employees ? (30-58 year) 49% male (N=1560) 51% female (N>=1604)	7.5 year FU BL: 2000-01	BMI (kg/m2), Objective 2 categories: <30 / ≥30 PA, self-report frequency of PA causing at least shortness of breath and sweating for ≥ 30 min. 2 categories: weekly / less frequent	Register-based	BMI: ≥30: N=567 PA (less frequent): N=746	N=208	OR adjusted for age, gender, mental disorder, physical illness, education, occupational grade, work hours, physical strain, job strain, job insecurity, PA, BMI, smoking ≥30: 1.18 (0.81-1.72) PA (less frequent): 1.20 (0.84-1.70)
Biering-Sorensen et al 1999 [22] Denmark	N=892 General population ? (30-60 year) 50% male (N=442) 50% female (N=450)	15 year FU BL: 1977-78	BMI (kg/m2), Objective 3 categories: ≤ 20 / 20 – 27 / >27 PA, Self-report PA in leisure time 2 categories: never / ever	Register-based	n/a	N=84	OR adjusted for age, dyspnea, suffering from colic nervousness, hospitalization, surgery, general health risk, general health, peak flow, isometric endurance test of back muscles, pain during the test, distance from home to work, sick leave, physical condition compared to those of same age, smoking, PA, BMI ≤ 20: n/a 20-27: reference >27: 2.44 (1.48-4.00) PA (never): 2.23 (1.43-3.50)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Friis et al 2008 [24] Denmark	N=12028 Employees (nurses) ? (44-66) 100% women	9-year FU BL: 1993	BMI (kg/m2), Self-report 3 categories: <25 / 25-29.9 / ≥30 PA, self-report Leisure time PA 2 categories: Little PA & sedentary / physically active	Register-based	BMI: 25-29.9: N=2599 ≥30: N=599 PA (little): N=3239	N=691	HR adjusted for health, work schedule, work area, work pressure, influence at work, physical demands, PA, BMI, marital status, spouses SES, income. <25: reference 25-29.9: 1.12 (0.92-1.35) ≥30: 1.63 (1.20-2.22) PA (active): 1.50 (1.23-1.83)
Hagen et al 2002 [13] Norway	N=25271 Employees ? (25-59 year) 60% male 40% female	10 year FU BL: 1984-86	BMI (kg/m2), Objective 4 categories: <24.1 / 24.1-26.3 / 26.4-28.6 / ≥28.6 PA, self-report Frequency/intensity/ duration of exercise 4 categories: 0-50% / 51-75% / 76-90% / 91-100%	Register-based Disability pension due to back diseases	BMI: 24.1-26.3: N=7705 26.4-28.6: N=4572 ≥28.6: N=3063 PA: 51-75%: N=6512 76-90%: N=5212 91-100%: N=2333	N=715	OR adjusted for age, gender, physical work, smoking, perceived health, diabetes, angina pectoris, worn out <24.1: reference 24.1-26.3: 1.0 (0.8-1.3) 26.4-28.6: 1.3 (1.0-1.6) ≥28.6: 1.6 (1.2-2.0) OR adjusted for age, gender, smoking, alcohol, BMI PA 0-50%: reference 51-75%: 1.4 (1.1-1.7) 76-90%: 1.2 (0.9-1.6) 91-100%: 1.9 (1.4-2.4)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Robroek et al 2012 [18] Nether-lands/ Europe	N=4923 Employees ? (50-country-specific retirement age) 56% male (N=2782) 44% female (N=2141)	4 year FU BL: 2004	BMI (kg/m^2), Self-report 3 categories: <25 / 25-29.9 / ≥30 PA, self-report regular participation in moderate and vigorous activities 2 categories: <1x/wk / ≥1x/wk	Self-report Exited the labour force because of recognised health problems.	BMI: 25-29.9: N=2084 (42%) ≥30: N=722 (15%) PA: <1x/wk: N=274 (6%)	N=103 (2%)	HR adjusted for age, gender, education, cohabitation status, self-perceived health, BMI/PA, alcohol, job control, job rewards <25: reference 25-29.9: 0.80 (0.51-1.28) ≥30: 1.29 (0.78-2.15) PA <1x/wk: 3.05 (1.68-5.55)
Ropponen et al 2011 [16] Sweden/ Finland	N=24043 General population (twins) ? (17-? year) 51% male (N=?) 49% female (N=?)	30 year FU BL: 1975	BMI (kg/m^2), Self-report Continuous PA, Self-report Frequency, duration, and intensity 3 categories: sedentary / conditional / Continuous (METs)	Register-based Disability pension due to osteoarthritis, or musculo-skeletal disorders	n/a	DP (MSD): 1819 / 24 043 (7.4%) DP (OA): 677 / 24 043 (2.8%)	HR adjusted for education, social class, chronic disease, musculoskeletal pain, use of analgesics, smoking, alcohol BMI F: 1.03 (1.01-1.05) M: 1.06 (1.03-1.08) PA unadjusted F: 1.00 (0.97-1.04) M: 0.99 (0.97-1.02)
Lack of PA							
Krause et al 1997 [34] USA/ Finland	N=968 General population ? (42-60 year) 100% male	4 year FU BL: 1984-89	PA, Self-report Total duration 4 categories: Quartiles (1st: shortest duration)	Self-report Disability retired	n/a	N=67 (14.5%)	OR age-adjusted 1st quartile: reference 2nd quartile: 1.02 (0.51-2.06) 3rd quartile: 0.74 (0.35-1.57) 4th quartile: 1.01 (0.50-2.03)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Krokstad et al 2002 [35] Norway	N=62369 General population ? (20-66 year) 52% male (N=32194) 48% female (N=30175)	10 year FU BL: 1984-86	PA, Self-report Leisure time PA 2 categories: <1x/wk / ≥1x/wk	Register-based	n/a	n/a	HR adjusted for age, education, health, employment status, occupational risk factors, psychosocial risk factors, perceived health, lifestyle factors 50-66 year: <1x/wk F: 1.18 (1.03-1.35) M: 1.12 (1.01-1.24)
Lahti et al 2012 [36] Finland	N=6275 Employees (40-60 year) 22% male (N=1355) 78% female (N=4920)	6.8 year FU BL: 2000-2002	PA, Self-report Leisure time PA 4 categories based on MET hours/wk: inactive / active moderate / active vigorous / conditioning	Register-based	Inactive: F: N=1180 M: N=350 Moderate: F: N=2208 M: N=395 Vigorous: F: N=998 M: N=364 Conditioning: F: N=534 M: N=246	N=435 (6.9)	HR adjusted for age, occupational social class, smoking, alcohol ,BMI, physical and mental strenuousness of work, physical health functioning, mental health functioning, sickness absence. inactive: reference moderate: F: 0.97 (0.76-1.23) M:0.56 (0.34-0.92) vigorous: F: 0.43 (0.29-0.64) M: 0.59 (0.34-1.01) conditioning: F: 0.41 (0.24-0.70) M: 0.20 (0.08-0.52)
Suominen et al 2005 [37] Finland	N=2196 Employees ? (15-64 year) 48% male (N=926) 52% female (N=996)	10 year FU BL: 1989	PA, Self-report 4 categories: 0x/month / 1x/month / 2-3x/ month / >3x/month	Register based Including individual early retirement pension (for those aged 55+)	0: N=1005 1x: N=443 2-3x: N=142	n=107	HR unadjusted 0x/month: reference 1x: 2.24 (1.41-3.55) 2-3x: 1.93 (0.98-3.74) >4x: 1.29 (0.77-2.17)

C2 Included studies presenting the relation between obesity and/or a lack of physical activity and unemployment.

[BL=baseline; BMI=body mass index; F=female; FU=follow-up; HR=hazard ratio; M=male; OR=odds ratio; PA=physical activity; RR=relative risk.]

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Overweight/Obesity							
Jusot et al 2008 [38] France	N=5707 Employees (private sector) ? (30-54 year) 58% male (N=3287) 42% female (N=2420)	4 year FU BL: 1992-95	BMI (kg/m2) self-report 3 categories: <25 / 25-29.9 / ≥30	Self-report Response options: Active / Unemployed / Inactive	25-29.9: F: N=453 (18.7%) M: N=1218 (37.1%) ≥30 F: N=161 (6.7%) M: N=243 (7.4%)	F: N=189 (7.8%) M: N=1826 (55.6%)	OR adjusted for age, education, type of job contract, household composition, children. <25: reference 25-29.9: F: 1.3 (0.9-1.9) M: 0.8 (0.6-1.2) ≥30 F: 2.0 (1.2-3.4) M: 0.5 (0.2-1.0)
Laitinen et al 2002 [14] Finland	N=9754 (register-based) General population 14 year 49% male (N=4183) 51% female (N=4912)	17 year FU BL: 1980	BMI age 14 (kg/m2), self-report 3 categories, gender-specific: F: <21.6 / 21.6-23.7 / ≥23.8 M: <21.3 / 21.4-23.6 / ≥23.7	Register-based ≥ 366 days on unemployment allowance	≥23.8(F), ≥23.7(M): M: N=248 F: N=241	≥ 366 days F: 10% (<21.6) M: 20% (<21.3)	OR adjusted for family SES at age 14, area of residence at age 14, school performance at age 16 <21.6/<21.3 21.6-23.7: reference ≥23.8: n/a ≥23.7: F: 1.12 (0.74-1.68) M: 1.08 (0.78-1.49)
Virtanen et al 2012 [39]	N=1083 General population 30 year 52% male 48% female	12 year FU BL: 1981	BMI (kg/m2), Self-report 2 categories: <25 / ≥25	Self-report	n/a	25%?	HR adjusted for gender, parental status, socioeconomic status, unemployment before age 30 ≥25.0: 0.94 (0.71-1.23)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
			Overweight/obesity and lack of PA				
Robroek et al 2012 [18] Netherlands/ Europe	N=4923 Employees ? (50-country-specific retirement age) 56% male (n=2782) 44% female (n=2141)	4 year FU BL: 2004	BMI (kg/m2), Self-report 3 categories: <25 / 25-29.9 / ≥30 PA, self-report regular participation in moderate and vigorous activities 2 categories: <1x/wk /≥1x/wk	Self-report Exited the labour force because of recognised health problems.	BMI: 25-29.9: N=2084 (42%) ≥30: N=722 (15%) PA: <1x/wk: N=274 (6%)	n=218 (4%)	HR adjusted for age, gender, education, cohabitation status, self-perceived health, BMI/PA, alcohol, job control, job rewards <25: reference 25-29.9: 1.07 (0.79-1.46) ≥30: 1.36 (0.94-1.99) PA (<1x/wk): 1.84 (1.13-3.01)
			Lack of PA				
Liira et al 1999 [19] Finland	N=781 (construction workers) N=877 (forest workers) Employees (forest workers, construction workers) ? (<50 year) 100% male	5 year FU BL: 1989	PA, Self-report Engaging in leisure time activities to improve physical fitness 2 categories: <1x/wk /≥1x/wk	Self-report >24 months unemployed	≥ 1x/wk PA: within group FU >24 months unemployment Construction: 35% Forest: 37%	FU >24 months unemployment Construction: n=195 (25%) Farming: N=67 (8%)	OR age-adjusted <1x/wk construction: 1.57 (1.11-2.22) farming: 1.60 (0.91-2.81)

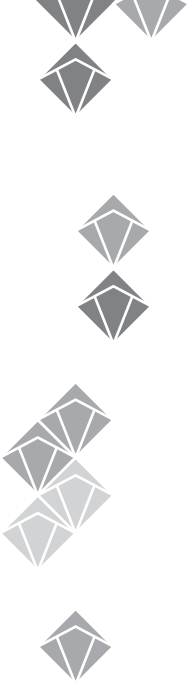
C3 Included studies presenting the relation between obesity and/or a lack of physical activity and early retirement.

[BL=baseline; BMI=body mass index; F=female; FU=follow-up; HR=hazard ratio; M=male; OR=odds ratio; PA=physical activity; RR=relative risk.]

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
Overweight/Obesity							
Houston et al 2008 [41] USA	N=6483 Employees ? (45-64 year) White F: 50.2 years African American F 50.1 years White M: 50.6 years African American M 49.9 years 49% male (N=3190) 51% female (N=3293)	9 year FU BL: 1987-89	BMI (kg/m²), Objective 3 categories: <25 / 25-29.9 / ≥30	Self-report retiring early if they were <65 years	25-29.9 White F: 29.5% African-American F: 36.9% White M: 50.6% African-American M: 45.2% ≥30 White F: 19.9% African-American F: 45.5% White M: 22.5% African-American M: 29.5%	White F: 19.3% Afr-Am F: 21.5% White M: 21.6% African-American M: 18.7%	HR adjusted for education, smoke, income, occupation, occupational PA, marital status, field center <25: reference 25-29.9 White F: 0.85 (0.68-1.06) Afr-Am F: 1.27 (0.86-1.89) White M: 1.23 (1.00-1.52) African-American M: 0.73 (0.45 -1.18) ≥30 White F: 0.83 (0.63-1.09) African-American F: 1.26 (0.85-1.89) White M: 1.32 (1.03-1.69) African-American M: 1.21 (0.74-1.98)

CONTINUED

Author year Country	Population (N) Employees/general population Mean age at BL (range) Gender	Follow-up (FU) period (maximum or mean) BL year	Determinant definition	Outcome definition (disability pension)	Determinant prevalence (baseline) (N/%)	Outcome prevalence	Association estimate adjustment
			Overweight/obesity and lack of PA				
Friis et al 2007 [40] Denmark	N=5538 Employees (nurses) ? (51-59 year) 100% female	9 year FU BL: 1993	BMI (kg/m^2), Self-report 3 categories: <25 / 25-29.9 / ≥30 PA, Self-report Leisure time PA 2 categories: Little PA & sedentary / physically active	Register-based PEW (post-employment wage)	BMI: 25-29.9: N=1283 ≥30: N=292 PA (little): N=4068	N=3710	HR adjusted for health, work schedule, work area, work pressure, influence at work, physical demands, PA, BMI, marital status and spouses SES, income <25: reference 25-29.9: 1.12 (1.04-1.21) ≥30: 1.06 (0.91-1.24) PA (active): 1.13 (1.04-1.22)
Robroek et al 2012 [18] Netherlands / Europe	N=4923 Employees ? (50-country-specific retirement age) 56% male (N=2782) 44% female (N=2141)	4 year FU BL: 2004	BMI (kg/m^2), Self-report 3 categories: <25 / 25-29.9 / ≥30 PA, Self-report regular participation in moderate and vigorous activities 2 categories: <1x/wk / ≥1x/wk	Self-report Exited the labour force because of recognised health problems.	BMI: 25-29.9: n=2084 (42%) ≥30: n=722 (15%) PA: <1x/wk: n=274 (6%)	N=589 (12%)	HR adjusted for age, gender, education, cohabitation status, self-perceived health, BMI/PA, alcohol, job control, job rewards <25: reference 25-29.9: 1.08 (0.90-1.30 ≥30: 1.01 (0.79-1.31) PA (<1x/wk): 0.94 (0.65-1.35)



chapter 4

THE INFLUENCE OF POOR HEALTH ON COMPETING EXIT ROUTES FROM PAID EMPLOYMENT AMONG OLDER WORKERS IN 11 EUROPEAN COUNTRIES

SUBMITTED

REEUWIJK KG

VAN KLAVEREN D

VAN RIJN RM

BURDORF A

ROBROEK SJW

ABSTRACT

Objectives

Determine the influence of poor health on competing exit routes from paid employment among older workers in Europe, and evaluate differences in estimates between conventional and competing risk approaches.

Methods

The study population consisted of 5,273 respondents (6-years follow-up) from the Survey of Health, Ageing, and Retirement in Europe (SHARE). The effect of poor health on exit routes from paid employment was assessed with a stratified Cox model, a cause specific Cox model and a Fine & Gray (F&G) model. Competing risk analyses were used to calculate absolute risks of labour force exit among European regions.

Results

In the F&G model poor health was a risk factor for disability benefit (subdistribution hazard ratio (SHR) 3.22), and unemployment (SHR 1.32).HRs in the Cox analyses were 4-17% higher than SHRs. In Bismarckian countries low educated older workers living alone and in poor health had an 11% risk of disability benefit, 7% of unemployment, 46% of early retirement, and 7% of becoming economically inactive. In Scandinavian countries the risks were 10%, 7% ,29%, and 3% respectively, and in Southern Europe 4%, 5%, 35%, and 7%.

Conclusions

Workers with poor health are more likely to leave the labour force than workers with good health. The risks for the voluntary routes were lowest in Scandinavian countries, for the more involuntary routes risks were lowest in Southern Europe. The conventional Cox analysis overestimates relative as well as absolute risks of leaving the workforce. The F&G model allows for better estimation of these risks in the presence of competing exit routes.

Key words

cause specific model; competing risk analysis; Cox proportional hazards models; disability benefit; early retirement; Fine and Gray model; survival analysis; unemployment; workforce exit

INTRODUCTION

Various studies have demonstrated the influence of poor health on labour force exit. In a meta-analysis self-rated poor health was a risk factor for disability benefit (Relative Risk (RR) 3.61), unemployment (RR 1.44) and early retirement (RR 1.27) [1]. Different analytical techniques have been used to estimate the strength of the relation between poor health and a specific exit route in longitudinal studies. Most studies have explored the relation between poor health and loss of paid employment by focusing on one specific exit route, primarily disability benefit and early retirement, and either used logistic regression analysis based on complete follow-up [e.g. 2], or Cox proportional hazard analysis with censoring of event times for workers at the end of their follow-up [e.g. 3, 4]. In recent years some studies have included multiple exit routes by conducting a stratified Cox analysis comparing workers within separate exit routes with those workers who remained in paid employment [e.g. 5, 6].

The disadvantage of these Cox models is that they ignore the fact that exit routes are to some extent competing processes. For example, receiving a disability benefit (which requires health problems in order to be eligible) is an event typically taking place earlier in life than early retirement, which results in healthier workers exiting paid employment via early retirement. In addition, exit routes may work as communicating vessels. Also, dropping out of the labour force through one particular route may depend on eligibility criteria. Thus, it may be important to include these so called competing events (i.e. other exit routes than the event of interest) in the analysis when estimating the relation between health and labour force exit. Until now, few studies have applied a competing risk analysis to determine the relation between poor health and multiple exit routes [7-9], but it remains unknown whether the results of conventional analyses differ substantially from those of competing risk analysis.

Competing risk analysis is an alternative for conventional survival and Cox proportional hazards regression analysis in the presence of multiple (competing) exit routes of paid employment. Moreover, a competing risk approach allows for direct estimation of both relative and absolute risks [10]. Absolute risk estimates give additional insight into the impact of poor health on labour force exit. For example, it is relevant whether the absolute risks are 4% vs. 2% for workers with poor and good health respectively or 20% vs. 10%. This is also important when comparing the impact of poor health on leaving the workforce across different countries with different disability arrangements, policies and legislation for employment protection. For instance, previous research found that in Scandinavian countries individuals with poor health and lower educational level participate more often in the labour market than similar individuals from other welfare state regimes [11].

The aims of the current study were i) to determine the influence of poor health on multiple (competing) exit routes from paid employment among older workers, in terms of relative as well as absolute risk, ii) to determine whether these risks are different among European regions, and iii) to evaluate the differences in estimates of relative and absolute risk between three analytical techniques, i.e. a stratified Cox approach, a cause specific Cox approach, and a Fine & Gray approach.

METHODS

Study sample and design

A longitudinal study with a 6-year follow-up was conducted with respondents from 11 European countries in four waves of the Survey of Health, Ageing, and Retirement in Europe (SHARE) [12]. SHARE started in 2004, aiming to gain insight into ageing and how it affects individuals in the diverse cultural settings of Europe. For that purpose, data on health, socio-economic status, and family relationships were collected by interview [13, 14]. The overall household response in the first wave (release 2.6.0) across all SHARE countries was 62%, yet substantial differences were observed between countries [15]. Due to different institutional conditions an uniform framework for sampling was not achievable. Different national and local registries were used to permit stratification by age. Sampling designs varied from simple random sampling from national population registers to multi-stage sampling using regional/local population registers [16].

Data from the first (2004-2005 release 2.6.0) [17], second (2006-2007 release 2.6.0) [18, 19], third (2008-2009 release 1.0.0) [20-22], and fourth (2011-2012 release 1.1.1) [23-25] wave were used in this study. Figure 1 shows the study flow, starting at baseline with 13,282 participants aged between 50 and the country specific retirement age (43% of the total study population n=30,816). A total of 78 participants lacked data on employment status, resulting in a study population of 13,204 people, of whom 7,174 (54%) were in paid employment. During follow-up 5,621 of them participated in at least one follow-up measurement. For 348 participants either information on employment status at follow-up, or demographic characteristics at baseline was missing, or the transition out of employment was reported after the last wave. This resulted in a study population of 5,273 participants that was available for analyses. SHARE has been reviewed and approved by the Ethics Committee of the University of Mannheim [26].

Labour force participation

The outcome of the current study was self-reported work status, which was ascertained during follow-up. At wave 2 and wave 4 a single question was used: “In general, which of the following best describes your current employment situation? Retired, employed or self-employed, unemployed and looking for work, permanently sick or disabled, homemaker, other (rentier, living off own property, student, voluntary work)”. For each category of labor force exit, the month and year of exit were asked. At wave 3, a life-course approach was used to assess all periods of paid employment and exit from paid employment. Participants answered the question “Which of these best describes your situation after you left your last job?”. The year of exit from paid employment was ascertained when applicable.

Five mutually exclusive categories were created: (i) paid employment, i.e. all participants who worked until the country-specific retirement age or were still working at the end of the follow-up period; (ii) disability benefit, i.e. participants who were permanently sick or disabled; (iii) unemployment, i.e. those who became unemployed from their last job; (iv) early retirement, i.e. those who were retired, but had not reached the country-specific

retirement age yet; and (v) economically inactive, i.e. those who stopped working for other reasons than disability, unemployment, or early retirement, for example because of being a homemaker. When a participant reported multiple events, only the first event in time was considered. In case a participant reported multiple events at the same time-point, the following hierarchy was used (i) disability benefit, (ii) unemployment, (iii) economically inactive, (iv) early retirement.

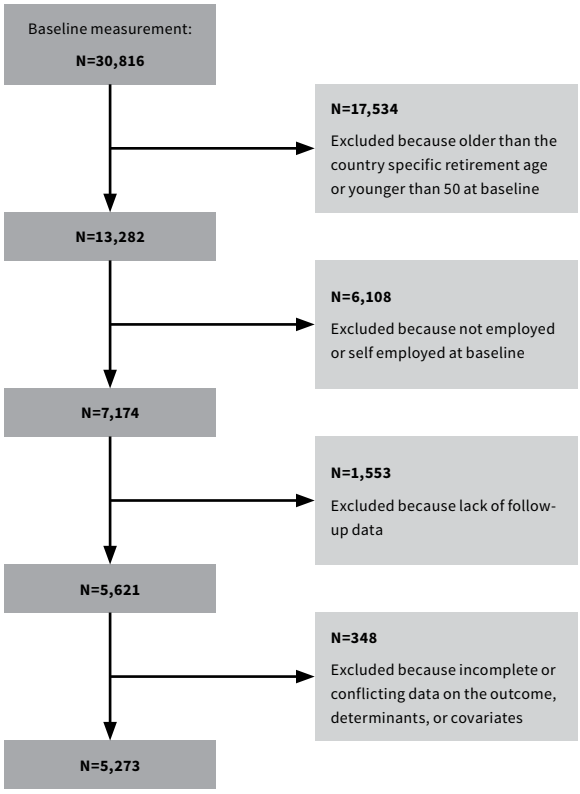


Figure 1. Selection of study population at baseline.

Health

Self-rated health was measured at baseline using the question "Would you say your health is…", with answers ranging from excellent (1) to poor (5). Poor health was defined as less than good health, collating the answers moderate and poor. This frequently used question has been shown to be a good indicator of general health [27].

Individual characteristics

At baseline, information on sex, month and year of birth, educational level, marital status, and country was collected. The highest level of education was coded according to the 1997

International Standard Classification of Education (ISCED-97) and categorised into low (pre-primary, primary, and lower secondary education), intermediate (upper secondary education), and high (post-secondary education). Using marital status, participants were categorised into those who were living with a spouse or partner in the same household and those living alone. Three European regions were distinguished according to their welfare regime [11]; Bismarckian countries (Netherlands, France, Germany, Belgium, Austria, Switzerland); Scandinavian countries (Sweden, Denmark), and Southern Europe (Italy, Spain, Greece). Additionally, mortality was registered during follow-up.

Statistical analyses

Descriptive statistics were used to describe the study population: frequencies for dichotomous and categorical variables and means with standard deviations for continuous variables. Furthermore, cumulative incidence curves of four specific exit routes out of paid employment were created based on Kaplan-Meier curves for workers with poor health and on estimates for workers with poor health from the Fine & Gray competing risk analysis. In the latter, self-rated health was the independent variable and the type of route out of paid employment was the dependent variable.

