Determinants of voluntary early retirement for older workers with and without chronic diseases
A Danish prospective study

Sewdas, Ranu; Thorsen, Sannie Vester; Boot, Cécile R. L.; Bjørner, Jakob Bue; Van der beek, Allard J.

ORIGINAL ARTICLE

Determinants of voluntary early retirement for older workers with and without chronic diseases: A Danish prospective study

RANU SEWDAS[1] , SANNIE VESTER THORSEN[2] , CÉCILE R.L. BOOT[1],
JAKOB BUE BJØRNER[2,3] & ALLARD J. VAN DER BEEK[1]

¹Department of Public and Occupational Health, Amsterdam Public Health Research Institute, Amsterdam UMC, VU University Amsterdam, Amsterdam, The Netherlands, ²The Danish National Research Centre for the Working Environment, Denmark, ³Optum Patient Insights and Faculty of Health and Medical Sciences, Department of Public Health, University of Copenhagen, Denmark

Abstract

Aims: This study explored differences in determinants (i.e. health-related, work-related and social factors) of voluntary early retirement between older workers with and without chronic diseases in Denmark. **Methods:** Workers aged 56–64 years who were members of a voluntary early retirement scheme were selected from the Danish National Working Environment Survey (2008–2009) and were followed in a public register for four years. Cox regression analyses were performed separately for older workers with and without chronic disease to identify the associations between determinants and voluntary early retirement. To explore the differences between groups, an interaction term between the determinant and having a chronic disease was included in the analyses for the total population. **Results:** Among 1861 eligible older workers, determinants associated with a higher risk of voluntary early retirement included poorer self-rated health, more depressive symptoms, a higher physical workload, lower job satisfaction and lower influence at work. For older workers with a chronic disease (*n*=1185), the presence of work–family conflict was also associated with a higher risk of voluntary early retirement, whereas for those with no chronic disease (*n*=676), a poorer relationship with colleagues was an additional determinant. Higher emotional demands, a higher work pace and higher quantitative demands were not significantly associated with voluntary early retirement for either group. None of the interaction terms was found to be statistically significant (*p*>0.05). **Conclusions:** Determinants associated with voluntary early retirement did not significantly differ between older workers with or without a chronic disease in Denmark. We conclude that several health-related, work-related and social factors are important for prolonged labour force participation of older workers (with and without a chronic disease).

Keywords: *Voluntary early retirement, chronic disease, older workers, ageing, employment participation*

Background

To limit the increasing ratio of retired elderly to the active working population and to minimize the economic burden caused by an ageing population, current European policies encourage older workers to extend their working life [1]. For example, the Danish government has introduced a gradual increase in the state pension age from 65 years in 2012 to 67 years or older by 2024 [2]. In addition, the maximum period for obtaining early retirement benefit from the Danish voluntary early retirement scheme has been reduced from five to three years before state pension age. Similar policy measures have been taken in several other European countries, leading to an increasing number of older workers in the labour force [3]. However, the question remains whether the whole population of older workers is able to work longer or whether there are differences within this population

Correspondence: Cécile R.L. Boot, Department of Public and Occupational Health, VU University Medical Center, Van der Boechorststraat 7, 1081 BT Amsterdam, The Netherlands. E-mail: crl.boot@vumc.nl

based on their health status (e.g. having a chronic disease). The risk of living with a chronic disease increases with age for both men and women [4] and, as a result of the increasing number of older workers in the labour market, a large percentage will have a chronic disease.

Older workers with a chronic disease have a higher risk of an early exit from the labour force [5,6] and older workers in good health are more likely to prolong their working life [7,8]. An explanation for this might be that health-related problems caused by the presence of a chronic disease lead to functional limitations at work. Following this, older workers with a chronic disease may have specific needs for continued labour force participation that differ from older workers without a chronic disease. Additional knowledge about these differences is a key factor in supporting sustained employment for an older working population.

We focus here on important factors for prolonged labour force participation of older workers (with and without chronic disease) by investigating the factors associated with voluntary early retirement. The role of health-related, work-related and social factors on voluntary early retirement have been acknowledged by several studies [9–16]. For example, poor health was shown to be a risk factor for early retirement [9,13,16–18]. Previous studies have reported that unfavourable working conditions related to physical demands, psychosocial demands or the lack of job control may push people towards early retirement [10,11,15]. The opinion of a partner or spouse on early retirement was also found to be associated with early retirement [9]. Taken together, several health-related, work-related and social factors influence older workers' labour force participation.

