

BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (<http://bmjopen.bmj.com>).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

Sickness absence as a predictor of disability retirement in different occupational classes: a register-based study of 1.7 million Finns in 2007–2014

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-020491
Article Type:	Research
Date Submitted by the Author:	08-Nov-2017
Complete List of Authors:	Salonen, Laura; Turun Yliopisto, Department of Social Research Blomgren, Jenni; Kela, Research Department Laaksonen, Mikko; Finnish Centre for Pensions, Niemi, Mikko; Turun Yliopisto, Department of Social Research; Kela
Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Public health, Sociology
Keywords:	OCCUPATIONAL & INDUSTRIAL MEDICINE, PUBLIC HEALTH, SOCIAL MEDICINE

SCHOLARONE™
Manuscripts

1
2
3 **Sickness absence as a predictor of disability retirement in different**
4 **occupational classes: a register-based study of 1.7 million Finns in**
5 **2007–2014**
6
7
8
9

10 Salonen, Laura¹, Blomgren, Jenni², Laaksonen, Mikko³ & Niemelä, Mikko^{1,2}

11
12
13 ¹ Salonen, Laura

14 Postal address: Lonttistentie 27 B 24, 20100 Turku, Finland

15 Email: ksalo@utu.fi

16 Telephone number: +358 41 546 8506
17
18
19
20

21 ² Blomgren, Jenni

22 Institution: the Social Insurance Institution of Finland

23 City and country: Helsinki, Finland
24
25
26

27 ³ Laaksonen, Mikko

28 Institution: the Centre of Pensions

29 City and country: Helsinki, Finland
30
31
32
33

34 ^{1,2} Niemelä, Mikko

35 Department: Department of Social Research

36 Institution: University of Turku

37 City and country: Turku, Finland
38
39
40
41

42 Institution: the Social Insurance Institution of Finland

43 City and country: Helsinki, Finland.
44
45
46

47 Word count: 2891
48
49
50
51
52
53
54
55
56
57
58
59
60

ABSTRACT

Objectives The objective of the study was to examine diagnosis-specific sickness absences of different lengths as predictors of disability retirement in different occupational classes.

Setting Register-based prospective cohort study up to 8 years of follow-up.

Participants: A 70% random sample of the non-retired Finnish population aged 25–62 at the end of 2006 was included (N=1,727,644) and linked to data on sickness absences in 2005 and data on disability retirement in 2007–2014.

Primary and secondary outcome measures: By the use of Cox proportional hazards models, we analysed the association of all-cause and diagnosis-specific sickness absence with the risk of all-cause disability retirement in different occupational classes during an eight-year follow-up.

Results: A long sickness absence was a strong predictor of disability retirement in all occupational classes, but in particular in upper non-manual employees. The association was seen in all diagnostic groups, but it was strongest for sickness absence due to mental and behavioural disorders. Adjusting for the diagnosis of sickness absence partly attenuated the association between the length of sickness absence and the risk of disability retirement in all employed groups.

Conclusions: A long sickness absence is a strong predictor of disability retirement in all occupational classes. Preventing the accumulation of sickness absence days and designing more efficient policies for different occupational classes may be crucial to reduce the number of transitions to early retirement due to disability.

Article summary

Strengths and limitations of this study

- A strength of this study was the 8-year prospective and population-based cohort design
- Data were obtained from national registers, constituting highly reliable sources with objective register-based measures, no self-report bias, practically no loss to follow-up and very little missing information
- We were able to utilize date-specific information on both sickness absence and disability retirement.
- A limitation to this study was the lack of information on, for example, health status, health behaviours or work environment that could explain or mediate the observed associations.
- Due to the observational nature of the data, causal effects cannot be established.

INTRODUCTION

Large numbers of employees leave the labour market early due to health problems [1]. In particular, those in disadvantaged social positions have an increased risk of problems with health and work ability [2–7]. Both inequalities in health and a loss of workforce due to health problems cause substantial costs for societies [1,8]. To extend working lives, which has become an important target in many OECD countries [9], identifying those with an increased risk of work disability is crucial.

Previous studies have discovered several sociodemographic, work-environmental and health-related predictors of work disability [10–13]. One of the strongest early markers of disability retirement is sickness absence [14]. The risk of disability retirement has been shown to depend on both the duration and the diagnosis of sickness absence. In particular, long-term sickness absence [4,5] and sickness absence due to musculoskeletal diseases [15]; mental and behavioural disorders [16]; and diseases of the nervous, respiratory, and circulatory systems [5] indicate a high risk of disability retirement.