Next, the effect of poor self-rated health on labour force exit via various routes during follow-up was analysed using different risk regression models: a stratified Cox model, a Cox model with censoring by competing events (cause-specific hazard model), and a competing risk model based on Fine and Gray's proportional subdistribution hazards approach [10]. The models differ from each other in the way they handle competing events.

In the stratified Cox approach workers with competing events were not included in the analysis. Thus, workers from each specific pathway out of paid employment were compared only with workers who stayed in paid employment. Workers were censored at the end of their follow-up or when they reached the country specific retirement age. This approach resembles a multinomial regression analysis whereby workers with the event of interest are compared solely with those workers who stayed in the workforce (leaving workers with another event out of sight). In this analysis one does not take into account that workers are at risk for the event of interest until the moment they experience a competing event. These workers are simply not included in the analysis and, hence, the total number of person-years at risk is influenced.

In the cause specific Cox approach, workers from each specific exit route were compared with all other workers (i.e. those who stayed in paid employment, but also those who left via another exit route than the route of interest). Workers were not only censored at the end of their follow-up, or when they reached the official retirement age, but also when they experienced a competing event [28]. Censoring the time to the event of interest for workers with a competing event assumes that those with a competing event stay at the same risk for the event of interest as those who remain in the risk set [29, 30].

In the Fine & Gray competing risk approach, workers within each specific exit route were compared with all workers [10]. However, contrary to the cause specific Cox approach, those who experienced a competing event were not censored, but were kept in the risk population [29]. Therefore, the likelihood of the occurrence of the event was estimated,

taking into account the likelihood that another event may precede the occurrence of the event of interest. Workers were censored at the end of their follow-up, or when they reached the country specific retirement age.

Each separate exit route was successively the event of interest, hence the other exit routes were then seen as competing events (e.g. when disability benefit was the event of interest, unemployment, early retirement and becoming economically inactive were the competing events). Death was also considered as a competing event. We adjusted the associations between poor self-rated health and labour force exit for age, sex, education, marital status and European region.

Hazard ratios (HR) for the Cox analyses and subdistribution hazard ratios (SHR) for the competing risks analyses, both with corresponding 95% CI, were calculated as measure of association. A value greater than one indicates an increased likelihood of labor force exit. However, one should keep in mind that although the SHR and the HR both measure the association between independent variables and labour force exit, their underlying assumptions are different [31] (see also Discussion of this paper). The 6-year probabilities of disability, unemployment, early retirement, and becoming economically inactive were calculated for low educated male workers aged 60-64 years who were not cohabiting, with good or poor health, in the three European regions.

All analyses were conducted using STATA 13.1 [32]. For the stratified Cox regression the command 'stcox' [33] was used, the cause specific Cox analysis was performed using 'stcompadj' [34]. For the Fine & Gray competing risks approach the command 'stcrreg' was used [35].

RESULTS

The study population consisted of 5,273 employees (Figure 1) with a median time of 55 months until any event or censoring. Table 1 shows the population characteristics of the total study population and the characteristics of the subjects per exit route. A small majority of the study population was male, and the mean age in years at enrolment was 55.3 (SD 3.6). In total, 36% had a high educational level, and almost 20% was not married or cohabitating. Eleven percent reported a less than good self-rated health. In total, 34% of the study population left the workforce during the 6 year follow-up period because of early retirement (20%), unemployment (6%), becoming economically inactive (5%), and disability benefit (3%). The most common pathway in the group of economic inactivity was exit due to becoming a homemaker (57%). During follow-up 63 participants died (1%).

In Table 2 the distribution of employment status at follow-up is described per European region. In all European regions early retirement was the main exit route (22.9% in Bismarckian countries, 16.9% in Scandinavian countries, and 15.4% in Southern Europe). The observed percentage of workers who remained in paid employment during the whole follow-up was lowest in Bismarckian countries (59.4%) compared with Scandinavian countries (68.6%) and Southern Europe (71%).

Figure 2 shows the cumulative incidence curves of the four exit routes out of paid employment based on the Kaplan-Meier curves for workers with poor health (figure 2a) and estimates from the Fine & Gray competing risk analysis for workers with poor health (figure 2b). The probabilities based on the Kaplan-Meier curves are typically higher than when estimated with the competing risks approach. The largest differences between both methods were observed for exit through early retirement (34.1% according to the Kaplan-Meier approach vs. 27.6% according to the competing risk analysis at the 84th month of follow-up) and unemployment (13.8% vs. 7.2%).

Workers with a less than good self-rated health had a higher risk of disability benefit in all models (HR 3.58 (95%CI 2.56-5.00) for the stratified Cox model, HR 3.36 (95%CI 2.41-4.69) for the cause specific Cox model, and SHR 3.22 (95%CI 2.30-4.51) for the Fine & Gray competing risks model). Poor health was also statistically significantly associated with unemployment in the stratified Cox model (HR 1.54) and the cause specific Cox model (HR 1.43), but not in the Fine & Gray competing risks model (SHR 1.32). An elevated but statistically non-significant relation was found for the influence of poor health on early retirement and becoming economically inactive (Table 3). Table 3 also shows that the stratified Cox model resulted in the highest risk rates, followed by the cause specific Cox model. The lowest estimates were observed for the Fine & Gray competing risks approach. Differences ranged from 10% to 17% for the stratified Cox model compared to the competing risks model, and from 4% to 12% for the cause specific Cox model compared to the competing risks model.

Table 4 describes the absolute 6-year probabilities of labour force exit for workers (60-64 years, male, low educational level, not cohabiting) from three European regions with good or poor self-rated health. The cause-specific Cox model and the Fine & Gray competing risk approach produced very similar results. Overall, workers with poor health had a higher probability to leave the workforce via disability benefit, unemployment, or due to becoming economically inactive than workers with good health. The probability to leave the workforce via early retirement was somewhat higher among workers with good health than among workers with poor health in all European regions. In Bismarckian and Scandinavian countries, workers with poor health had an approximate probability of 10-11% to leave the workforce via disability benefit, whereas this probability was lower for workers from Southern Europe (4%). Workers with poor health from Scandinavian countries and from Southern Europe had a lower probability of early retirement than workers from Bismarckian countries (29%, 35-37%, and 45% respectively). In Scandinavian countries the probability of becoming economically inactive among workers with poor health was two times lower than in Bismarckian countries or in Southern Europe. However, workers from Southern Europe had a somewhat lower probability to become unemployed when in poor health than workers from Bismarckian or Scandinavian countries.

Table 1. Baseline characteristics for the total population and per exit route group [a,b]

	Total population (n=5,273)	Worker [c] (n=3,394)	Disability benefit (n=179)	Unemployment (n=314)	Early retirement (n=1,037)	Economically inactive (n=286)
	%	%	%	%	%	%
Sex, female	43.8	44.1	39.1	45.5	39.8	59.1
Age, years						
50-54	45.7	54.5	43.0	51.0	19.3	32.5
55-59	40.3	33.7	48.0	41.4	58.2	48.3
60-64	14.1	11.9	8.9	7.6	22.6	19.2
Educational level						
High	36.3	38.7	26.8	25.8	33.9	33.2
Moderate	32.5	31.5	38.0	36.6	34.2	31.1
Low	31.2	29.8	35.2	37.6	31.9	35.7
Unmarried/not cohabitating	18.7	19.7	21.2	20.1	15.9	13.3
Less than good self-rated health	11.1	9.3	29.1	14.7	11.3	13.6

[a] *type of exit route was determined during follow-up, at baseline all included subjects were in paid employment.*

[b] *the characteristics of the 63 people who died during follow-up are not presented in a separate column in this table but are included in the total population*

[c] *still at work at the end of follow-up or worked until the country-specific retirement age.*

Table 2. Distribution of employment status at follow-up per European region of origin.

	Bismarckian countries (n=2,746)	**Scandinavian countries (n=1,371)**	**Southern Europe (n=1,156)**
	%	%	%
Employment status at follow-up			
Worker	59.4	68.6	71.0
Disability benefit	4.3	3.1	1.6
Unemployment	6.3	6.4	4.7
Early retirement	22.9	16.9	15.4
Economically inactive	6.3	3.2	6.1

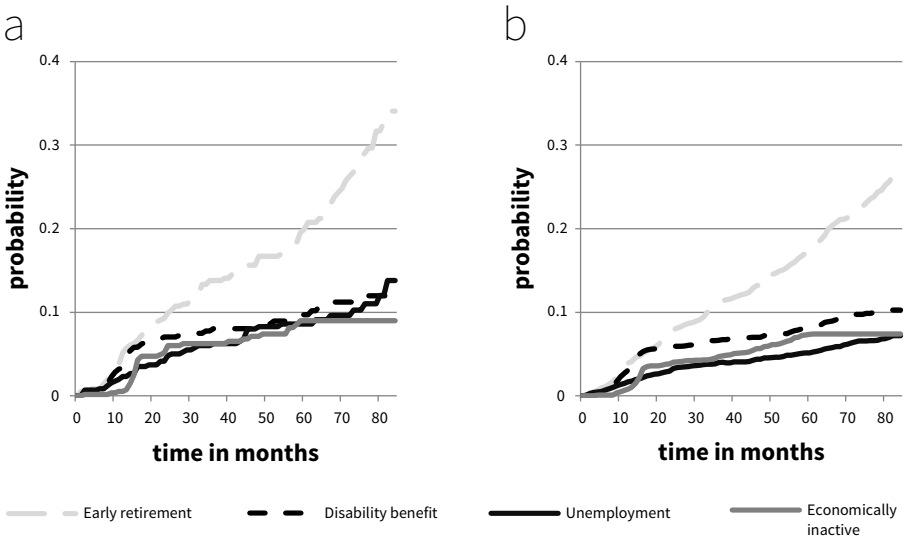


Figure 2. Cumulative incidence of four specific exit pathways out of paid employment based on Kaplan-Meier curve for workers with poor health (a) and estimates from the Fine & Gray competing risk analysis for workers with poor health (b).

Table 3. The influence of poor self-rated health assessed at baseline on the likelihood of exit from paid employment during a 6-year follow-up among older employees in Europe, expressed by the Hazard Ratio (HR) and Subdistribution Hazard Ratio (SHR) using a stratified Cox approach, a cause specific Cox approach and a Fine & Gray competing risks approach a.

	Stratified Cox model		**Cause specific Cox model**		**Fine & Gray competing risks model**	
	HR	95%CI	HR	95%CI	SHR	95%CI
Poor self-rated health on:						
Disability benefit	**3.58**	**2.56-5.00**	**3.36**	**2.41-4.69**	**3.22**	**2.30-4.51**
Unemployment	**1.54**	**1.12-2.12**	**1.43**	**1.04-1.97**	1.32	0.96-1.83
Early retirement	1.13	0.93-1.38	1.07	0.88-1.30	0.94	0.77-1.16
Economical inactivity	1.25	0.89-1.76	1.23	0.87-1.73	1.13	0.81-1.58

[a] *All analyses are adjusted for sex, age, educational level, marital status, and European region.* **Bold** *numbers indicate statistical significance at p 0.05*

Table 4. Predicted 6-year probability (%) of exit from paid employment through different routes per European region for good and poor health among 60-64 year old low educated males who live alone, calculated using the cause specific Cox method and the Fine & Gray competing risk method.

	Bismarckian countries		**Scandinavian countries**		**Southern Europe**	
	Self-rated health		Self-rated health		Self-rated health	
	Good	Poor	Good	Poor	Good	Poor
Disability benefit						
Cause specific	3.6	10.8	3.3	10.1	1.4	4.3
Fine & Gray	3.6	11.1	3.1	9.8	1.3	4.1
Unemployment						
Cause specific	5.2	6.4	6.0	7.9	4.0	5.2
Fine & Gray	5.1	6.7	5.6	7.4	3.7	4.8
Early retirement						
Cause specific	48.4	45.0	30.4	29.2	38.5	37.0
Fine & Gray	47.7	45.7	30.1	28.6	36.7	35.0
Economically inactive						
Cause specific	6.1	6.5	2.7	3.0	6.9	7.7
Fine & Gray	5.9	6.7	2.5	2.8	6.4	7.2

DISCUSSION

Older workers in Europe with a poor self-rated health are at risk of exit from paid employment, most notably through disability benefit followed by unemployment. The likelihood of labour force exit among workers with poor health varied across welfare state regime. The probability of early retirement and becoming economically inactive was lowest in Scandinavian countries, whereas the likelihood of disability benefit and unemployment was lowest in Southern Europe. The comparison of analytical techniques showed that both Cox approaches resulted in 4% to 17% higher risk ratios than the Fine & Gray competing risk model. The HRs from the stratified Cox approach were 2-7% higher than the HRs form the cause-specific Cox model. An appealing feature of the Fine & Gray competing risk model is that the estimated risk ratios directly translate to absolute probabilities.

Until now, various studies have looked at the influence of poor health on exit from work. However, our study is the first that present both relative and absolute risks of work displacement via specific exit routes among workers with poor health. Some studies have graphically shown the probability of labour force exit [36-40]. However, these results were based on Kaplan-Meier curves which do not take competing events into account and, as also shown in the current study, will typically overestimate the absolute risk of different exit routes [31]. In the presence of competing risk situations, such as exit routes from paid employment, conventional survival techniques will be biased as they imply that workers who are censored at a specific moment in time are representative for the population still at risk [29, 31, 41]. Hence, those who are censored should not be subjects with a systematically higher or lower likelihood on the event of interest (i.e workers with a competing event). Therefore, they typically overestimate the probability on a specific exit route.

The likelihood of labour force exit through the more involuntary exit routes of disability benefit and unemployment was higher for workers with poor health. The relation between poor health and disability benefit is not surprising, since a declined health is one of the essential requirements for receiving such a benefit. Furthermore, our results corroborate findings from previous research [1, 7-9]. Various studies have reported a relation between poor health and the exit route of unemployment [e.g. 42, 43]. It is of interest to note that in our study this association was statistically significant in both Cox models but not in the Fine & Gray model, although in the latter model a SHR of 1.32 was observed. In an earlier competing risk analysis in the POLS study a SHR of 1.76 for poor health and unemployment was reported [7]. The current study has a follow-up period which encompasses the economic crisis of 2008 and onwards, and it may be hypothesized that poor health is a less important risk factor for unemployment in countries in time periods with high unemployment [44].

The current study did not establish a significant relation between poor health and the more voluntary exit routes early retirement and becoming economically inactive. Moreover, the absolute risk of early retirement was slightly but consistently higher in the group with good health compared to workers with poor health. The literature is not conclusive about

the relation between poor health and early retirement. In the meta-analysis by Van Rijn et al, a statistically significant increased risk of early retirement was reported (pooled RR 1.27) [1], while recent studies using a competing risks approach did not found a significant relation (SHR 0.97-1.11) [7, 8]. A possible explanation for these mixed findings is that in this exit route other factors play a more prominent role, such as financial arrangements, social situations and welfare state regime [5, 45, 46]. Furthermore, there is some qualitative evidence that not only poor health, but also good health can play a role in the transition to early retirement. For example, people who want to enjoy life while still vital and choose to retire when their health allows them to enjoy retirement [47].

There are several methods to calculate absolute risks, taking into account competing events. In the current study the Fine & Gray method and the cause-specific Cox method were used. They gave nearly the same results, but an advantage of the Fine & Gray method is that the covariate effects (expressed in SHR) translate directly to absolute risks. Furthermore, the risk ratio (SHR) from the Fine & Gray model can be interpreted as the amount of excess risk for a worker with poor health compared to a worker with good health. For example, the SHR of 1.32 for unemployment in this study, implies that workers with poor health have a 1.32 times higher instantaneous risk of becoming unemployed than workers with good health. The risk ratio from the cause specific Cox model (HR) does not translate verbatim to valid absolute risks, since in order to calculate these risks the cause specific hazards of the competing events are also needed [31].

In this study the HR from two different Cox models and the SHR of the Fine & Gray competing risk approach were compared. As all models have their own way of handling competing events, they yield different effect estimates. The estimates from the stratified Cox model were systematically higher than the estimates from the cause specific Cox model (where workers with competing events were censored) and the Fine & Gray model (where workers with competing events were kept in the risk population). The results can be explained by the fact that poor health was a risk factor for the most important competing events [30]. When the independent variable (poor health) would be associated with the event of interest, but not with the competing events, the SHR would be very similar to the HR from both Cox models, especially the cause-specific Cox model. When the independent variable would be associated with the event of interest in an opposite way than with the competing events, the SHR would be higher than both HRs from the Cox analyses.

Differences in labour force exit probabilities were found between European regions. In the oldest age group exit through disability benefits and unemployment was lowest in Southern Europe. These exit routes were strongest related to poor health. Since labour force participation among 50-54 year old subjects at enrolment in the SHARE study was lowest in Southern Europe, some differences in health selection out of the workforce may have already occurred before the age of 50 years. Exit trough the more voluntary routes, early retirement and becoming economically inactive, was lowest in Scandinavian countries. This is in concordance with a comparative study in Europe indicating that the Scandinavian welfare regime facilitates to a larger degree an inclusive labour force than other welfare states [11].

Strengths and limitations

Strengths of our study are its longitudinal character, the use of a large international dataset, and the use of competing risk analysis to estimate the overall relation between poor health and exit from paid employment as well as the absolute risks for labour force exit. Furthermore, the associations were estimated with two Cox models as well a competing risk method , allowing us to compare different analytical techniques. However, some considerations have to be addressed. First, retirement and early retirement were defined by the country specific retirement age at the time of the start of SHARE (i.e. 2004). Nowadays, the official retirement age is rising in most Western countries. However, since this is a gradual process we did not expect major influence on the outcomes of the study. Second, our analyses did not take into account re-entering to paid employment after leaving the labour force. Yet, the percentage of people re-entering the work force is relatively low, ranging from roughly 30% for unemployed to 1% for early retirement. These numbers are similar to what has previously been reported in other studies [8, 48].

CONCLUSION

Workers with poor health, compared with workers with good health, have a higher risk of disability benefit and unemployment, a slightly increased risk of becoming economically inactive, but no elevated risk of early retirement. The absolute risks of labour force exit differed per European region. The choice of analytical technique influenced the strength of the associations. The conventional Cox analysis overestimates relative as well as absolute risks. The Fine & Gray model allows for better estimation of relative and absolute risks of leaving the labour force in the presence of competing exit routes.

REFERENCES

1. van Rijn RM, Robroek SJW, Brouwer S, Burdorf A. Influence of poor health on exit from paid employment: a systematic review. *Occup Environ Med*. 2014;71(4):295-301.
2. Lund T, Csonka A. Risk factors in health, work environment, smoking status, and organizational context for work disability. *Am J Ind Med*. 2003;44(5):492-501.
3. 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.
4. Bültmann U, Christensen KB, Burr H, Lund T, Rugulies R. Severe depressive symptoms as predictor of disability pension: a 10-year follow-up study in Denmark. *Eur J Public Health*. 2008;18(3):232-4.
5. Jensen LD, Ryom PK, Christensen MV, Andersen JH. Differences in risk factors for voluntary early retirement and disability pension: a 15-year follow-up in a cohort of nurses' aides. *BMJ Open*. 2012;2(6).
6. Robroek SJW, Schuring M, Croezen S, Stattin M, Burdorf A. Poor health, unhealthy behaviors, and unfavorable work characteristics influence pathways of exit from paid employment among older workers in Europe: a four year follow-up study. *Scand J Work Environ Health*. 2013;39(2):125-33.
7. Robroek SJW, Rongen A, Arts CH, Otten FWH, Burdorf A, Schuring M. Educational Inequalities in Exit from Paid Employment among Dutch Workers: The Influence of Health, Lifestyle and Work. *PLoS ONE*. 2015;10(8):e0134867.
8. Leijten FRM, de Wind A, van den Heuvel SG, Ybema JF, van der Beek AJ, Robroek SJW, et al. The influence of chronic health problems and work-related factors on loss of paid employment among older workers. *J Epidemiol Community Health*. 2015;69(11):1058-65.
9. Pietiläinen O, Laaksonen M, Rahkonen O, Lahelma E. Self-Rated Health as a Predictor of Disability Retirement: The Contribution of Ill-Health and Working Conditions. *PLoS ONE*. 2011;6(9):e25004.
10. Fine JP, Gray RJ. A Proportional Hazards Model for the Subdistribution of a Competing Risk. *J Am Stat Assoc*. 1999;94(446):496-509.
11. van der Wel KA, Dahl E, Thielen K. Social Inequalities in "Sickness": Does Welfare State Regime Type Make a Difference? A Multilevel Analysis of Men and Women in 26 European Countries. *Int J Health Serv*. 2012;42(2):235-55.
12. Börsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbmacher J, Malter F, et al. Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *Int J Epidemiol*. 2013;42(4):992-1001.
13. Health, Ageing and Retirement in Europe. First results from the Survey of Health, Ageing and Retirment in Europe. Börsch-Supan A, Brugiavini A, Jürges H, Mackenbach

J, Siegrist J, Weber G, editors. Mannheim: Mannheim Research Institute for the Exonomics of Aging (MEA); 2005.

14. Börsch-Supan A, Hank K, Jürges H. A new comprehensive and international view on ageing: introducing the 'Survey of Health, Ageing and Retirement in Europe'. *Eur J Ageing*. 2005;2:24553.

15. SHARE project. Sample; 2013. Available from: http://www.share-project.org/data-access-documentation/sample.html.

16. The Survey of Health, Aging, and Retirement in Europe - Methodology. Börsch-Supan A and Jürges H, editors. Mannheim: Mannheim Research Institute for the Economics of Aging (MEA); 2005.

17. Börsch-Supan A. Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 1. Release version: 2.6.0. SHARE-ERIC. Data set. 2013 doi10.6103/SHARE.w1.260.

18. Börsch-Supan A. Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 2. Release version: 2.6.0. SHARE-ERIC. Data set. 2013 doi10.6103/SHARE.w2.260.

19. First results from the Survey of Health, Ageing and Retirement in Europe (2004-2007). Starting the longitudinal dimension. Börsch-Supan A, Brugiavini A, Jürges H, et al, editors. Mannheim: Mannheim Research Institute for the Economics of Aging (MEA); 2008.

20. Börsch-Supan A. Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 3 – SHARELIFE. Release version: 1.0.0. SHARE-ERIC. Data set. 2010 doi10.6103/SHARE.w3. 100.

21. The individual and the welfare state. Life histories in Europe. Börsch-Supan A, Brandt M, Hank K, Schröder M, editors. Heidelberg: Springer; 2011.

22. Retrospective data collection in the Survey of Health, Ageing and Retirement in Europe. SHARELIFE methodology. Schröder M, editor. Mannheim: Mannheim Research Institute for the Economics of Aging (MEA); 2011.

23. Börsch-Supan A. Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 4. Release version: 1.1.1. SHARE-ERIC. Data set. 2013 doi10.6103/SHARE.w4.111.

24. Active ageing and solidarity between generations in Europe: First results form SHARE after the economic crisis. Börsch-Supan A, Brandt M, Litwin H, Weber G, editors. Berlin: De Gruyter; 2013.

25. SHARE Wave4: Innovations & Methodology. Malter F and Börsch-Supan A, editors. Munich: MEA, Max Planck Institute for Social Law and Social Policy; 2013.

26. SHARE project. Frequently Asked Questions; 1.5 Where can I get information on ethics approval of SHARE; 2013. Available from: http://www.share-project.org/groupfaq/faqs.html #1.6.

27. Idler EL, Benyamini Y. Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies. *J Health Soc Behav*. 1997;38(1):21-37.

28. Putter H, Fiocco M, Geskus RB. Tutorial in biostatistics: competing risks and multi-state models. *Statist Med*. 2007;26(11):2389-430.

29. Lau B, Cole SR, Gange SJ. Competing Risk Regression Models for Epidemiologic Data. *Am J Epidemiol*. 2009;170(2):244-56.

30. Wolbers M, Koller MT, Witteman JC, Steyerberg EW. Prognostic models with competing risks: methods and application to coronary risk prediction. *Epidemiology*. 2009;20(4):555-61.

31. Andersen PK, Geskus RB, de Witte T, Putter H. Competing risks in epidemiology: possibilities and pitfalls. *Int J Epidemiol*. 2012;41(3):861-70.

32. StataCorp. Stata Statistical Software: Release 13. 2013.

33. StataCorp. stcox-Cox proportional hazards model. Available from: http://www.stata.com/manuals13/ststcox.pdf.

34. E. Coviello. Help for stcompadj; 2009. Available from: http://fmwww.bc.edu/repec/bocode/s/stcompadj.html.

35. StataCorp. stcrreg - Competing-risks regression. Available from: http://www.stata.com/manuals13/ststcrreg.pdf.

36. Alexanderson K, Kivimäki M, Ferrie JE, Westerlund H, Vahtera J, Singh-Manoux A, et al. Diagnosis-specific sick leave as a long-term predictor of disability pension: a 13-year follow-up of the GAZEL cohort study. *J Epidemiol Community Health*. 2012;66(2):155-9.