To date, few studies have investigated whether or not the factors associated with voluntary early retirement are similar for older workers with or without a chronic disease [5,6,19,20] and these studies have found inconsistent results. For example, a recent study from the Netherlands showed that having low psychosocial resources at work (i.e. low levels of autonomy, task variation, supervisor support or coworker support) was associated with an early exit from the labour force for workers with a chronic disease; however, this was not the case for older workers without a chronic disease [6, 19]. By contrast, a study from the UK showed that favourable working conditions did not significantly reduce the risk of voluntary early retirement for older workers with a chronic disease [5]. The available studies on this topic have relied on self-reported early retirement, which we believe is less accurate than objective data

retrieved from a register. In addition, most available studies were conducted in the Netherlands or the UK. Research in other countries may help to establish whether the risk factors are general or country-specific.

The aim of this study was to compare the effects of various determinants (i.e. health-related, work-related and social factors) on voluntary early retirement based on registry data for older workers with and without a chronic disease in Denmark.

Methods

Study design and population

To investigate the determinants of voluntary early retirement among older workers with and without a chronic disease, a prospective study followed participants in the Danish National Working Environment Survey (DANES) for four years (2008–2012) in the National DREAM register [21]. DANES was conducted from late 2008 to early 2009 and included 12,559 participants aged 18 years and older. The DANES 2008-questionnaire survey contains data about work environment, self-perceived health, lifestyle, social factors and background factors (i.e. age, sex and level of education). The variables (except for depression and physical workload) from DANES 2008 were based on questions from the Copenhagen Psychosocial Questionnaire (COPSOQ-II), which is a questionnaire on psychosocial work- and health-related factors [22]. The COPSOQ-II has 41 scales and 127 questions. To minimize the response burden, only one or two questions from each scale were included in DANES 2008 and a psychometric analysis was performed to select the best questions, leaving 54 questions [22]. The reliability of the selected questions from each scale was tested by Cohen's weighted kappa in a test–retest design and the reliability was found to be moderate to very good (Cohen's weighted kappa 0.53–0.81). Further details on the DANES 2008 study design can be found elsewhere [23].

Participants were included if (at baseline) they were (a) between 56 and 64 years of age (i.e. meaning that they were at risk of voluntary early retirement, which is possible starting from the age of 60 years, within four years); (b) employed and a member of the Danish voluntary early retirement scheme; and (c) had valid data (i.e. a response week—the week number in which the participant responded to the questionnaire). Participants who were self-employed at baseline were excluded. In total, 1861 participants were included in the study (Figure 1). The participants were categorized into two groups based on the presence of a chronic disease because
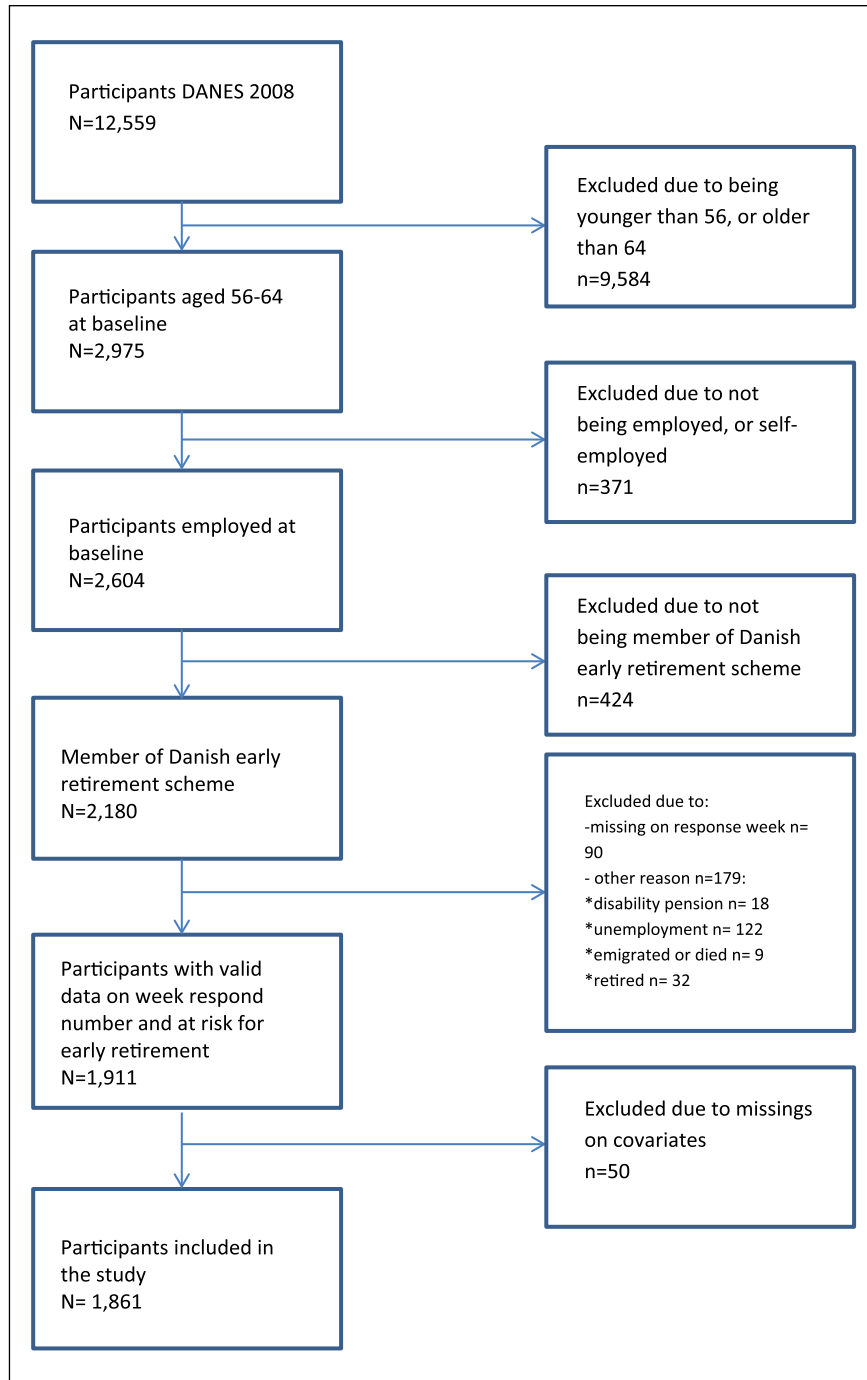
Figure 1. Flow chart of the study population.

