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Influence of poor health on exit from paid employment: a systematic review

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ABSTRACT

The objective was to provide a systematic literature review on associations between poor health and exit from paid employment through disability pension, unemployment and early retirement, and to estimate the magnitude of these associations using meta-analyses. Medline and Embase databases were searched for longitudinal studies on the relationship between health measures and exit from paid employment. Random-effects models were used to estimate the pooled effects. In total, 29 studies were included. Self-perceived poor health was a risk factor for transition into disability pension (relative risk (RR) 3.61; 95% CI 2.44 to 5.35), unemployment (RR 1.44; 95% CI 1.26 to 1.65) and early retirement (RR 1.27; 95% CI 1.17 to 1.38). Workers with mental health problems had an increased likelihood for transition into disability pension (RR 1.80; 95% CI 1.41 to 2.31) or unemployment (RR 1.61; 95% CI 1.29 to 2.01). Chronic disease was a risk factor for transition into disability pension (RR 2.11; 95% CI 1.90 to 2.33) or unemployment (RR 1.31; 95% CI 1.14 to 1.50), but not for early retirement. This meta-analysis showed that poor health, particularly self-perceived health, is a risk factor for exit from paid employment through disability pension, unemployment and, to a lesser extent, early retirement. To increase sustained employability it should be considered to implement workplace interventions that promote good health.

INTRODUCTION

In most Western countries a higher and prolonged labour force participation throughout a worker's life is necessary to safeguard the social and economic realities of an aging society. In order to achieve this ambition, governments are developing policies to stimulate labour force participation, particularly to keep workers in the workforce till older age.^{1–4}

The success of the developed policies depends on better understanding of the relationship between the impact of health on labour force participation.⁵ In the past few years several studies have demonstrated that health status may have a profound impact on the ability of workers to be actively engaged in paid employment and to prolong their meaningful contribution to a productive society. There is evidence from different longitudinal studies that poor health plays a role in exit from paid employment, due to disability pension,^{6–9} unemployment^{8 10 11} and early retirement.^{8 10 12} A community based survey in the UK found evidence for health related job loss, especially in relation to musculoskeletal disorders and mental illness.¹³ Pedersen *et al*⁶ demonstrated that the risk of transition (from employment,

unemployment or sickness absence) into disability pension was increased in those with a chronic disease. However, the risk of transition from work into unemployment was lower in those with a chronic disease. A prospective register study, with 15 years follow-up, in a cohort of nurses' aides found that risk factors for disability pension were mainly health related (eg, low back pain, sick leave spells), whereas economic factors (eg, income of spouse) influence the decision to retire early.¹⁴ A recent meta-analysis showed evidence for the association between important health behaviour factors and exit from paid employment. Obese, and to a lesser extent overweight, workers had an increased likelihood of exit from paid employment through disability benefit. Workers with lack of physical activity had an increased risk of disability benefit and unemployment.¹⁵

The impact of various health measures on exit from paid employment suggests that these measures differ between the main pathways of leaving the labour force, particularly between the involuntary (ie, disability pension, unemployment) and more voluntary routes (ie, early retirement) of exit from work. In order to understand and quantify the importance of different health measures on labour market exit pathways, the literature needs to be synthesised. Therefore, our aim was to provide a systematic literature review of the associations between different health measures and exit from paid employment through disability pension, unemployment and early retirement, and to estimate the magnitude of these associations using meta-analyses.

MATERIALS AND METHODS

Literature search

Comprehensive literature searches were conducted by the first author (RMvR) in Medline, Embase and Web of Science (inception of databases to July 2013). The following keywords were used: health, work related, early-retirement, unemployment, disability pension, study design. The full search strategy is presented in online supplementary appendix I.

Based on title and abstract one reviewer (RMvR) selected the articles for full text appraisal. Two reviewers (RMvR, SJWR) independently selected articles for final inclusion. Each article had to fulfil all of the following criteria: (1) a health measure was described, (2) exit from paid employment was defined as receiving disability pension, unemployment or early retirement, (3) the association between health and exit from paid employment was expressed in an OR, relative risk (RR) or HR, or sufficient raw data was available to calculate associations, (4) a longitudinal study design was

used, (5) the study had to involve a non-patient population, and (6) the article was published in a peer reviewed scientific journal written in English. A consensus method was used to resolve disagreements.

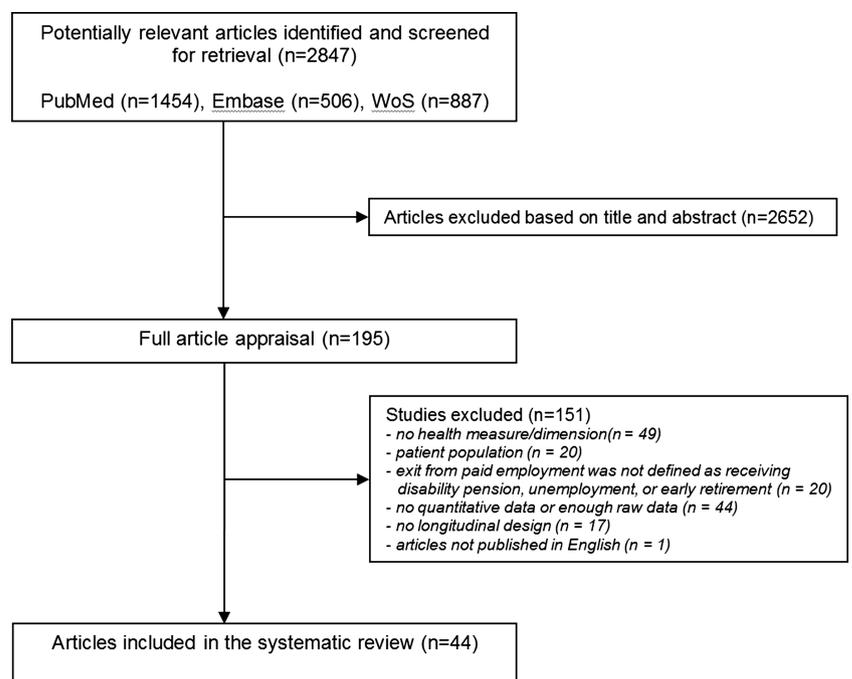
Data extraction

Relevant information on study population (age, gender, sample size), health measures, exit routes from paid employment and measures of associations with corresponding CI were extracted from the included articles by the first author (RMvR). The core findings in each article were expressed by measures of associations (OR, RR or HR) with corresponding 95% CIs. Where possible, these associations were directly extracted from the original article. For articles in which this information was not presented, associations calculated using raw data were provided.

Data analysis

Heterogeneity of the included studies was determined using the I^2 statistics, which indicates the percentage of total variation across studies that is due to heterogeneity rather than chance.¹⁶ Due to observed heterogeneity ($I^2 > 50\%$ for disability pension) we conducted random-effects meta-analyses of the health effects on disability pension, unemployment and early retirement. 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 between-study and within-study variability.¹⁷ We used an Excel spreadsheet for pooling of RRs.¹⁸ In the meta-analysis we used measures of association that were adjusted for potential confounders, as presented in the original articles. An OR or HR was considered as approximation of RR when the frequency of outcome event was less than 10%. A higher frequency of events will lead to an OR that substantially overestimated the RR.^{19–20} Population attributable fractions (PAF) were calculated for significant determinants of exit from paid employment, using the formula $PAF = Pe(RR-1)/(1+Pe(RR-1))$ where Pe represents the prevalence of health problems in the study population.²¹

Figure 1 Flow chart of the included studies.



RESULTS

Characteristics of the included studies

Our search of the literature resulted in 2847 potentially relevant articles (figure 1). After title and abstract screening, 195 articles were retrieved for full text appraisal. Finally, 44 articles were included describing the influence of health on the risk of disability pension (n=29), unemployment (n=17) and early retirement (n=9). Exclusion of articles was mainly due to lack of health measures (n=49), absence of quantitative data (n=44) or study population restricted to a specific patient group (n=20). Several studies provided more than one measure of association and thus the sum of associations presented exceeds the number of included articles, for disability pension (self-perceived health: n=13, mental health: n=29, chronic disease: n=42), unemployment (self-perceived health: n=14, mental health: n=15, chronic disease: n=25) and early-retirement (self-perceived health: n=6, chronic disease: n=22). No studies were found on the association between mental health problems and exit through early retirement. In 12 articles no measure of association was presented, therefore we used the available raw data to calculate an OR with 95% CI.^{9 11 22–31}

Disability pension

Twenty-nine studies reported on the impact of health on the risk of disability pension (see online supplementary appendix II).^{7–9 14 23–28 30–48} In 23 out of 29 studies the frequency of events was less than 10%, therefore OR and HR were considered as an approximation of RR.

Self-perceived health was evaluated in 12 studies,^{7–9 23 24 26 30 36 37 43 46 48} presenting 13 associations. In all 12 studies self-perceived poor health was a significant risk factor for transition into disability pension (table 1) with a pooled RR of 3.61 (95% CI 2.44 to 5.35), table 2 and figure 2. Poor health was measured on a 5-point Likert scale,^{7–9 26 43 46} a 4-point Likert scale,^{23 24 48} or with the short-form health survey (SF-12 or SF-36).^{30 36} In eight studies poor health was defined as 'less than good health',^{7–9 24 30 43 46 48} whereas the other studies

Table 1 Summary of associations between health measures and exit routes from paid employment as presented in the studies included in this systematic review

	Disability pension		Unemployment		Early retirement	
	No. of studies*	Range (RR/OR/HR)	No. of studies*	Range (RR/OR/HR)	No. of studies*	Range (RR/OR/HR)
Self-perceived health						
▶ All studies together	13	1.30–7.38	14	0.94–2.15	6	1.17–1.55
▶ Studies with significant associations	13	1.30–7.83	9	1.14–2.15	4	1.20–1.55
▶ Studies without significant associations	0	–	5	0.94–1.49	2	1.17–1.20
Mental health						
▶ All studies together	29	0.49–7.56	15	0.77–4.80	0	–
▶ Studies with significant associations	18	1.40–7.56	10	1.57–4.80		
▶ Studies without significant associations	11	0.49–2.23	5	0.77–1.10		
Chronic disease						
▶ All studies together	42	1.13–5.62	25	0.90–2.20	22	0.61–3.46
▶ Studies with significant associations	35	1.32–5.62	4	1.35–2.11	6	1.21–3.46
▶ Studies without significant associations	7	1.13–1.60	21	0.90–2.20	16	0.61–1.56
MSD						
▶ All studies together	25	1.14–4.64	9	0.9–2.20	4	0.90–1.76
▶ Studies with significant associations	23	1.50–4.64	0	–	1	1.76
▶ Studies without significant associations	2	1.14–1.60	9	0.9–2.20	3	0.91–1.56
Respiratory						
▶ All studies together	5	1.80–3.92	0	–	7	0.82–3.46
▶ Studies with significant associations	4	1.80–3.92			1	3.46
▶ Studies without significant associations	1	1.14			6	0.82–1.17
Other						
▶ All studies together	12	1.13–5.62	16	0.84–2.11	11	0.87–1.47
▶ Studies with significant associations	8	1.32–5.62	4	1.35–2.11	4	1.21–1.47
▶ Studies without significant associations	4	1.13–1.53	12	0.84–1.52	7	0.87–1.42

*Total number of studies within a category heading does not necessarily equal the number of studies included because some studies provide more than one association. MSD, musculoskeletal disorder.

defined poor health as 'less than fair health',²³ 'less than moderate health',²⁶ or as a cut-off value <40 on the SF-36.³⁶ Explorative analysis showed no influence of different cut-off values on pooled estimates of self-perceived poor health ('less than good health': RR 3.08, 95% CI 1.94 to 4.88; 'less than fair/moderate health': RR 4.07, 95% CI 1.70 to 9.71).