37. Friis K, Ekholm O, Hundrup YA, Obel EB, Grønbaek M. Influence of health, lifestyle, working conditions, and sociodemography on early retirement among nurses: The Danish Nurse Cohort Study. *Scand J Public Health*. 2007;35(1):23-30.

38. Rai D, Kosidou K, Lundberg M, Araya R, Lewis G, Magnusson C. Psychological distress and risk of long-term disability: population-based longitudinal study. *J Epidemiol Community Health*. 2012;66(7):586-92.

39. Schuring M, Robroek SJW, Otten FW, Arts CH, Burdorf A. The effect of ill health and socioeconomic status on labor force exit and re-employment: a prospective study with ten years follow-up in the Netherlands. *Scand J Work Environ Health*. 2013;39(2):134-43.

40. Wedegaertner F, Arnhold-Kerri S, Sittaro N, Bleich S, Geyer S, Lee WE. Depression- and anxiety-related sick leave and the risk of permanent disability and mortality in the working population in Germany: a cohort study. *BMC Public Health*. 2013;13(1):1-10.

41. Noordzij M, Leffondré K, van Stralen KJ, Zoccali C, Dekker FW, Jager KJ. When do we need competing risks methods for survival analysis in nephrology? *Nephrol Dial Transplant*. 2013; 28(11):2670-7.

42. Jusot F, Khlat M, Rochereau T, Serme C. Job loss from poor health, smoking and obesity: a national prospective survey in France. *J Epidemiol Community Health*. 2008;62(4):332-7.

43. van den Berg, 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.

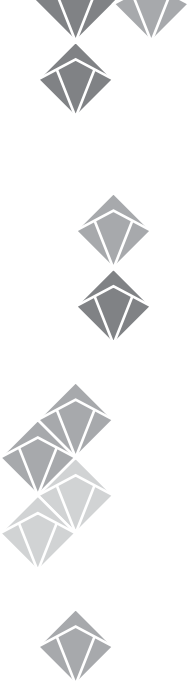
44. Schuring M, Burdorf L, Kunst A, Mackenbach J. The effects of ill health on entering and maintaining paid employment: evidence in European countries. *J Epidemiol Community Health*. 2007;61(7):597-604.

45. 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.

46. Reeuwijk KG, de Wind A, Westerman MJ, Ybema JF, van dB, Geuskens GA. "All those things together made me retire": qualitative study on early retirement among Dutch employees. *BMC Public Health*. 2013;13(1):1-11.

47. de Wind A, Geuskens GA, Reeuwijk KG, Westerman MJ, Ybema JF, Burdorf A, et al. Pathways through which health influences early retirement: a qualitative study. *BMC Public Health*. 2013;13(1):1-9.

48. Burdorf A, van den Berg T, Avendano M, Kunst A, Mackenbach J. The effects of ill health on displacement from the labour market and potential impact of prevention. In: Börsch-Supan A, Agar B, Jürges H, Kapteyn A, Mackenbach J, Siegrist J, et al, editors. First results from the Survey of Health, Ageing and Retirement in Europe (2004-2007): Starting the longitudinal dimension. Mannheim: Mannheim Research Institute for the Economics of Aging (MEA); 2008. p. 137-42.



chapter 5

THE PROGNOSTIC VALUE OF THE WORK ABILITY INDEX FOR SICKNESS ABSENCE AMONG OFFICE WORKERS

PLOS ONE 2015;10(5):E0126969

REEUWIJK KG

ROBROEK SJW

NIESSEN MAJ

KRAAIJENHAGEN RA

VERGOUWE Y

BURDORF A

ABSTRACT

Background

The work ability index (WAI) is a frequently used tool in occupational health to identify workers at risk for a reduced work performance and for work-related disability. However, information about the prognostic value of the WAI to identify workers at risk for sickness absence is scarce.

Objectives

To investigate the prognostic value of the WAI for sickness absence, and whether the discriminative ability differs across demographic subgroups.

Methods

At baseline, the WAI (score 7-49) was assessed among 1,331 office workers from a Dutch financial service company. Sickness absence was registered during 12-months follow-up and categorised as 0 days, 0<days<5, 5≤days<15, and ≥15 days in one year. Associations between WAI and sickness absence were estimated by multinomial regression analyses. Discriminative ability of the WAI was assessed by the Area Under the Curve (AUC) and Ordinal c-index (ORC). Test characteristics were determined for dichotomised outcomes. Additional analyses were performed for separate WAI dimensions, and subgroup analyses for demographic groups.

Results

A lower WAI was associated with sickness absence (≥15 days vs. 0 days: per point lower WAI score OR=1.27; 95%CI 1.21-1.33). The WAI showed reasonable ability to discriminate between categories of sickness absence (ORC=0.65; 95%CI 0.63-0.68). Highest discrimination was found for comparing workers with ≥15 sick days with 0 sick days (AUC=0.77) or with 1-5 sick days (AUC=0.69). At the cut-off for poor work ability (WAI≤27) the sensitivity to identify workers at risk for ≥15 sick days was 7.5%, the specificity 99.6%, and the positive predictive value 82%. The performance was similar across demographic subgroups.

Conclusions

The WAI could be used to identify workers at high risk for prolonged sickness absence. However, due to low sensitivity many workers will be missed. Hence, additional factors are required to better identify workers at highest risk.

INTRODUCTION

With an ageing population there is a need to retain healthy and productive workers. Prevention of, especially long-term, sickness absence can contribute to this goal. Since workers with multiple episodes or long-term sickness absence have an increased risk for mortality and are more likely to exit the labour force through disability benefits and unemployment [1–6], it would be helpful to identify high-risk workers before sickness absence occurs.

Several studies have suggested that the work ability index (WAI) could be used as a predictive tool to identify workers at high risk for long-term sickness absence or disability benefits [7–9]. The WAI is a frequently used tool in occupational health to assess a person's work ability on a sum score between 7 and 49 in order to prevent temporary or permanent exit from work [10,11]. There is evidence that poor or moderate work ability, as compared to excellent work ability, is related to, especially long-term, sickness absence. Kujala et al (2006) reported an elevated risk for > 9 days of sickness absence among employed Finnish men and women with poor or moderate work ability in their early 30s (odds ratios ranging from 2.10 to 5.47) [8]. Alavinia et al (2009) showed similar findings among construction workers (rate ratios ranging from 2.35 for moderate spells of sick leave, to 3.76 for long spells) [12].

However, these associations do not provide insight into how well the WAI discriminates between workers with and without future sickness absence. Therefore, quantification of the discriminative ability of the WAI is needed. Among construction workers, the WAI discriminated adequately between workers at high-risk and low-risk for future disability benefits with an area under the curve (AUC) of 0.78 [13]. Among workers with chronic back pain, similar findings were reported. Those with a WAI score of 20 points or less had a 16-fold higher risk for disability benefits than those with a higher WAI score (AUC 0.80) [14]. At this moment, information about the prognostic value of the WAI to discriminate between workers with different durations of sickness absence is scarce. To the knowledge of the authors there is only one study which investigates whether the WAI is a suitable screening instrument for long-term sickness absence [15]. Furthermore, it remains unknown whether the discriminative ability differs across age, sex, and education groups, which are found to be important individual determinants of sickness absence [16]. This study aims to investigate 1) the prognostic value of the WAI in the prediction of sickness absence, and 2) whether the discriminative ability differs across sex, age, and educational groups.

METHODS

Study design and population

This longitudinal study with 12-months follow-up is part of a larger study aiming to gain insight into the impact of a web-based health promotion program on absenteeism [17]. Workers from a Dutch financial services company who completed participation in a Health Risk Assessment (HRA), called PreventionCompass [17], were included in this study. Pregnant women were excluded from participation in the HRA. Based on a previous reported participation level of 34% [18], it was estimated that approximately 11,000 workers were invited to participate in the HRA between August 1 2007 and July 1 2009. The sickness absence register was made available for the study period only. Therefore, to allow a full follow-up of 12 months, only workers who enrolled in the HRA before June 30 2008 were eligible for participation in the current study. Because of the limited capacity for onsite collection of biometric measurements, workers were gradually invited to participate in the HRA. A total of 3,826 workers participated in the HRA between August 1 2007 until July 1 2009. Of them, 1,351 participated before June 30 2008 and were eligible for participation in this study. Complete information on sickness absence, work ability, and individual characteristics was available for 1,331 workers.

At inclusion a web-based health questionnaire was completed (30–45 minutes), biometric measurements (height, weight, waist circumference, blood pressure) were taken, and laboratory samples were tested. The health questionnaire included questions on individual characteristics, work, lifestyle, personal health history, family risk, and psychological health factors. Based on the health questionnaire completion date, a 12-month follow-up period was defined for each participant in the study. Workers with incomplete data on sickness absence, work ability, or individual characteristics were excluded from the analyses.

Ethical statement

Participants were invited by the company's human resources department, who sent anonymous emails based on a random selection of workers by month of birth. The invitation e-mail included information on the HRA and informed workers that participation was voluntary and at no cost, that all personal information would be treated confidentially, and that no individual results would be shared with their employer or other parties [17]. A single reminder was sent after two weeks.

Observational research with questionnaire data does not fall within the ambit of the Dutch Act on research involving human subjects and does not require the approval of an ethics review board. In accordance with the requirements for identifiable data collection in the Dutch Code of Conduct for Observational Research digital informed consent was obtained from all study participants as part of the activation procedure of their online PreventionCompass account [19]. NIPED does collect and process personal information in the HRA. However, NIPED acts in accordance with the Dutch data protection act, in its use of personal details. Only anonymized data were made available to the researchers of the Erasmus MC.

Sickness absence

During the study period, the sickness absence register was maintained by the occupational health service, which registered frequency and duration of every absence episode. Sickness absence was registered as calendar days from the first sick day onwards. In the analyses, absence episodes of three days or more were multiplied by the fraction of employment for part-time workers. The total number of sick days during the one year follow up period was categorized into 0 days (no absence), 0<days<5 (less than one week), 5≤days<15 (between 1 and 2 weeks), and ≥ 15 days (more than 2 weeks). These categories reflect different actions undertaken in the disease management, varying from a single contact by the supervisor to involvement of the occupational health physician. Specific diagnosis of the disease resulting in sickness absence was not made available to the researchers.

Work ability

Work ability was measured using the WAI, which has been shown to be a valid, reliable, and crossnational instrument for use in occupational health [20– 22]. The WAI consists of 7 dimensions. Dimension 1 asks to indicate on a scale from 0 (not able to work) to 10 (lifetime best) to estimate the current work ability compared with the lifetime best. Dimension 2 contains two questions and assesses on a 5-point scale ranging from 1 (very poor) to 5 (very good) the subjective current work ability in relation to the physical and mental demands of work (sum score of dimension 2 ranges from 2–10). Dimension 3 assesses the number of diseases diagnosed by a physician. To prevent overlap in the HRA questionnaire, the presence of diseases was ascertained using questions on the personal health history instead of the list of 14 diseases asked in the WAI (i.e. injury due to accident, musculoskeletal disease, cardiovascular disease, respiratory disease, mental disorder, neurological or sensory disease, digestive disease, genitourinary disease, skin disease, tumour or cancer, endocrine or metabolic disease, blood disease, heritable disease, other disorders/diseases). The questions on personal health history encompassed all disease categories included in the WAI, except skin disease and heritable diseases.

The number of diseases are accumulated, and scores for this dimension range from 1 (≥5 diseases) to 7 (0 diseases). Dimension 4 assesses on a six point scale ranging from 1 (fully impaired) to 6 (no impairments) the subjective estimation of work impairments due to disease by asking whether the illness is a hindrance in their job. Dimension 5 concerns the number of days off work due to sick leave in the previous 12 months, with answering categories ranging from 0 days (5) to 100 days or more (1). Dimension 6 asks 'Do you believe, according to your present state of health, that you will be able to do your current job two years from now?'. A score of 1 (hardly able to work), 4 (not sure), or 7 (fairly sure) could be obtained. Dimension 7 assesses the mental resources in the past few months using three questions concerning enjoying regular daily activities, being active and alert, and feeling to be full of hope about the future, with answering categories ranging from 'never' (0) to 'always' (4). For dimension 7 a sum score was calculated, leading to a score of 1 (if the sum score ranged between 0–3 points) to 4 (if the sum score ranged between 10–12 points) [23, 24]. The total WAI score was calculated as the sum score of the 7 dimensions and ranges from 7–49. The WAI was categorised into "poor" (7–27), "moderate" (28–36),

"good" (37–43), and "excellent" (44–49) work ability [24]. The WAI score was converted so that the highest value (49) represented the poorest work ability and the lowest value (7) the best work ability in order to describe that lower work ability is a risk factor for a greater number of sick days. The converted score was used in all analyses, except for the descriptive statistics, to facilitate the interpretability of the results.

Individual factors

Information on sex, age, and education was collected in the baseline questionnaire. Age in years was categorised into three groups: < 40 years, 40–49 years, and ≥ 50 years. Education was measured as the highest educational level ever completed and classified into three groups: high (higher vocational schooling, or university), middle (higher secondary schooling, or middle vocational schooling), and low (primary school, lower and middle secondary schooling, or lower vocational schooling).

Statistical analysis

For the main variables descriptive statistics were generated, i.e. numbers and percentages for dichotomous and categorical variables, and means and standard deviations for continuous variables. Univariate and multivariable multinomial logistic regression analyses were used to assess the association of the WAI score and individual characteristics with the occurrence of sickness absence. To assess the fit of the multinomial model a post estimation for goodness-of- fit was performed [25]. Although sickness absence is an ordinal variable, a multinomial regression analysis rather than an ordinal logistic regression analysis was performed to gain insight into the associations across the specific sickness absence categories. Previous studies have shown that short-term and long-term sickness absence are different types of sickness absence and have different determinants [6,16,26,27]

To assess the ability of the WAI to discriminate between workers with different durations of sickness absence, pairwise AUC's were estimated. The pairwise AUC compares each pair of categories using only those workers that belong to one of the two categories at hand [28]. For our study there are four categories of sickness absence, hence, six pairwise AUC's were estimated. To determine the overall ability of the WAI to discriminate correctly between these categories of sickness absence the ordinal cindex (ORC) was estimated as the average of all pairwise AUC's [29]. The 95% confidence intervals (95%CI) were estimated with bootstrapping using 200 bootstrap replications [29]. The ORC is an attractive measure since it summarizes the discriminative ability for ordinal outcomes into one single metric that can be compared directly with the AUC measure for a dichotomous outcome. The ORC is similarly interpreted as the traditional AUC: a value of 0.5 indicates a discriminative ability not better than chance, an AUC of 1.0 indicates perfect discrimination [29]. The discriminative ability was also estimated for each separate WAI dimension. Additionally, the discriminative ability of the WAI was assessed after removing the single dimensions in order to explore whether the prognostic value of the WAI was mainly driven by one of its dimensions. To assess whether the discriminative ability of the WAI was different across sex, age, and educational groups, subgroup analyses were performed.

Test characteristics (sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV)) of the total WAI score were assessed at the cut-off between poor and moderate work ability (≤ 27) and at the cut-off between moderate and good work ability (≤ 36). ROC curves were created to calculate the AUC. Subsequently, sensitivity and specificity were assessed for different numbers of sick days (0 days vs. ≥ 1 days; < 5 days vs. ≥ 5 days; < 15 days vs. ≥ 15 days). The PPV was estimated as the true positives divided by the total positives. The NPV was estimated as the true negatives divided by the total negatives.

All analyses were conducted with SPSS 20.0 for Windows (IBM Software, Chicago), except for the calculation of the 95%CI around the ORC, which were calculated with R, version (R_3.0.3.tar.gz) (R Foundation for Statistical Computing, Vienna). Confidence intervals for the test characteristics were estimated using efficient-score method, described by Newcombe [30,31]. A p-value <0.05 was considered statistically significant.

RESULTS

The characteristics of the study population are presented in Table 1. Nearly half of the population was female (46.8%), and age ranged from 21–62 years, with a mean of 43.3 years (±8.9 years). One fifth of the population had a low educational level (20.4%).

WAI as a determinant of sickness absence

During the follow-up period, 80% of the study population had at least one day of sickness absence. Almost one fifth (19.5%) was absent from work ≥ 15 days due to sickness (Table 1).

Table 2 shows that workers with lower work ability were more likely to have sickness absence (OR per point lower WAI score: 1.10, 1.13, and 1.27 for 0<days< 5, 5≤days<15, and ≥ 15 days versus 0 days). The goodness-of-fit analysis of the multivariable multinomial regression analysis showed that the estimated probabilities and observed probabilities did not significantly differ (p-value = 0.11), and thus was sufficient.

When using the traditional four categories of the WAI index, there was a clear upward trend for lower WAI categories with larger odds ratios for greater number of sick days, i.e. workers with a poor/moderate (OR 15.14, 95% CI 7.69–29.81), or good (OR 4.12, 95%CI 2.77–6.14) work ability had a higher likelihood on ≥ 15 sick days than workers with excellent work ability (appendix S1 Table).

Prognostic value of the WAI

The ORC was 0.65 (95%CI 0.63–0.68), representing a 65% probability that the WAI correctly separates two cases from two randomly chosen categories of sickness absence. Figure 1 shows that the WAI fails to separate workers without sickness absence from workers with 0<days<5 of absence. The WAI could best discriminate between workers with 0 or 0<days<5 sick days and workers with ≥ 15 sick days (AUC 0.77, and 0.69 respectively).

Dimension five (i.e. sickness absence in previous year) had the best discriminative ability (ORC 0.67, 95%CI 0.65–0.70) as compared to the other WAI dimensions (Table 3). Excluding dimension five from the total WAI score resulted in a minor decrease in ORC from 0.65 to 0.63 (Table 3). Exclusion of other dimensions also resulted in minor changes in ORC of 0.01, or no change at all.

Figure 2 presents the test characteristics of the WAI for predicting different numbers of sick days. At the cut-off between poor and moderate work ability (score ≤ 27) the sensitivity was 7.5%, specificity 99.6%, and PPV 82.0% (NPV was also 82.0%) for < 15 sick days vs. ≥ 15 sick days. At the cut-off between moderate and good work ability (score ≤ 36) sensitivity increased to 23.5%, but specificity and PPV decreased to 93.5% and 46.7%, respectively, for <15 sick days vs. ≥ 15 sick days.

Table 1. Characteristics of study sample consisting of office workers (n = 1,331).

	n (%) or mean ±sd
Work ability and sickness absence	
Work ability index (7–49)[a]	42.1 ±4.8
Work ability index category	
Excellent	589 (44.3)
Good	594 (44.6)
Moderate	122 (9.2)
Poor	26 (2.0)
Cumulative number of sick days during 1 year	
0 days	266 (20.0)
0<days<5	404 (30.4)
5≤days<15	401 (30.1)
≥ 15 days	260 (19.5)
Individual factors	
Sex, female	623 (46.8)
Age	
< 40	490 (36.8)
40–50	480 (36.1)
≥ 50	361 (27.1)
Education	
High	561 (42.1)
Middle	499 (37.5)
Low	271 (20.4)

[a] *higher scores indicate better work ability. n: number of workers; sd: standard deviation.*

Discriminative ability of the WAI for sickness absence across subgroups

The ability of the WAI to discriminate between different categories of sickness absence was similar for male and female office workers (ORC 0.66 versus 0.64), as well as for different age groups (ORC 0.65). No differences in discriminative ability were observed between educational groups (high: ORC 0.66, 95%CI 0.61–0.71, middle: ORC 0.62, 95%CI 0.59–0.66, and low: ORC 0.66, 95%CI 0.62–0.71) (appendix S2 Table).

Table 2. Univariate and multivariable multinomial regression analyses with odds ratios and 95% confidence intervals for the association between work ability, and individual factors with sickness absence among office workers (n = 1,331).

	Univariate **Sickness absence**			**Multivariable** **Sickness absence**		
	0<days<5[a] OR(95%CI)	5≤days<15[a] OR(95%CI)	≥ 15 days[a] OR(95%CI)	0<days<5[a] OR(95%CI)	5≤days<15[a] OR(95%CI)	≥ 15 days[a] OR(95%CI)
Work ability index (WAI)						
WAI score (7–49)[b]	**1.10 (1.05–1.15)**	**1.13 (1.08-1.18)**	**1.27 (1.21–1.33)**	**1.11 (1.06–1.16)**	**1.15 (1.10–1.20)**	**1.27 (1.21–1.33)**
Individual factors						
Sex, female	**1.56 (1.14–2.13)**	**1.39 (1.01–1.90)**	**1.51 (1.07–2.14)**	1.23 (0.87–1.73)	1.06 (0.75–1.50)	1.15 (0.77–1.70)
Age years						
< 40	1	1	1	1	1	1
40–50	0.75 (0.52–1.08)	0.82 (0.57–1.19)	1.30 (0.85–1.98)	0.71 (0.48–1.05)	0.75 (0.51–1.11)	0.99 (0.62–1.57)
≥ 50	**0.49 (0.33–0.73)**	**0.53 (0.36–0.78)**	1.16 (0.75–1.78)	**0.42 (0.27–0.65)**	**0.41 (0.26–0.64)**	0.62 (0.37–1.05)
Edu cation						
High	1	1	1	1	1	1
Middle	0.98 (0.69–1.38)	1.14 (0.81–1.61)	**1.91 (1.29–2.84)**	0.94 (0.65–1.34)	1.07 (0.75–1.54)	1.53 (1.00–2.35)
Low	1.17 (0.76–1.79)	1.16 (0.75–1.79)	**2.78 (1.74–4.43)**	1.29 (0.80–2.08)	1.24 (0.77–2.02)	**2.10 (1.23–3.58)**

[a]0 days of sickness absence is reference category. [b]lower scores indicate better work ability. **Bold** *p-value <0.05; OR: odds ratio; 95% CI: 95% confidence interval; n: number of workers.*

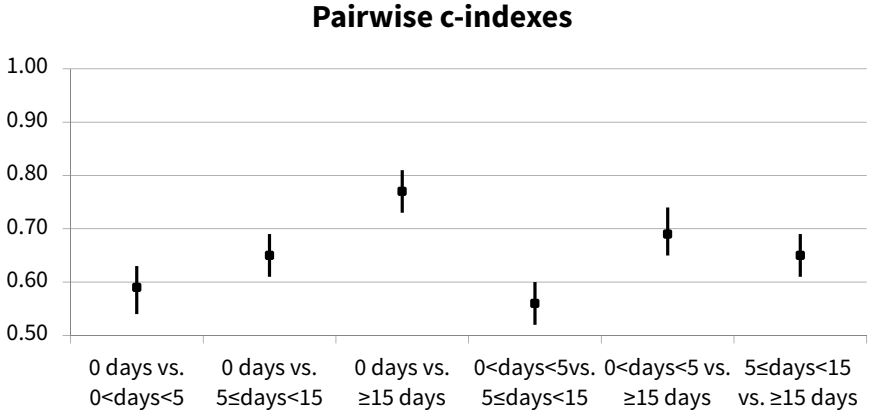


Figure 1. Pairwise AUCs: ability of the work ability index (WAI) to discriminate between categories of sickness absence. AUC: Area under the curve.

Table 3. Discriminative ability of the WAI dimensions in the prediction of different durations of sickness absence among office workers (n = 1,331).