we were interested in whether the presence of any chronic disease influenced the effect of the determinants on voluntary early retirement. Having a chronic disease was assessed using the question, 'Has a doctor ever told you that you have or had one of the following diseases?'. The answer categories were: asthma, diabetes, cardiovascular disease, back pain, hearing impairment, skin disease, depression or other mental disorder, or another chronic disease. Those who answered 'no, never' were placed in the group of older workers without a chronic disease and those who answered 'yes' to one of the answer categories were placed in the group of older workers with a chronic disease.

Dependent variable

The outcome variable was 'age (in weeks) at voluntary early retirement'. Retirement information from 2008 to 2012 was retrieved from the DREAM register data (linked to the DANES database), which covers all social welfare beneficiaries in Denmark [21]. The DREAM register contains data from the Danish Ministry of Employment, Ministry of Social Affairs, Ministry of Education, Ministry of Integration, 241 municipalities and Statistics Denmark [21]. The DREAM register contains information on a weekly basis. In Denmark, an early retirement benefit (Efterløn) can be claimed from the Danish voluntary early retirement scheme at age 60 years or older. However, claiming the retirement benefit after the age of 62 years is encouraged because it leads to higher benefits for early retirement. Entitlement to the Danish voluntary early retirement scheme (Efterløn) requires membership and contributions to the early retirement scheme for at least 25 of the last 30 years.

Independent variables

All information from the independent variables at baseline was obtained from the DANES 2008 questionnaire.

Health-related factors. Self-rated health was measured using the question, 'In general, which of the following would you say best describes your health?: 'excellent', 'very good', 'good', 'fair', or 'poor'?' [24]. These scores, ranged between 1 and 5, were used as descriptive statistics. For the analyses, the answer categories were recoded as 0, 0.25, 0.5, 0.75 and 1.0. Thus self-rated health ranged from 0 (better self-rated health) to 1 (poorer self-rated health). Self-rated health can be scored as a dichotomous variable, nominal variable or a continuous scale because a previous study has shown that all three scoring methods for self-rated health are linked to mortality [25]. In this study, self-rated health was analysed as a continuous scale. Depressive symptoms were measured using the Major Depression Inventory Scale (MDI) with 12 items [26]. These items were assessed using a six-point scale (scores between 0 and 5). We used 10 items in total because items 8 and 10 each have two sub-items (a and b). Therefore a total score could vary from 0 to 50 and these scores were used as descriptive statistics. For the analyses, the answer categories were recoded between 0 and 1. Thus the depression score ranged from 0 (less depressive symptoms) to 1 (more depressive symptoms). The MDI can be scored as a continuous scale or dichotomous variables [26]. A previous study has shown that continuous scoring can be used to predict long-term sickness absence [27].

Work-related factors. Work-related factors from DANES 2008 were largely based on questions from COPSOQ-II [22]. Physical workload at a person's main job was measured by asking, 'How would you describe your physical activity at your main job?' and the answers included 'mostly sedentary', 'mostly work while standing or walking', 'work while standing or walking with some lifting and carrying' and 'heavy or fast-moving work that is physically strenuous'. Job satisfaction was assessed by asking, 'How pleased are you with your job as a whole, everything taken into consideration?' and the answers included 'very satisfied', 'satisfied', 'unsatisfied' and 'very unsatisfied'.