Seventeen studies investigated the influence of mental health problems on the risk of disability pension, presenting 29 associations (table 1).^{23 24 26 28 30–38 40 44 45 47} In 18 out of 29 associations mental health problems were a significant risk factor resulting in a pooled RR of 1.80 (95% CI 1.41 to 2.31) across 29 associations (table 2).

In 13 studies the influence of chronic diseases on the risk of disability pension was evaluated, presenting 42 associations

(table 1).^{14 23 24 26 27 34–36 38 39 41–43} In 35 out of 42 associations chronic disease was a significant risk factor with a pooled RR of 2.11 (95% CI 1.90 to 2.33) across the 42 associations. A large part of the associations reported on musculoskeletal disorders (25 out of 42), resulting in pooled RR of 2.23 (95% CI 1.93 to 2.59, table 2).

The PAF of self-perceived poor health, mental health problems and chronic diseases for transition into disability pension ranged from 3.9% to 76.8%, from 0% to 48.6% and from 1.6% to 69.9%, respectively (figure 3). Within the group of chronic diseases, we made a distinction between musculoskeletal disorders, respiratory diseases and other chronic disease, resulting in PAFs ranging from 1.2% to 69.9%, from 1.7% to 14.5% and from 0.7% to 40.1%, respectively.

Table 2 Pooled relative risks (RRs) of health measures for disability pension, unemployment and early retirement

	Disability pension			Unemployment			Early retirement		
	No. of studies*	Sample size	RR (95% CI)	No. of studies*	Sample size	RR (95% CI)	No. of studies*	Sample size	RR (95% CI)
Self-perceived health	13	111 999	3.61 (2.44 to 5.35)	14	99 617	1.44 (1.26 to 1.65)	6	32 567	1.27 (1.17 to 1.38)
Mental health	29	282 459	1.80 (1.41 to 2.31)	15	20 166	1.61 (1.29 to 2.01)	–	–	–
Chronic disease	42	66 097	2.11 (1.90 to 2.33)	25	18 003	1.31 (1.14 to 1.50)	22	16 071	1.10 (0.99 to 1.21)
MSD	25	58 052	2.23 (1.93 to 2.59)	9	5582	1.22 (1.01 to 1.48)	4	7534	1.23 (0.86 to 1.77)
Respiratory	5	31 208	2.35 (1.31 to 4.20)	–	–	–	7	6010	0.97 (0.89 to 1.04)
Other	12	39 637	2.22 (1.63 to 3.03)	16	13 007	1.35 (1.14 to 1.60)	11	11 759	1.12 (0.93 to 1.36)

*Total number of studies within a determinant does not necessarily equal the number of studies included because some studies provide more than 1 association. MSD, musculoskeletal disorder.

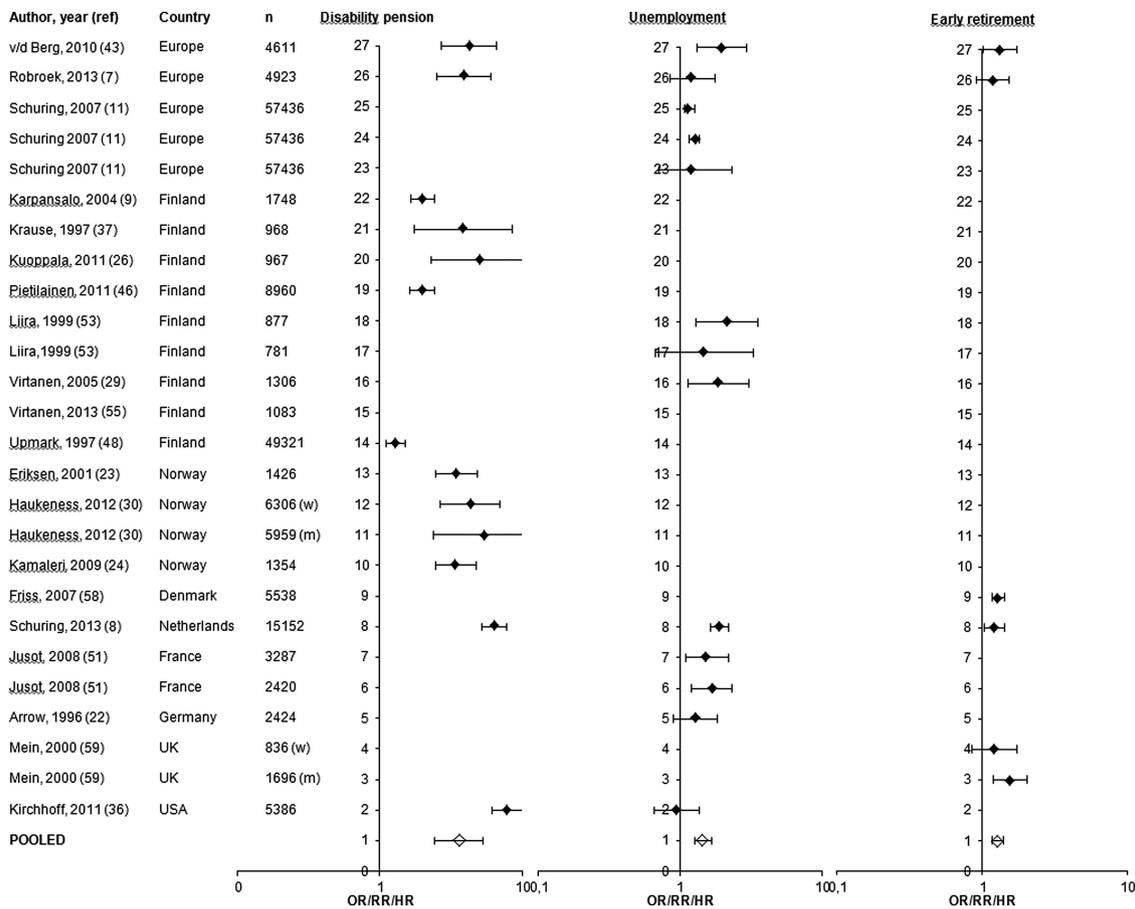


Figure 2 Association between self-perceived poor health and disability pension, unemployment and early retirement.

Unemployment

Seventeen studies investigated the influence of health on the risk of unemployment (see online supplementary appendix III).^{7 8 10 11 22 29 36 39 43 49-56} In 14 out of 17 studies the frequency of events was less than 10%, therefore OR and HR were considered as an approximation of RR.

Self-perceived health was evaluated in 10 studies, presenting 14 associations.^{7 8 11 22 29 36 43 48 53 55} In 9 out of 14

associations self-perceived poor health was a significant risk factor for unemployment (table 1). Three studies presented results for different subgroups. Jusot *et al*⁵¹ reported no differences between men and women, poor health was found to be a precursor of unemployment in both genders. Liira and Leino-Arjas⁵³ reported that a self-perceived poor health was a statistically significant risk factor for unemployment in construction workers (OR 2.15, 95% CI 1.30 to 3.56), but not in forestry workers (OR 1.49, 95% CI 0.67 to 3.28). Schuring *et al*¹¹ found that self-perceived poor health was a statistically significant risk factor for unemployment in low and intermediate educated people, but not in highly educated people. Pooling of all studies resulted in a RR of 1.44 (95% CI 1.26 to 1.65, table 2).

Seven studies described the influence of mental health problems on the risk of unemployment, within a total of 15 associations (table 1).^{29 36 46 52-54 56} In 10 out of 15 associations mental health problems were a significant risk factor of unemployment with a pooled RR of 1.61 (95% CI 1.29 to 2.01) across all 15 associations (table 2).

Seven studies investigated the influence of chronic diseases on unemployment presenting 25 associations with RR varying from 0.90 to 2.20 (table 1).^{22 36 39 43 49 52 53} In 4 out of 25 associations a chronic disease was a significant risk factor for unemployment. In the meta-analysis the association between chronic disease and unemployment was statistically significant (pooled RR of 1.31, 95% CI 1.14 to 1.50) (table 2).

The PAF of self-perceived poor health, mental health problems and chronic diseases for transition into unemployment ranged from 2.2% to 14.2%, from 0.0% to 32.7% and from 0.0% to 9.9%, respectively (figure 3).

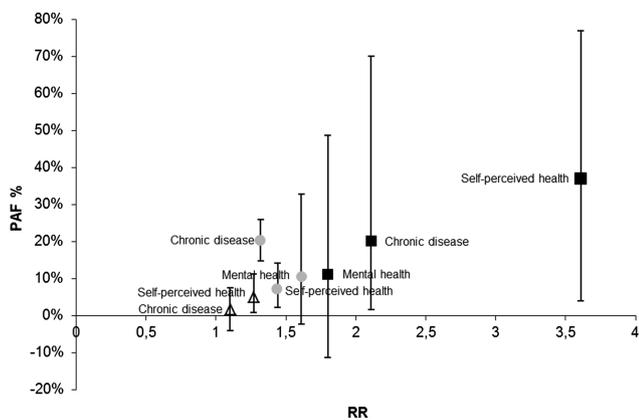


Figure 3 Relation between relative risk (RR) and population attributable fraction (PAF) for each health dimension and each pathway of leaving the labour force. Mean PAFs were calculated and reported with their range (error bars). ■=disability pension, ●=unemployment, Δ=early retirement.

Early retirement

Nine studies investigated the influence of health on the risk of early retirement (see online supplementary appendix IV).^{7 8 10 14 39 43 57–59} In six out of nine studies the frequency of events was less than 10%, therefore OR and HR were considered as an approximation of RR.

Self-perceived health was evaluated in five studies, presenting six associations (table 1).^{7 8 43 58 59} In four out of six associations self-perceived poor health was a significant risk factor of early retirement, resulting in a pooled RR of 1.27 (95% CI 1.17 to 1.38) (table 2).

No studies reported on the association between mental health problems and exit through early retirement.

Five studies investigated the influence of chronic diseases on early retirement, presenting 22 associations (table 1).^{14 39 43 57 59} In 6 out of 22 associations a statistically significant association between chronic disease and early retirement was reported. Pooling of all five studies resulted in a RR of 1.10 (95% CI 0.99 to 1.21) (table 2).

The PAF of self-perceived poor health and chronic diseases for transition into early retirement ranged from 0.8% to 11.1% and from 0.0% to 7.5%, respectively (figure 3).

DISCUSSION

This meta-analysis shows that poor health increases the risk of exit from paid employment due to disability pension, unemployment and early retirement. The relative importance differed by pathway of exit from paid employment. The strongest associations were found for exit from paid employment through disability pension, followed by unemployment and, to a lesser extent, early retirement. Self-perceived poor health had a stronger effect on displacement through disability pension than mental health problems and presence of a chronic disease. The PAFs were largest for self-perceived poor health on disability pension, and for chronic diseases on disability pension and unemployment, indicating that good health and not having a chronic disease are important factors in maintaining paid employment.