	Single dimensions[a] ORC (95%CI)	**Exclusion analyses[b] ORC (95%CI)**
Dim 1. Subjective work ability	**0.59 (0.55–0.61)**	**0.66 (0.64–0.68)**
Dim 2. Work ability in relation to demands	**0.60 (0.57–0.62)**	**0.65 (0.63–0.67)**
Dim 3. Number of diseases	**0.59 (0.56–0.61)**	**0.65 (0.62–0.67)**
Dim 4. Work impairments	**0.58 (0.56–0.60)**	**0.65 (0.63–0.67)**
Dim 5. Sick leave past year	**0.67 (0.65–0.70)**	**0.63 (0.60–0.65)**
Dim 6. Prognosis of work ability	**0.52 (0.51–0.54)**	**0.65 (0.63–0.68)**
Dim 7. Mental resources	**0.56 (0.54–0.58)**	**0.65 (0.63–0.68)**

[a]discriminative ability of the single WAI dimensions. [b]discriminative ability of the total WAI score minus a dimension. **Bold** *p-value <0.05; ORC: ordinal c-index; 95% CI: 95% confidence interval; Dim: dimension.*

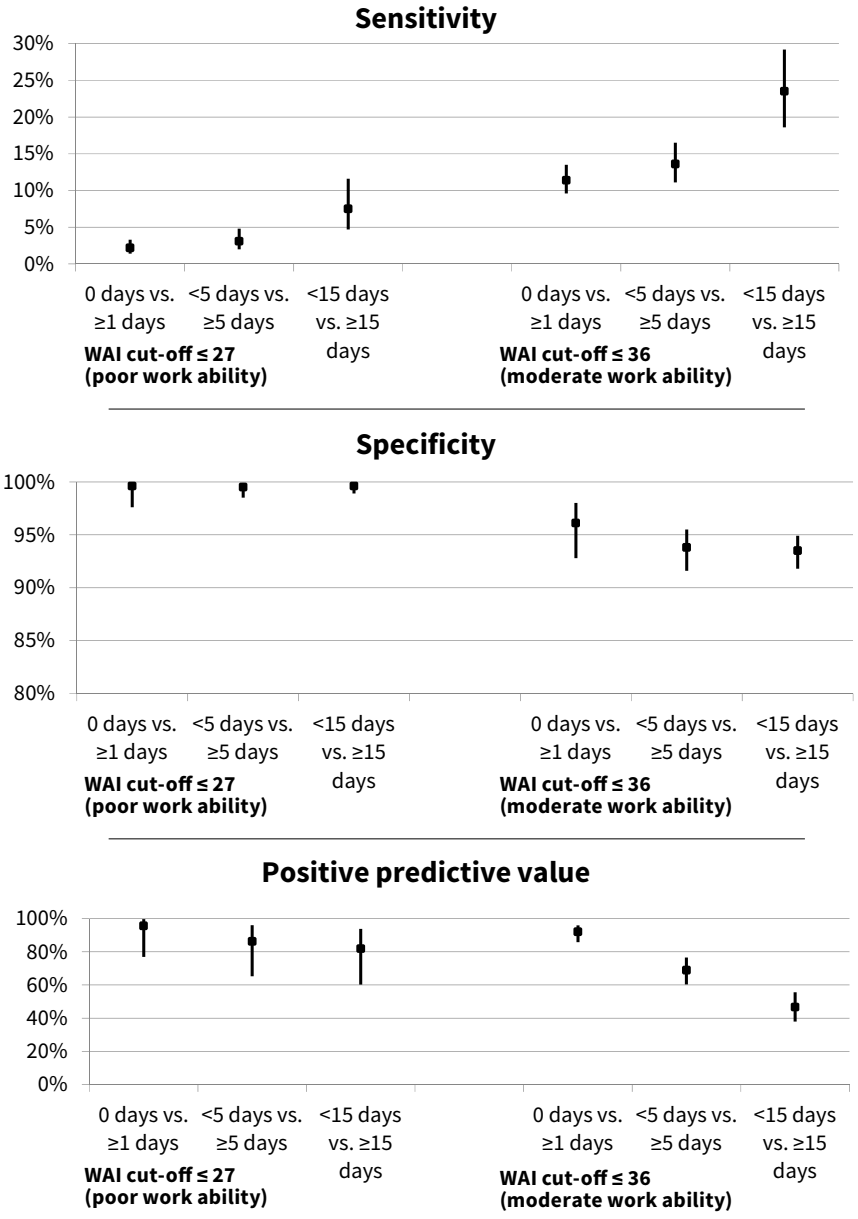


Figure 2. Test characteristics (sensitivity, specificity, and positive predictive value) at different cut-off values of the work ability index (WAI) for different durations of sickness absence.

DISCUSSION

Until now, information about the prognostic value of the WAI was scarce. In this study the WAI showed a reasonable ability to discriminate between different durations of sickness absence. The WAI could fairly well identify workers with prolonged sickness absence from workers without absence or with low absence. This confirms that the WAI could be used to identify workers at risk for prolonged sickness absence. Although the WAI had a high specificity, its sensitivity was low. Due to this low sensitivity, not all workers with prolonged sickness absence are identified by a low work ability score. The discriminative ability did not differ between demographic subgroups.

In the Netherlands, workers are required to call in sick for work to their employer on the first day of their absence. A worker will be paid at least 70% of his/her full salary during the first two years of sickness absence. A worker is eligible for disability benefit after the first two years of sickness absence [8,32,33]. In our study population 19.5% of the participants had prolonged sickness absence (≥15 days) during the follow-up year. This is comparable with the findings of other Dutch studies (16–21%) [12,26,34]. However, 80% of our participants had at least one day of sickness absence. Other Dutch studies reported lower prevalences of sickness absence (34–58%) [12,26,34]. These differences in short-term sickness absence may be explained by differences in study population and measurement method.

Previous studies found that lower work ability was associated with sickness absence [8,12,35], disability benefits [22], and productivity loss at work [36]. This study confirmed that a lower WAI score was related to sickness absence, especially ≥ 15 sick days. Moreover, we found that the WAI was able to correctly discriminate between four categories of sickness absence in 65% of the cases. Discrimination between workers without sickness absence and workers with ≥ 15 sick days was even better (77% correct classification of the cases). A recent study found a very similar ability of the WAI to discriminate between workers with more than 14 sick days and those with less than 14 sick days (AUC 0.78) [15]. Besides, this trend in discriminative ability is similar to the earlier reported trend in associations between a lower work ability score and sickness absence, which are systematically stronger for a greater number of sick days [8, 12, 35].

The results of this study show that the overall ability of the WAI to discriminate between the four categories of sickness absence was reasonable. The WAI discriminated best between 0 or 0<days<5 sick days versus ≥ 15 sick days. This indicates that the WAI could be used as a tool to identify office workers at future risk for prolonged sickness absence. However, at the cut-off between poor and moderate work ability only 7.5% of the workers with ≥ 15 sick days were identified by their poor work ability score. On the other hand, the PPV of 82% indicates that from all workers with a poor work ability score at baseline, 82% had ≥ 15 sick days at follow-up. For the practical use of the WAI in public and occupational health care this suggests that workers with a poor work ability score are highly likely to have ≥ 15 sick days in the next 12 months, but that many workers with sickness absence of two weeks or more will not be identified by a poor work ability score. Hence, additional factors are required to better identify workers at highest risk for prolonged sickness

absence. Introducing a higher cut-off in the WAI, for example between moderate and good work ability, might also be a solution. It improves the sensitivity to 24%, however, at the expense of lower specificity and PPV.

Since workers with poor work ability are highly likely to have prolonged sickness absence in the next 12 months, interventions aiming at prevention of prolonged sickness absence could be targeted at workers with poor (and moderate) work ability. However, one has to recognize that many workers at risk for prolonged sickness absence will be missed when only focusing on the WAI score. Therefore, additional information on risk factors for sickness absence, such as on the private situation, organizational factors, or on physical and psychosocial work related factors, and lifestyle related factors, may be needed to better identify those workers at highest risk.

To the knowledge of the authors this is the first study that evaluated the prognostic value of the individual dimensions of the WAI. The first dimension of the WAI (i.e. self-assessed current work ability, range 0–10) has often replaced the WAI in clinical and population-based studies [37,38]. A Swedish study concluded that the first dimension of the index and the full WAI had a very strong correlation (Spearman r = 0.87) and showed similar associations with degree of sick leave [39]. However, our study indicates that the whole index has a somewhat better discriminative ability (ORC 0.65) than the first dimension of the WAI (ORC 0.59).

Among construction workers, Roelen et al (2014) found similar results, whereby the first dimension had a fair discriminative ability (AUC = 0.67), while the total index had an adequate discriminative ability (AUC = 0.78) to identify workers at risk for disability benefit [13]. The differences in outcomes between the studies may be explained by the fact that the Swedish study focused on correlations and associations while our study and that of Roelen et al (2014) focused on the discriminative ability. Furthermore, the Swedish study consisted of female workers who were already on long-term sick leave, while our study consisted of male and female office workers. This may also have contributed to different findings.

Despite the fact that a previous review reported an association between individual characteristics and sickness absence [16], there were no large differences in the discriminative ability of the WAI across age, sex, and educational groups. This indicates a generic discriminative ability of the WAI in the identification of sickness absence.

Strengths and limitations

Some strengths and limitations need to be considered. The large study population, longitudinal data, and register-based information regarding the number of sick days are strengths of this study [40,41]. A first important consideration is the fact that the WAI includes information on previous sickness absence. From other studies it is known that sickness absence in previous years is a predictor for future sickness absence [42,43]. However, the exclusion analysis indicated that the discriminative ability of the WAI was not fully driven by this single dimension. Second, selection bias cannot be ruled out, since it is not clear whether the respondents are a representative sample of all workers in the financial service company. Overall, participation in the HRA was not selective for

education, gender, and age [44]. Therefore, the potential effect of this bias is considered low. Third, this study was conducted among office workers (i.e. white-collar workers) in the financial industry in midst of the global financial crisis. Therefore, it remains unknown whether our results are generalizable to occupations with a higher physical workload (i.e. blue-collar workers). However, it is likely that results will be comparable since studies on the association between work ability and sickness absence show similar results for both occupational groups [8,12]. Fourth, the presence of diseases diagnosed by a physician was ascertained using the questions on personal health history rather than the original third dimension of the WAI. The items on personal health history encompassed all disease categories included in the original WAI index question, except for skin disease and heritable diseases. This may have resulted in a slightly lower disease prevalence and hence a slightly higher WAI score. Last, when interpreting the results one has to keep in mind that this tool is aimed at a selective primary prevention strategy and should be used only within workplaces where workers have sufficient employment protection against health-related redundancy policies.

CONCLUSION

Until now, information about the prognostic value of the WAI was scarce. From this study we can conclude that the work ability index is able to identify workers with prolonged sickness absence fairly well. This indicates that the WAI could be used to identify workers at high risk for prolonged sickness absence. However, due to a low sensitivity, not all workers with prolonged sickness absence are identified by a low work ability score. Hence, additional factors are required to better identify workers at risk for prolonged sickness absence.

REFERENCES

1. Alexanderson K, Kivimäki M, Ferrie JE, Westerlund H, Vahtera J, Singh-Manoux A, et al. Diagnosis-specific sick leave as a long-term predictor of disability pension: A 13-year followup of the GAZEL cohort study. J Epidemiol Community Health. 2012;66:155–9.
2. Hultin H, Lindholm C, Moller J. Is there an association between long-term sick leave and disability pension and unemployment beyond the effect of health status? A cohort study. PLoS One. 2012;7:e35614.
3. Pedersen J, Bjorner JB, Burr H, Christensen KB. Transitions between sickness absence, work, unemployment, and disability in Denmark 2004–2008. Scand J Work Environ Health.2012;38:51626.
4. Koopmans PC, Roelen CAM, Groothoff JW. Frequent and long-term absence as a risk factor for work disability and job termination among employees in the private sector. Occup Environ Med . 2008;65:494–9.
5. Virtanen M, Kivimäki M, Vahtera J, Elovainio M, Sund R, Virtanen P, et al. Sickness absence as a risk factor for job termination, unemployment, and disability pension among temporary and permanent employees. Occup Environ Med. 2006;63:212–7.
6. Kivimäki M, Head J, Ferrie JE, Shipley MJ, Vahtera J, Marmot MG. Sickness absence as a global measure of health: Evidence from mortality in the Whitehall II prospective cohort study. BMJ. 2003;327:364.
7. Sell L. Predicting long-term sickness absence and early retirement pension from self-reported work ability. Int Arch Occup Environ Health. 2009;82:1133–8.
8. Kujala V, Tammelin T, Remes J, Vammavaara E, Ek E, Laitinen J. Work ability index of young employees and their sickness absence during the following year. Scand J Work Environ Health. 2006;31:75–84.
9. Roelen CAM, Heymans MW, Twisk JWR, Klink JJL, Groothoff JW, van Rhenen W. Work ability index as tool to identify workers at risk of premature work exit. J Occup Rehabil. 2014;24:747–54.
10. Tuomi K, Huuhtanen P, Nykyri E, Ilmarinen J. Promotion of work ability, the quality of work and retirement. Occup Med. 2001;51:318–24.
11. van den Berg TIJ, Elders LAM, de Zwart BCH, Burdorf A. The effects of work-related and individual factors on the work ability index: A systematic review. Occup Environ Med. 2009;66:211–20.
12. Alavinia SM, van den Berg TIJ, van Duivenbooden JC, Elders LAM, Burdorf A. Impact of workrelated factors, lifestyle, and work ability on sickness absence among Dutch construction workers. Scand J Work Environ Health. 2009;35:325–33.
13. Roelen CAM, van Rhenen W, Groothoff JW, van der Klink JJL, Twisk JWR, Heymans MW. Work ability as prognostic risk marker of disability pension: Single-item work

ability score versus multiitem work ability index. Scand J Work Environ Health. 2014;40:428–31.

14. Bethge M, Gutenbrunner C, Neuderth S. Work ability index predicts application for disability pension after work-related medical rehabilitation for chronic back pain. Arch Phys Med Rehabil. 2013;94:2262–8.

15. Schouten LS, Joling CI, van der Gulden JW, Heymans MW, Bültmann U, Roelen CAM. Screening manual and office workers for risk of long-term sickness absence: Cut-off points for the work ability index. Scand J Work Environ Health. 2015;41(1):36-42.

16. Beemsterboer W, Stewart R, Groothoff J, Nijhuis F. A literature review on sick leave determinants (1984–2004). Int J Occup Med Environ Health. 2009;22:169–79.

17. Niessen MAJ, Kraaijenhagen RA, Dijkgraaf MGW, van Pelt D, van Kalken CK, Peek N. Impact of a web-based worksite health promotion program on absenteeism. J Occup Environ Med. 2012;54:404–8.

18. Colkesen E, Niessen M, Peek N, Vosbergen S, Kraaijenhagen R, van Kalken CK, et al. Initiation of health-behaviour change among employees participating in a web-based health risk assessment with tailored feedback. J Occup Med Toxicol. 2011;6:5.

19. Federation of Biomedical Scientific Societies. (2004) Code of conduct for use of data in health research. Available: http://www.federa.org/sites/default/files/bijlagen/coreon/code_of_conduct_for_medical_research_1.pdf. Accessed April 20, 2013.

20. Radkiewicz P, Widerszal-Bazyl M. Psychometric properties of work ability index in the light of comparative survey study. International Congress Series. 2005;280:304–9.

21. de Zwart BCH, Frings-Dresen MHW, van Duivenbooden JC. Test—retest reliability of the work ability index questionnaire. Occup Med. 2002;52:177–81.

22. Alavinia SM, de Boer AGEM, van Duivenbooden JC, Frings-Dresen MHW, Burdorf A. Determinants of work ability and its predictive value for disability. Occup Med. 2009;59:32–7.

23. Tuomi K, Ilmarinen J, Eskelinen L, Järvinen E, Toikkanen J, Klockars M. Prevalence and incidence rates of diseases and work ability in different work categories of municipal occupations. Scand J Work Environ Health. 1991;17:67–74.

24. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. (1998) Work ability index. Helsinki: Finnish In- stitute of Occupational Health.

25. Fagerland MW, Hosmer DW, Bofin AM. Multinomial goodness-of-fit tests for logistic regression models. Stat Med. 2008;27:4238–53.

26. Robroek SJW, van den Berg TIJ, Plat JF, Burdorf A. The role of obesity and lifestyle behaviours in a productive workforce. Occup Environ Med. 2011;68:134–9.

27. Marmot M, Feeney A, Shipley M, North F, Syme SL. Sickness absence as a measure of health status and functioning: From the UK Whitehall II study. J Epidemiol Community Health. 1995;49:124–30.

28. van Calster B, Vergouwe Y, Looman CN, van Belle V, Timmerman D, Steyerberg EW. Assessing the discriminative ability of risk models for more than two outcome categories. Eur J Epidemiol. 2012;27:761–70.

29. van Calster B, van Belle V, Vergouwe Y, Steyerberg EW. Discrimination ability of prediction models for ordinal outcomes: Relationships between existing measures and a new measure. Biom J. 2012;54:674–85.

30. Newcombe RG. Two-sided confidence intervals for the single proportion: Comparison of seven methods. Stat Med. 1998;17:857–72.

31. Clinacal Calculator 1. From an observed sample: Estimates of population prevalence, sensitivity, speci- ficity, predictive values, and likelihood ratios. Available: http://vassarstats.net/clin1.html. Accessed May 8, 2014.

32. Ministery of Work and Social Affairs. Ziekteverzuim van het werk. Available: http://www.rijksoverheid.nl/onderwerpen/ziekteverzuim-van-het-werk. Accessed April 25, 2014.

33. UWV. Stappenplan bij ziekte. Available: http://www.uwv.nl/Particulieren/ik_ben_ziek/ik_ben_ziek_en_heb_een_werkgever/reintegratie_tijdens_ziekte/stappenplan.aspx. Accessed April 25, 2014.

34. Roelen CA, van Rhenen W, Groothoff JW, van der Klink JJ, Bültmann U, Heymans MW. The development and validation of two prediction models to identify employees at risk of high sickness absence. Eur J Public Health. 2013;23:128–33.

35. Lund T, Christensen KB, Vaez M, Labriola M, Josephson M, Villadsen E, et al. Differences in sickness absence in Sweden and Denmark: The cross national HAKNAK study. Eur J Public Health. 2009;19:343–9.

36. van den Berg T, Robroek S, Plat J, Koopmanschap M, Burdorf A. The importance of job control for workers with decreased work ability to remain productive at work. Int Arch Occup Environ Health. 2011;84:705–12.

37. de Croon EM, Sluiter JK, Nijssen TF, Kammeijer M, Dijkmans BAC, Lankhorst GJ, et al. Work ability of Dutch employees with rheumatoid arthritis. Scand J Rheumatol. 2005;34:277–83.

38. van de Vijfeijke H, Leijten FRM, Ybema JF, van den Heuvel SG, Robroek SJW, van der Beek AJ, et al. Differential effects of mental and physical health and coping style on work ability: A 1-year follow-up study among aging workers. J Occup Environ Med. 2013;55:1238–43.

39. 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;36:404–12.

40. Ferrie JE, Kivimäki M, Head J, Shipley MJ, Vahtera J, Marmot MG. A comparison of self-reported sickness absence with absences recorded in employers' registers: Evidence from the Whitehall II study. Occup Environ Med. 2005;62:74–9.

41. Voss M, Stark S, Alfredsson L, Vingård E, Josephson M. Comparisons of self-reported and register data on sickness absence among public employees in Sweden. Occup Environ Med. 2008;65:61–7.

42. Roelen CAM, Koopmans PC, Schreuder JAH, Anema JR, van der Beek AJ. The history of registered sickness absence predicts future sickness absence. Occup Med. 2011;61:96–101.

43. Hultin H, Lindholm C, Malfert M, Moller J. Short-term sick leave and future risk of sickness absence and unemployment—the impact of health status. BMC Public Health. 2012;12:861.

44. Niessen MA, Laan EL, Robroek SJ, Essink-Bot ML, Peek N, Kraaijenhagen RA, et al. Determinants of participation in a web-based health risk assessment and consequences for health promotion programs. J Med Internet Res. 2013;15:e151.

APPENDIX

S1 Table. Univariate multinomial regression analyses with odds ratios and 95% confidence intervals for the association between categories of work ability with sickness absence among office workers (n = 1,331).

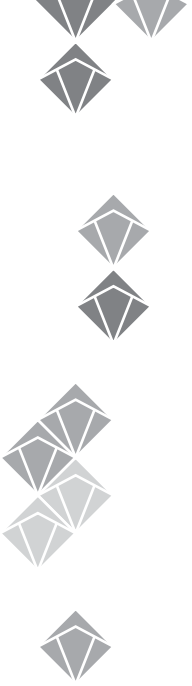
	Sickness absence		
	0 < days < 5[a]	**5 ≤ days < 15[a]**	**≥ 15 days[a]**
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Work ability categories			
Excellent	1	1	1
Good	**1.80 (1.29-2.51)**	**2.77 (1.99-3.87)**	**4.12 (2.77-6.14)**
Moderate	**2.36 (1.15-4.84)**	**3.29 (1.61-6.73)**	**11.66 (5.70-23.84)**
Poor	2.59 (0.27-25.14)	2.19 (0.20-24.42)	**53.44 (7.03-406.39)**

[a]0 sick days is reference category. **Bold** *p-value <0.05; OR: odds ratio; 95% CI: 95% confidence interval; n: number of workers.*

S2 Table. Discriminative ability of the WAI in the prediction of different durations of sickness absence among office workers, subgroup analysis (n = 1,331).

	Discriminative ability
	ORC (95% CI)
Sex	
Male	**0.66 (0.61-0.69)**
Female	**0.64 (0.61-0.68)**
Age	
< 40	**0.65 (0.60-0.69)**
40-50	**0.65 (0.62-0.69)**
≥ 50	**0.65 (0.61-0.70)**
Education	
High	**0.66 (0.61-0.71)**
Middle	**0.62 (0.59-0.66)**
Low	**0.66 (0.62-0.71)**

Bold *p-value <0.05; WAI: Work ability index; ORC: ordinal c-index; 95% CI: 95% confidence interval.*



chapter 6

HOW WORK IMPAIRMENTS AND REDUCED WORK ABILITY ARE ASSOCIATED WITH HEALTH CARE USE IN WORKERS WITH MUSCULOSKELETAL DISORDERS, CARDIOVASCULAR DISORDERS OR MENTAL DISORDERS

JOURNAL OF OCCUPATIONAL REHABILITATION 2014;24(4):631-9

REEUWIJK KG

ROBROEK SJW

HAKKAART L

BURDORF A

ABSTRACT

Purpose

The aim of this study was to explore how work impairments and work ability are associated with health care use by workers with musculoskeletal disorders (MSD), cardiovascular disorders (CVD), or mental disorders (MD).

Methods

In this cross-sectional study, subjects with MSD (n = 2,074), CVD (n = 714), and MD (n = 443) were selected among health care workers in 12 Dutch organizations. Using an online questionnaire, data were collected on individual characteristics, health behaviors, work impairments, work ability, and consultation of a general practitioner (GP), physiotherapist, specialist, or psychologist in the past year. Univariate and multivariate logistic regression analyses were performed to explore the associations of work impairments and work ability with health care use.

Results

Lower work ability was associated with a higher likelihood of consulting any health care provider among workers with common disorders (OR 1.05–1.45). Among workers with MSD work impairments increased the likelihood of consulting a GP (OR 1.55), specialist (OR 2.05), and physical therapist (OR 1.98). Among workers with CVD work impairments increased the likelihood of consulting a specialist (OR 1.94) and physical therapist (OR 2.73). Among workers with MD work impairments increased the likelihood of consulting a specialist (OR 1.79) and psychologist (OR 1.82).

Conclusion

Work impairments and reduced work ability were associated with health care use among workers with MSD, CVD, or MD. These findings suggest that addressing work-related problems in workers with common disorders may contribute in reducing health care needs.

Key words

Cardiovascular disease; Health care utilization; Mental disorders; Musculoskeletal disease; Work ability; Work impairments

INTRODUCTION

Health care use and subsequent costs are rising in Western countries [1, 2]. In the Netherlands, health care expenditures have almost doubled in the past decade, which can only partly be attributed to aging of the population [3]. The total health care costs were approximately 74 billion euro in 2007 (for 16 million inhabitants) of which cardiovascular disorders (CVD) accounted for 9.3%, mental disorders (MD) excluding dementia and

mental disabilities for 9.1%, and musculoskeletal disorders (MSD) for 6.6% [4–6]. In order to retain an affordable health care it is important to identify modifiable risk factors for health care use which may be targeted in interventions.

To date, numerous studies have reported that health care use is associated with the presence and severity of diseases [7–9]. Similarly, the role of individual characteristics [9–11] and lifestyle [12–14] on health care use among those with health complaints is well studied. Since the majority of adults are engaged in paid employment, it is of particular interest to evaluate how well workers with health problems cope with demands at work. It has been well documented that poor health is an important predictor of productivity loss at work, sickness absence, decreased work ability, and exit from work [15–19]. Surprisingly, less is known about how the interplay between work demands and perceived health problems may influence health care use. Several studies have shown that a decreased work ability, defined as a person's physical and mental ability to cope with the demands of work [20], is associated with increased sickness absence (RR 3.58), productivity loss at work (OR 4.08–5.54), and disability pension (OR 34.16) [19, 21–23]. Previous research has also suggested an association between adverse physical and psychosocial work-related factors and higher health care use among people with MSD [24, 25]. Similarly, in the general working population, psychosocial risk factors at work were found to prompt visiting a general practitioner (GP) or specialist [26].

Although some studies have identified the influence of work-related risk factors for increased health care use, the importance of work impairments due to health problems and the work ability on health care use have barely been studied. While previous studies often focused on health care use for one particular disease, this study incorporated workers with three common disorders (physical as well as mental) which account for a substantial proportion of health care expenditures.

This present study aims to investigate the association of work impairments and work ability with health care use among workers with MSD, CVD, and MD.

METHODS

Study Sample and Data Collection

The study population consisted of workers from 12 health care organizations in Limburg, the Netherlands. These organizations comprised a hospital (n = 1), a nursing home (n = 1), homes for physically or mentally handicapped persons (n = 4), mental health care organizations (n = 4), a home care organization (n = 1), and a maternal care organization (n = 1). These organizations had commissioned an occupational health organization to launch a program to investigate the sustainable employability of their workforce. As part of this program, an online questionnaire survey was conducted on health, health care use, work ability, and work impairments. Each participant was notified at the start of the questionnaire that the information would be used for scientific purposes and that filling out the questionnaire was considered as informed consent. It was ensured by the

occupational health organization that all potentially identifying information, such as names of workers, company or department, was removed from their database before data transfer to Erasmus MC, who guaranteed strict confidentiality of individual, non-coded information. This procedure is in agreement with the Dutch Code of Conduct for health research [27].