Emotional demands, work pace, quantitative demands, and influence and relationships with colleagues were all assessed using a five-point Likert scale ranging from 'always' to 'never/hardly ever'. Emotional demands were assessed by asking, 'Does your work put you in emotionally disturbing situations?' and 'Do you have to relate to other people's personal problems as part of your work?'. Work pace was assessed by asking, 'Do you have to work very fast?'. Quantitative demands were assessed by asking, 'How often do you not have time to complete all your work tasks?'. Influence at work (i.e. job control) was assessed by the questions 'Do you have a large degree of influence concerning your work?' and 'Can you influence the amount of work assigned to you?'. Relationships with colleagues was assessed by asking, 'Is there a good atmosphere between you and your colleagues?'. For analysis, all answer categories were recoded between 0 and 1 (e.g. a five-point Likert scale was recoded to 0, 0.25, 0.5, 0.75 and 1). Thus all work-related variables ranged from 0 (better working conditions) to 1 (poorer working conditions).

Work–family conflict. Work–family conflict was assessed using three questions: 'Do you often feel a conflict between your work and your private life, making you want to be in both places at the same time?', 'Do you feel that your work drains so much of your energy that it has a negative effect on your private life?' and 'Do you feel that your work takes so much of your time that it has a negative effect on your private life?'. These questions had four possible answers ranging from 'no, never/not at all' to 'yes, absolutely/often'. The mean score of these three items was calculated for descriptive statistics ranging between 1 and 4. For analysis, all answer categories were recoded between 0 and 1 and ranged from 0

(lower work–family conflict) to 1 (higher work–family conflict).

Covariates. Sex (male/female), educational level and mode of data collection were included as confounders. Educational level was categorized as follows: 1=no occupational training, semi-skilled workers education or similar (<12 months), one year of vocational training; 2=completed apprenticeship or vocational training; 3=other occupational training (≥12 months); 4=higher education for less than three years; 5=higher education for three to four years; and 6= higher education for more than four years. The mode of data collection was defined as internet or post versus telephone. Although the two forms of data collection were found to be comparable, we included the mode of data collection as a confounder.

Analyses

Descriptive statistics (e.g. means, standard deviations, frequencies and percentages) were used to report the baseline characteristics for the groups with and without a chronic disease. From all independent variables, the means of the original scales were reported as descriptive statistics to compare the mean scores of our population with those of the same population in other studies.

The answer categories in the analyses were standardized to make the variables more comparable. Answer categories were recoded between 0 and 1 (e.g. a five-point Likert scale was recoded to 0, 0.25, 0.5, 0.75 and 1.0). In this way, health-related factors, work-related variables and work–family conflict ranged from 0 (better health/working conditions) to 1 (poorer health/working conditions). All variables were analysed as a continuous scale because continuous scales were used for the validation of questions from the COPSOQ-II [22] and this method was proved to be successful in a previous study [15].

Cox regression analyses (SAS 9.3 proc PHreg) were performed separately for the groups of older workers with and without a chronic disease to identify the associations between the determinants and age at voluntary early retirement. The participant's calendar age was used as the time axis and started at 60 years (=0 weeks) because retirement was only possible at 60 years or older. Participants who were older than 60 years when they answered the questionnaire had a start time with a value higher than 0 (delayed entry). For instance, a participant who answered the questionnaire at age 61 years had a start time of +52 weeks on the time axis. Participants who were younger than 60 years when answering the questionnaire had a negative start time on the time axis (e.g. a participant who answered the questionnaire at age 57 years had a start time of −156 weeks on the time axis). The end-time was calculated for each participant based on the age when they had taken voluntary early retirement (e.g. the end-time for those who retired early at age 62 years corresponded to +104 weeks on the time axis; note that retirement was not possible before the age of 60 years). Participants were followed until 31 December 2012.

Participants were censored if they had accepted a disability pension, turned 65 years of age or died. A previous study found differences between fully work-disabled and unemployed people (including those who retired early). People who were fully work-disabled were more often older, experienced more frequent occurrences of symptoms related to their disease and more pain and fatigue, and had more functional disabilities than those who were unemployed [28]. Because it is unlikely that people without a chronic disease will transition from work to a disability pension, we censored participants if they went onto a disability pension. Covariates such as sex, educational level and mode of data collection were included in the adjusted model. For each determinant, the confidence interval (CI) of 95% was reported for the hazards ratio (HR).

To test the differences between groups with and without a chronic disease, the covariate 'having a chronic disease yes/no' was used to examine possible effect modification (multiplicative interaction) in similar Cox regression analyses among the total population of both groups of workers [29]. By studying multiplicative interaction, subgroups of participants in which the determinant was likely to have the largest effect on the outcome measurement can be identified. Effect modification was considered significant if the interaction term between the covariate 'having a chronic disease yes/no' with $p<0.05$.