However, to our knowledge, there are no studies focusing on whether this association varies by occupational class. There are large occupational class differences in both sickness absences of various lengths [17,18] and the risk of disability retirement [19–22]. The differences between occupational classes are substantial in sickness absence due to musculoskeletal diseases, but they are smaller in sickness absence due to

1
2
3 mental and behavioural disorders [23,24]. The varying diagnostic profiles of the
4 occupational classes may confound the association between the length of sickness
5 absence and the risk of disability retirement. This emphasizes the need to consider both
6 the length and diagnosis of sickness absence when occupational class differences in
7 the risk of disability retirement are examined.
8
9
10

11
12 The aim of the study was to examine diagnosis-specific sickness absences of different
13 lengths as predictors of disability retirement in different occupational classes. We
14 examined, first, how the length of all-cause sickness absence predicts disability
15 retirement in different occupational classes and, second, how the length of sickness
16 absence due to musculoskeletal diseases, mental and behavioural disorders or other
17 diagnoses predicts disability retirement in different occupational classes. Finally, we
18 studied whether the differences in the diagnoses of sickness absences explain the
19 occupational class differences in the association between the length of sickness
20 absence and disability retirement.
21
22
23
24
25
26
27

28 **METHODS**

29 **Study population**

30
31 Our data were drawn from several linked registers of the Social Insurance Institution of
32 Finland (Kela), the Finnish Centre for Pensions and Statistic Finland. A 70% random
33 sample of the non-retired Finnish population aged 25–62 years at the end of 2006 was
34 retrieved from the population data file of Kela (N=1,727,644). Data on
35 sociodemographic characteristics in 2006, new medically certified sickness absence
36 episodes longer than ten working days starting in 2005 and new disability pensions from
37 2007 to 2014 were linked using the participants' personal identification numbers.
38
39
40
41
42
43

44 **Measurement of disability retirement**

45
46 Data on disability retirement were retrieved from the registers of the Finnish Centre for
47 Pensions (earnings-related pensions) and Kela (basic level national pensions). In
48 Finland, the disability retirement system covers all permanent residents. Disability
49 pensions can be granted to persons aged 18–62 (earnings-related scheme) or 16–64
50 (national pension scheme), if their work disability is medically assessed to be long-term
51 (at least one year) or permanent. Transferring to full- or part-time disability pensions
52 between 1 January 2007 and 31 December 2014 was analysed in this study.
53
54
55
56
57
58
59
60

Measurement of sickness absence

Sickness absence was measured through sickness allowance, derived from the register of Kela. In Finland, sickness allowance is paid to compensate for the income losses caused by work incapacity lasting up to approximately one year, after which a disability pension can be granted. A sickness allowance may be paid after a waiting period of ten working days of work incapacity (Sundays and midweek holidays are not counted as working days). A sickness certificate from a physician is required. All new sickness absence spells that started during the time period 1 January 2005 to 31 December 2005 were included, and each spell was followed until its end. All, including possible multiple spells, were totalled per diagnostic category (see below) per person. Since disability retirement is usually followed by one year of sickness absence, we started the follow-up at 1 January 2007.

The diagnostic groups were chosen based on statistics of the two most prevalent diagnostic causes of sickness absence in 2005 [25]. Three diagnostic groups for sickness absences were used: musculoskeletal diseases (M00–M99), mental and behavioural disorders (F00–F99) and other diagnoses (the rest of the diagnostic groups). The length of sickness absence was calculated as the total number of days in each diagnostic group, and they were categorized as follows: 0 days, 1–30 days, 31–60 days, 61–180 days and over 180 days, per diagnostic group (Table 1).

Measurement of occupational class

Information on occupational class at the end of 2006 was drawn from the register of Statistic Finland [26] and categorized into five classes: upper non-manual employees, lower non-manual employees, manual workers, self-employed workers and those classified as being outside employment. The latter group included long-term unemployed persons (58.1%), students (20.1%) and missing or unknown (21.8%). Pensioners were excluded from this study at the baseline since the study focused on new disability retirements.

Other covariates

Information on gender, age, marital status and level of urbanisation at the end of 2006 was drawn from the registers of Kela. Age was categorized into four groups in 10-year intervals. Marital status was categorized into three groups: never married, married and

1
2
3 “other”, which included those who were divorced or widowed and those with missing
4 information. The level of urbanisation was categorized into urban, densely populated
5 and rural according to classifications of Statistic Finland [27], and those with missing
6 information were dropped (n = 824,915). The distributions of the covariates are shown
7 in Table 1.
8
9
10