Poor health, particularly self-perceived poor health, is a risk factor for exit from paid employment, especially through disability pension. The strong relation between self-perceived poor health and disability pension is not surprising, since health problems are a requirement for receiving a disability pension. However, eligibility of a disability pension does not depend on health problems alone, but also on individual, social, economic and legal factors.^{60 61} For example, the relationship between poor health and unemployment is consistent across Europe, but seems to vary across the type of welfare state regime. A study by Van der Wel *et al* found that the likelihood of non-employment was consistently lower in the Scandinavian welfare state regime type. The protective effect of welfare regimes reducing the risk of non-employment among workers with longstanding illness was largest in Scandinavian countries.⁶² Alternative measures to express the influence of health problems on exit from paid employment are, for example, lost working years due to health problems or working life expectancy.^{63 64}

Perceived health shows stronger associations than mental health and chronic diseases with regard to exit from paid employment. In the majority of the studies in this review, perceived health (19 out of 19), mental health problems (21 out of 23) and chronic diseases (14 out of 19) were self-reported. Thus, it is reasonable to assume that the differences in magnitude of the associations between health measures and exit from

paid employment are not due to systematic differences in ascertainment of these health measures. Studies which have included a variety of different health measures in the same study population endorse this assumption. For example, Van den Berg *et al* demonstrated higher associations for self-perceived poor health with disability pension (OR 4.24), unemployment (OR 1.96) and early retirement (OR 1.32) compared with the associations found for chronic diseases with OR 2.62, OR 1.30 and OR 1.28, respectively.⁴³ A study by Kuoppala *et al* showed that self-perceived poor health increased the risk of receiving a disability pension (OR 5.11, 95% CI 2.31 to 11.28). Whereas, in the same study, a lower association was found between poor mental well-being and disability pension (OR 2.77, 95% CI 1.32 to 5.80).²⁶

The strong association between perceived health and exit from paid employment could be explained by the fact that self-perceived health partly reflects health-related quality of life, which is an integrated perception of health, including its biological, psychological and social dimensions.⁶⁵ For example, important risk factors for poor health, like obesity and physical activity, are associated with exit from paid employment through disability benefit.¹⁵ In the majority of the studies perceived health was measured with a single question on a 4-point or a 5-point scale. This restriction could be seen as a disadvantage. However, the assessment of self-perceived health has been found to be useful in evaluating health status in large epidemiological studies and has been shown to be a strong predictor of mortality in high as well as low socioeconomic groups.⁶⁶

The impact of self-perceived poor health, mental health problems and chronic diseases is higher for the involuntary pathways (disability pension, unemployment) than for a more voluntary pathway (early retirement). For example, Van den Berg *et al* demonstrated that self-perceived poor health was significantly associated with disability pension (OR 4.24, 95% CI 2.71 to 2.62) and unemployment (OR 1.96; 95% CI 1.32 to 2.92), but was borderline significant with early retirement (OR 1.32; 95% CI 1.01 to 1.32).⁴³ A study by Kirchhoff *et al*³⁶ showed that self-perceived poor health significantly increased the risk of receiving disability pension (RR 7.83; 95% CI 6.11 to 10.04). However, no association was found between poor health and exit from paid employment due to unemployment (RR 0.94; 95% CI 0.65 to 1.37).

The mean PAFs of self-perceived poor health, mental health problems and chronic diseases for transition into disability pension were 36.9%, 11.1% and 20.6%, respectively. The PAFs of chronic diseases ranged from 1.6% to 69.9% and, in general, larger PAF values were observed for studies with a higher prevalence of receiving disability pension.

The mean PAF of poor health for transition into unemployment varied between 4.0% for chronic diseases to 10.6% for mental health. For transition into early retirement, the mean PAF of self-perceived poor health and chronic diseases was 4.7% and 1.7%, respectively. These findings suggest that poor health is a major risk factor for exit from paid employment, especially through disability pension. Thus, policies to promote sustainability of paid employment should incorporate health promotion.

The observational studies in this systematic review suggest that interventions aimed at promoting good health in the workplace may have an important contribution to increase sustained employability. There are indications that workplace health promotion improves self-perceived health and worker productivity, and will also lead to a decline in sick days.^{67–69} Besides, unhealthy lifestyle behaviours, physical and psychosocial work demands as well as

organisational level factors play a role in exit from paid employment.^{38 70–72} Therefore, it should be considered to integrate health promotion activities with activities aimed at occupational health and safety to maintain a productive workforce.

A strength of this systematic review is the availability of enough studies of good quality (large sample size, longitudinal design) on the association between health measures and disability pension, unemployment and early retirement to conduct informative meta-analyses to estimate the magnitude of these associations. However, this study also has some limitations. First, the literature search may not be comprehensive enough, because publications in languages other than English were not included, and the search was limited to two computer-based bibliographical databases. Therefore, it might be possible that some useful studies were missed. Second, there is substantial variation between studies according to definitions of outcome and risk factor, follow-up period, and sex and age of the study population. However, in an explorative meta-regression analysis no determinants of heterogeneity were found. Third, the majority of studies are from Scandinavian countries, hampering the generalisability of findings to other countries. Consequently, the influence of type of welfare regime on the relationship between poor health and different pathways of leaving the labour market cannot be determined. Fourth, the calculation of exit from paid employment attributable to poor health was based on the methodology of PAF.²¹ This method may yield biased estimates when used with RR estimates adjusted for confounding. When the crude RR is greater than the adjusted risk, as was observed in the current review, the PAF may be underestimated.⁷³ Last, although publication bias cannot be ruled out, there was no relation between the magnitude of risk estimates and their CIs of self-perceived health and mental health and the risk of exit from paid employment due to disability benefit, unemployment and early retirement. For chronic diseases larger risk estimates had larger CIs concerning exit from paid employment due to disability benefit, but not for unemployment and early retirement. Therefore, results about the influence of chronic diseases on the risk of disability benefit should be interpreted with some caution.

After summarising the literature it can be concluded that self-perceived poor health is a risk factor for exit from paid employment due to disability pension, unemployment and early retirement. The proportions of persons leaving the labour market that could be attributed to self-perceived poor health were 36.9%, 7.0% and 4.7%, respectively for disability pension, unemployment and early retirement. Having mental health problems or a chronic disease was related with an increased risk of receiving disability pension or becoming unemployed, but not with early retirement. Primary preventive interventions focusing on promoting good health may contribute to sustained employability. Therefore, in order to maintain a productive workforce, it should be considered to integrate health promotion activities with activities aimed at occupational health and safety.

Correction notice This article has been corrected since it was published Online First. The relative risk values in the abstract have been updated.

Contributors RMvR: executed the systematic review, conducted the literature search, selected relevant articles for inclusion, performed the data extraction, analysed the data and wrote the manuscript. SJWR: helped conduct the literature search, selected relevant articles for inclusion and contributed to the content of the manuscript. SB and AB initiated the study and contributed to the content of the article. All four authors made a substantial contribution to the information and material submitted and have read and approved the final version.

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REFERENCES

- Cooke M. Policy changes and the labour force participation of older workers: evidence from six countries. *Can J Aging* 2006;25:387–400.
- Doyle Y, McKee M, Rechel B, et al. Meeting the challenge of population ageing. *BMJ* 2009;339:b3926.
- Ilmarinen JE. Aging workers. *Occup Environ Med* 2001;58:546–52.
- von Bonsdorff ME, Huhtanen P, Tuomi K, et al. Predictors of employees' early retirement intentions: an 11-year longitudinal study. *Occup Med (Lond)* 2010;60:94–100.
- Cai L, Kalb G. Health status and labour force participation: evidence from Australia. *Health Econ* 2006;15:241–61.
- Pedersen J, Bjorner JB, Burr H, et al. Transitions between sickness absence, work, unemployment, and disability in Denmark 2004–2008. *Scand J Work Environ Health* 2012;38:516–26.
- Robroek SJW, 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.
- Schuring M, Robroek SJW, Otten FWJ, 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.
- Karpansalo M, Manninen P, Kauhanen J, et al. Perceived health as a predictor of early retirement. *Scand J Work Environ Health* 2004;30:287–92.
- Cardano M, Costa G, Demaria M. Social mobility and health in the Turin longitudinal study. *Soc Sci Med* 2004;58:1563–74.
- Schuring M, Burdorf L, Kunst A, et al. The effects of ill health on entering and maintaining paid employment: evidence in European countries. *J Epidemiol Community Health* 2007;61:597–604.
- van den Berg TI, Elders LA, Burdorf A. Influence of health and work on early retirement. *J Occup Environ Med* 2010;52:576–83.
- Solomon C, Poole J, Palmer KT, et al. Health-related job loss: findings from a community-based survey. *Occup Environ Med* 2007;64:144–9.
- Jensen LD, Ryom PK, Christensen MV, et al. 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:e000991.
- Robroek SJ, Reeuwijk KG, Hillier FC, et al. The contribution of overweight, obesity, and lack of physical activity to exit from paid employment: a meta-analysis. *Scand J Work Environ Health* 2013;39:233–40.
- Higgins JP, Thompson SG, Deeks JJ, et al. Measuring inconsistency in meta-analyses. *BMJ* 2003;327:557–60.
- Higgins J, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0* [updated March 2011]. The Cochrane Collaboration. 2011. <http://www.cochrane-handbook.org>
- Fleiss JL. The statistical basis of meta-analysis. *Stat Methods Med Res* 1993;2:121–45.
- Davies HT, Crombie IK, Tavakoli M. When can odds ratios mislead? *BMJ* 1998;316:989–91.
- McNutt LA, Wu C, Xue X, et al. Estimating the relative risk in cohort studies and clinical trials of common outcomes. *Am J Epidemiol* 2003;157:940–3.
- Hennekens C, Buring B, Mayrent S. *Epidemiology in medicine*. Boston: Lippincott Williams & Wilkins, 1987.
- Arrow JO. Estimating the influence of health as a risk factor on unemployment: a survival analysis of employment durations for workers surveyed in the German Socio-Economic Panel (1984–1990). *Soc Sci Med* 1996;42:1651–9.
- Eriksen W, Natvig B, Bruusgaard D. Sleep problems: a predictor of long-term work disability? A four-year prospective study. *Scand J Public Health* 2001;29:23–31.
- Kamaleri Y, Natvig B, Ihlebaek CM, et al. Does the number of musculoskeletal pain sites predict work disability? A 14-year prospective study. *Eur J Pain* 2009;13:426–30.
- Koivumaa-Honkanen H, Koskenvuo M, Honkanen RJ, et al. Life dissatisfaction and subsequent work disability in an 11-year follow-up. *Psychol Med* 2004;34:221–8.
- Kuoppala J, Lamminpaa A, Vaananen-Tomppo I, et al. Employee well-being and sick leave, occupational accident, and disability pension: a cohort study of civil servants. *J Occup Environ Med* 2011;53:633–40.
- Natvig B, Eriksen W, Bruusgaard D. Low back pain as a predictor of long-term work disability. *Scand J Public Health* 2002;30:288–92.
- Sivertsen B, Overland S, Neckelmann D, et al. The long-term effect of insomnia on work disability: the HUNT-2 historical cohort study. *Am J Epidemiol* 2006;163:1018–24.
- Virtanen P, Vahtera J, Kivimaki M, et al. Labor market trajectories and health: a four-year follow-up study of initially fixed-term employees. *Am J Epidemiol* 2005;161:840–6.
- Haukenes I, Gjesdal S, Rortveit G, et al. Women's higher likelihood of disability pension: the role of health, family and work. A 5–7 years follow-up of the Hordaland Health Study. *BMC Public Health* 2012;12:720.