Sensitivity analysis

A sensitivity analysis was conducted to test a main effect of having a chronic disease on voluntary early retirement by performing a Cox regression analysis between having a chronic disease and age at voluntary early retirement.

Results

Table I shows the baseline characteristics for the group of older workers (aged 56–64 years old at

Table I. Baseline characteristics for the groups of participants with and without a chronic disease (*N*=1861).

Characteristics	Chronic disease (*n*=1185)	No chronic disease (*n*=676)
Retired between 2009 and 2012	510 (43)	276 (41)
Mean follow-up time (weeks)	123±67	123±66
Age (years)	58.6±2.2	58.5±2.2
Male sex	611 (52)	308 (46)
Educational level[a]		
1	161 (14)	101 (15)
2	149 (13)	118 (17)
3	214 (18)	130 (19)
4	146 (12)	71 (11)
5	370 (31)	200 (30)
6	145 (12)	56 (8)
Mode of data collection (internet/post versus telephone)	1058 (89)	591 (87)
Health-related factors[b]		
Self-rated health (1–5)	2.8±0.8	2.3±0.7
Depressive symptoms (0–50)	7.6±6.8	5.1±5.3
Work-related factors[b]		
Physical workload (1–4)	1.9±0.9	2.0±0.9
Job satisfaction (1–4)	1.8±0.6	1.7±0.6
Emotional demands (1–5)	2.6±1.0	2.5±1.0
Work pace (1–5)	3.4±0.9	3.4±0.9
Quantitative demands (1–5)	2.7±1.0	2.5±1.0
Influence at work (1–5)	2.7±1.0	2.7±1.0
Relationships with colleagues (1–5)	1.7±0.7	1.6±0.7
Social factor[b]		
Work–family conflict (1–4)	1.9±0.7	1.8±0.7

Data are presented an *n* (%) or mean±SD values.

[a]1: no occupational training, semi-skilled workers education or similar (<12 months), one year of vocational training; 2: completed apprenticeship or vocational training; 3: other occupational training (≥12 months); 4: higher education <3 years; 5: higher education 3–4 years; 6: higher education >4 years.

[b]Higher scores indicate a poor health status and worst working conditions.

baseline) with and without a chronic disease in the sample of 1861 participants who met the inclusion criteria. From the total eligible sample, 786 (42%) participants retired between 2009 and 2012 and 1185 (64%) participants reported having at least one chronic disease.

Determinants of voluntary early retirement among older workers with a chronic disease

The adjusted analyses showed that among the participants with a chronic disease, an increased risk of voluntary early retirement was found for those with poorer self-rated health (HR 2.15, 95% CI 1.37–3.37) and for those having more depressive symptoms (HR 2.05, 95% CI 1.14–3.71) (Table II). For work-related factors, a higher risk of voluntary early retirement was found for a higher physical workload (HR 1.84, 95% CI 1.37–2.48), lower job satisfaction (HR 3.08, 95%CI 2.09–4.55) and lower influence at work (HR 1.94, 95% CI 1.36–2.77). A small increased risk of voluntary early retirement was found for a higher score on work–family conflict (HR 1.59, 95% CI 1.11–2.27).

Determinants of voluntary early retirement among older workers without a chronic disease

Among the older workers without a chronic disease, an increased risk of voluntary early retirement was found for those with poorer self-rated health (HR 2.56, 95% CI 1.27–5.16) and for those with more depressive symptoms (HR 4.22, 95% CI 1.47–12.11) (Table II). For work-related factors, a higher risk of voluntary early retirement was found for higher physical workload (HR 2.09, 95% CI 1.39–3.13), lower job satisfaction (HR 5.27, 95% CI 2.96–9.40), lower influence at work (HR 1.69, 95% CI 1.04–2.75) and a poorer relationship with colleagues (HR 2.81, 95% CI 1.44–5.49).

Comparison of determinants

The interaction between having a chronic disease and a poorer relationship with colleagues was closest to significance with a *p*=0.06. However, no interaction had *p*<0.05 and therefore this study did not show a significant difference in the HRs of the determinants between those with or without a chronic disease.

Table II. Association models between health, work-related and social factors, and age at voluntary early retirement between 2008 and 2012 in Cox regression analyses.