11 **Statistical methods**

12
13 Each individual in the study population was followed from 1 January 2007 until the start
14 of a disability pension, the start of another type of pension, age 63 (the first potential
15 old-age retirement age), death or the end of the study period on 31 December 2014.
16 The mean follow-up time was 7.0 years. Differences in the risk of disability retirement
17 during 2007–2014 by occupational class and length of sickness absence were analysed
18 with Cox proportional hazards regression. All analyses were conducted separately for
19 men and women and were adjusted for age, marital status and level of urbanisation of
20 the home municipality at the end of 2006 (later referred to as sociodemographic
21 variables). The results are presented as hazard ratios (HR) with their 95% confidence
22 intervals (CI). The analyses were conducted using the Stata 14.2 software.
23
24
25
26
27
28
29
30

31 **Ethical considerations**

32
33 The study used secondary data retrieved from registers, and thus no ethics approval
34 was required according to Finnish law. Good scientific practice and data protection
35 regulations were followed in the collection, use and reporting of the data. Kela, the
36 Finnish Centre for Pensions and Statistics Finland provided permission to use the
37 anonymous register-based data.
38
39
40
41
42
43
44

45 **RESULTS**

46 **Population characteristics**

47
48 During the 8-year follow-up, a total of 123,736 persons transferred to disability
49 retirement, including 7.0% of men and 7.3% of women (Table 1). A higher percentage
50 of women (12.5%) than men (8.9%) had at least one spell of sickness absence (SA)
51 that started in 2005. Both the prevalence of sickness absence and the proportion of
52 those experiencing disability retirement were higher among those in lower occupational
53 classes and among those who were of older age, those whose marital status was other
54
55
56
57
58
59
60

than married or never married, and those who lived in rural municipalities. Additionally, the same groups had a higher median number of sickness absence days. In every diagnostic group of sickness absence, the proportion of persons with a new disability retirement was higher among those with longer sickness absences.

Table 1 Distributions of the study population in 2006 (N=1,727,644), prevalence and length of sickness absence (SA) beginning in 2005 and proportion of participants experiencing a disability retirement (DR) in 2007-2014.

	Men				Women			
	Distr. (%)	SA in 2005 (%)	SA days in 2005 ¹ (median)	New DR in 2007-2014 (%)	Distr. (%)	SA in 2005 (%)	SA days in 2005 ¹ (median)	New DR in 2007-2014 (%)
Occupational class								
Upper non-manual	19.6	5.3	31	2.6	18.3	7.2	31	3.3
Lower non-manual	17.7	8.1	32	4.3	41.4	11.9	33	6.5
Manual worker	35.0	12.2	34	8.1	17.7	13.8	35	10.6
Self-employed	12.2	7.0	42	7.1	6.9	7.8	40	7.3
Outside employment	15.5	8.1	60	13.2	15.7	9.0	50	10.3
Age								
25-34	25.9	5.9	33	2.4	25.0	7.1	33	2.4
35-44	27.9	8.5	34	4.2	27.6	10.0	33	4.5
45-54	28.3	10.6	37	11.6	28.9	12.7	35	11.7
55-62	17.9	11.0	40	11.0	18.5	13.5	37	11.0

Marital status

Never married	35.6	7.3	36	6.1	27.6	8.3	33	5.7
Married	52.2	9.3	35	6.5	55.5	11.0	34	7.1
Other	12.3	11.6	40	12.1	16.9	14.6	36	11.5

Level of urbanisation

Urban	57.5	8.3	35	6.3	59.3	10.2	34	6.8
Densely populated	16.0	9.5	36	7.7	15.6	11.2	35	7.7
Rural	26.5	9.6	36	8.2	25.1	11.4	36	8.2

No. of SA days in 2005; All

0	91.1		0	6.1	87.5		0	5.9
1-30	3.7		19	12.0	5.4		19	13.0
31-60	2.3		42	15.8	3.5		42	15.8
61-180	2.1		90	21.3	2.7		88	22.2
over 180	0.7		296	30.7	0.9		284	32.6

No. of SA days in 2005; MSD²

0	97.1		0	6.7	97.3		0	6.7
1-30	1.3		19	15.3	1.8		19	17.9
31-60	0.7		43	19.1	1.0		44	20.5
61-180	0.7		90	22.2	0.9		91	24.8
over 180	0.2		297	30.8	0.2		294	34.7

No. of SA days in 2005; Mental³

0	98.9		0	6.9	97.3		0	7.0
1-30	0.4		19	14.2	1.0		20	14.0
31-60	0.3		43	19.4	0.6		43	18.0
61-180	0.3		93	27.3	0.5		93	24.4
over 180	0.2		319	33.3	0.2		303.5	32.9

No. of SA days in 2005; Other⁴

0	95.0		0	6.7	93.7		0	6.9
1-30	2.3		20	11.0	3.1		20	11.6
31-60	1.3		42	13.7	1.9		41	13.1
61-180	1.0		89	18.0	1.1		85	17.5
over 180	0.3		289	28.9	0.3		265	28.5