- 31 Wedegaertner F, Arnold-Kerri S, Sittaro NA, et al. 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;13:145.
- 32 Ahola K, Gould R, Virtanen M, et al. Occupational burnout as a predictor of disability pension: a population-based cohort study. *Occup Environ Med* 2009;66:284–90; discussion 2–3.
- 33 Ahola K, Toppinen-Tanner S, Huuhtanen P, et al. Occupational burnout and chronic work disability: an eight-year cohort study on pensioning among Finnish forest industry workers. *J Affect Disord* 2009;115:150–9.
- 34 Ahola K, Virtanen M, Honkonen T, et al. Common mental disorders and subsequent work disability: a population-based Health 2000 Study. *J Affect Disord* 2011;134:365–72.
- 35 Alexanderson K, Kivimaki M, Ferrie JE, 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;66:155–9.
- 36 Kirchhoff AC, Krull KR, Ness KK, et al. Physical, mental, and neurocognitive status and employment outcomes in the childhood cancer survivor study cohort. *Cancer Epidemiol Biomarkers Prev* 2011;20:1838–49.
- 37 Krause N, Lynch J, Kaplan GA, et al. Predictors of disability retirement. *Scand J Work Environ Health* 1997;23:403–13.
- 38 Lund T, Csonka A. Risk factors in health, work environment, smoking status, and organizational context for work disability. *Am J Ind Med* 2003;44:492–501.
- 39 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.
- 40 Overland S, Glozier N, Sivertsen B, et al. A comparison of insomnia and depression as predictors of disability pension: the HUNT Study. *Sleep* 2008;31:875–80.
- 41 Ropponen A, Narusyte J, Alexanderson K, et al. Stability and change in health behaviours as predictors for disability pension: a prospective cohort study of Swedish twins. *BMC Public Health* 2011;11:678.
- 42 Rothenbacher D, Arndt V, Fraisse E, et al. Early retirement due to permanent disability in relation to smoking in workers of the construction industry. *J Occup Environ Med* 1998;40:63–8.
- 43 van den Berg T, Schuring M, Avendano M, et al. The impact of ill health on exit from paid employment in Europe among older workers. *Occup Environ Med* 2010;67:845–52.
- 44 Bultmann U, Christensen KB, Burr H, et al. Severe depressive symptoms as predictor of disability pension: a 10-year follow-up study in Denmark. *Eur J Public Health* 2008;18:232–4.
- 45 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.
- 46 Pietilainen O, Laaksonen M, Rahkonen O, et al. Self-Rated Health as a Predictor of Disability Retirement—The Contribution of Ill-Health and Working Conditions. *PLoS ONE* 2011;6:e25004.
- 47 Rai D, Kosidou K, Lundberg M, et al. Psychological distress and risk of long-term disability: population-based longitudinal study. *J Epidemiol Community Health* 2012;66:586–92.
- 48 Upmark M, Hemmingsson T, Romelsjo A, et al. Predictors of disability pension among young men—the role of alcohol and psychosocial factors. *Eur J Public Health* 1997;7:20–8.
- 49 Bildt C, Michelsen H. Occupational conditions exceed the importance of non-occupational conditions and ill health in explaining future unemployment among women and men. *Arch Womens Ment Health* 2003;6:115–26.
- 50 Earle A, Heymann SJ. What causes job loss among former welfare recipients: the role of family health problems. *J Am Med Womens Assoc* 2002;57:5–10.
- 51 Jusot F, Khat M, Rochereau T, et al. Job loss from poor health, smoking and obesity: a national prospective survey in France. *J Epidemiol Community Health* 2008;62:332–7.
- 52 Leino-Arjas P, Liira J, Mutanen P, et al. Predictors and consequences of unemployment among construction workers: prospective cohort study. *BMJ* 1999;319:600–5.
- 53 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;25:42–9.
- 54 Thielen K, Nygaard E, Andersen I, et al. Employment consequences of depressive symptoms and work demands individually and combined. *Eur J Public Health*. Published Online First: 1 Feb 2013. doi:10.1093/eurpub/ckt011
- 55 Virtanen P, Janlert U, Hammarstrom A. Health status and health behaviour as predictors of the occurrence of unemployment and prolonged unemployment. *Public Health* 2013;127:46–52.
- 56 Whooley MA, Kiefe CI, Chesney MA, et al. Depressive symptoms, unemployment, and loss of income—The CARDIA study. *Arch Intern Med* 2002;162:2614–20.
- 57 Ames RG, Trent RB. Respiratory impairment and symptoms as predictors of early retirement with disability in US underground coal miners. *Am J Public Health* 1984;74:837–8.
- 58 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.
- 59 Mein G, Martikainen P, Stansfeld SA, et al. Predictors of early retirement in British civil servants. *Age Ageing* 2000;29:529–36.
- 60 Ostby KA, Orstavik RE, Knudsen AK, et al. Health problems account for a small part of the association between socioeconomic status and disability pension award. Results from the Hordaland Health Study. *BMC Public Health* 2011;11:12.
- 61 Stattin M, Jarvholm B. Occupation, work environment, and disability pension: a prospective study of construction workers. *Scand J Public Health* 2005;33:84–90.
- 62 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;42:235–55.
- 63 Knudsen AK, Overland S, Hotopf M, et al. Lost working years due to mental disorders: an analysis of the Norwegian disability pension registry. *PLoS One* 2012;7:e42567.
- 64 Lacaille D, Hogg RS. The effect of arthritis on working life expectancy. *J Rheumatol* 2001;28:2315–19.
- 65 Wilson IB, Cleary PD. Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. *JAMA* 1995;273:59–65.
- 66 Burstrom B, Fredlund P. Self rated health: Is it as good a predictor of subsequent mortality among adults in lower as well as in higher social classes? *J Epidemiol Community Health* 2001;55:836–40.
- 67 Burton WN, McCalister KT, Chen CY, et al. The association of health status, worksite fitness center participation, and two measures of productivity. *J Occup Environ Med* 2005;47:343–51.
- 68 Lechner L, de Vries H, Adriaansens S, et al. Effects of an employee fitness program on reduced absenteeism. *J Occup Environ Med* 1997;39:827–31.
- 69 Rongen A, Robroek SJW, Van Lenthe FJ, et al. Workplace health promotion: a meta-analysis of effectiveness. *Am J Prev Med* 2013;44:406–15.
- 70 Alavinia SM, Molenaar D, Burdorf A. Productivity loss in the workforce: associations with health, work demands, and individual characteristics. *Am J Ind Med* 2009;52:49–56.
- 71 Albertsen K, Lund T, Christensen KB, et al. Predictors of disability pension over a 10-year period for men and women. *Scand J Public Health* 2007;35:78–85.
- 72 van den Heuvel SG, Geuskens GA, Hoofman WE, et al. Productivity loss at work; health-related and work-related factors. *J Occup Rehabil* 2010;20:331–9.
- 73 Darrow LA, Steenland NK. Confounding and bias in the attributable fraction. *Epidemiology* 2011;22:53–8.

Appendix I: Medline search strategy

	Search terms
#1	<u>Health</u> (health[MeSH:NoExp] OR health[tw] OR "well-being"[All Fields] OR "health status"[MeSH:NoExp] OR "health status"[All Fields] OR "physical health"[All Fields]) OR ("mental health"[MeSH] OR "mental health"[All fields]) OR (hospitalization[MeSH] OR hospitalization[All Fields] OR hospitalisation[All Fields]) OR ("quality of life"[MeSH] OR "quality of life"[All Fields]) OR ("chronic disease"[MeSH] OR "chronic disease"[All Fields] OR "chronic illness") OR "perceived-health"[All Fields] OR "ill-health"[All Fields] OR "long-standing illness"[all fields] OR "activities of daily living"[MeSH:NoExp] OR "activities of daily living"[tw] OR ADL[all fields] OR "instrumental activities of daily living"[all fields] OR IADL[all fields] OR functional limitation*[All Fields] OR "disability"[tiab]
#2	<u>Work related</u> ("Occupations"[MeSH] OR "occupations"[all fields] OR "occupation"[all fields]) OR "work-related"[All Fields] OR "worker"[All Fields] OR "employee"[all fields] OR "work"[MeSH:NoExp] OR ("labour"[All Fields] OR "labor"[All Fields]) OR "job"[All Fields] OR ("employment"[MeSH:NoExp] OR "employment"[tw])
#3	<u>Early-retirement</u> "early-retirement"[all fields]
#4	<u>Unemployment</u> "Unemployment"[MeSH] OR "unemployment"[all fields] OR "unemployed"[all fields]
#5	<u>Disability pension</u> "disability pension"[all fields] OR "work-disability"[all fields] OR "disability retirement"[all fields]
#6	<u>Work ability</u> "Work ability"[all fields]
#7	<u>Productivity</u> Presenteeism[all fields] OR "work limitations"[all fields] OR productivity[tw] OR "productivity loss"[all fields]
#8	<u>Study design</u> ("Cohort studies"[MeSH] OR "cohort studies"[All Fields] OR "cohort study"[All Fields]) OR ("longitudinal studies"[MeSH] OR "longitudinal studies"[all fields] OR "longitudinal study"[All Fields] OR longitudinally[All Fields]) OR ("prospective studies"[MeSH] OR "prospective studies"[All Fields] OR "prospective study"[All Fields]) OR ("follow-up studies"[MeSH] OR "follow-up studies"[All Fields] OR "follow-up study"[All Fields] OR follow-up[All Fields]) OR ("retrospective studies"[MeSH] 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[tiab] OR "clinical trials as topic"[MeSH:noexp] OR randomly[tiab] OR trial[ti])
#9	<u>Sustainable Employability</u> #3 OR #4 OR #5 OR #6 OR #7
#10	#1 AND #2 AND #9 AND #8

Appendix II: Included studies presenting the relation between **disability pension** and different health measures/ dimensions.