Characteristics	Chronic disease		No chronic disease	
	Crude models	Adjusted models[a]	Crude models	Adjusted models[a]
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Health-related factors				
Poorer self-rated health (0–1)	**2.49 (1.60–3.88)**	**2.15 (1.37–3.37)**	**2.35 (1.18–4.69)**	**2.56 (1.27–5.16)**
More depressive symptoms (0–1)	**2.54 (1.41–4.55)**	**2.05 (1.14–3.71)**	**3.85 (1.33–11.11)**	**4.22 (1.47–12.11)**
Work-related factors				
Higher physical workload (0–1)	**2.08 (1.57–2.75)**	**1.84 (1.37–2.48)**	**2.19 (1.50–3.19)**	**2.09 (1.39–3.13)**
Lower job satisfaction (0–1)	**2.99 (2.02–4.41)**	**3.08 (2.09–4.55)**	**4.84 (2.75–8.51)**	**5.27 (2.96–9.40)**
Higher emotional demands (0–1)	0.92 (0.65–1.30)	0.96 (0.67–1.39)	1.19 (0.75–1.92)	1.47 (0.90–2.39)
Higher work pace (0–1)	**1.51 (1.00–2.27)**	1.43 (0.95–2.17)	**1.87 (1.04–3.34)**	1.67 (0.94–2.97)
Higher quantitative demands (0–1)	0.89 (0.63–1.24)	0.93 (0.66–1.31)	0.92 (0.58–1.48)	1.08 (0.67–1.74)
Lower influence at work (0–1)	**2.36 (1.67–3.35)**	**1.94 (1.36–2.77)**	**2.03 (1.26–3.27)**	**1.69 (1.04–2.75)**
Poorer relationships with colleagues (0–1)	1.28 (0.79–2.07)	1.27 (0.79–2.04)	**2.44 (1.23–4.82)**	**2.81 (1.44–5.49)**
Social factor				
Higher work–family conflict (0–1)	1.40 (0.99–1.99)	**1.59 (1.11–2.27)**	1.06 (0.62–1.83)	1.32 (0.76–2.29)

CI: confidence interval; HR: hazards ratio.
[a]Adjusted for sex, educational level and mode of data collection.
Bold values significant at 0.05.

Sensitivity analyses

An increased risk of voluntary early retirement was found for participants with a chronic disease compared with those without a chronic disease in the analysis with adjustment for sex, educational level and mode of data collection. The crude analysis showed an HR of 1.20 (95% CI 0.95–1.28) and an HR of 1.18 (95% CI 1.02–1.37) was found for the adjusted analysis.

Discussion

This study showed that poorer self-rated health, more depressive symptoms, a higher physical workload, lower job satisfaction and a lower influence at work were determinants of voluntary early retirement among workers with and without a chronic disease. For workers with a chronic disease, a higher score on work–family conflict was associated with a higher risk of voluntary early retirement, whereas a poorer relationship with colleagues was associated with a higher risk of voluntary early retirement among those without a chronic disease. Higher emotional demands, a higher work pace and higher quantitative demands were not significantly associated with voluntary early retirement for either group.

In line with previous studies, this study also found that poorer self-rated health and more depressive symptoms were strongly associated with voluntary early retirement [9,13,16–18,30]. We therefore conclude that better health enables older workers to work longer. This study also confirms that a higher risk of voluntary early retirement was observed among those with a higher physical workload, lower job satisfaction and a lack of job control [10,11,15,18]. Therefore our results indicate that employers can support Danish older workers by reducing their physical workload and providing them with more influence on the number of their tasks and on how, when and where to perform those tasks. One special finding in this study was that a poorer relationship with colleagues is an important reason for voluntary early retirement among older workers without a chronic disease. Given this finding, employers may focus on increasing social support – for example, by promoting teamwork or team-building activities.

We found no difference between older workers with or without a chronic disease in the factors related to voluntary early retirement. This result corresponds to findings from another recent study with a similar research design (using retirement as an outcome and controlling for confounding variables) [5]. By contrast, another study has shown that the influence of low psychosocial resources at work and high physical demands differed between workers with and without a chronic disease [19]. However, that study did not differentiate between exit routes (e.g. unemployment, disability pension, voluntary early retirement) and did not control for confounding variables. These methodological differences may explain the different findings. The present study adds to these two studies because we used data (age at voluntary early retirement)

retrieved from a register. An advantage of using an objective measurement for voluntary early retirement instead of self-reported voluntary early retirement is that our data were not affected by recall bias.

According to the International Classification of Functioning, Disability and Health model, many personal (i.e. demographic, psychological and health-related) and environmental (i.e. social and work-related) factors influence work participation among workers with a chronic disease [31]. It could be that this study did not include all the determinants important for voluntary early retirement and therefore we recommend that further research should explore other personal (including financial) and environmental factors important for workers with a chronic disease by using a mixed method design. There are two other reasons for finding a lack of significant differences. First, it could be that unhealthy workers had already left the labour force via a work disability pension, leaving a selection of workers with and without a chronic disease in good health in the present study population, also called the 'healthy worker effect' [32]. Future research is needed to follow participants at younger ages using data with longer follow-up periods to avoid the selection of relatively 'healthy' older workers at baseline. Second, it could be that the sample sizes were insufficiently large to find statistically significant interactions between determinants and having a chronic disease. As the data collection was conducted years ago, we were constrained to the sample size available. With the available sample size, it could be possible that we missed relevant interaction terms because they did not reach statistical significance due to low power.