All workers from the participating organizations (n = 9,516) were invited by the occupational health organization by regular mail or email, which provided workers with an individualized password, to fill out the questionnaire on a secure website. Data collection took place between September 2011 and July 2012. The response ranged from 39 to 95% across organizations. Total response was 55% (n = 5,217), nine workers were excluded from the analysis because of incomplete data. Thus, complete data on health care use, work impairments, work ability, lifestyle, and individual characteristics were available for 5,208 workers.

In the questionnaire each respondent indicated on a list of 13 disorders (accident, MSD, CVD respiratory disorder, MD neurological disorder, genitourinary disorder, endocrine disorder, skin disorder, tumors, digestive system disorder, blood disorder, heritable disorder) whether they had a disorder that was diagnosed by a physician. In the current study we selected the two disorders with the highest prevalence (MSD with 2,074 cases and CVD with 714 cases) and one disorder with a moderate prevalence but high health care use (MD with 443 cases).This selection covers 3 out of 4 chronic diseases with the highest burden of disease [28]. Some respondents had a combination of these disorders and they were considered in multiple categories.

Measures

Individual Characteristics, Health, and Lifestyle-Related Factors

Information on gender, age, and education was collected. Age in years was categorized into four groups < 30, 30–40, 40–50, and ≥ 50 years. Education was assessed by the highest degree obtained and classified into three groups, i.e. high (higher vocational schooling or university), intermediate (higher secondary schooling or intermediate vocational schooling), and low (primary school, lower and intermediate secondary schooling, or lower vocational schooling).

The presence of disorders was assessed with the third question of the work ability index (WAI) [20]. This question is a limitative list of 13 broad categories of currently present diseases, diagnosed by a physician, with dichotomous answers. This list of self-reported diagnosed disorders was used to select workers with MSD, CVD or MD, as well as to assess multimorbidity. Multimorbidity was considered present when a worker reported more than one disorder. Information on smoking, physical activity, and body mass index (BMI) was collected. Smoking was assessed using one question ‘Doe you smoke?’ (yes/no). Leisure-time physical activity was assessed on the basis of one question in workers wore daily physically active for at least 30 min during leisure-time (yes/no). Self-reported height in meters and weight in kilograms were assessed and were used to calculate BMI (kg/m2). Three BMI categories were defined: normal (BMI < 25 kg/m2), overweight (BMI between 25 and 30 kg/m2), and obese (BMI ≥ 30 kg/m2) [29].

Impairments and Work Ability

Work impairments were measured using the fourth question of the WAI list [20]. This question addressed current functional limitations due to health problems, based on an ordinal scale. Answers were classified into three categories: no impairments (no impairments or no disorders, diseases or complaints); moderate impairments (able to perform one's job, but with some impairments or sometimes have to adjust working pace or the way of working); and severe impairments (individuals have often adjusted work pace and activities, or are capable only of part-time work, or are unable to work at all).

Work ability was measured with the first question of the WAI [20]. This question rated a worker's current work ability relative to the best work ability during their life on a 11-point scale ranging from zero (unable to work) tot ten (current work ability equals best work ability ever). Lower work ability was used as a continuous variable, expressed by the decrease in work ability relative to the maximum score of ten.

Health Care Use

Self-reported information on consulting a health care provider in the previous 12 months was measured. Six dichotomous variables (yes/no) indicated whether a GP, specialist, physical therapist, psychologist, psychiatrist, or other health care provider had been consulted during the past 12 months. Due to similarities in underlying health problems, visiting a psychologist and psychiatrist were merged into one group. The group of 'other health care providers' was left out due to the large variety in health providers, like dentist or gynecologist, which were not considered relevant for the current study. The questions on health care use referred to health problems in general and were not specific for distinguished common disorders.

Analysis

For the main variables, descriptive statistics were generated, i.e. frequencies and percentages for dichotomous and categorical variables, and means and standard deviations for continuous variables. Logistic regression analyses were used to estimate among workers with specific disorders the associations between work impairments and lower work ability with health care use (consulting a GP, specialist, physical therapist, and psychologist or psychiatrist). Type of care was not mutually exclusive. All multivariate analyses were adjusted for individual characteristics (gender, age, and education level), multimorbidity, and lifestyle- related factors (smoking, physical activity, and BMI). The odds ratios (OR) with corresponding 95% confidence intervals (95%CI) were calculated as the measure of association. A *p* value below 0.05 was considered statistically significant. All analyses were conducted with the Statistical Package for Social Sciences (SPSS) version 20.0 for Windows (IBM Software, Chicago).

RESULTS

The characteristics of the respondents with MSD, CVD, and MD are presented in Table 1. The majority of the total study population (n = 5,208) was female (80%) and age ranged from 17 to 66 years, with a mean of 43.2 years (± 11.4 years). Men (response 53%) and women (response 55%) were equally likely to fill in the questionnaire. Workers younger than 20 years of age (response 30%) were less likely to fill in the questionnaire than older workers (response 55%). Forty per cent of the workers had MSD, 14% CVD, and 9% MD. Severe work impairments were present in 11 % of workers and 36% had moderate impairments. Work ability was reduced on average by 2.1 points (±1.6). There was a moderate association between work impairments and work ability (Pearson r 0.38). Some workers had a combination of the three disorders of interest (MSD, CVD, MD), the overlap in this study between these disorders is shown in Figure 1. Multimorbidity with other disorders than MSD, CVD, or MD was also possible. Overall, multimorbidity was present in 69% of those with MSD, 75% of those with CVD, and 85% of those with MD. Figure 2 shows that the GP was the most consulted health care provider in the previous 12 months, with 75% among workers with MSD, 76% of those with CVD, and 82% of those with MD. Health care use of all providers was significantly different between the three disorders.

Determinants of Health Care Use

Musculoskeletal Disorder

Both work impairments and work ability were associated with consultation of any health care provider. The univariate analyses showed that workers with a lower work ability were more likely to consult a health care provider than workers with excellent work ability [ORs per 10% lower work ability ranged between 1.12 (95%CI 1.06–1.18) for physical therapist and 1.37 (95%CI 1.27–1.48) for psychologist/psychiatrist (data not shown)]. In the multivariate analyses including both work impairments and work ability and all potential confounders (individual characteristics, multimorbidity, and lifestyle- related factors) the strength of the association between work ability and health care use reduced slightly, ranging between 2% decrease for psychologist/psychiatrist (OR 1.37–OR 1.35) and 8% decrease for visiting a specialist (OR 1.20–OR 1.10). All associations remained statistically significant for all health care providers, except for physical therapists (OR 1.05, 95%CI 0.99–1.12) (Table 2). Workers with moderate or severe work impairments were statistically significantly more likely to consult a GP, specialist, or physical therapist than workers who experienced no impairments (Table 2). A statistically significant trend was observed for increasing severity of work impairments and a higher likelihood to consult a specialist or physical therapist.

Cardiovascular Disorder

Both work impairments and lower work ability were associated with a higher likelihood of consulting a health care provider. Lower work ability was associated with a higher likelihood of consulting all health care providers in the univariate analyses [ORs per 10% decrease in work ability ranging between 1.23 (95%CI 1.11–1.36) for specialists and 1.51 (95%CI 1.30–1.74) for psychologists (data not shown)]. In the multivariate analyses, the

strength of the association between work ability and health care use reduced, ranging between 4% decrease for visiting a GP (OR 1.28–OR 1.23) and 13% decrease for visiting a physical therapist (OR 1.24–OR 1.08). The associations between work impairments, work ability, and consulting a GP or a psychologist, remained statistically significant in the multivariate analysis (Table 2). Workers with severe work impairments were more likely to consult a specialist (OR 1.94, 95%CI 1.17–3.22) or physical therapist (OR 2.73, 95%CI 1.58–4.70) than workers without work impairments (Table 2).

Table 1. Population characteristics of health care workers with MSD, CVD, and MD from 12 Dutch organizations

	MSD (n=2,074) n (%)	**CVD** (n=714) n (%)	**MD** (n=443) n (%)
Individual characteristics			
Age			
< 30 years	239 (11.5)	21 (2.9)	59 (13.3)
30-40 years	361 (17.4)	59 (8.3)	89 (20.1)
40-50 years	574 (27.7)	177 (24.8)	115 (26.0)
≥ 50 years	900 (43.4)	457 (64.0)	180 (40.6)
Gender, female	1694 (81.7)	517 (72.4)	348 (78.6)
Education			
Low	245 (11.8)	118 (16.5)	49 (11.1)
Intermediate	1,164 (56.1)	333 (46.6)	243 (54.9)
High	665 (32.1)	263 (36.8)	151 (34.1)
Work-related factors			
Work impairments			
No	517 (24.9)	262 (36.7)	83 (18.7)
Moderate	1,151 (55.5)	322 (45.1)	219 (49.4)
Severe	406 (19.6)	130 (18.2)	141 (31.8)
Reduced work ability[a], mean (sd)	2.5 (1.7)	2.3 (1.5)	3.4 (2.0)
Multimorbidity			
More than one disorder diagnosed	1,428 (68.9)	534 (74.8)	378 (85.3)
Lifestyle			
Current smoker	483 (23.3)	137 (19.2)	127 (28.7)
Insufficient physical activity in leisure time	710 (34.2)	240 (33.6)	157 (35.4)
BMI			
Normal weight	1,032 (49.8)	254 (35.6)	222 (50.1)
Overweight	737 (35.5)	305 (42.7)	145 (32.7)
Obese	305 (14.7)	155 (21.7)	76 (17.2)

[a] range 0-10, zero work ability in the best period, ten not able to work at al. MSD musculoskeletal disorder, CVD cardiovascular disorder, MD mental disorder, n number of workers, sd standard deviation, BMI body mass index

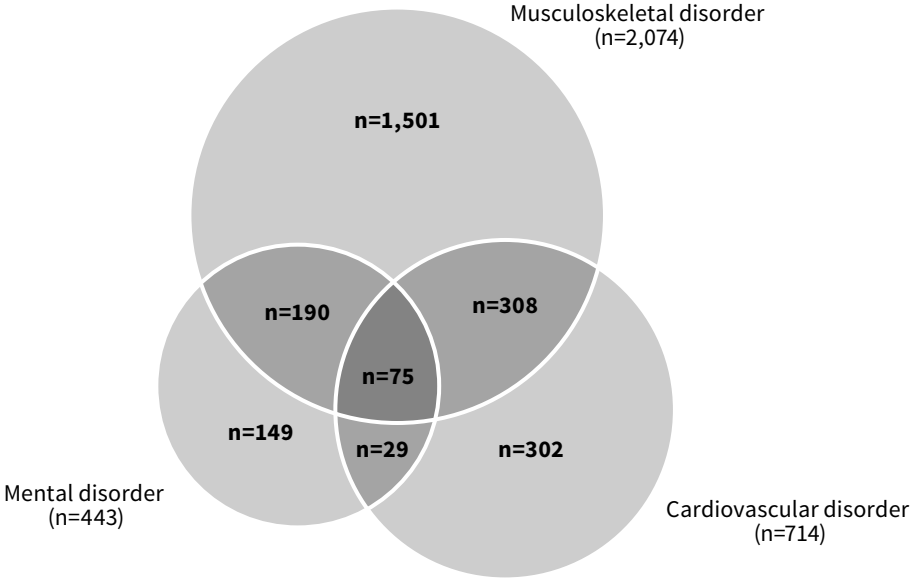


Figure 1. Venn diagram for the overlap between MSD, CVD and MD within health care workers from 12 Dutch organizations.

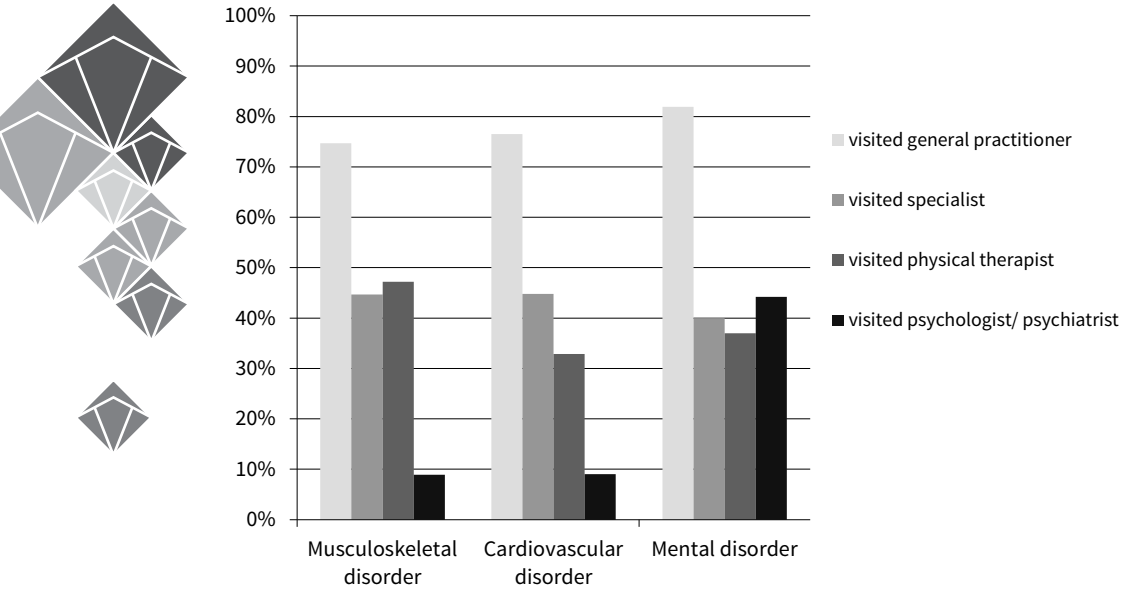


Figure 2. Prevalence of health care use (GP, specialist, physical therapist, and psychologist/psychiatrist) among health care workers with MSD (n=2,074), CVD (n=714), and MD (n=443), from 12 Dutch organizations.

Mental Disorder

Both work impairments and work ability were associated with a higher likelihood of consulting a health care provider. Workers with a lower work ability were statistically significantly more likely to consult a GP, physical therapist, and psychologist than workers with excellent work ability [OR per 10% decrease in work ability ranging from 1.13 (9 %CI 1.03–1.25) for physical therapists and 1.22 (95%CI 1.06–1.40) for GPs (data not shown)]. In the multivariate analyses, adjustment for confounders changed associations between work ability and health care use with less than 5%. Similar patterns were observed in the multivariate and univariate analyses for the associations between work impairments and consultation of a health care provider (Table 2). Although not statistically significant at $p < 0.05$, the associations between severe work impairments and visiting a specialist (OR 1.79, 95%CI 0.92–3.48) or a psychologist (OR 1.82, 95%CI 0.93–3.54) indicated that workers with severe work impairments were more likely to consult a specialist or a psychologist than workers without impairments (Table 2).

Table 2. Multivariate logistic regression analyses with OR and 95% confidence intervals for work impairments, lower work ability and health care use among health care workers with MSD, CVD, or MD, from 12 Dutch organizations.

	GP OR (95% CI)[b]	Specialist OR (95% CI)[b]	Physiotherapist OR (95% CI)[b]	Psychologist OR (95% CI)[b]
MSD (n=2,074)				
Work impairments	1	1	1	1
no	1.64 (1.29-2.08)*	1.19 (0.94-1.49)	1.33 (1.07-1.66)*	1.32 (0.84-2.09)
moderate	1.55 (1.09-2.21)*	2.05 (1.50-2.80)*	1.98 (1.46-2.68)*	1.34 (0.76-2.37)
severe				
Lower work ability[a]	1.10 (1.02-1.18)*	1.10 (1.04-1.17)*	1.05 (0.99-1.12)†	1.35 (1.23-1.47)*
CVD (n=714)				
Work impairments	1	1	1	1
no	1.23 (0.80-1.90)	1.52 (1.04-2.23)*	2.16 (1.41-3.32)*	1.76 (0.79-3.93)
moderate	0.89 (0.50-1.60)	1.94 (1.17-3.22)*	2.73 (1.58-4.70)*	1.61 (0.62-4.22)
severe				
Lower work ability[a]	1.23 (1.06-1.42)*	1.11 (0.99-1.25)†	1.08 (0.96-1.21)	1.45 (1.22-1.72)*
MD (n=443)				
Work impairments	1	1	1	1
no	1.55 (0.80-3.02)	1.25 (0.69-2.25)	1.45 (0.78-2.67)	1.55 (0.86-2.78)
moderate	0.98 (0.46-2.07)	1.79 (0.92-3.48)†	1.55 (0.78-3.07)	1.82 (0.93-3.54)†
severe				
Lower work ability[a]	1.23 (1.06-1.43)*	0.99 (0.89-1.11)	1.11 (1.00-1.24)†	1.13 (1.01-1.26)*

*[a] range 0/10, zero work ability in the best period, ten unable to work at all. [b] adjusted for individual factors (age, gender, education), mulimorbidity, and lifestyle related factors (smoking, physical activity, BMI). * p value < 0.05. † p value < 0.10. GP general practitioner, OR odds ratio, 95%CI 95% confidence interval, n number of workers, MSD musculoskeletal disorder, CVD cardiovascular disorder, MD mental disorder.*

DISCUSSION

Work impairments were associated with health care use among health care workers with MSD, CVD, or MD. Similarly, workers with lower work ability were more likely to consult a GP, a specialist, a physiotherapist, and a psychologist. Despite the moderate correlation between work impairments and work ability, the results of the current study suggest that a lower work ability as well as perceived impairments at work might be a prompt for workers to seek health care.

Health Care Use Among Workers with MSD, CVD, and MD

Health care use seemed relatively high in comparison with other studies. Among workers with MSD, almost 75% visited a GP, 45% a specialist, and 48% a physical therapist in the past 12 months. However, one has to bear in mind that the health care use was not limited to care seeking for a specific disorder. The method of population attributable fraction may be used to attribute health care use to the presence of a specific disorder, based on the prevalence of the specific disorder and the likelihood of health care use among workers with that disorder relative to workers without that disorder [30]. We observed proportions in line with other studies. For example, Molano et al. [31] found that 44% of scaffolders with low back pain visited a GP. This is comparable with the population attributable fraction of 42% in our study population. Similarly, Ikonen et al. [32] found that 46% of male workers, and 51% of female workers with physician-diagnosed MSD visited an occupational health physician. As for MD, our finding that 44% visited a psychologist or psychiatrist was also relatively high when compared with previous studies [33, 34]. They reported that 21–25% of the individuals with a psychiatric disorder reported the use of mental health services [33, 34], which is almost twice as low as what we found. On the other hand, the same studies found that 83–91% of these subjects visited a primary care physician, which is in line with our finding that 82% visited a GP. The relative high numbers of health care use in our study population may be explained by the fact that our population consisted of workers in the health care sector, hence, they likely know how to access health care better than workers from other sectors. More than half of our study population had an intermediate education level, indicating that the majority of our sample probably consists of nursing personnel, and assisting personnel (e.g. receptionists, administrative workers), rather than physicians. Only limited evidence is present about health care use among nursing personnel. One study found that nurses use health care less often than the general population [35]. Information about health care use of other workers within the health care sector is lacking.

The GP was the most commonly visited health care provider in this study. This is due to the fact that the GP serves as gate keeper in the Dutch health care system. Hence, the GP is often the first health care provider to be consulted by individuals before having access to other services like specialist care. In the Netherlands, the physical therapist and psychologist can be visited without referral of the GP. However, their services are not always fully covered by the health insurance, unlike the GP visits [36]. Therefore, individuals may be less likely to consult these health providers compared with a GP.

Work Impairments Among Workers with MSD, CVD, and MD

A large part of the respondents with MSD, CVD, and MD had moderate or severe work impairments (75.1, 63.3, and 81.3% respectively). A recent study among employees from a large Dutch railway company reported among workers with musculoskeletal complaints about 50% experienced work impairments due to these complaints [37]. Comparable results were reported for persons with heart disease (48%), major depression (45%), and generalized anxiety disorder (54%) [38]. The higher occurrence of impairments in our study population is due to the fact that we could not distinguish between impairments due to a specific disorder and impairments due to the considerable multimorbidity that was adjusted for in the analysis. Since mutual adjustment of MSD, CVD, and MD did not change the results presented in Table 2, the influence of work impairments is not limited to those workers who had a combination of MSD, CVD, and MD.

Previous studies showed that sickness absence [39] and productivity loss at work [19] was also relatively common in people with MSD, CVD, or MD. Leijten et al. [39] reported that among workers with MD about 70% had at least 1 day of sickness absence in the previous year, and among workers with MSD and CVD these figures were 55 and 52%, respectively.

Work Impairments, Work Ability, and Health Care Use

Earlier studies have shown that a reduced WAI predicts disability benefit [22], reduced work productivity, and sickness absence [21, 23]. In the current study a reduced work ability was also associated with health care use.

Several recently published studies also explored the association between work ability in the general workforce (i.e. not within workers with specific disorders) and health care use. A longitudinal study from Germany [40] and two Scandinavian studies [32, 41] observed an association between a poor work ability as measured with the WAI and health care use. A limitation of these studies is that the measure of work ability, the WAI, includes several questions on presence of health problems and experienced functional limitations, which in itself may explain health care use [7–9]. In the present study the concept of work ability was measured by a single question, independent from health status. Our results showed that a lower work ability was associated with an increased likelihood of health care use. The OR for the associations between work ability and health care use were presented per 10% lower work ability score in this study. Hence, for example when work ability is strongly reduced to a score of five (instead of the maximum of ten) the OR for visiting a psychologist among respondents with CVD accumulates from 1.45 to 6.36 and indicates a substantially increased likelihood of consulting a health care provider.

Among workers with common disorders the perceived impairments while performing their regular activities at work prompted seeking health care. For most disorders the severity of impairments did seem to increase health care use, but only for MSD a statistically significant trend was observed for degree of severity and likelihood of having visited a specialist or physiotherapist. Thus, although our study population contained many workers with common disorders, the study lacked some power to disentangle determinants of specific referral patterns.

Work Impairment, Work Ability, and Health Care Use in MSD, CVD, and MD

To our knowledge this is one of the first studies exploring the association between work impairments, work ability, and health care use within specific disorder groups. For mental as well as physical disorders, workers with work impairments and workers with a lower work ability were more likely to visit a health care professional. These results suggest that focusing on work impairments and keeping good work ability may be important for future interventions to reduce the need for health care use among workers with common mental or physical disorders.

Strength and Limitations

A strength of the present study is the large study population. However, some limitations need to be addressed. Firstly, we had no information on severity of MSD, CVD, and MD and therefore it could not be established how disease severity could have influenced the observed associations between work impairments and health care use. Several studies have shown that severity of disease is associated with work impairments [42, 43] and, thus, it may be hypothesized that both disease severity and impairments may prompt health care use. It may even be considered that work impairments partly mediates the association between disease severity and health care use. In these explanations both disease severity and work impairments are targets for intervention, whereby the exact interplay between disease severity, work impairments, and work conditions will guide the actual content of effective interventions in occupational groups. Secondly, the cross-sectional design does not permit the establishment of causal relationships. However, the findings suggest that attention for chronic health problems as well as attention for impairments at work due to these health problems is likely to be relevant. Thirdly, results of this study were based on dichotomous data of consulting a health provider and frequency of use was not taken into account due to lack of precise information on frequency of health care use. Consequently, we were also unable to make statements about subsequent health care expenditures. Fourthly, health care use, work impairments, and work ability were all selfreported and thus vulnerable to recall bias [44, 45]. However, self-reported work ability is a widely used measure in the field of occupational health and it has shown to be a predictor for long-term sick leave, productivity loss, and disability benefit [21–23]. Lastly, the group ‘other health provider’ was left out of this study. Some respondents indicated that they had visited a specialist, such as dermatologist, gynecologist, or rheumatologist. In a sensitivity analysis we included these care providers in the category ‘specialist’, but the results changed very little due to a low frequency of care seeking.

Since the study population consisted of a selective group of workers with a paid job in the health care sector, results may differ in other sectors. Around 80% of the study population was female, which is representative for workers in the health care sector [46, 47].

CONCLUSION

Work impairments and reduced work ability were associated with health care use among health care workers with MSD, CVD, or MD. These findings suggest that addressing work-related problems in workers with common disorders may contribute in reducing health care needs.