Author Year Country	Follo w-up	Population	Health measure		Outcome (sustainable employability)		Results	
			Description	Prevalence, <i>n</i>	Description	Frequency, <i>n</i>	OR/RR/HR	95% CI
Self-perceived health								
Van den Berg(43) 2010 Netherlands/ Europe	2 yrs	n=4611 - Employees - 55% male (n=2523) - 45% female (n=2088) - 48% aged 50-54 yrs - 40% aged 55-59 yrs - 12% aged 60-63 yrs	Less than good perceived health; measured on a 5-point scale (very good – very bad)	793	Disability pension; exit the labour force due to health problems	90	OR 4.24 ^a	2.71-6.62
Eriksen(23) 2001 Norway	4 yrs	n=1426 - General population - 50% male (n=713) - 50 % female (n=713) - 15% age 20-22 - 20% age 30-32 - 31% age 40-42 - 24% age 50-52 - 11% age 60-62	Poor self evaluated health; measured on a 4-point scale (very good - poor)	333 (N=1426)	Long term work disability; absence form work because of sickness ≥ 8 weeks during the previous year, receiving rehabilitation benefits, or being disability pensioned	75 (N=160)	OR 3.45	2.45-4.84
Haukenes (30) 2012 Norway	1-7 yrs	n=12265 - general population - 49% male	Less than good self-perceived health; measured with the SF-12	w:4665 (N=6306) m:4429 (N=5959)	Disability pension; national register of disability pension. Award of at least 50% disability pension during follow-up of 1 to 7 years after participating in the health survey.	w:212(N=230) m: 93 (N=99)	OR 4.29 OR 5.45	2.64-6.97 2.38-12.46
Kamaleri(24) 2009 Norway	14 yrs	n=1354 - General population - 45% male (n=609) - 55% female (n=745) - 25% age 20-22 - 20% age 30-32 - 31% age 40-42 - 24% age 50-52	Very poor – poor self-reported health; measured on a 4-point scale (very good - very poor)	306 (N=1354)	Disability pension; self-reported employment status, having either permanent or long-term (> 1 year) social security benefits due to illness	79 (N=176)	OR 3.41	2.45-4.75
Karpansalo (9) 2004 Finland	16 yrs	n=1748 - general population - 100% male	Less than good self-perceived health; measured on 5-point Likert scale and categorized into three classes	1011 (N=1748)	Disability pension; pension registers of the Social Insurance Institution of Finland and the Central Pension Security Institute.	566 (N=855)	OR 1.99	1.64-2.41
Kirchhoff(36) 2011 USA	9 yrs	n= 5386 - Employees, childhood cancer survivors - 50% male (n=2693) - 50% female (n=2693) - 56% age 25-34 - 35% age 35-44 - 9% age 45+	Poor physical Health; measured with SF-36		Health related unemployment; unable to work because of illness or disability (self-reported)		RR 7.83	6.11-10.04
Krause(37)	4 yrs	n=968	Self-perceived health		Disability retirement; self-reported		OR 2.45(2 nd tert) ^b	1.30-4.64

1997 Finland		- General population - 100% male					OR 3.86 (1 st tert) ^b	1.74-8.57
Kuoppala(26) 2011 Finland	7 yrs	n=967 - Employees (civil service) - 47% male (n=455) - 53% female (n=512) - mean age(SD):45.1(9.7)	Rather – very bad self reported health; measured on 5-point Likert scale (very good - very bad)	53 (N=962)	Disability pension; register based and provided by the Actuary Division of State Treasury	9 (N=44)	OR 5.11	2.31-11.28
Pietilainen (46) 2011 Finland	10 yrs	n=8960 - employees - 20% male - aged 40-60 years	Less than good self-perceived health; measured on a 5-point Likert scale (excellent-poor)		Disability pension; Finnish Centre for Pensions registers	625	HR 1.98 ^c	1.62-2.42
Robroek (48) 2013 Netherlands / Europe	4 yrs	N=4923 - general population - 56% male - mean age(SD): 55.2(3.5) yrs	Less than good self-perceived health; measured on 5 point likert scale (excellent – very poor)	531 (N=4923)	Disability pension; self-reported, individuals stating they are permanently sick or disabled	103	HR 3.90 ^d	2.51-6.05
Schuring (49) 2013 Netherlands	10 yrs	N=15152 - employees - 60% male - aged 18-64 yrs	Less than good self-perceived health; measured on 5 point likert scale (very good – very poor)	1279 (N=10516)	Disability pension; Dutch tax register as provided by Statistics Netherlands, receiving a disability pension for >50% of personal income	398	HR 6.39 ^e	5.20-7.86
Upmark (50) 1997 Sweden	20 yrs	N=49321 - employees (military service) - 100% male	Less than good self-perceived health; measured on 4-point scale (very good - very bad)	6743(N=39435)	Disability pension; obtained from the National Swedish Social Insurance Board	298 (N=914)	RR1.3	1.10-1.50
Mental health								
Ahola(32) 2009 Finland	1 yrs	n=3125 - Employees - 52% male (n=1625) - 48% female (n=1500) - 33% age 30-39 - 37% age 40-49 - 30% age 50-60	Burnout; measured with Maslach Burnout Inventory General Survey consisting of 16 items on a 7-point scale (never-daily)	842	Work disability pension; from records of the social Insurance Institution of Finland and the Finnish Centre for pensions	113	OR 1.49 ^f	1.24-1.80
Ahola(33) 2009 Finland	8 yrs	n= 7810 - employees - 76% male (n=5936) - 24% female (n=1874) - 20% age <35 - 31% age 35-44 - 39% age 45-54 - 10% age =>55	Mild burnout; measured with Maslach Burnout Inventory General Survey consisting of 16 items on a 7-point scale (never- daily) Severe burnout; measured with Maslach Burnout Inventory General Survey consisting of 16 items on a 7-point scale (never- daily)	3028 (N=7575) 235 (N=4782)	Disability pension; granted for chronic illness handicap or injury that has resulted in decreased work ability.	244 (N=471) 36 (N=263)	HR 1.16 ^g HR 1.57 ^g	0.96-1.39 1.09-2.26
Ahola(34) 2011	7 yrs	n=3164 - general population	Depression; determined by Composite International	134	Full-time or part-time disability pension from independent pension	17	OR 1.71 ^h	0.87-3.36

Finland		- 49% male (n=1550) - 51% female (n=1614) - 44% age 30-39 - 22% age 40-44 - 24% age 45-49 - 23% age 50-54 - 11% age 55-58	Diagnostic Interview Anxiety; determined by Composite International Diagnostic Interview	77	institutions due to chronic illness, handicap, or injury which has been verified by a medical certificate and independently evaluated to have resulted in considerably decreased work ability.	11	OR 2.23 ^h	0.97-5.13
Alexandersson(35) 2012 France	17 yrs	n=20434 - Employees - 73% male (n=14917) - 275 female (n=5517) - men aged 40-50 yrs - women aged 35-50 yrs	Sick-leave diagnosis; sick leave spells ≥7 days with diagnosis - Psychiatric	W: 740 (N=5518) M: 575 (N=14916)	Disability pension; temporary or permanent DP or > 600 sick-leave days during 2 consecutive years	71 (N=245) 44 (N=284)	HR 4.14 ⁱ HR 7.56 ⁱ	2.90-5.91 5.24-8.56
Bulltman (44) 2008 Denmark	10 yrs	n=5106 - Employees - 52% male - aged 18 to 59 years	Severe depressive symptoms; measured with Mental Health Inventory (MHI-5)	150 (N=5106)	Disability pension; granted by the municipal authorities	11 (N=111)	HR 2.38 ^l	1.22-4.66
Eriksen(23) 2001 Norway	4 yrs	n= 1426 - General population - 50% male (n=713) - 50% female (n=713) - 15% age 20-22 - 20% age 30-32 - 31% age 40-42 - 24% age 50-52 - 11% age 60-62	High level of emotional symptoms (well-being); General Health Questionnaire	388 (N=1287)	Long term work disability; absence from work because of sickness ≥ 8 weeks during the previous year, receiving rehabilitation benefits, or being disability pensioned	62 (N=77)	OR 2.03	1.42-2.90
Haukenes (30) 2012 Norway	1-7 yrs	n=12265 - general population - 49% male	Less than good self-perceived mental health; measured with the SF-12	W:4968(N=6306) M:4333 (N=5959)	Disability pension; national register of disability pension. Award of at least 50% disability pension during follow-up of 1 to 7 years after participating in the health survey.	w:176(N=230) m: 85 (N=99)	OR 0.87 OR 2.30	0.64-1.19 1.31-4.07
Kamaleri(24) 2009 Norway	14 yrs	n=1354: - General population - 45% male (n=609) - 55% female (n=745) - 25% age 20-22 - 20% age 30-32 - 31% age 40-42 - 24% age 50-52	Psychological distress; 20 item general health questionnaire with scores ranging 0-3.	855 (N=1235)	Disability pension; self-reported employment status, having either permanent or long-term (> 1 year) social security benefits due to illness	109 (N=152)	OR 1.15	0.79-1.67
Karpansalo (45) 2005 Finland	16 yrs	n=1726 - general population - 100% male - mean age(SD): 52.5(4.1)	Depressive symptoms; measured with the Human Population Laboratory (HPL) depression score, sumscore was categorised into thirds (low, medium, high)	600 (high) 559 (medium)	Disability pension; pension registers of the Social Insurance Institution and the central pension security institute, applied when disability continues > 300 working days or when having a long work history and at least 56 yrs of age.	861	RR 1.43 ^k RR 1.06 ^k	1.21-1.79 0.89-1.26

Kirchhoff(36) 2011 USA	9 yrs	n= 5386 - Employees, childhood cancer survivors - 50% male (n=2693) - 50% female (n=2693) - 56% age 25-34 - 35% age 35-44 - 9% age 45+	Poor mental Health; measured with SF-36 Depression; Brief symptom inventory, 18 item checklist. Anxiety; Brief symptom inventory, 18 item checklist.		Health related unemployment; unable to work because of illness or disability (self-reported)		RR 1.20 RR 1.15 RR 0.88	0.98-1.48 0.92-1.43 0.69-1.12
Krause(37) 1997 Finland	4 yrs	n=968 - General population - 100% male	Mental illness Depression; Minnesota Multiphasic Personality Inventory		Disability retirement; self-reported		OR 0.49 ^b OR 1.52 ^b	0.12-2.08 0.91-2.54
Kuoppala(26) 2011 Finland	7 yrs	n=967 - Employees (civil service) - 47% male (n=455) - 53% female (n=512) - mean age(SD):45.1(9.7)	Rather- very bad mental well-being; measured on 5-point scale (very bad- very good) Psychiatric morbidity; 12-item version of the General Health Questionnaire	98 (N=961) 184 (N=954)	Disability pension; register based and provided by the Actuary Division of State Treasury	10(N=44) 16 (N=43)	OR 2.77 OR 2.62	1.32-5.80 1.38-4.97
Lund(38) 2003 Denmark	2 yrs	n=3240 - employees - aged 18-64 yrs	Poor mental health; measured with the SF-36	90	Work disability; receiving a disability retirement pension, or having received sick leave benefits for at least 10 weeks immediately prior to follow-up, or having received sick leave benefits > 15 weeks during follow-up	77	OR 3.80 ^l	1.66-8.81
Overland(40) 2008 Norway	4 yrs	n=37302 - general population - 47% male (n= 17535) - 53% female (n= 19773) - mean age 44.3 yrs	Depression; measured with the Hospital Anxiety and Depression scale (HADS)	2137 (N=33473)	Disability pension; awarded according to an application stating cause-specific and lasting reduced functional ability due to an acknowledged medical condition	96 (N=681)	OR 1.56 ^m	1.24-1.96
Rai (47) 2012 UK / Sweden	5 yrs	n=17205 - general population - 44% male - mean age 41 yrs	Psychological distress; measured with 12-item General Health Questionnaire, divided into 4 groups: no distress (0), mild distress (1-2), moderate distress (3-7), severe distress (8-12)	2878 (Mild) 2772 (Moderate) 1285 (Severe)	Disability pension; Swedish social insurance register, awarded to people with an underlying disabling medical condition that lead to an inability to work full-time for > 1 year	108 (N=359) 141 (N=392) 149 (N=400)	HR 1.7 ⁿ HR 2.2 ⁿ HR 4.0 ⁿ	1.4-2.2 1.8-2.8 3.2-5.0
Sivertsen(28) 2006 Norway		n=37308 - General population - 47% male (n=17535) - 53% female (n=19773) - mean age 44 yrs	Anxiety (score<8); measured on the 7-item subscale of Hospital Anxiety and Depression scale (HADS)	915(N=37308)	Disability pension; awarded according to an application stating cause-specific and lasting reduced functional ability due to an acknowledged medical condition.	239 (N=5297)	OR 2.19	1.88-2.55
Wedegaerther(31) 2013 Germany	6.4 yrs	n=128001 - employees - 67% male	Depression; major depression (single or recurrent episode), reactive depressive episode, neurotic depression, brief depressive reaction, prolonged depressive reaction, depressive	3822 (N=119671)	Disability pension; retirement before age 58 yrs (financially unattractive to retire before age 58 without demonstrated health reason)	314 (N=4914)	OR 2.16	1.92-2.44