The strengths of this study are its longitudinal design, the follow-up through public registers and the high response rate in the baseline survey of 70% [23]. However, this study has also several limitations. The determinants were analysed on a continuous scale. Other scoring methods, such as using nominal or dichotomous variables, might be preferred, but a consensus is lacking. The advantage of a continuous scale is the sensitivity for change, whereas the advantage of a dichotomous or nominal scale is that it does not assume a linear relation with the effects. However, a linear relation was found between the determinant and outcome variable for all determinants. As everyone in our study population had the financial opportunity to obtain voluntary early retirement benefits and we excluded those who were not a member of the voluntary early retirement scheme, the results of this study might not be applicable to other countries with different retirement schemes. Because our study population was probably homogeneous with regards

to the financial possibility to retire early, we cannot clarify the importance of financial factors related to voluntary early retirement in Denmark. By contrast, this could also be considered a methodological strength, because in many other countries financial pressures may tend to overshadow important health-related, work-related and social factors. Another limitation is that the group of workers with a chronic disease might be too heterogeneous; different chronic diseases may lead to different limitations at work. Therefore the heterogeneity of the chronic disease group may have reduced the possibility of finding significant differences.

The prolonged labour force participation of older workers is a challenge for governments in European countries. This study and the study by Fleischmann et al. [5] indicate that the factors determining prolonged labour force participation are similar for workers with and without a chronic disease. However, older workers with a chronic disease take more sick leave, have a lower work ability and we showed that they retire earlier than their colleagues without a chronic disease [5,6,33,34]. Therefore, regardless of finding no evidence for the specific needs of older workers with a chronic disease, policy advisers and researchers should acknowledge the vulnerability of older workers in general and, in particular, those with a chronic disease in our ageing labour force. All older workers will benefit from positive working conditions (e.g. more influence on job tasks and lower physical demands) and good self-rated health enables older workers to work longer. Therefore we recommend that future research focuses on developing and implementing health and work environment promotion programmes in the workplace to enable the sustained employability of all older workers.

This study showed that the influence of health-related, work-related and social determinants of voluntary early retirement do not significantly differ among older workers with or without a chronic disease in Denmark. It also showed that a higher physical workload, lower job satisfaction and lower influence at work were associated with a higher risk of voluntary early retirement and that good self-rated health and fewer depressive symptoms could reduce the risk of voluntary early retirement for older workers (with or without a chronic disease). Optimizing work-related factors may facilitate sustained employment for an older working population in general.

Author contributions

All authors contributed to the design of this paper. The authors RS, SVT and CB contributed to the data analysis. The authors RS and CB participated

in drafting the article. All authors revised the article critically for important intellectual content.

Conflict of interest

The authors declare that there is no conflict of interest.

Funding

Availability of data and material

The register data used and/or analysed during the present study are not available on request. Data from DANES 2008 are available from the project leader on reasonable request

Ethics approval

Approval was obtained from the Danish Data Protection Agency.

ORCID iDs

Ranu Sewdas https://orcid.org/0000-0002-8774-0823
Sannie Vester Thorsen https://orcid.org/0000-0002-8778-9053

References

[1] Sigg R and De-Luigi V. *The success of policies aimed at extending working life*. Geneva: International Social Security, 2007.

[2] Hasselhorn HM and Apt W. *Understanding employment participation of older workers: Creating a knowledge base for future labour market challenges. Research report*. Berlin: Federal Ministry of Labour and Social Affairs and Federal Institute for Occupational Safety and Health, 2015.

[3] OECD. *Labour force participation rate (indicator)*, https://data.oecd.org/emp/labour-force-participation-rate.htm (2017, accessed 1 February 2019).

[4] Harbers MM and Achterberg PW. *Europeans of retirement age: Chronic diseases and economic activity*. Bilthoven: RIVM, 2012.

[5] Fleischmann M, Carr E, Stansfeld SA, et al. Can favourable psychosocial working conditions in midlife moderate the risk of work exit for chronically ill workers? A 20-year follow-up of the Whitehall II study. *Occup Environ Med* 2018;75:183–90.

[6] Sewdas R, van der Beek AJ, de Wind A, et al. Determinants of working until retirement compared to a transition to early retirement among older workers with and without chronic diseases: Results from a Dutch prospective cohort study. *Scand J Public Health* 2018;46:400–8.

[7] Griffin B and Hesketh B. Post-retirement work: The individual determinants of paid and volunteer work. *J Occup Organiz Psychol* 2008;81:101–21.

[8] Wang M, Zhan Y, Liu S, et al. Antecedents of bridge employment: A longitudinal investigation. *J Appl Psychol* 2008;93:818–30.