REFERENCES

1. American Diabetes Association. Economic costs of diabetes in the U.S. in 2012. Diabetes Care. 2013;36(4):1033–46.
2. Organisation for Economic Co-operation and Development. Total expenditure on health. Health: key tables from OECD, No. 1; 2012. doi:10.1787/hlthxp-total-table-2012-2-en.
3. Berenschot L, van der Geest L. Integrale zorg in de buurt. Meer gezondheidsresultaat per euro. Utrecht: NYFER; 2012.
4. Slobbe LCJ, Smit JM, Groen J, Poos MJJC, Kommer GJ. Trends in kosten van ziekten in Nederland 1999–2010: Kosten per diagnose; 2011. http://www.kostenvanziekten.nl/systeem /kosten-van-ziekten-tool/Default.aspx?ref=kvz_v2l1b1p4r3c0i0t1j0o6y4a-1g0d254s54z0f0w2. Accessed 12 Apr 2013.
5. Slobbe LCJ, Smit JM, Groen J, Poos MJJC, Kommer GJ. Trends in kosten van ziekten in Nederland 1999–2010: Kosten voor psychische stoornissen; 2011. http://www.kostenvanziekten.nl/systeem/kosten-van-ziekten-tool/Default.aspx?ref=kvz_v2l1b1p4r3c0i0t1j0o6y4a-1g0d205s54 z0f0w2. Accessed 12 Apr 2013.
6. Slobbe LCJ, Smit JM, Groen J, Poos MJJC, Kommer GJ. Trends in kosten van ziekten in Nederland 1999–2010: Totale kosten; 2011. http://www.kostenvanziekten.nl/systeem/kosten-van-ziek ten-tool/Default.aspx?ref=kvz_v2l1b1p4r0c0i0t1j0o6y4a-1g0d254s54z0f0w2. Accessed 12 Apr 2013.
7. Dugan JMA, Virani SS, Ho V. Medicare eligibility and physician utilization among adults with coronary heart disease and stroke. Med Care. 2012;50(6):547–53.
8. Gulley SP, Rasch EK, Chan L. If we build it, who will come?: Working-age adults with chronic health care needs and the medical home. Med Care. 2011;49(2):149–55.
9. de Meijer CAM, Koopmanschap MA, Koolman XHE, van Doorslaer EKA. The role of disability in explaining long-term care utilization. Med Care. 2009;47(11):1156–63.
10. Polder JJ, Bonneux L, Meerding WJ, van der Maas PJ. Age- specific increases in health care costs. Eur J Public Health. 2002;12(1):57–62.
11. Wang PS, Lane M, Olfson M, Pincus HA, Wells KB, Kessler RC. Twelve-month use of mental health services in the United States: results from the national comorbidity survey replication. Arch Gen Psychiatry. 2005;62(6):629–40.
12. Orszag PR, Ellis P. The challenge of rising health care costs—A view from the congressional budget office. N Engl J Med. 2007;357(18):1793–5.
13. Fonseca VR, Nobre MRC, Pronk NP, Santos LA. The association between physical activity, productivity, and health care utilization among employees in brazil. J Occup Environ Med. 2010;52(7):706–12.

14. Goetzel RZ, Anderson DR, Whitmer RW, Ozminkowski RJ, Dunn RL, Wasserman J, et al. The relationship between modifi- able health risks and health care expenditures. An analysis of the multi-employer HERO health risk and cost database. J Occup Environ Med. 1998;40(10):84354.

15. van den Berg TIJ, Alavinia SM, Bredt FJ, Lindeboom D, Elders LAM, Burdorf A. The influence of psychosocial factors at work and life style on health and work ability among professional workers. Int Arch Occup Environ Health. 2008;81(8):1029–36.

16. Labriola M, Lund T, Burr H. Prospective study of physical and psychosocial risk factors for sickness absence. Occup Med. 2006;56(7):469–74.

17. Schuring M, Robroek SJW, Otten FW, Arts CH, Burdorf A. The effect of ill health and socioeconomic status on labor force exit and re-employment: a prospective study with ten years follow-up in the Netherlands. Scand J Work Environ Health. 2013;39(2): 134–43.

18. Robroek SJW, Schuring M, Croezen S, Stattin M, Burdorf A. Poor health, unhealthy behaviors, and unfavorable work characteristics influence pathways of exit from paid employment among older workers in Europe: a four year follow-up study. Scand J Work Environ Health. 2013;39(2):125–33.

19. Alavinia SM, Molenaar D, Burdorf A. Productivity loss in the workforce: associations with health, work demands, and individual characteristics. Am J Ind Med. 2009;52(1):49–56.

20. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work ability index. 2nd ed. Helsinki: Finnish Institute of Occupational Health; 1998.

21. Alavinia SM, van den Berg TIJ, van Duivenbooden C, Elders LAM, 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.

22. Alavinia SM, de Boer AGEM, van Duivenbooden JC, Frings-Dresen MHW, Burdorf A. Determinants of work ability and its predictive value for disability. Occup Med. 2009;59(1):327.

23. van den Berg T, Robroek S, Plat J, Koopmanschap M, Burdorf A. The importance of job control for workers with decreased work ability to remain productive at work. Int Arch Occup Environ Health. 2011;84(6):705–12.

24. Josephson MSG, Vingard E. Workplace factors and care seeking for low-back pain among female nursing personnel. Scand J Work Environ Health. 1998;24(6):465–72.

25. Vingard E, Alfredsson L, Hagberg M, Kilbom A, Theorell T, Waldenstrom M. To what extent do current and past physical and psychosocial occupational factors explain care-seeking for low back pain in a working population? Results from the musculoskeletal intervention center-Norrtalje study. Spine (Phila Pa 1976). 2000;25(4):493–500.

26. Azagba S, Sharaf M. Psychosocial working conditions and the utilization of health care services. BMC Public Health. 2011;11(1):642.

27. Federation of Biomedical Scientific Societies. Code of conduct for use of data in health research; 2004. http://www.federa.org/ sites/default/files/bijlagen/coreon/ code_of_conduct_for_ medical_ research_1.pdf. Accessed 20 Apr 2013.

28. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis for the global burden of disease study 2010. Lancet. 2012;380(9859): 2163–96.

29. World Health Organization Europe. Body mass index—BMI; 2013. www.euro.who. int/en/what-we-do/health-topics/disease-prevention/ nutrition/a-healthy-lifestyle/ body-mass-index-bmi. Accessed 19 Apr 2013.

30. Flegal KM, Graubard BI, Williamson DF. Methods of calculating deaths attributable to obesity. Am J Epidemiol. 2004;160(4): 331–8.

31. Molano SM, Burdorf A, Elders LAM. Factors associated with medical care-seeking due to low-back pain in scaffolders. Am J Ind Med. 2001;40(3):275–81.

32. Ikonen A, Rasanen K, Manninen P, Raurio M, Husman P, Ojajärvi A, et al. Use of health services by Finnish employees in regard to health-related factors: the population-based health 2000 study. Int Arch Occup Environ Health. 2013;86(4):451–62.

33. Wang J, Langille DB, Patten SB. Mental health services received by depressed persons who visited general practitioners and family doctors. Psychiatr Serv. 2003;54(6):878–83.

34. Parikh SV, Lin E, Lesage AD. Mental health treatment in Ontario: selected comparisons between the primary care and specialty sectors. Can J Psychiatry. 1997;42(9):929–34.

35. Lindo JLM, LaGrenade J, McCaw-Binns A, Eldemire-Shearer D. Health status and health maintenance practices among doctors and nurses at two hospitals in Jamaica. West Indian Med J. 2009;58(6):539–45.

36. Enthoven AC, van de Ven WPMM. Going Dutch—managed competition health insurance in the Netherlands. N Engl J Med. 2007;357(24):2421–3.

37. Zoer I, Frings-Dresen MHW, Sluiter JK. Are musculoskeletal complaints, related work impairment and desirable adjustments in work age-specific? Int Arch Occup Environ Health. 2014;87(6)647-54.

38. Kessler RC, Greenberg PE, Mickelson KD, Meneades LM, Wang PS. The effects of chronic medical conditions on work loss and work cutback. J Occup Environ Med. 2001;43(3):218–25.

39. Leijten FRM, van den Heuvel SG, Ybema JF, Robroek SJW, Burdorf A. Do work factors modify the association between chronic health problems and sickness absence among older employees? Scand J Work Environ Health. 2013;39(5):477–85.

40. Bethge M, Radoschewski FM, Gutenbrunner C. The work ability index as a screening tool to identify the need for rehabilitation: longitudinal findings from the second German sociomedical panel of employees. J Rehabil Med. 2012;44(11)980-7.

41. Lamminpaa A, Kuoppala J, Vaaranen-Tomppo I, Hinkka K. Employee and work-related predictors for entering rehabilitation: a cohort study of civil servants. J Rehabil Med. 2012;44(8): 669–76.

42. Lerner D, Adler DA, Rogers WH, Chang H, Lapitsky L, McLaughlin T, et al. Work performance of employees with depression: the impact of work stressors. Am J Health Promot. 2010;24(3):205–13.

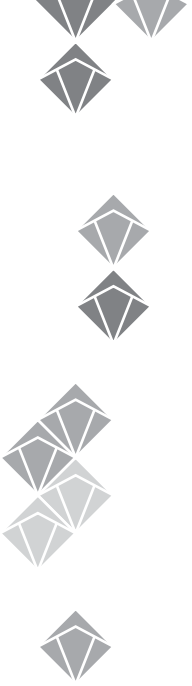
43. Von Korff M, Katon W, Lin EHB, Simon G, Ciechanowski P, Ludman E, et al. Work disability among individuals with diabetes. Diabetes Care. 2005;28(6):1326–32.

44. Drapeau A, Boyer R, Diallo F. Discrepancies between survey and administrative data on the use of mental health services in the general population: findings from a study conducted in Quebec. BMC Public Health. 2011;11(1):837.

45. Short ME, Goetzel RZ, Pei X, Tabrizi MJ, Ozminkowski RJ, Gibson TB, et al. How accurate are self-reports? Analysis of self- reported health care utilization and absence when compared with administrative data. J Occup Environ Med. 2009;51(7):786–96.

46. Luime JJ, Koes BW, Miedem HS, Verhaar JAN, Burdorf A. High incidence and recurrence of shoulder and neck pain in nursing home employees was demonstrated during a 2-year follow-up. J Clin Epidemiol. 2005;58(4):407–13.

47. Trinkoff AM, Lipscomb JA, Geiger-Brown J, Brady B. Musculoskeletal problems of the neck, shoulder, and back and functional consequences in nurses. Am J Ind Med. 2002;41(3):170–8.



chapter 7

GENERAL DISCUSSION

RATIONALE FOR OBJECTIVES

The social security systems in Western countries are put under pressure by an ageing population due to decreasing birth rates and increased longevity. Recently, many governments in developed countries have introduced policies to increase the proportion of older workers in paid employment. In order to prevent premature exit from work there is increasing attention for sustainable employability. Several factors that influence sustained employment have been identified in previous studies. For example, individual factors such as age, education, health, and lifestyle related factors, but also psychosocial and physical work related factors, financial arrangements and government policies play a role (e.g. [1-6]). However, why and how these factors are involved in specific exit routes out of paid employment remains largely unknown. Furthermore, although lifestyle related factors are well established risk factors for productivity loss at work, sickness absence and reduced work ability [1, 3], there is less insight into the particular role of these factors on leaving the workforce via different routes. Poor health has been identified as a factor involved in labour force exit [7], but most studies have focused on a single exit route rather than multiple exit routes [8-10] or did a stratified analysis comparing workers within each separate exit route with those who remained in paid employment [11, 12]. This may influence the results, since exit routes are to some extent competing processes. This leads to the first objective of this thesis:

> To study determinants of exit from paid employment via disability, unemployment, and early retirement.

When aiming to contribute to the development of interventions targeted at enhancing sustained employment, it is not only of interest to study the determinants and consequences of decreased sustainable employability, but also to pay attention to identifying workers at risk. Several studies have suggested that the work ability index (WAI) [13] could be used as a predictive tool to identify workers at high risk of long-term sickness absence or disability benefit since a poor or moderate work ability score is strongly associated with sickness absence [14, 15]. However, these associations do not provide insight into how well the WAI discriminates between workers with and without future sickness absence. This leads to the second objective of this thesis:

> To explore the predictive value of work ability to identify persons at high risk of long-term sickness absence.

Apart from rising costs for social benefits and pensions, increasing health care use and subsequent costs also put the social security system under pressure in Western countries [16, 17]. Therefore, we were interested whether sustained employment was a factor involved in health care use. Since the majority of adults are engaged in paid employment, it is of particular interest to evaluate how the interplay between work demands and perceived health problems may influence health care use. This leads to the third objective of this thesis:

To determine the consequences of decreased work ability on health care use.

In this chapter the main objectives will be answered based on the studies in this thesis. Thereafter, methodological considerations will be discussed followed by the interpretation of the findings. This chapter concludes with recommendations for future research, policy and practice.

MAIN FINDINGS

Objective 1: To study determinants of exit from paid employment via disability, unemployment, and early retirement.

The complex character of exit from paid employment has been demonstrated by the fact that multiple factors have been identified in this thesis, that influence labour force exit (chapter 2-4). Self-rated health, lifestyle-related related factors, but also work-related factors, competences, work-life balance, and financial factors played a role in displacement from work. The relative importance of the determinants differed by exit pathway. Health, for example, was a stronger determinant for exit through involuntary routes of disability benefit and unemployment, as compared to the more voluntary route of early retirement. We even observed a slightly higher percentage of workers with good health leaving the workforce via early retirement than workers with poor health (chapter 4).

In chapter 2 the focus was on non-health related determinants of early retirement among older workers. This qualitative study revealed that a combination of push and pull factors and financial opportunities played a role in the process towards early retirement. The specific mix of factors involved differed between individuals. Push factors towards early retirement included organisational changes (e.g. restructuring, or continuous changes in work protocols), conflicts at work, high work pressure, high physical job demands, and dissatisfaction with the limited use of one's skills and knowledge. These factors seemed to influence the decision to retire early through reduced motivation, ability and opportunity to continue working. For example, a physical demanding job was reported to decrease the ability to continue working until the official retirement age, whereas insufficient use of skills and knowledge decreased the motivation to stay in the workforce. Workers who felt unable to find a new job due to their age experienced a reduced opportunity to continue working. Pull factors towards early retirement were more often related to social life and included the wish to do other things outside of work, to enjoy life, have more flexibility, spend more time with the spouse or close relatives or friends, and provide care to others. As these wishes gained importance, respondents became less motivated to continue their working life. In all cases financial opportunities to retire early were essential in the final decision to leave the workforce via early retirement. However, among some individuals financial factors became important in the context of push and pull factors, whereas they played a more direct role among others. When ranking the relative importance of the

factors involved in early retirement, financial factors appeared to be most important and were often a precondition for early retirement.

The role of lifestyle related factors and poor health was studied in chapter 3 and 4. The synthesised literature about the role of overweight, obesity, and lack of physical activity on premature exit from the labour force (chapter 3) showed that obese workers (pooled RR 1.53; 95%CI 1.35-1.72), and to a lesser extent workers with overweight (pooled RR 1.16; 95%CI 1.08-1.24), had an increased likelihood of exit from paid employment through disability benefit. Also workers with a lack of physical activity were at a higher risk of disability benefit. Although the number of studies was low, limited physical activity was a risk factor of unemployment as well, but not of early retirement. A high BMI was neither a risk factor of unemployment nor of early retirement.

In concordance with the findings on lifestyle-related risk factors, workers with a poor self-rated health were at higher risk of disability benefit than workers with good self-rated health (SHR 3.22; 95% CI 2.30-4.51) (chapter 4). They also had an elevated risk of unemployment (SHR 1.32), but not of becoming economically inactive or leaving the workforce via early retirement. As described in the qualitative study (chapter 2), it is likely that other factors than health play a more dominant role in the mainly voluntary exit route of early retirement.

The study population used in chapter 4 allowed us to compare labour force exit among workers with poor health in three European regions (Bismarckian countries, Scandinavian countries, and Southern Europe). The main exit route in all regions was early retirement. However, in Scandinavian countries early retirement (29%) was less frequent than in Southern Europe (35%) and Bismarckian countries (45%). There were also some regional differences in the absolute risks of leaving the workforce via disability benefit. Among older workers with low education and in poor health, four per cent of the workers in Southern Europe left via disability benefit, while this was more than twice as high in Scandinavian and Bismarckian countries (10%) among comparable workers. Further, workers from Southern Europe had a somewhat lower chance to become unemployed when in poor health than workers from Bismarckian or Scandinavian countries.

Overall, these results show that multiple risk factors (e.g. individual characteristics, workrelated, lifestyle-related, country-related) determine the ability of older workers to remain in paid employment until older age.

Objective 2: To explore the predictive value of work ability to identify workers at high risk of long-term sickness absence.

Chapter 5 describes how well the WAI performed as a tool to identify workers at high risk for shorter and longer durations of sickness absence in a one year follow-up study. When using the traditional four categories of the WAI, there was a clear upward trend for lower WAI categories showing larger odds ratios for a greater number of sick days. For example, workers with poor/moderate work ability (OR 15.14; 95%CI 7.69-29.81), or good work ability (OR 4.12; 95%CI 2.77-6.14) had a higher likelihood on ≥ 15 sick days than workers with excellent work ability. The ability of the WAI to discriminate between workers with different durations of sickness absence was assessed by pairwise Area Under the Curves

(AUCs). The pairwise AUC compares each pair of categories using only those workers that belong to one of the two categories at hand [18]. Four categories of sickness absence (i.e. 0 days, 0 < days < 5, 5 ≤ days > 15, ≥ 15 days) were present, hence, six pairwise AUCs were estimated. Overall ability of the WAI to discriminate correctly between the four categories of sickness absence was represented by the ordinal cindex (ORC) and estimated as the average of six pairwise AUCs [19]. Overall, there was a 65% probability that the WAI correctly separates two workers with different sickness absence durations (ORC 0.65; 95%CI 0.63-0.68). However, the WAI could best discriminate between workers without sickness absence and workers with the longest duration of sickness absence (i.e. ≥ 15 days) (AUC 0.77).

At the WAI cut-off between poor and moderate work ability (score ≤ 27) the sensitivity was 7.5% for < 15 sick days vs. ≥ 15 sick days, indicating that 7.5% of the workers with ≥ 15 sick days were identified by their poor work ability score. On the other hand specificity was 99.6%, and the positive predictive value was 82%. The latter indicates that from all workers with a poor work ability score at baseline, 82% had ≥ 15 sick days at follow-up. These results suggest that the WAI could be used to identify workers at high risk for prolonged sickness absence. However, due to low sensitivity, most high risk workers will not be identified based on their WAI score. This severely hampers the applicability of the WAI as prognostic instrument for sickness absence. Additional factors to the WAI may improve the predictive ability and allows for better identification of workers at highest risk.

Objective 3: To determine the consequences of decreased work ability on health care use.

The cross-sectional study in chapter 6 describes clear associations between lower work ability and increased health care use. Similarly, workers who experienced impairments at work due to a health problem were more likely to consult a GP, specialist, physiotherapist, or psychologist. The study incorporated workers with three common disorders – musculoskeletal disorder (MSD), cardiovascular disorders (CVD), and mental disorder (MD) – which account for a substantial proportion of health care expenditures. Workers with MSD and a lower work ability had a higher chance to consult a health care providers than workers with MSD and better work ability (OR 1.05-1.35). As these odds ratios represent the increased likelihood on health care use per 10% lower work ability score, this likelihood can accumulate substantially when work ability is for example reduced by a score of 5 out of 10. Furthermore, workers with MSD who experienced moderate or severe impairments at work were more likely to visit a GP, specialist, or physiotherapist. Similarly, workers with CVD and MD were also more likely to visit a health care provider when experiencing lower work ability or impairments at work. The results of chapter 6 imply that lower work ability as well as perceived impairments at work often co-occur with seeking health care.

METHODOLOGICAL CONSIDERATIONS

Several methodological techniques have been used to answer the objectives of this thesis. These techniques all have their pros and cons which should be taken into account when interpreting the findings. In this part, the considerations of three pairs of opposite strategies in this thesis will be discussed: qualitative vs. quantitative research, association measures vs. prediction measures, and a cross-sectional study design vs. a longitudinal study design.

Qualitative vs. quantitative information on exit routes

Determinants of exit from paid employment were studied in both a qualitative (chapter 2) and quantitative (chapter 3 and 4) manner. In chapter 2, non-health related determinants of labour force exit through early retirement were identified in semi-structured interviews. Although qualitative research cannot quantify associations between the determinants and exit through early retirement, it is a very suitable method to gain detailed knowledge about how and why certain factors play a role in the retirement process at the individual level. The qualitative study shows for example the complex interplay between different push and pull factors whereby respondents mentioned that several factors simultaneously played a role in their decision to retire early. This complex interplay cannot easily be unravelled in the quantitative study since statistical interaction (i.e. synergy) requires a large study population and may indeed have a different interpretation than perceived by respondents. Additionally, due to the open character of the qualitative study, it allows respondents to come up with important factors that played a role in their retirement process that were not yet identified in the literature. Such as, that insufficient use of older workers' skills and knowledge could contribute to early retirement. This can be of particular interest in early phases of research, as it allows to identify potential determinants for labour force exit, which can be studied in further in quantitative studies. Quantitative studies are then useful to understand the relative importance of involved factors on the population level and thus in the development of interventions aiming to increase working life. Thus, combining qualitative and quantitative methods to unravel the process of labour force exit is essential to see the whole picture.

Association vs. prediction

Associations are determined at population level whereas prediction is more relevant at the individual level. Most studies in this thesis present associations to quantify the relation between a determinant and outcome (chapter 3 to 6). Although associations are informative, it is also of interest to quantify individual absolute risks on a certain outcome or to establish whether a determinant can be used for screening purposes. Chapter 5 does not only describe the association between decreased work ability and a higher risk of longer durations of sickness absence, but went a step further towards prediction of sickness absence based on WAI score.

Various studies have reported strong associations (ORs of 2.1 to 5.5) between decreased work ability and, especially long-term, sickness absence [4, 14, 15]. A few other studies looked at the predictive ability of the WAI for sickness absence [20, 21]. The WAI discriminated

correctly between workers with ≥ 15 sick days and workers without sick days in 77% of the cases in our study (AUC 0.77). Others reported similar AUCs in the discrimination between workers with ≥ 2 weeks of sickness absence and < 2 weeks of sickness absence (AUC 0.77-0.78) [20, 21]. Although this discriminative ability seems adequate, sensitivity at the cut-off of poor work ability (i.e. ≤ 27) was poor (0.075) when predicting sickness absence of more than 2 weeks. This makes the WAI a less suitable prognostic instrument when aiming to detect these durations of sickness absence. Thus, strong associations at population level do not necessarily translate directly to individual relevance.

Cross-sectional vs. longitudinal studies

A cross-sectional design was used to study the association between work impairments and reduced work ability among workers with MSD, CVD, or MD (chapter 6). A disadvantage of this method is that it does not allow for the establishment of causal relationships. In other words, did work impairments and reduced work ability precede an increase in health care use or did health care prompt impairments in work and a reduced work ability? Moreover, health care use was retrospectively assessed over the 12 months prior to the questionnaire, whereas impairments in work and work ability were a reflection of the respondents' situation at the time of the questionnaire. This also made it difficult to determine cause and effect. What we do know from this study is that work impairments often co-occur with health care use in workers with chronic health problems, and it also goes for reduced work ability and health care use. This indicates that it may be relevant to pay attention to the work context in workers with common health problems, when aiming to reduce health care needs. These cross-sectional studies are informative as a first exploratory step. In the ideal situation, the next step would be determining the exact timing of cause and effect so that we could analyse with more certainty what determinant triggered what outcome. This would require a more dynamic way of data collection in which modern technology, like mobile applications, could play a role in helping respondents to register their health, work ability, and impairments at work on a regular (e.g. weekly) basis. This type of data could then be linked to health care use registries. Since such optimal study design cannot easily be achieved for various reasons, amongst others availability of data and privacy issues, cross-sectional studies on determinants of health care use remain important.

Results described in chapters 3, 4, and 5 are based on longitudinal studies where determinants were measured at baseline and outcomes during follow-up. Therefore we were better able to draw some conclusions about causality. However, results in these chapters are still based on dichotomous measures (e.g. received a disability benefit yes/no at a certain point in time) which hampers the translation towards more real live working careers. Longitudinal studies which transform these dichotomous measures into longitudinal measures of working careers, like working life expectancy or working years lost, will be one of the challenges for future research.

INTERPRETATION OF NEW INSIGHTS

Two key findings from this thesis are selected and described more thoroughly in this section. To start, methodological insights on analysing multiple exit routes simultaneously in longitudinal data will be explained. Next, a discussion will follow about the WAI as a prognostic tool to identify high risk workers for sickness absence.

Labour force exit routes as competing events

In previous (longitudinal) studies, various analytical techniques have been used to estimate the relation between a determinant (e.g. poor health) and labour force exit. For example, by focusing on one specific exit route and using a logistic regression analysis or a Cox proportional hazard analysis [8-10]. Recently, some studies incorporated multiple exit routes and used a stratified Cox analysis where workers within each specific exit route were compared with workers who stayed employed the entire follow-up [11, 12]. However, these methods, to a large extent, ignore the fact that exit routes may act as competing events. As an alternative, competing risk analysis could be performed [22]. This technique incorporates the fact that another event may precede the occurrence of the event of interest. Additionally, it allows for direct estimation of relative and absolute probabilities [22]. In the presence of competing risks, conventional survival techniques like Kaplan-Meier curves will overestimate the probability on the event of interest, as they assume that those who are censored are representative for the population still at risk (independent censoring assumption) [23, 24]. Thus, the censored workers should not be those with systematically higher or lower likelihood on the event of interest (such as workers with a competing event). This is illustrated in chapter 4 of this thesis, whereby probabilities based on the Kaplan-Meier curves were typically higher (i.e. overestimated the individual risk on a specific exit route) than the estimated probabilities from the Fine & Gray competing risk analysis (e.g. individual risk to leave the workforce via early retirement was 34.1% according to the Kaplan-Meier curve, vs. 27.6% according to the competing risk analysis).