			conditions not elsewhere classified					
			Anxiety; unspecified anxiety states	3719 (N=119568)		203 (N=4803)	OR 1.40	1.21-1.61
			Chronic disease					
Van den Berg(43) 2010 Netherlands/ Europe	2 yrs	n=4611 - Employees - 55% male (n=2523) - 45% female (n=2088) - 48% aged 50-54 yrs - 40% aged 55-59 yrs - 12% aged 60-63 yrs	Chronic disease; ≥ 1 diagnoses by a doctor during lifetime: Mobility problems; ≥1 affirmative answers on a list of 10 mobility problems Instrumental limitations; ≥1 limitations of the 13 instrumental activities of daily living	1130 1287 170	Disability pension; exit the labour force due to health problems	90	OR 2.62 ^a OR 3.22 ^a OR 2.98 ^a	1.69-4.07 2.06-5.03 1.50-5.91
Ahola(34) 2011 Finland	7 yrs	n=3164 - general population - 49% male (n=1550) - 51% female (n=1614) - 44% age 30-39 - 22% age 40-44 - 24% age 45-49 - 23% age 50-54 - 11% age 55-58	Physical illness; caseness if diagnostic criteria for some physical illness were fulfilled	1752	Full-time or part-time disability pension from independent pension institutions due to chronic illness, handicap, or injury which has been verified by a medical certificate and independently evaluated to have resulted in considerably decreased work ability.	169	OR 2.25 ^h	1.58-3.20
Alexandersson(35) 2012 France	17 yrs	n=20434 - Employees - 73% male (n=14917) - 275 female (n=5517) - men aged 40-50 yrs - women aged 35-50 yrs	Sick-leave diagnosis; sick leave spells ≥7 days with diagnosis - Circulatory - Respiratory - Musculoskeletal - Injury	W: 250(N=5518) M: 526(N=14916) W: 576(N=5518) M: 815(N=14916) W: 696(N=5518) M:1358(N=14916) W: 416 (N=5518) M:1203(N=14916)	Disability pension; temporary or permanent DP or > 600 sick-leave days during 2 consecutive years	18 (N=245) 29 (N=284) 36 (N=245) 35 (N=284) 51(N=245) 67(N=284) 33(N=245) 41(N=284)	HR 3.10 ⁱ HR 5.62 ⁱ HR 2.62 ⁱ HR 3.92 ⁱ HR 3.29 ⁱ HR 4.64 ⁱ HR 2.68 ⁱ HR 3.64 ⁱ	1.82-5.28 3.69-8.56 1.72-3.99 2.64-5.84 2.24-4.82 3.35-6.42 2.22-5.27 2.06-4.37
Eriksen(23) 2001 Norway	4 yrs	n= 1426 - General population - 50% male (n=713) - 50% female (n=713) - 15% age 20-22 - 20% age 30-32 - 31% age 40-42 - 24% age 50-52 - 11% age 60-62	Neck pain; pain during the previous 12 months Low back pain; pain during the previous 12 months Shoulder pain; pain during the previous 12 months	694 (N=1311) 757 (N=1319) 708 (N=1317)	Long term work disability; absence from work because of sickness ≥ 8 weeks during the previous year, receiving rehabilitation benefits, or being disability pensioned	98(N=141) 101(N=147) 103(N=146)	OR 2.19 OR 1.73 OR 2.24	1.51-3.20 1.20-2.49 1.54-3.26
Jensen (14)	15 yrs	n=4616	Upper limb disorder; > than 30	102 (N=2428)	Disability pension; Danish national	63 (N=540)	HR 2.18	1.57-3.01

2012 Denmark		- Employees (nurse's aides) - 2% male - mean age (SD): 42.7(9.4)	days sick leave the last year because of upper limb disorder Lower limb disorder; > than 30 days sick leave the last year because of lower limb disorder Cardiovascular disease Lung diseases Skin diseases Gastro intestinal diseases Rheumatologic inflammatory diseases Nervous disorder	114 (N=2428) 352 (N=2428) 563 (N=2428) 406 (N=2428) 306 (N=2428) 68 (N=2428) 100 (N=2428)	register on public transfer payments, obtaining disability pension require an evaluation of work ability which is to be reduced to a minimum	64 (N=540) 93 (N=540) 152 (N=540) 105 (N=540) 98 (N=540) 33 (N=540) 41 (N=540)	HR 1.51 HR 1.14 HR 1.14 HR 1.13 HR 1.39 HR 2.42 HR 1.31	1.08-2.11 0.94-1.38 0.93-1.39 0.90-1.42 1.10-1.76 1.67-3.52 0.92-1.87
Kamaleri(24) 2009 Norway	14 yrs	n=1354: - General population - 45% male (n=609) - 55% female (n=745) - 25% age 20-22 - 20% age 30-32 - 31% age 40-42 - 24% age 50-52	Bodily pain; self-reported pain in the past 12 months in 10 different body regions.	1170 (N=1354)	Disability pension; self-reported employment status, having either permanent or long-term (> 1 year) social security benefits due to illness	168 (N=176)	OR 3.69	1.78-7.63
Kirchhoff(36) 2011 USA	9 yrs	n= 5386 - Employees, childhood cancer survivors - 50% male (n=2693) - 50% female (n=2693) - 56% age 25-34 - 35% age 35-44 - 9% age 45+	Somatic distress; Brief symptom inventory, 18 item checklist.		Health related unemployment; unable to work because of illness or disability (self-reported)		RR 1.32	1.08-1.61
Kuoppala(26) 2011 Finland	7 yrs	n=967 - Employees (civil service) - 47% male (n=455) - 53% female (n=512) - mean age(SD):45.1(9.7)	Occasionally – constantly musculoskeletal symptoms; musculoskeletal symptoms on neck/shoulder region, upper arms, lower back scored on 3-point scale (never- constantly)	739 (N=961)	Disability pension; register based and provided by the Actuary Division of State Treasury	40 (N=44)	OR 3.12	1.10-8.81
Lund(38) 2003 Denmark	2 yrs	n=3240 - employees - aged 18-64 yrs	Musculoskeletal symptoms in neck/shoulders; problems within the last 12 months Chronic Bronchitis; Assessed using the British Medical	1593 530	Work disability; receiving a disability retirement pension, or having received sick leave benefits for at least 10 weeks immediately prior to follow-up, or having received sick leave benefits > 15 weeks during	77	OR 1.60 ^l OR 1.80 ^l	0.92-2.77 1.01-3.21

			Research Council respiratory questionnaire		follow-up			
Lund(39) 2001 Denmark	3 yrs	n=2918 - employees (waste collectors, municipal workers) - 100% male - mean age 44.3 yrs	Chronic bronchitis; British Medical Research Council respiratory questionnaire Musculoskeletal disorders; 12 months prevalence of problems in the hips Musculoskeletal disorders; 12 months prevalence of problems in the knees		Disability pension/ long term sick leave (< 2 months)	102	OR 3.68 ^o OR 2.72 ^o OR 1.91 ^o	1.97-6.89 1.54-4.81 1.11-3.28
Natvig(27) 2002 Norway	4 yrs	n=1426 - employees - 49.6% male (n=707) - 50.4% female (n=719) - 15% aged 20-22 - 20% aged 30-32 - 31% aged 40-42 - 24% aged 50-52 - 11% aged 60-62	Musculoskeletal complaints; pain or discomfort during previous week Localized LBP; LBP reported as the only localization of musculoskeletal pain LBP as part of widespread pain; LBP plus symptoms from ≥4 other areas of the body LBP and some additional pain; LBP plus symptoms from 1-3 areas of the body Pain; pain or discomfort during the previous week, but not LBP	891 (N=1426) 81 (N=679) 185 (N=783) 120 (N=718) 442 (N=1040)	Long-term work disability; sick leave > 8 weeks during the year prior to follow-up, receiving rehabilitation benefits, or disability pension.	126 (N=160) 7 (N=53) 26 (N=72) 31 (N=77) 50 (N=96)	OR 2.43 OR 1.14 OR 1.96 OR 4.18 OR 1.53	1.63-3.60 0.49-2.60 1.17-3.28 2.52-6.94 1.00-2.33
Ropponen(41) 2011 Sweden	25 yrs	n= 16713 - general population (twins) - 48% male (n= 8022) - 52% female (n=8691) - <65 years - not retired at FU	Stable number of pain locations; having the same pain at BL and FU Decrease of pain locations; decrease of pain locations after BL Increase of pain locations; increase of pain locations after BL		Disability pension; due to all diagnoses as registered in the MiDAS database, by the National Social Insurance Agency		HR 2.04 ^p HR 1.72 ^p HR 2.15 ^p	1.60-2.59 1.33-2.21 1.92-2.42
Rothenbacher(42) 1998 Germany	4.4 yrs	n= 4958 - employees (construction industry) - 100% male - mean age(SD) 50(5.4)	Self reported back pain; experience with any type of back pain or sciatica Physician assessed back pain: local pain or tenderness of the paravertebral muscles	2613 (N=4574) 1017 (N=4574)	Disability pension; health related reasons a worker cannot engage in any substantial gainful employment and therefore is granted indemnity for the rest of his life	238(N=340) 121(N=340)	RR 1.60 ^o RR 1.80 ^o	1.30-2.10 1.40-2.20

			Medical diagnosis of back problems; diagnosis as it appears in the employees medical records	1282 (N=4574)		126(N=340)	RR 1.50 ^q	1.20-1.80
			Other					
Koivumaa(25) 2004 Finland	11 yrs	n= 22136 - General population (twins) - 50% male (n=11068) - 50% female (n=11068) - mean age 31.2 yrs	Intermediate – dissatisfied life satisfaction; 4-item life satisfaction scale (range 4-20) Ill health; register based, self reported symptoms and life history	m:9037 (N=11037) w:8738 (N=11099) m:1720 (N=11037) w:2081 (N=11099)	Disability pension; continuously unable to work for 1year due to disease or injury according to an evaluation made by a physician: registered by the Social Insurance Institution of Finland	619 (N=696) 442 (N=504) 272 (N=696) 258 (N=504)	OR 1.84 OR 1.98 OR 3.94 OR 5.05	1.44-2.34 1.51-2.59 3.35-4.63 4.21-6.05
Overland(40) 2008 Norway	4 yrs	n=37302 - general population - 47% male (n= 17535) - 53% female (n= 19773) - mean age 44.3 yrs	Insomnia; difficulty falling asleep, maintaining sleep, or experiencing nonrestorative sleep for a period ≥1 month, resulting in impaired daytime functioning	2999 (N=34335)	Disability pension; awarded according to an application stating cause-specific and lasting reduced functional ability due to an acknowledged medical condition	152 (N=736)	OR 1.66 ^m	1.37-2.01