[9] de Wind A, Geuskens GA, Ybema JF, et al. Health, job characteristics, skills, and social and financial factors in relation to early retirement – results from a longitudinal study in the Netherlands. *Scand J Work Environ Health* 2014;40:186–94.

[10] Friis K, Ekholm O, Hundrup YA, et al. Influence of health, lifestyle, working conditions, and sociodemography on early retirement among nurses: The Danish Nurse Cohort Study. *Scand J Public Health* 2007;35:23–30.

[11] Lund T, Iversen L and Poulsen KB. Work environment factors, health, lifestyle and marital status as predictors of job change and early retirement in physically heavy occupations. *Am J Indust Med* 2001;40:161–9.

[12] Lund T and Villadsen E. Who retires early and why? Determinants of early retirement pension among Danish employees 57–62 years. *Eur J Ageing* 2005;2:275–80.

[13] Reeuwijk KG, van Klaveren D, van Rijn RM, et al. The influence of poor health on competing exit routes from paid employment among older workers in 11 European countries. *Scand J Work Environ Health* 2017;43:24–33.

[14] Robroek SJ, Schuring M, Croezen S, et al. 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;39:125–33.

[15] Thorsen SV, Jensen PH and Bjorner JB. Psychosocial work environment and retirement age: A prospective study of 1876 senior employees. *Int Arch Occup Environ Health* 2016;89:891–900.

[16] van Rijn RM, Robroek SJ, Brouwer S, et al. Influence of poor health on exit from paid employment: A systematic review. *Occup Environ Med* 2014;71:295–301.

[17] Schuring M, Robroek SJ, Otten FW, et al. 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;39:134–43.

[18] van den Berg T, Elder L and Burdorf A. Influence of health and work on early retirement. *J Occup Environ Med* 2010;52:576–83.

[19] Boot CRL, Deeg DJ, Abma T, et al. Predictors of having paid work in older workers with and without chronic disease: A 3-year prospective cohort study. *J Occup Rehabil* 2014;24:563–72.

[20] Leijten FR, de Wind A, van den Heuvel SG, 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;69:1058–65.

[21] Hjollund NH, Larsen FB and Andersen JH. Register-based follow-up of social benefits and other transfer payments: accuracy and degree of completeness in a Danish interdepartmental administrative database compared with a population-based survey. *Scand J Public Health* 2007;35:497–502.

[22] Pejtersen JH, Kristensen TS, Borg V, et al. The second version of the Copenhagen Psychosocial Questionnaire. *Scand J Public Health* 2010;38(3 Suppl):8–24.

[23] Bjorner JB, Burr H, Feveile H, et al. *Ændringer i det danske arbejdsmiljø fra 2005 til 2008*. Copenhagen: National Research Centre for the Working Environment. 2010.

[24] Bjorner JB, Kristensen TS, Orth-Gomér K, et al. Self-rated health: a useful concept in research, prevention and clinical medicine. 1996, Stockholm: Swedish Council for Planning and Coordination of Research

[25] Assari S, Lankarani MM and Burgard S. Black–white difference in long-term predictive power of self-rated health on all-cause mortality in United States. *Ann Epidemiol* 2016;26:106–14.

[26] Bech P, Rasmussen NA, Olsen LR, et al. The sensitivity and specificity of the Major Depression Inventory, using the Present State Examination as the index of diagnostic validity. *J Affect Disord* 2001;66:159–64.

[27] Thorsen SV, Rugulies R, Hjarsbech PU, et al. The predictive value of mental health for long-term sickness absence: the Major Depression Inventory (MDI) and the Mental Health Inventory (MHI-5) compared. *BMC Med Res Methodol* 2013;13:115.

[28] Baanders AN, Rijken PM and Peters L. Labour participation of the chronically ill. A profile sketch. *Eur J Public Health* 2002;12:124–30.

[29] Twisk JWR. *Inleiding in de toegepaste biostatistiek*. 2nd ed. Amsterdam: Reed Business, 2014.

[30] Karpansalo M, Kauhanen J, Lakka TA, et al. Depression and early retirement: Prospective population based study in middle aged men. *J Epidemiol Community Health* 2005;59:70–4.

[31] World Health Organization. *International classification of functioning, disability and health: ICF*. Geneva: WHO, 2001.

[32] McMicheal A. Standardized mortality ratios and the 'healthy workers effect': scratching beneath the surface. *J Occup Environ Med* 1976;18:165–8.

[33] Koolhaas W, van der Klink JJ, de Boer MR, et al. Chronic health conditions and work ability in the ageing workforce: The impact of work conditions, psychosocial factors and perceived health. *Int Arch Occup Environ Health* 2014;87:433–43.

[34] Roskes K, Donders NC and van der Gulden JW. Health-related and work-related aspects associated with sick leave: A comparison of chronically ill and non-chronically ill workers. *Int Arch Occup Environ Health* 2005;78:270–8.