Two competing risk methods were used in chapter 4 to quantify the relation between poor health and labour force exit and to calculate individual probabilities on the event of interest: the Fine & Gray method [22] and the cause-specific Cox regression analysis [25]. The relations between poor health and exit through disability benefit, unemployment, early retirement, and becoming economically inactive, expressed by Hazard Ratios in the cause-specific method were 3.36, 1.43, 1.07, and 1.23, respectively. The Subdistribution Hazard Ratios (SHRs) from the Fine & Gray method were 4-12% lower: 3.22, 1.32, 0.94, and 1.13, respectively. Both methods reached very similar results when it comes to absolute probabilities. For example, in Bismarckian counties, male workers aged 60-64 years with a low education who lived alone had a 10.8% probability to leave the workforce via disability benefit according to the cause-specific method, and a probability of 11.1% according to the Fine & Gray method. However, the variables in the Fine & Gray analysis translate directly to absolute probabilities, while for the causespecific approach, the cause-specific hazards of the competing events must also be incorporated in the calculations which make these calculations much more complex [24]. Therefore, the Fine & Gray approach

is an interesting alternative for conventional Cox models in competing risks situations to quantify the relation between determinant and outcome, and to estimate individual probabilities. Furthermore, Kaplan-Meier curves should not be used to estimate individual probabilities in competing risk situations.

Work ability index as prognostic tool for sickness absence

In chapter 5 of this thesis the ability of the WAI to be used as a prognostic tool for longer durations of sickness absence was explored. Earlier studies already demonstrated the association between lower work ability and sickness absence [4, 15, 26]. However, there are only a few studies that investigated the use of the WAI as a prognostic tool [20, 21, 27]. Although, the WAI had a reasonable ability to discriminate between four categories of sickness absence (ordinal c-index (ORC) 0.65), the sensitivity at the cut-off of poor work ability (i.e. ≤ 27) was very low (7.5%). Thus, the strong association between low work ability and sickness absence at population level, does not translate to a good prediction at the individual level (expressed in the low sensitivity). Only 7.5% of the workers who had ≥ 15 sick days during follow-up were identified by their poor work ability score at baseline. This hampers the suitability of the WAI as a prognostic tool to identify high risk workers. A recent study reported that sensitivity increases when predicting long term sickness absence of more than 4, 6 or 12 weeks. For example, a cut-off at WAI 36 (i.e. moderate work ability) corresponded with a sensitivity of 66% for sickness absence episodes of >90 days [20]. These results demonstrate the complex choice to be made in prevention strategies. The WAI seems to predict sickness absence > 3 months rather well, but this is an infrequent event which happens only in 1 to 2% of the workers on sick leave. In a high risk prevention strategy the WAI seems appropriate, but this strategy will have limited impact on total sickness absence in any study population. Thus, when aiming at the prevention of sickness absence episodes of 2 weeks or more (which are more common), interventions at a population level (primary prevention), rather than focusing on workers with a poor WAI score (secondary prevention), seems most promising [28].

RECOMMENDATIONS

Recommendations for future research

Explore the interplay of determinants of labour force exit at micro, meso, macro level

Although several determinants of exit form paid employment have been identified in this thesis, still little is known about the complex interplay of determinants at micro (individual level), meso (organisational level) and macro (country level) level. This asks for international studies in which determinants at all three levels are included. The SHARE study used in chapter 4 already allows for comparison of health as a determinant of labour force exit between European regions. However, the sample was too small to evaluate determinants of labour force exit per country separately. Furthermore, determinants at meso level (e.g. company policy) are not available in this study.

Explore determinants of labour force exit after changing social and economic legislations

Many countries, including the Netherlands, have recently introduced policies to extend working life. For example, increasing the official retirement age, introducing more stringent eligibility criteria for a disability benefit, and taxation of early retirement benefits as income. The studies included in this thesis were performed during different periods when these policies were effectuated. Therefore, it is of great importance to determine whether the introduced legislations have improved labour force participation and whether these legislation have increased or decreased labour force participation among those workers with chronic health problems.

Shorter time windows to explore cause and effect

The study described in chapter 6 on the consequences of work impairments and decreased work ability for health care use was performed on cross-sectional data. This allowed us to gain insight into the association between the work related determinants and health care use, but not into cause and effect. In the ideal situation future research on this topic should be performed on longitudinal data which is collected with short time windows between the measurements. For example, weekly measurements of work impairments, health, work ability combined with detailed registry data about health care use would be a great source of information to disentangle the cause and effect issue. The current development of mobile applications could play a role in this type of data collection. However, before we can use these types of dynamic data collection, issues on availability and privacy should be addressed.

Recommendations for occupational health professionals

Focus on primary prevention of sickness absence

Earlier studies showed that preventive interventions for long term sickness absence are more effective and cost-effect when aimed at high risk groups [29-31]. However, work in this thesis (chapter 5) showed that it is not easy to identify workers at high risk of sickness absence. The WAI showed very low sensitivity to detect these workers. Therefore, focusing on the whole working population maybe a more effective strategy in preventing long term sickness absence [28].

Tailored interventions needed

Multiple factors have been identified to influence labour force exit (chapter 2-4). The combination of factors involved in displacement from work could differ per worker, and therefore a tailored approach would be advised. To ensure a good fit between the demands at work and the ability and wishes of the employee a constant dialogue between employer and employee from an early phase of the career onwards may be helpful.

Recommendations for policy

Improving labour market opportunities for older workers

Since new policies on labour participation make it more difficult to exit the labour market via early retirement and disability benefits, it is necessary to further improve working

conditions, including flexible working arrangements, policies supporting sufficient skills and capacities to continue working, and to improve labour market opportunities for older workers.

Investment in working conditions may reduce health care use

The study in chapter 6 shows an association between work related conditions (work impairments and work ability) and health care use. Although a causal relation could not be established, it gives an indication that attention for work impairments and work ability among workers with chronic health problems is likely to be relevant when aiming to reduce health care use and subsequent costs. Thus, also for health care insures it is likely beneficial to focus on healthy workers and therefore invest in this group.

REFERENCES

1. van den Berg, TIJ, Elders LAM, de Zwart BCH, 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.
2. Ilmarinen JE. Aging workers. *Occup Environ Med*. 2001;58(8):546-552.
3. Robroek SJW, van den Berg, TIJ, Plat JF, Burdorf A. The role of obesity and lifestyle behaviours in a productive workforce. *Occup Environ Med*. 2011;68(2):134-9.
4. Alavinia SM, van den Berg TIJ, van Duivenbooden C, Elders LAM, 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.
5. van der Wel KA, Dahl E, Thielen K. Social Inequalities in "Sickness": Does Welfare State Regime Type Make a Difference? A Multilevel Analysis of Men and Women in 26 European Countries. *Int J Health Serv*. 2012;42(2):235-55.
6. Fischer JAV, Sousa-Poza A. The institutional determinants of early retirement in Europe. St. Gallen: Department of Economics University of St. Gallen; 2006. Report No.: 2006-08.
7. van Rijn RM, Robroek SJW, Brouwer S, Burdorf A. Influence of poor health on exit from paid employment: a systematic review. *Occup Environ Med*. 2014;71(4):295-301.
8. Lund T, Csonka A. Risk factors in health, work environment, smoking status, and organizational context for work disability. *Am J Ind Med*. 2003;44(5):492-501.
9. 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.
10. Bültmann U, Christensen KB, Burr H, Lund T, Rugulies R. Severe depressive symptoms as predictor of disability pension: a 10-year follow-up study in Denmark. *Eur J Public Health*. 2008;18(3):232-4.
11. Jensen LD, Ryom PK, Christensen MV, Andersen JH. Differences in risk factors for voluntary early retirement and disability pension: a 15-year follow-up in a cohort of nurses' aides. *BMJ Open*. 2012;2(6):e000991.
12. Robroek SJW, Schuring M, Croezen S, Stattin M, Burdorf A. Poor health, unhealthy behaviors, and unfavorable work characteristics influence pathways of exit from paid employment among older workers in Europe: a four year follow-up study. *Scand J Work Environ Health*. 2013;39(2):125-33.
13. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. Work ability index. 2nd ed. Helsinki: Finnish Institute of Occupational Health; 1998.
14. 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.

15. Kujala V, Tammelin T, Remes J, Vammavaara E, Ek E, Laitinen J. Work ability index of young employees and their sickness absence during the following year. *Scand J Work Environ Health*. 2006;31(1):75-84.

16. Organisation for Economic Co-operation and Development. Total expenditure on health. Health: key tables from OECD; 2014. Available from: http://www.oecd-ilibrary.org/social-issues-migration-health/total-expenditure-on-health-2014-1_hlthxp-total-table-2014-1-en.

17. American Diabetes Association. Economic Costs of Diabetes in the U.S. in 2012. *Diabetes Care*. 2013;36(4):1033-46.

18. Van Calster B, Vergouwe Y, Looman CN, Van Belle V, Timmerman D, Steyerberg E. Assessing the discriminative ability of risk models for more than two outcome categories. *Eur J Epidemiol*. 2012;27(10):761-70.

19. Van Calster B, Van Belle V, Vergouwe Y, Steyerberg EW. Discrimination ability of prediction models for ordinal outcomes: Relationships between existing measures and a new measure. *Biom J*. 2012;54(5):674-85.

20. Schouten LS, Joling CI, van der Gulden JW, Heymans MW, Bultmann U, Roelen CA. Screening manual and office workers for risk of long-term sickness absence: cut-off points for the work ability index. *Scand J Work Environ Health*. 2015;41(1):36-42.

21. Schouten LS, Bültmann U, Heymans MW, Joling CI, Twisk JWR, Roelen CAM. Shortened version of the work ability index to identify workers at risk of long-term sickness absence. *Eur J Public Health*. 2015 doi:10.1093/eurpub/ckv198. [Epub ahead of print].

22. Fine JP, Gray RJ. A Proportional Hazards Model for the Subdistribution of a Competing Risk. *J Am Stat Assoc*. 1999;94(446):496-509.

23. Noordzij M, Leffondré K, van Stralen KJ, Zoccali C, Dekker FW, Jager KJ. When do we need competing risks methods for survival analysis in nephrology? *Nephrol Dialysis Transplant*. 2013;28(11):2670-7.

24. Andersen PK, Geskus RB, de Witte T, Putter H. Competing risks in epidemiology: possibilities and pitfalls. *Int J Epidemiol*. 2012;41(3):861-70.

25. Putter H, Fiocco M, Geskus RB. Tutorial in biostatistics: competing risks and multi-state models. *Statist Med*. 2007;26(11):2389-430.

26. Lund T, Christensen KB, Vaez M, Labriola M, Josephson M, Villadsen E, et al. Differences in sickness absence in Sweden and Denmark: the cross national HAKNAK study. *Eur J Public Health*. 2009;19(3):343-9.

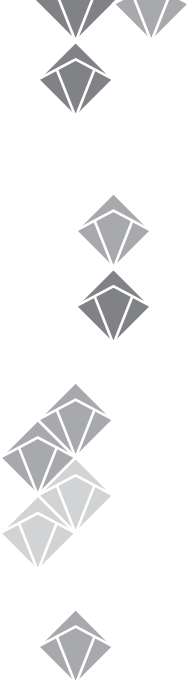
27. Reeuwijk KG, Robroek SJW, Niessen MAJ, Kraaijenhagen RA, Vergouwe Y, Burdorf A. The Prognostic Value of the Work Ability Index for Sickness Absence among Office Workers. PLoS ONE. 2015;10(5):e0126969.

28. Rose G. Sick individuals and sick populations. *Int J Epidemiol*. 2001;30(3):427-32.

29. Kant I, Jansen NWH, van Amelsvoort LGPM, van Leusden R, Berkouwer A. Structured early consultation with the occupational physician reduces sickness absence among office workers at high risk for long-term sickness absence: a randomized controlled trial. *J Occup Rehabil*. 2008;18(1):79-86.

30. Taimela S, Justén S, Aronen P, Sintonen H, Läärä E, Malmivaara A, et al. An occupational health intervention programme for workers at high risk for sickness absence. Cost effectiveness analysis based on a randomised controlled trial. *Occup Environ Med*. 2008;65(4):242-8.

31. Taimela S, Malmivaara A, Justén S, Läärä E, Sintonen H, Tiekso J, et al. The effectiveness of two occupational health intervention programmes in reducing sickness absence among employees at risk. Two randomised controlled trials. *Occup Environ Med*. 2008;65(4):236-41.



SUMMARY / SAMENVATTING

SUMMARY

The social security systems in Western countries are being put under pressure by an ageing population due to decreasing birth rates and increased longevity. Although the retirement age is rising, many workers still leave paid employment before the official retirement age. To facilitate longer working lives, the objectives of this thesis were as follows:

1. To study determinants of exit from paid employment via disability, unemployment, and early retirement.
2. To explore the predictive value of work ability to identify persons at high risk of long-term sickness absence.
3. To determine the consequences of decreased work ability for health care use.

Data from four cohorts were used to answer the objectives: the Study on Transitions in Employment, Ability and Motivation (STREAM), the Survey of Health, Ageing, and Retirement in Europe (SHARE), a cohort from the Netherlands Institute for Prevention and e-Health Development (NIPED) Research Foundation containing Dutch workers from the financial sector, and a cohort of Dutch health care personnel.

To study determinants of exit from paid employment via disability, unemployment, and early retirement.

The complex character of exit from paid employment has been demonstrated by the fact that multiple factors were identified that influence this process (chapter 2-4). Self-rated health, lifestyle-related related factors, but also work-related factors, sufficient competences, work-life balance, and financial factors played a role in exit from paid employment. The relative importance of the determinants differed by exit pathway. Health, for example, was a stronger determinant for exit through involuntary routes of disability benefit and unemployment, as compared to the more voluntary route of early retirement (chapter 4).

In chapter 2 the focus was on non-health related determinants of early retirement among older workers. This qualitative study revealed that a combination of push and pull factors and financial opportunities played a role in the process towards early retirement. The specific mix of factors involved in this process differed between individuals. Push factors towards early retirement included organizational changes (e.g. restructuring, or continuous changes in work protocols), conflicts at work, high work pressure, high physical job demands, and dissatisfaction with the limited use of one's skills and knowledge. Pull factors towards early retirement were more often related to social life and included the wish to do other things outside of work, to enjoy life, have more flexibility, spend more time with the spouse or close relatives or friends, and to care of others. In all cases financial opportunities to retire early were essential in the final decision to leave the workforce. Among some individuals financial factors became only important in the context of push and pull factors, whereas for others they played a more direct role. When ranking the relative importance of the factors involved in early retirement, financial factors appeared to be most important and were often a precondition for early retirement.

The role of lifestyle related factors and poor health in exit from paid employment was studied in chapter 3 and 4. The synthesized literature about the role of overweight, obesity, and lack of physical activity for premature exit from the labour force (chapter 3) showed that obese (pooled relative risk (RR) 1.53), and to a lesser extent overweight (pooled RR 1.16) workers had an increased likelihood of exit from paid employment through disability benefit. Also workers with a lack of physical activity were at a higher risk of disability benefit. Although the number of studies was low, limited physical activity was a risk factor of unemployment as well, but not of early retirement. A high BMI was neither a risk factor for unemployment nor for early retirement.

In concordance with the findings on lifestyle-related risk factors, workers with a poor self-rated health were at a higher risk of disability benefit than workers with good self-rated health (subdistribution hazard ratio (SHR) 3.22) (chapter 4). Workers with poor self-rated health also had an elevated risk of unemployment (SHR 1.32), but not of becoming economically inactive or leaving the workforce via early retirement. As described in the qualitative study (chapter 2), it is likely that factors other than health play a more dominant role in the mainly voluntary exit route of early retirement.

Overall, results from chapter 2-4 show that multiple risk factors (e.g. individual characteristics, work-related, lifestyle-related) determine the ability of older workers to remain in paid employment until older age.

To explore the predictive value of work ability to identify workers at high risk of long-term sickness absence.

Chapter 5 describes how well the work ability index (WAI) performs as a tool to identify workers at high risk for varying durations of sickness absence in a one year follow-up study. The ability of the WAI to discriminate correctly between the four categories of sickness absence (i.e. 0 days, 0 < days < 5, 5 ≤ days > 15, ≥ 15 days) showed that there was a 65% probability that the WAI correctly can separates two workers with different sickness absence durations (ordinal c-index (ORC) 0.65; 95%CI 0.63-0.68). However, the WAI could best discriminate between workers without sickness absence and workers with the longest duration of sickness absence (i.e. ≥ 15 days) (Area under the Curve (AUC) 0.77).

At the WAI cut-off between poor and moderate work ability (WAI score ≤ 27) the sensitivity was 7.5% for < 15 sick days vs. ≥ 15 sick days, indicating that 7.5% of the workers with ≥ 15 sick days were identified by their poor work ability score. On the other hand specificity was 99.6%, indicating that 99.6% of the workers with <15 sick days did not had a poor work ability score. The positive predictive value was 82%, which indicates that from all workers with a poor work ability score at baseline, 82% had ≥ 15 sick days at follow-up. These results suggest that the WAI could be used to identify some workers at high risk for prolonged sickness absence. However, due to low sensitivity, most high risk workers will not be identified based on their WAI score. This severely hampers the applicability of the WAI as prognostic instrument for sickness absence. Additional factors to the WAI may improve the predictive ability and might allow for better identification of workers at highest risk.

To determine the consequences of decreased work ability on health care use.

The cross-sectional study in chapter 6 describes clear associations between lower work ability and impairments at work on the one hand, and increased health care use on the other hand. Workers who experienced impairments at work due to a health problem were more likely to consult a GP, specialist, physiotherapist, or psychologist. The study incorporated workers with three common disorders – musculoskeletal disorder (MSD), cardiovascular disorders (CVD), and mental disorder (MD) – which account for a substantial proportion of health care expenditures in the Netherlands. Workers with MSD and a lower work ability had a higher chance to consult health care providers than workers with MSD and better work ability (OR 1.05-1.35). As these odds ratios represent the increased likelihood of health care use per 10% lower work ability score (range score 0-10), this likelihood can accumulate substantially when work ability is for example reduced by a score of 5 out of 10. Furthermore, workers with MSD who experienced moderate or severe impairments at work were more likely to visit a GP, specialist, or physiotherapist. Similarly as workers with MSD, workers with CVD and MD were also more likely to visit a health care provider when experiencing lower work ability or impairments at work. The results of chapter 6 imply that lower work ability as well as perceived impairments at work often co-occur with seeking health care.

Conclusions

In chapter 7 the main objectives were answered, methodological issues were discussed and key findings were interpreted. The chapter ends with recommendations for different stakeholders. The following can be concluded and recommended from this thesis:

- A combination of factors are involved in the decision to retire early;
    - The factors involved differed per individual.
    - Financial factors were always considered and often decisive in the decision to retire early.
- Workers suffering from obesity are at greater risk to leave paid employment via disability benefit than workers with normal weight;
    - To a lesser extent this was also true for overweight.
- Limited physical activity was a risk factor for both disability benefit and unemployment, but the available studies in the meta-analysis were low.
- Poor health is a risk factor for exit of paid employment, especially through the more involuntary routes of disability benefit and unemployment.
    - Slightly more workers with good health leave paid employment via early retirement as compared to workers with poor health.
- The WAI could best discriminate between workers without sickness absence and workers with sickness absence of two or more weeks. However, the WAI is less suitable

as a predictive tool to identify workers at high risk of sickness absence since sensitivity is too low (7.5%).

  - Therefore, in the prevention of long term sickness absence, focusing on the whole working population may be a more effective strategy than a high risk approach

- Work impairments and reduced work ability were associated with health care use among health care workers with MSD, CVD, and MD.
- Kaplan-Meier curves do not properly quantify (i.e. overestimate) absolute risks of exit form paid employment in the presence of competing exit routes.
- The Fine & Gray approach is an interesting alternative for conventional Cox models in competing risks situations to quantify the relation between poor health and different exit routes out of paid employment, and to estimate individual probabilities of labour force exit due to poor health.
- Future research should focus on the complex interplay of determinants of exit form paid employment at micro (individual level), meso (organisational level) and macro (country level) level.

  - This asks for international studies in which determinants at all three levels are included.

- The studies included in this thesis were performed on data gathered in the period right before new social and economic legislations to prolong working life were effectuated. Therefore, it is of great importance to determine whether the introduced legislations have improved labour force participation and whether these legislations have increased or decreased labour force participation among those workers with chronic health problems.
- Since new policies on labour participation make it more difficult to exit the labour market via early retirement and disability benefits, it is necessary to further improve working conditions.
- To gain more insight into causal relations, a more dynamic form of data collection with short time windows between measurements would be helpful. However, before we can use these types of data collection, issues on availability and privacy should be addressed.
- The combination of factors involved in displacement from work could differ per worker, and therefore a tailored approach to worklife prolongation would be advised. To ensure a good fit between the demands at work and the ability and wishes of the employee a constant dialogue between employer and employee from an early phase of the career onwards may be helpful.
- Attention for work impairments and work ability among workers with chronic health problems is likely to be relevant when aiming to reduce health care use and subsequent costs. Thus, also for health care insures it is likely beneficial to focus on healthy workers and therefore invest in this group.

SAMENVATTING

Het sociale stelsel in Westerse landen staat onder druk door een ouder wordende populatie, veroorzaakt door lagere geboortecijfers en een langere levensduur. Hoewel de leeftijd waarop men met pensioen gaat de afgelopen jaren is gestegen, verlaten nog steeds veel werknemers het werkzame leven voor de officiële pensioenleeftijd. Om langer doorwerken mogelijk te maken had dit proefschrift de volgende doelstellingen:

1. Het bestuderen van determinanten van uitstroom uit betaald werk via arbeidsongeschiktheid, werkloosheid en vroegpensioen.
2. Het in kaart brengen van de voorspellende waarde van werkvermogen om werknemers te kunnen identificeren die een hoog risico op ziekteverzuim hebben.
3. Het bepalen wat de gevolgen van een verlaagd werkvermogen in termen van zorggebruik zijn.

Om de doelstellingen te beantwoorden zijn in dit proefschrift vier cohorten gebruikt: de Study on Transitions in Employment, Ability and Motivation (STREAM), de Survey of Health, Ageing, and Retirement in Europe (SHARE), een cohort van het NIPED-instituut met daarin Nederlandse werknemers uit de financiële sector en als laatst een cohort bestaande uit Nederlands zorgpersoneel.

Het bestuderen van determinanten van uitstroom uit betaald werk via arbeidsongeschiktheid, werkloosheid en vroegpensioen.

Het complexe karakter van uitval uit betaald werk wordt onderstreept door het feit dat er in dit proefschrift verscheidene factoren zijn gevonden die invloed hebben op uitval uit werk (hoofdstuk 2-4). Zelfgerapporteerde gezondheid, leefstijlgerelateerde factoren, maar ook werkgerelateerde factoren, het hebben van de juiste competenties, werk-privébalans en financiële factoren speelden een rol bij uitval uit werk. De onderlinge verhouding tussen de determinanten verschilde per uitstroomroute. Gezondheid was bijvoorbeeld een sterkere determinant van uitval via meer ‘onvrijwillige’ routes als arbeidsongeschiktheid en werkloosheid, dan van uitval via een meer ‘vrijwillige’ route als vroegpensioen (hoofdstuk 4).

In hoofdstuk 2 lag de focus op de niet-gezondheidgerelateerde determinanten van vroegpensioen onder oudere werknemers. Deze kwalitatieve studie liet zien dat een combinatie van zogenaamde ‘push- en pullfactoren’ en financiële mogelijkheden een rol speelden in het proces tot vroegpensioen. Onder ‘pushfactoren’ verstaan we bijvoorbeeld reorganisaties, veranderingen op de werkvloer, conflicten op het werk, hoge werkdruk of zwaar fysiek werk. ‘Pullfactoren’ zijn vaak meer gerelateerd aan de privésfeer, enkele voorbeelden zijn de wens om andere dingen te doen buiten het werk, van het leven genieten, flexibeler willen zijn of meer tijd willen besteden met de partner. De specifieke combinatie van factoren die uiteindelijk een rol speelde verschilde per individu. In alle gevallen waren de financiële mogelijkheden om met voegpensioen te gaan van essentieel belang in de uiteindelijke beslissing om vervroegd uit te treden. Wel was het zo dat bij sommige werknemers financiële factoren pas aan de orde kwamen in

de context van push- en pullfactoren, terwijl ze bij anderen een meer directe rol hadden in het beslissingsproces. Als we het relatieve belang van alle factoren die meespelen in het besluit om met vroegpensioen te gaan naast elkaar leggen, zien we dat financiële factoren vaak een voorwaarde waren om uiteindelijk te beslissen om vervroegd uit te treden.