^a Adjusted for age, sex, educational level, lifestyle, work characteristics; ^b adjusted for age; ^c adjusted for pre-existing diseases, general health questionnaire, limiting longstanding illness, sickness absence > 2 weeks, prescribed medication purchases, hospitalizations, special reimbursement; ^d adjusted for age, sex, educational level, cohabitation status, BMI, lack of physical activity, excessive alcohol intake, low job control, low rewards; ^e adjusted for health, demographic variables, socioeconomic indicators; ^f adjusted for sex, age, marital status, occupational status, sector, mental disorders, physical illnesses; ^g adjusted for sex, age, marital status, socioeconomic status, registered medication use, self-reported chronic illness; ^h adjusted for age, gender, statistical significant clinical socio-demographic, work-related, health behavior factors, and treatment factors; ⁱ adjusted for age, occupational class; ^j adjusted for age, sex, cohabitation, children living at home, retirement of spouse, socioeconomic position, health behavior, presence of chronic disease; ^k adjusted for age, education, occupation, BMI, alcohol consumption, smoking, maximal oxygen uptake, chronic disease at baseline; ^l adjusted for age, sex, company size, public or private sector; ^m adjusted for sex, age somatic disease, pain, education, SES, health behavior; ⁿ adjusted for age, sex, sociodemographic and lifestyle factors, cohabiting or living alone, employed or not, occupational socioeconomic class, education, gross household, sedentary or active lifestyle, cannabis use in past year, daily smoking, BMI, self-reported daily pain, physical illness, secondary car register diagnosis of a common mental disorder of psychiatric illness; ^o adjusted for work environment, lifestyle; ^p adjusted for zygosity, birth year, years of education, marital status, number and severity diseases; ^q adjusted for age, profession, company size, nationality.

Appendix III: Included studies presenting the relation between **unemployment** and different health measures/ dimensions.

Author	Follo w-up	Population	Health measure		Outcome (sustainable employability)		Results	
			Description	Prevalence	Description	frequency	OR/RR/HR	95% CI
			Self-perceived health					
Van den Berg(43) 2010 Netherlands/ Europe	2 yrs	n=4611 - Employees - 55% male (n=2523) - 45% female (n=2088) - 48% aged 50-54 yrs - 40% aged 55-59 yrs - 12% aged 60-63 yrs	Less than good perceived health; measured on a 5-point scale (very good – very bad)	793	Unemployed; laid off from last job but not claiming normal pension benefits	127	OR 1.96 ^a	1.32-2.92
Arrow (22) 1996 Germany	6 yrs	n=2424 - employees - 74% male (n=1794) - 26% female (n=630) - 22% age 18-29 - 60% age 30-50 - 18% age 51-64	Not satisfied with health status; self-reported	383	Unemployment; self-reported employment status for each month of the previous year	44(N=231)	OR 1.29	0.90-1.82
Jusot (53) 2008 France	4 yrs	n=5707 - employees (private sector) - 58% male (n=3287) - 42% female (n=2420) - aged 30-54 yrs	Non-optimal self- rated health; rated on a 0-10 scale		Unemployment; self-reported		OR 1.7 (w) ^b OR 1.5 (m) ^b	1.2-2.3 1.1-2.2
Kirchhoff (36) 2011 USA	9 yrs	n= 5386 - Employees, childhood cancer survivors - 50% male (n=2693) - 50% female (n=2693) - 56% age 25-34 - 35% age 35-44 - 9% age 45+	Poor physical Health; measured with SF-36		Unemployed but seeking work		RR 0.94	0.65-1.37
Liira (55) 1999 Finland	5 yrs	n=781 (construction ind.) n=877 (forestry workers) - employees - 100% male - aged <50 yrs	Poor – very poor subjective health; related to the health of others of the same age		Long-term unemployment; without a job at the time of follow-up and had been out of work > 24 months	195 (CW) 67 (FW)	OR 2.15 ^c OR 1.49 ^c	1.30-3.56 0.67-3.28
Robroek (48) 2013 Netherlands / Europe	4 yrs	N=4923 - general population - 56% male - mean age(SD): 55.2(3.5) yrs	Less than good self-perceived health; measured on 5 point likert scale (excellent – very poor)	531 (N=4923)	Unemployment; self-reported, individuals who became unemployed from their last job before they reached statutory retirement	218	HR 1.21 ^d	0.84-1.76
Schuring (11) 2007 Netherlands / Europe	4 yrs	N=57436 - General population - 61% male - aged16-24: 11%	Less than good self-perceived health; measured on a 5 point likert scale (very good – very bad)	14748	Unemployment; defined as those people who worked <15 h/week and who considered themselves as being unemployed.	3000	OR 1.14(low edu) OR 1.28(inter edu) OR 1.20(high edu)	1.07 - 1.26 1.15 - 1.35 0.70 - 2.30

		- aged 25-44: 55% - aged 45-54: 21% - aged 55-65: 9%						
Schuring (49) 2013 Netherlands	10 yrs	N=15152 - employees - 60% male - aged 18-64 yrs	Less than good self-perceived health; measured on 5 point likert scale (very good – very poor)	1329 (N=11382)	Unemployment; Dutch tax register as provided by statistics Netherlands, receiving unemployment or social security benefits	1264	HR 1.89 ^e	1.63-2.18
Virtanen(29) 2005 Finland	4 yrs	n=1306 - employees (public sector) - 100% female - mean age 35.8 yrs	Average-poor self-reported health; measured on a 6-point scale (excellent-poor)	207 (N=1237)	Unemployment; self-reported unemployment including short-term employment on government subsidized contracts	24(N=92)	OR 1.86	1.13-3.03
Virtanen(57) 2013 Sweden	12 yrs	N=1083 - general population - 52% male - mean age 30 yrs	Suboptimal self-perceived health; measured on a 3 point scale (good – poor) and divided into 2 groups: optimal (good) and suboptimal (something in between, poor)		Unemployment; self-reported, classified when respondent marked 'unemployed' or 'participating in active labour market policy measure'		HR 1.48 ^f	1.13-1.94
Mental health								
Bildt (51) 2003 Sweden	4 yrs	n=420 - General population - 47% male (n=197) - 53% female (n=223) - aged 46 -64 yrs	Sub-clinical depression; at least 2 depressive symptoms at any time during the past year Reduced psychological wellbeing; measured with general health questionnaire	9(w) 10(m) 22(w) 24(m)	Unemployment; self-reported	25(w) 26(m)	W: RR 0.90 ^c M: RR 1.10 ^c W: RR 3.2 ^c M: RR 4.8 ^c	0.20-4.90 0.20-6.00 1.4-7.6 2.0-11.4
Kirchhoff(36) 2011 USA	9 yrs	n= 5386 - Employees, childhood cancer survivors - 50% male (n=2693) - 50% female (n=2693) - 56% age 25-34 - 35% age 35-44 - 9% age 45+	Poor mental Health; ; measured with SF-36 Depression; Brief symptom inventory, 18 item checklist. Anxiety; Brief symptom inventory, 18 item checklist. Somatic distress; Brief symptom inventory, 18 item checklist.		Unemployed but seeking work		RR 2.08 RR 1.57 RR 0.77 RR 1.14	1.48-2.91 1.10-2.24 0.52-1.15 0.79-1.66
Leino-Arjas(54) 1999 Finland	4 yrs	n=586 - employees (construction ind.) - 100% male - aged 40-59 yrs	Frequent stress symptoms; measured on a 4-point scale (never - continuously)		Long term unemployment; >24 months' redundancy during follow-up, self -reported	115(N=586)	OR 2.06 ^c	1.36-3.14
Liira(55) 1999 Finland	5 yrs	n=781 (construction ind.) n=877 (forestry workers) - employees - 100% male - aged <50 yrs	Frequent stress symptoms; measured on a 4-point scale (never - continuously)		Long-term unemployment; without a job at the time of follow-up and had been out of work > 24 months	195 (CW) 67 (FW)	OR 1.62 ^c OR 1.76 ^c	1.17-2.25 1.06-2.94
Thielen (56)	2 yrs	N=5758	Depressive symptoms; measured	2)2595 (N=5758)	Unemployment; register information	2)171(N=435)	OR 1.02 ^g	0.80-1.28

2013 Denmark		- general population - 50% male - aged 40 yrs: 51% - aged 50 yrs: 49%	with the 10- item Major Depression Inventory, divided into four groups: 1) no symptoms (0-2), 2) at least one symptom (3-8), 3) less than major depression (9-19), 4) major depression (>19)	3)663 (N=5758) 4)167 (N=5758)	on employment and social benefits data from statistics Denmark, unemployed >50% of all days during registration year	3)89 (N=435) 4)63 (N=435)	OR 2.08 ^g OR 1.99 ^g	1.54-2.80 1.22-3.26
Virtanen(29) 2005 Finland	4 yrs	n=1306 - employees (public sector) - 100% female - mean age 35.8 yrs	Psychological distress; measured with the general health questionnaire	356 (N=1243)	Unemployment; self-reported unemployment including short-term employment on government subsidized contracts	25 (N=92)	OR 0.92	0.57-1.49
Whooley (58) 2002 USA	5 yrs	N=5115 - General population - 44% male - mean age 30.6 yrs	Depressive symptoms; measured with the 20-item Center for Epidemiologic Studies Depression Scale (CES-D)	354 (N=1935)	Unemployment; self-reported, unemployed and looking for work for more than 2 months	118 (N=453)	OR 1.6 ^h	1.2-2.0
Chronic disease								
Van den Berg(43) 2010 Netherlands/ Europe	2 yrs	n=4611 - Employees - 55% male (n=2523) - 45% female (n=2088) - 48% aged 50-54 yrs - 40% aged 55-59 yrs - 12% aged 60-63 yrs	Chronic disease; ≥ 1 diagnoses by a doctor during lifetime: Mobility problems; ≥1 affirmative answers on a list of 10 mobility problems Instrumental limitations; ≥1 limitations of the 13 instrumental activities of daily living	1130 1287 170	Unemployed; laid off from last job but not claiming normal pension benefits	127	OR 1.30 ^a OR 1.03 ^a OR 1.31 ^a	0.88-1.93 0.69-1.54 0.58-2.93
Arrow(22) 1996 Germany	6 yrs	n=2424 - employees - 74% male (n=1794) - 26% female (n=630) - 22% age 18-29 - 60% age 30-50 - 18% age 51-64	Chronic illness; chronic illness lasting at least 1 year	764	Unemployment; self-reported employment status for each month of the previous year	87 (N=231)	OR 1.35	1.02-1.79
Bildt(51) 2003 Sweden	4 yrs	n=420 - General population - 47% male (n=197) - 53% female (n=223) - aged 46 -64 yrs	Low back pain; medical consultation and treatment by a doctor, physiotherapist or chiropractor during the 12 months preceding follow-up Neck and shoulder pain; medical consultation and treatment by a doctor, physiotherapist or chiropractor during the 12 months preceding follow-up	14(w) 17 (m) 27(w) 16(m)	Unemployment; self-reported	25 (w) 26 (m)	RR 0.90 ^c RR 2.20 ^c RR 0.90 ^c RR 2.10 ^c	0.40-2.40 0.90-5.70 0.30-2.60 0.70-6.10
Kirchhoff(36) 2011 USA	9 yrs	n= 5386 - Employees, childhood cancer survivors	Somatic distress; Brief symptom inventory, 18 item checklist.		Unemployed but seeking work		RR 2.08	1.48-2.91

		<ul style="list-style-type: none"> - 50% male (n=2693) - 50% female (n=2693) - 56% age 25-34 - 35% age 35-44 - 9% age 45+ 						
Leino-Arjas(54) 1999 Finland	4 yrs	n=586 <ul style="list-style-type: none"> - employees (construction ind.) - 100% male - aged 40-59 yrs 	Number of diseases; 1 2 ≥3 Current diseases; diagnosed by a physician: <ul style="list-style-type: none"> - Cardiovascular - Musculoskeletal - Respiratory - Gastrointestinal - Urogenital - Skin - Neoplastic - Haematological - Neurological and sensory - Mental Frequent musculoskeletal symptoms; aches, stiffness, tenderness on movement, numbness or pain during the past year, measured on a 4-point scale (never - continuously)		Long term unemployment; >24 months' redundancy during follow-up, self -reported	115(N=586)	OR 1.27 ^c OR 0.99 ^c OR 1.52 ^c OR 1.39 ^c OR 1.22 ^c OR 1.25 ^c OR 2.11 ^c OR 0.64 ^c OR 1.88 ^c OR 1.42 ^c OR 0.84 ^c OR 1.75 ^c OR 7.28 ^c OR 1.22 ^c	0.67-2.39 0.50-1.95 0.84-2.73 0.84-2.30 0.79-1.89 0.71-2.21 1.21-3.68 0.14-2.88 1.03-3.41 0.45-4.53 0.18-3.93 1.03-2.97 1.70-31.18 0.79-1.89
Liira(55) 1999 Finland	5 yrs	n=781 (construction ind.) n=877 (forestry workers) <ul style="list-style-type: none"> - employees - 100% male - aged <50 yrs 	Frequent musculoskeletal symptoms; aches, stiffness, tenderness on movement, numbness or pain during the past year, measured on a 4-point scale (never - continuously)		Long-term unemployment; without a job at the time of follow-up and had been out of work > 24 months	195 (CW) 67 (FW)	OR 1.11 ^c OR 1.24 ^c	0.80-1.55 0.72-2.08
Lund(39) 2001 Denmark	3 yrs	n=2918 <ul style="list-style-type: none"> - employees (waste collectors, municipal workers) - 100% male - mean age 44.3 yrs 	Musculoskeletal disorders; 12 months prevalence of problems in the hips		Unemployment	102	OR 1.33 ^l	0.75-2.38
			Other					
Cardano(10) 2004 Italy	10 yrs	n=127384 <ul style="list-style-type: none"> - General population - aged 25-49 	Poor health; hospital admission (1984-1986) for any illness or accident		Unemployment or discouraged (housewife)	5223	OR 1.08	0.98-1.19
Earle(52) 2002	17 yrs	n=783 <ul style="list-style-type: none"> - General population 	Health limitation		Job loss; job ending that was followed by a period of unemployment	438	OR 1.53	1.19-1.97

USA		- 100% female - mean age 27.1 yrs			of at least 3 months			
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^a Adjusted for age, sex, educational level, lifestyle, work characteristics; ^b adjusted for age, educational level, type of job contract, household composition, presence of children of less than 6yrs in the household; ^c adjusted for age; ^d adjusted for age, sex, educational level, cohabitation status, BMI, lack of physical activity, excessive alcohol intake, low job control, low rewards; ^e adjusted for health, demographic variables, socioeconomic indicators; ^f adjusted for sex, parental status, and socioeconomic status, unemployment before age 30; ^g adjusted for sex, age, cohabitation status, vocational education, alcohol consumption, smoking, obesity, back pain, depressive symptoms; ^h adjusted for sex, ethnicity, marital status, education, annual family income, history of unemployment during past 3 yrs, home ownership, smoking, social network; ⁱ adjusted for work environment, lifestyle.

Appendix IV: Included studies presenting the relation between **early retirement** and different health measures/ dimensions.

Author	Follo w-up	Population	Health measure		Outcome (sustainable employability)		Results	
			Description	Prevalence	Description	frequency	OR/RR/HR	95% CI
Self-perceived health								
Van den Berg(43) 2010 Netherlands/ Europe	2 yrs	n=4611 - Employees - 55% male (n=2523) - 45% female (n=2088) - 48% aged 50-54 yrs - 40% aged 55-59 yrs - 12% aged 60-63 yrs	Less than good perceived health; measured on a 5-point scale (very good – very bad)	793	Early retirement; self-reported retirement before the age of 63 years	482	OR 1.32 ^a	1.01-1.72
Friis(60) 2007 Denmark	9 yrs	n=5538 - employees (nurses) - 100% female - aged > 44 yrs	Fair - very poor self reported health; measured on a 5-point scale (very good -very poor)	700 (N=5349)	Early retirement; withdrawal from the labour market to post-employment wage (PEW)	505 (N=3599)	HR 1.28 ^b	1.16-1.41
Mein(61) 2000 UK	7 yrs	n=2532 - employees (civil servants) - 67% male (n=1696) - 33% female (n=836) - 57% age 50-5 - 43% age 55-59.5	Poor/very poor self reported health; health over the last 12 months measured on a 5- point scale (very good - very poor)	386 (m) 329 (w)	Early retirement; self-reported retirement before the age of 59.5 years	125 (n=468) 85 (n=210)	HR 1.55 ^c HR 1.16 ^c	1.18-2.04 0.78-1.73
Robroek (48) 2013 Netherlands / Europe	4 yrs	N=4923 - general population - 56% male - mean age(SD): 55.2(3.5) yrs	Less than good self-perceived health; measured on 5 point likert scale (excellent – very poor)	531 (N=4923)	Early retirement; self-reported, retirement before the statutory country specific retirement age	589	HR 1.17 ^d	0.90-1.51
Schuring (49) 2013 Netherlands	10 yrs	N=15152 - employees - 60% male - aged 18-64 yrs	Less than good self-perceived health; measured on 5 point likert scale (very good – very poor)	587 (N=3751)	Early retirement; Dutch tax register as provided by statistics Netherlands, pension as main source of income before they reached the age of 65 yrs	961	HR 1.20 ^e	1.02-1.41
Chronic disease								
Van den Berg(43) 2010 Netherlands/ Europe	2 yrs	n=4611 - Employees - 55% male (n=2523) - 45% female (n=2088) - 48% aged 50-54 yrs - 40% aged 55-59 yrs - 12% aged 60-63 yrs	Chronic disease; ≥ 1 diagnoses by a doctor during lifetime:	1130	Early retirement; self-reported retirement before the age of 63 years	482	OR 1.28 ^a	1.01-1.62
			Mobility problems; ≥1 affirmative answers on a list of 10 mobility problems	1287			OR 1.15 ^a	0.91-1.46
			Instrumental limitations; ≥1 limitations of the 13 instrumental activities of daily living	170			OR 0.99 ^a	0.59-1.69
Ames(59) 1984 USA	5 yrs	n=1394 - employees (coal miners)	Respiratory Impairment: - Obstruction - Restriction - Forced expiratory Flow rate		Early retirement with disability; self-reported retirement with either 'disability' or 'concern over health'		OR 0.96 OR 0.98 OR 0.96	0.91-1.02 0.94-1.02 0.62-1.48

			- Cough - Phlegm - Breathlessness				OR 0.82 OR 3.46 OR 1.17	0.32-2.10 1.40-8.51 0.49-2.83
Jensen (14) 2012 Denmark	15 yrs	n=4616 - Employees (nurse's aides) - 2% male - mean age (SD): 42.7(9.4)	Upper limb disorder; > than 30 days sick leave the last year because of upper limb disorder	117 (N=2792)	Early retirement; Danish national register on public transfer payments, available from the age of 60 years if the person has achieved 25 years of membership of an unemployment benefit fund for a period of 30 years.	41 (N=904)	HR 1.04	0.72-1.50
			Lower limb disorder; > than 30 days sick leave the last year because of lower limb disorder	131 (N=2792)		47 (N=904)	HR 0.91	0.63-1.31
			Cardiovascular disease	405 (N=2792)		185 (N=904)	HR 1.47	1.27-1.69
			Lung diseases	648 (N=2792)		191 (N=904)	HR 0.88	0.75-1.05
			Skin diseases	466 (N=2792)		106 (N=904)	HR 0.61	0.49-0.75
			Gastro intestinal diseases	352 (N=2792)		135 (N=904)	HR 1.21	1.00-1.47
			Rheumatologic inflammatory diseases	78 (N=2792)		36 (N=904)	HR 1.76	1.25-2.48
			Nervous disorder	115 (N=2792)		40 (N=904)	HR 0.87	0.62-1.24
Lund(39) 2001 Denmark	3 yrs	n=2918 - employees (waste collectors, municipal workers) - 100% male - mean age 44.3 yrs	Musculoskeletal disorders; 12 months prevalence of problems in the knees		Early retirement	102	OR 1.56 ^f	0.67-3.60
Mein(61) 2000 UK	7 yrs	n=2532 - employees (civil service) - 67% male (n=1696) - 33% female (n=836) - 57% age 50-5 - 43% age 55-59.5	Many (>2) longstanding illnesses; illness that has troubled or affect you over a period of time	123 (m) 50 (w)	Early retirement; self-reported retirement before the age of 59.5 years	41 (n=468) 17 (n=210)	HR 1.40 ^c HR 1.42 ^c	1.01-1.95 0.85-2.37
			Some (1) longstanding illness; illness that has troubled or affect you over a period of time	505 (m) 271 (w)		140 (n=468) 74 (n=210)	HR 1.08 ^c HR 1.25 ^c	0.88-1.33 0.94-1.68
			Other					
Cardano(10) 2004 Italy	10 yrs	n=127384 - General population - aged 25-49	Poor health; hospital admission (1984-1986) for any illness or accident		Early retirement	1656	OR 1.46	1.25-1.69
Mein(61) 2000 UK	7 yrs	n=2532 - employees (civil service) - 67% male (n=1696) - 33% female (n=836) - 57% age 50-5 - 43% age 55-59.5	Poor general health; General Health Questionnaire (GHQ), 30 items	406 (m) 270 (w)	Early retirement; self-reported retirement before the age of 59.5 years	126 (n=468) 75 (n=201)	HR 1.26 ^c HR 1.16 ^c	1.02-1.56 0.85-1.57

^a Adjusted for age, sex, educational level, lifestyle, work characteristics; ^b adjusted for working schedule, working area, pressure of work/ work speed, influence at work, physical demands at work, leisure- time physical activity, BMI, marital status and spouse's SES, place of residence; ^c adjusted for age, duration of employment in the civil service, employment grade, job satisfaction, perceived health, marital status, material problems, housing tenure, car access, long-term illness, general health questionnaire score, job demands and work support; ^d adjusted for age, sex, educational level, cohabitation status, BMI, lack of physical activity, excessive alcohol intake, low job control, low rewards; ^e adjusted for health, demographic variables, socioeconomic indicators; ^f adjusted for work environment, lifestyle, marital status.