Welke rol leefstijlgerelateerde factoren en slechte gezondheid spelen in uitval uit werk werd in hoofdstuk 3 en 4 bestudeerd. De review met meta-analyse over de rol die overgewicht, obesitas en gebrek aan lichamelijke activiteit spelen in uitval uit betaald werk (hoofdstuk 3) liet zien dat werknemers met obesitas (gepoold relatief risico (RR) 1.53) en in mindere mate ook werknemers met overgewicht (gepoold RR 1.16) een verhoogde kans hadden om uit te vallen door arbeidsongeschiktheid. Ook werknemers met een gebrek aan lichamelijke activiteit hadden een hoger risico op arbeidsongeschiktheid. Hoewel het aantal studies beperkt was, bleek een gebrek aan lichamelijke activiteit ook een risicofactor voor werkloosheid, maar niet voor vroegpensioen. Een hoog BMI was geen risicofactor voor werkloosheid en ook niet voor vroegpensioen.

Werknemers met een slechte zelfgerapporteerde gezondheid hebben een hoger risico op arbeidsongeschiktheid dan werknemers die hun gezondheid als goed ervoeren (subdistribution hazard ratio (SHR) 3.22) (hoofdstuk 4). Deze werknemers hadden ook een verhoogd risico op werkloosheid (SHR 1.32), maar niet op vroegpensioen of op economisch inactief worden. Zoals beschreven in de kwalitatieve studie (hoofdstuk 2), is het aannemelijk dat er andere factoren een prominentere rol spelen dan gezondheid in de voornamelijk zelfgekozen route van vroegpensioen.

Samenvattend laten de resultaten uit hoofdstuk 2-4 zien dat verschillende risicofactoren (bijv. individuele kenmerken, werkgerelateerd en leefstijlgerelateerd) bepalen in hoeverre een oudere werknemer in staat is om tot op hogere leeftijd in betaald werk te blijven.

Het in kaart brengen van de voorspellende waarde van werkvermogen om werknemers te kunnen identificeren die een hoog risico op ziekteverzuim hebben.

Hoofdstuk 5 beschrijft in een studie met 1 jaar follow-up, hoe goed de 'work ability index' (WAI) presteert als instrument om werknemers met een hoog risico op variërende perioden van ziekteverzuim te identificeren. De kans dat de WAI twee werknemers uit verschillende categorieën van verzuim (0 dagen, 0 < dagen < 5, 5 ≤ dagen > 15, ≥ 15 dagen) op de juiste manier van elkaar onderscheidde was 65% (ordinale c-index (ORC) 0.65; 95%CI 0.63-0.68). De WAI was echter het best in staat om werknemers zonder verzuim te onderscheiden van werknemers met de langste verzuimduur (nl. ≥ 15 dagen) (Area Under the Curve (AUC) 0.77, m.a.w. in 77% van de gevallen).

Op het afkappunt tussen slecht en verminderd werkvermogen (WAI score ≤ 27) was de sensitiviteit 7,5% voor < 15 ziektedagen vs. ≥ 15 ziektedagen. Dit betekent dat 7,5% van de werknemers die 15 dagen of meer verzuimden, geïdentificeerd konden worden op basis van hun slechte werkvermogen. Aan de andere kant was de specificiteit 99,6% en de positief voorspellende waarde 82%. Dat laatste betekent dat van alle werknemers met een slecht werkvermogen op baseline, 82% uiteindelijk 15 dagen of meer had verzuimd in het follow-upjaar. Deze resultaten suggereren dat de WAI gebruikt zou kunnen worden

om enkele werknemers te identificeren die een hoog risico lopen om langdurig te gaan verzuimen. Maar door de lage sensitiviteit worden de meeste werknemers die uiteindelijk langdurig gaan verzuimen niet geïdentificeerd door de WAI. Dit beperkt de mogelijkheid om de WAI in te zetten als voorspellend instrument voor ziekteverzuim sterk. Meer factoren toevoegen aan de WAI zou de voorspellende waarde van de WAI kunnen verbeteren en bijdragen om uiteindelijk de hoogrisicowerknemers te kunnen identificeren..

Het bepalen wat de gevolgen van een verlaagd werkvermogen in termen van zorggebruik zijn.

Het dwarsdoorsnedeonderzoek gepresenteerd in hoofdstuk 6 laat een duidelijke samenhang zien tussen een lager werkvermogen en een verhoogd zorggebruik evenals een samenhang tussen beperkingen op het werk en een verhoogd zorggebruik. Zo hadden werknemers die beperkingen op het werk ervoeren door gezondheidsproblemen een hogere kans om een huisarts, specialist, fysiotherapeut of psycholoog te raadplegen. In deze studie werden werknemers met drie veelvoorkomende aandoeningen meegenomen – klachten van het bewegingsapparaat, cardiovasculaire klachten, en psychische problemen – die samen een substantieel deel van de zorgkosten in Nederland voor hun rekening nemen. Werknemers met klachten van het bewegingsapparaat die een verminderd werkvermogen hadden, hadden een hogere kans om een medische deskundige te raadplegen dan werknemers met bewegingsapparaat klachten die geen verminderd werkvermogen hadden (OR 1,05-1,35). Deze odds ratio's vertegenwoordigen een verhoogde kans op zorggebruik per stapje van 10% verlaging in werkvermogen (score van 0-10). Dus de kans kan flink oplopen wanneer het werkvermogen bijvoorbeeld verlaagd is met 5 van de 10 punten. Verder hadden werknemers met klachten van het bewegingsapparaat die beperkingen in het werk ervoeren een hogere kans om de huisarts, specialist of fysiotherapeut te raadplegen dan degene die geen beperkingen ervoeren. Gelijksoortige resultaten werden gevonden voor werknemers met cardiovasculaire klachten en psychische problemen. De resultaten uit hoofdstuk 6 impliceren dat een lager werkvermogen en ervaren beperkingen in het werk vaak samen voorkomen met het zoeken van zorg.

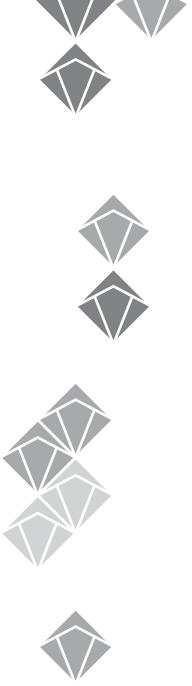
Conclusies

In hoofdstuk 7 worden de doelstellingen van dit proefschrift beantwoord, worden methodologische kanttekeningen geplaatst en hoofdbevindingen geïnterpreteerd. Het hoofdstuk eindigt met aanbevelingen voor de belangrijkste stakeholders. Het volgende kan naar aanleiding van de bevindingen in dit proefschrift worden geconcludeerd en aanbevolen:

- Een combinatie van factoren zorgt voor het uiteindelijke besluit om met vroegpensioen te gaan.
    - Welke specifieke factoren betrokken zijn verschilt per individu;
    - Maar financiële factoren spelen altijd een rol en waren vaak doorslaggevend in het besluit om vervroegd uit te treden.

- Werknemers met obesitas hebben een groter risico om uit te vallen uit betaalde arbeid via arbeidsongeschiktheid dan werknemers met een normaal gewicht.
    - In mindere mate geldt dit ook voor werknemers met overgewicht.
- Gebrek aan fysieke activiteit was een risicofactor voor zowel uitval door arbeidsongeschiktheid als werkloosheid, maar het aantal studies waarop deze bevinding werd gebaseerd is laag in de meta-analyse.
- Slechte gezondheid is een risicofactor voor uitval uit betaald werk, voornamelijk door 'onvrijwillige' routes als arbeidsongeschiktheid en werkloosheid.
    - Voor de meer 'vrijwillige' route van vroegpensioen zagen we dat iets meer werknemers met een goede gezondheid dan met een slechte gezondheid uitvielen via deze route.
- De WAI kon het best onderscheid maken tussen werknemers zonder verzuim en werknemers die twee weken of meer verzuimden. De WAI is echter minder geschikt als voorspellend instrument om werknemers die het risico lopen om te gaan verzuimen te identificeren omdat de sensitiviteit te laag is (7,5%);
    - Daarom zou een populatieaanpak (m.a.w. richten op alle werknemers) in plaats van een hoogrisico-strategie op dit moment waarschijnlijk meer effect hebben in het voorkomen van verzuim.
- Beperkingen in het werk en een verminderd werkvermogen hingen samen met zorggebruik bij werknemers uit de zorg met klachten van het bewegingsapparaat, cardiovasculaire klachten en psychische problemen.
- Kaplan-Meiercurves zijn niet geschikt om het absolute risico op uitstroom uit werk te kwantificeren in de aanwezigheid van concurrerende uitstroomroutes (ze geven namelijk een overschatting).
- De Fine & Gray-methode is een interessant alternatief voor gebruikelijke Cox modellen in de situatie waarin concurrerende risico's aanwezig zijn als we de relatie tussen slechte gezondheid en uitstroom via verschillende routes willen kwantificeren en om individuele kansen te schatten.
- Onderzoek zou zich in de toekomst moeten richten op het complexe samenspel van determinanten van uitstroom uit betaald werk op het microniveau (individueel niveau), mesoniveau (niveau van de organisatie) en macroniveau (landelijk niveau).
    - Dit vraagt om internationale studies waarin determinanten op al deze niveaus worden meegenomen.
- De studies in dit proefschrift zijn uitgevoerd op data die verzameld is in een periode net voordat er nieuwe wet- en regelgeving is ingevoerd om langer doorwerken te stimuleren. Daarom is het van groot belang om te onderzoeken of deze wet- en regelgeving arbeidsparticipatie in zijn algemeenheid, maar ook onder mensen met chronische gezondheidsproblemen, heeft verbeterd.

- Omdat nieuwe wet- en regelgeving het minder makkelijk maakt om het arbeidsproces te verlaten via vroegpensioen of arbeidsongeschiktheid, is het nodig om werkomstandigheden verder te verbeteren.
- Een dynamischere manier van data verzamelen zou kunnen bijdragen aan het beter inzichtelijk maken van causale relaties. Maar voor het zover is moeten problemen rondom beschikbaarheid en privacy worden opgelost.
- Omdat de combinatie van factoren die meespeelt in uitval uit werk per persoon kan verschillen wordt een gepersonaliseerde aanpak geadviseerd om langer doorwerken mogelijk te maken. Om de eisen van het werk en de mogelijkheden en wensen van de werknemer goed op elkaar te laten aansluiten is een constante dialoog tussen werkgever en werknemer al vanaf een vroeg stadium in de carrière waarschijnlijk bevorderend.
- Aandacht voor beperkingen op het werk en het werkvermogen van de werknemers met chronische gezondheidsproblemen is waarschijnlijk relevant in het beperken van zorggebruik en daarmee samenhangende kosten. Waarschijnlijk is het dus ook voor zorgverzekeraars aantrekkelijk om te focussen op en te investeren in gezonde werknemers.



DANKWOORD

ABOUT THE AUTHOR

LIST OF PUBLICATIONS

PHD PORTFOLIO

DANKWOORD

Zo dit was het dan… Ik hoop dat je dit proefschrift met veel plezier gelezen hebt (of is dit het eerste hoofdstuk wat je leest?). Dit werk heb ik natuurlijk niet allemaal alleen gedaan, veel mensen hebben er aan bijgedragen door samenwerking, steun, begeleiding, of in welke vorm dan ook. Hier wil ik jullie stuk voor stuk bedanken!

Allereerst mijn promotor Lex Burdorf en copromotor Suzan Robroek. Ik heb veel van jullie geleerd. Lex, bedankt voor je kritische blik, je begeleiding, je ideeën waar je me elke keer weer mee wist te prikkelen, de kans die je me gegeven hebt om te promoveren. De discussies die we de afgelopen jaren hebben gehad tijdens het schrijven van de artikelen hebben mijn blik verruimd en me geholpen in mijn ontwikkeling tot wie ik nu ben. Maar bovenal hebben ze veel plezier in mijn werk opgeleverd. Bedankt dat je me de ruimte hebt gegeven om mijn eigen ideeën te ontwikkelen. Suzan, ik ben ontzettend blij dat jij mijn copromotor bent geweest! Bedankt voor je kritische blik, je vertrouwen, steun en begeleiding. Ik heb enorm veel bewondering voor alle ballen die je in de lucht weet te houden. Ondanks dat je meerdere promovendi begeleidde, je eigen projecten had en in de afgelopen periode twee keer moeder bent geworden, kon ik altijd bij je terecht en wist je precies waar ik mee bezig was. Bij jou heb ik altijd mezelf kunnen zijn. Ik zou iedere promovendus een copromotor zoals jij gunnen.

Beste leden van mijn promotiecommissie, ik wil jullie hartelijk bedanken voor de tijd en aandacht die jullie hebben besteed aan mijn proefschrift en jullie aanwezigheid bij mijn verdediging.

De projectgroep van het project WAI/Werkvermogen bedankt voor de samenwerking en al jullie inspanningen. Ina, bedankt voor alle keren dat we samen op pad gingen door heel Limburg en voor de leuke gesprekken tijdens die autoritjes! Cas, ik vond het heel fijn om met je samen te werken. Als ik vragen had over de data, kon ik altijd bij je terecht. Ik wil ook alle projectleiders binnen de zorgorganisaties bedanken voor hun inzet en medewerking aan het onderzoek. Het feit dat de dingen die ik achter m'n computer uitzocht, door jullie in de praktijk konden worden gebruikt vond ik een van de leukste dingen in mijn werk. Ook alle medewerkers die hebben deelgenomen aan het onderzoek binnen de zorgorganisaties wil ik erg bedanken, zonder jullie was het zorgonderzoek er niet geweest.

Ik wil de STREAM-groep van TNO bedanken voor de fijne samenwerking, in het bijzonder Astrid en Goedele. Zonder dat we het toen wisten hebben we aan de eerste bouwstenen van dit proefschrift gewerkt! Marjan, heel erg bedankt dat je me in die tijd zoveel hebt geleerd over kwalitatief onderzoek.

Alle co-auteurs die een bijdrage hebben geleverd aan de artikelen in dit proefschrift, stuk voor stuk bedankt voor jullie input, kritische blik en hulp bij de soms uitdagende analysetechnieken.

MGZ-collega's, A&G-ers, kamergenoten, (o.a. Anne, Bouwine, Tessa, Rogier, Veerle, Merel, Carlijn, David, Britt, Yesim, Nanda, Karen) bedankt voor de gezellige tijd, de fijne werksfeer,

voor jullie hulp als ik niet uit m'n analyses kwam, voor het wegwijs maken op de afdeling toen in net binnen kwam. Fijn dat jullie deur altijd open stond als ik even wilde sparren. Het heeft ervoor gezorgd dat ik met een goed gevoel terug kijk op deze tijd!

Lieve (ex-)teamgenoten, in het bijzonder Janneke, Mark, Jan-Willem, Jasper, Marijke, Jeffrey, Tamara, Paul, jullie hebben wat promotieperikelen moeten doorstaan, maar hier ligt ie dan en ik ben er trots op! Bedankt voor alle fijne gesprekken, heerlijke humor en de leuke partijen die we gespeeld hebben. Het heeft me echt geholpen om dit voor elkaar te krijgen!

Domino, Fenna, Rienke, zonder jullie had ik nooit zo'n leuke tijd gehad op het Erasmus! Bedankt voor alle fijne momentjes van afleiding tijdens het werk en daarbuiten. Het was en is heerlijk om met jullie over alles te kunnen praten, van onbenulligheden tot levensvragen. Inmiddels zijn we allemaal uitgevlogen uit het Erasmus, maar elkaar gelukkig nog zeker niet uit het oog verloren. Ik waardeer onze vriendschap enorm en hoop dat die nog lang mag duren! Jo, Chris, Jess, Mandier, Myr we kennen elkaar al vanaf de middelbare school of zelfs nog langer en hebben inmiddels heel wat meegemaakt! Ik zou jullie voor geen goud willen missen, jullie betekenen veel voor me.

Han en Verena, Marten en Denice, Robin, Richard het is fijn om zulke schoonfamilie te hebben! Lieve pap en mam, bedankt dat jullie altijd zoveel vertrouwen in mij hebben en dat jullie er altijd voor me zijn. Jullie gaven me al jong het goede studievoorbeeld en zie hier het resultaat. M'n 'kleine' zussies, Jacq en Jet: ook al hebben we elkaar toen we klein waren wel eens de hersens ingeslagen (gelukkig is er voldoende van overgebleven om een proefschrift te kunnen schrijven) zijn we nu vooral goede vriendinnen. Heerlijk dat jullie zo in de buurt wonen en dat we regelmatig spontaan bij elkaar aan de eettafel zitten! Ik ben trots op wie jullie zijn en wat jullie hebben bereikt!

Lieve Han-Paul, wat als 'high school romance' is begonnen is inmiddels uitgegroeid tot heel wat meer. We zijn praktisch samen volwassen geworden, maar je weet me nog vaak te verrassen met lieve dingen! Ik ben er trots op dat ik mezelf inmiddels jouw vrouw mag noemen. Bedankt voor je steun, je liefde, je humor … voor alles! IK VIND JE LIEF!

ABOUT THE AUTHOR

Kerstin Gabriëlle Reeuwijk was born on October 8th, 1986 in Hoofddorp, the Netherlands. After graduating from secondary school (Kaj Munk College, Hoofddorp) in 2005, she travelled the east coast of Australia. She started her Bachelor of Health and Life Science at the VU University in Amsterdam in September 2006 and graduated Cum Laude with a major in Health Sciences. She obtained a research master's degree in Lifestyle and Chronic Disorders at the VU University Amsterdam in 2012, for which she successfully completed two master's internships. In between these internships, she explored Australia further. In May 2012, she was appointed as a junior researcher at the Department of Public Health at the Erasmus University Medical Centre in Rotterdam. During this period she wrote this thesis and performed practical research in the field of work and health. This research focused on the topic of sustainable employability of workers in the health care sector, but also on re-entering the labour market. As of May 2016, she works as a scientific staff member at the Health Council of the Netherlands in The Hague.

LIST OF PUBLICATIONS

In this thesis

Robroek SJ, Reeuwijk KG, Hillier FC, Bambra CL, van Rijn RM, Burdorf A. The contribution of overweight, obesity, and lack of physical activity to exit from paid employment: a meta-analysis. Scand J Work Environ Health 2013;39(3):233-40

Reeuwijk KG, de Wind A, Westerman MJ, Ybema JF, van der Beek AJ, Geuskens GA. 'All those things together made me retire': qualitative study on early retirement among Dutch employees. BMC Public Health 2013;13:516

Reeuwijk KG, Robroek SJ, Hakkaart L, Burdorf A. How work impairments and reduced work ability are associated with health care use in workers with musculoskeletal disorders, cardiovascular disorders or mental disorders. J Occup Rehabil 2014;24(4):631-9

Reeuwijk KG, Robroek SJ, Niessen MA, Kraaijenhagen RA, Vergouwe Y, Burdorf A. The prognostic value of the work ability index for sickness absence among office workers. PLoS One 2015;10(5):e0126969

Reeuwijk KG, van Klaveren D, van Rijn RM, Burdorf A, Robroek SJ. The influence of poor health on competing exit routes from paid employment among older workers in 11 European countries. submitted

Other publications

Reeuwijk KG, de Rooij M, van Dijk GM, Veenhof C, Steultjens MP, Dekker J. Osteoarthritis of the hip or knee: which coexisting disorders are disabling? Clin Rheumatol 2010;29(7):739-47

Robroek SJ, Reeuwijk KG, Molenaar D, van Haeff I, Mooren J, Burdorf A. Werkvermogen in de Limburgse zorg: aangrijpingspunten voor interventies. Tijdschrift voor HRM 2013;2:31-44

Reeuwijk KG, Robroek SJ, Molenaar D, Burdorf A. De associatie tussen een verminderde inzetbaarheid en frequentie en kosten van medische zorg. TBV 2013;21(7):298-304

de Wind A, Geuskens GA, Reeuwijk KG, Westerman MJ, Ybema JF, Burdorf A, Bongers PM, van der Beek AJ. Pathways through which health influences early retirement: a qualitative study. BMC Public Health 2013;13:292

Boschloo L, Reeuwijk KG, Schoevers RA, Penninx BWJH. The impact of lifestyle factors on the 2-year course of depressive and/or anxiety disorders. J Affect Disord 2014;159:73-9

PHD PORTFOLIO

Summary of PhD Training and Teaching

Name: Kerstin Gabriëlle van der Mark - Reeuwijk

Erasmus MC Department: Public Health

PhD period: May 2012 – Dec 2015

Promotor: Prof Dr ir A Burdorf

Copromotor: Dr SJW Robroek

	Year	Workload (ECTS)
1. PhD training		
General academic skills		
Scientific English	2013	4.0
Focus Groups	2013	0.5
Research Integrity for PhD students	2014	0.3
Time Management for PhD students	2015	0.2
In-depth NIHES courses		
Causal Inference	2012	0.7
Introduction in Global Public Health	2012	0.7
Methods in Public Health Research	2012	0.7
Methods in Health Service Research	2012	0.7
Didactic courses		
Teaching for Small Groups	2015	0.4
Teach the Teacher	2015	0.6
Presentations		
"All those things together made me retire": Qualitative study on early retirement among Dutch employees. Hannover, lidA symposium.	2012	0.5

Gedragsverandering. Roermond, Leernetwerk overleg.	2012	0.5
Duurzame inzetbaarheid en werkvermoden. Roermond, Syntens bijeenkomst.	2013	0.5
Resultaten tussenrapportage. Roermond, Leernetwerk overleg.	2013	0.5
Work impairments and reduced work ability associated with health care use. Rotterdam, Researchgroup meeting MGZ, Erasmus MC.	2013	0.5
Oorzaken en consequenties van verminderde inzetbaarheid op het werk. Enschede, Bewegen Werkt! Congres.	2013	0.5
Prognostic value of obesity, lifestyle, stress, and work ability for sickness absence. Helsinki, Work, Well-being and Wealth Conference.	2013	0.5
Oorzaken en consequenties van verminderde inzetbaarheid op het werk. Den Bosch, TransVorm bijeenkomst.	2013	0.5
Integrity in science. Rotterdam, Researchgroup meeting MGZ, ErasmusMC.	2014	0.5
Resultaten tussenmeting. Roermond, Leernetwerk overleg.	2014	0.5
Verminderde inzetbaarheid: oorzaken, consequenties en wat medewerkers doen om inzetbaar te blijven. Tilburg, TransVorm bijeenkomst.	2014	0.5
How work impairments and reduced work ability are associated with health care use in workers with common disorders. Copenhagen, Wellbeing at Work conference.	2014	0.5
Resultaten focusgroepen. Roermond, Leernetwerk overleg.	2014	0.5
Stand van zaken eindmeting. Roermond, Leernetwerk overleg.	2015	0.5
Sustainable employability in the health care sector. Rotterdam, Reseachgroup meeting MGZ, ErasmusMC.	2015	0.5
Eindresultaten Werkvermogen project Limburg. Roermond, Symposium Zorg aan Zet.	2015	0.5

Seminars and workshops

Seminars at the Department of Public Health, ErasmusMC, Rotterdam	2012-2015	3.3
Workshop Project Management, PhD day, Rotterdam	2012	0.1
Workshop Submitting Papers, PhD day, Rotterdam	2012	0.1
Workshop Networking, PhD day, Rotterdam	2013	0.1
Workshop Presentation Skills, PhD day, Rotterdam	2013	0.1

Workshop loopbaanontwikkeling, Rotterdam	2013	0.2
Social Epidemiology meetings, ErasmusMC, Rotterdam	2013-2014	0.5
Loopbaantraining, ErasmusMC, Rotterdam	2014	1.0
Workshop Discover your talents for the future, PhD day, Rotterdam	2015	0.1
Workshop Defend your thesis, PhD day, Rotterdam	2015	0.1
Where your PhD can take you, ErasmusMC, Rotterdam	2015	0.1
Workshop 'Maak je talent zichtbaar'	2015	0.3
International conferences and symposia		
lidA symposium, Hannover	2012	0.5
Bewegen Werkt! Congres, Enschede	2013	0.5
Work, Well-being and Wealth Conference, Helsinki	2013	0.5
STREAM symposium, Hoofddorp	2013	0.3
Nationaal Preventie Congres, Den Haag	2013	0.2
Wellbeing at Work, Copenhagen	2014	0.5
2. Teaching		
Masterclass Duurzame Inzetbaarheid, Urmond	2013	1.0
Supervising community projects, ErasmusMC, Rotterdam	2013-2014	3.0
Lecture Primaire preventie in de artsenpraktijk, ErasmusMC, Rotterdam	2015	0.5
Co-begeleiding master student MPA, ErasmusMC, Rotterdam	2015	1.0
Totaal		**30.8**