<i>All</i>	<i>100</i>	<i>8.9</i>	<i>36</i>	<i>7.0</i>	<i>100</i>	<i>12.5</i>	<i>35</i>	<i>7.3</i>
N	867,585	76,817		60,932	860,059	107,475		62,804

¹ Those with new sickness absence spell that started in 2005, ² Musculoskeletal diseases, ³ Mental and behavioural disorders, ⁴ Other diagnoses

[Figure 1]

Hazard ratios (HRs) for the risk of disability retirement for different lengths of sickness absence in different occupational classes are shown in Figure 1, and the reference group is upper non-manual employees with no new sickness absence spells, starting in 2005. Due to their multiplicative nature and to enable direct visual comparability, the HRs are plotted on a logarithmic scale [28,29]. In addition, Appendix tables 1 and 2 show the hazard ratios for disability retirement calculated with a separate reference group for each occupational class.

In general, the longer the sickness absence is, the higher the risk of all-cause disability retirement is in all occupational classes and in both genders. Upper non-manual employees had the lowest risk of disability retirement in men and women. Among men, those outside employment clearly had the highest risk of disability retirement, while among women the risk was highest for manual workers and those outside employment. Lower non-manual workers and self-employed workers were between these classes.

[Figure 2]

Among upper non-manual employees, the risk of disability retirement increased slightly more steeply with increasing length of sickness absence than in other occupational classes (Figure 1, Appendix tables 1 and 2). In upper non-manual men with over 180 days of sickness absence, the HR of disability retirement was almost 10-fold (HR 9.19 95% CI 7.40–11.40) compared to those with no sickness absence, whereas in manual workers, the same HR was 3.51 (95% CI 3.23–3.81) (Appendix table 1). Among women, the pattern was similar, but the occupational class differences were not as large as in men, with the HR being 7.26 (95% CI 6.16–8.57) in upper non-manual employees and 3.94 (95% CI 3.6–4.3) in manual workers, accordingly (Appendix table 2).

Figure 2 shows the HRs for all-cause disability retirement in different diagnostic groups, again calculated with upper non-manual employees without sickness absence as the reference group

(see Appendix tables 1 and 2 for separate reference groups). In every diagnostic group, the association between the length of sickness absence and the risk of disability retirement was largely similar. However, the association between increasing length of sickness absence and the risk of disability retirement was slightly stronger in sickness absence due to mental and behavioural disorders than in other diagnostic groups. In upper non-manual employee men with over 180 days of sickness absence due to mental and behavioural disorders, the HR of disability retirement was 9.74 (95% CI 7.10–13.37) compared to upper non-manual employees with no sickness absence due to the same diagnostic category, and the same HR was 7.28 (95% CI 4.22–12.55) when the sickness absence was due to musculoskeletal diseases and 6.89 (95% CI 4.78–9.93) due to other diagnoses (Appendix tables 1 and 2). Additionally, in women, a long sickness absence due to mental and behavioural disorders predicted disability retirement more strongly, especially in upper non-manual employees.

[Figure 3]

To assess how the different diagnostic profiles of sickness absence in different occupational classes affect the total association between length of sickness absence and disability retirement seen above in Figure 1, we calculated the HRs after adjusting for the diagnosis of sickness absence (Figure 3). In general, adjusting for the diagnosis somewhat attenuated the association of increasing lengths of sickness absence with risk of disability retirement in every occupational class. However, in men, the length of sickness absence continued to predict disability retirement more strongly among upper non-manual employees than it did in other occupational classes. In women, the occupational class differences in the strength of association between the increasing length of sickness absence and the risk of disability retirement were largely explained by the occupational class differences after controlling for the diagnosis of sickness absence.

DISCUSSION

Main findings

1 Our results indicate that the length of sickness absence was associated with a higher risk of
2 disability retirement in all occupational classes, especially in upper non-manual employees. The
3 length of sickness absence due to mental and behavioural disorders predicted disability
4 retirement slightly more strongly than the length of sickness absence due to other diagnoses,
5 with the association again being stronger in upper non-manual employees than in other
6 occupational classes. The diagnosis of sickness absence partly explained the differential
7 association between the length of sickness absence and the risk of disability retirement in
8 different occupational classes.
9
10
11
12
13

14 **Interpretation of the results**

15
16 In this study, we found that manual workers and those outside employment clearly had a higher
17 risk of disability retirement than did the other occupational classes, especially among those with
18 no sickness absence or with short-term sickness absence. Among those with a long-term
19 sickness absence, the occupational class differences were narrower. The unemployed, which
20 was the largest subgroup in those outside employment, and manual workers generally had
21 poorer health [21,30–33] and health behaviour [30,34], physically more strenuous jobs
22 [21,30,34] and less job control [21,30,34,35] than did higher occupational classes, which
23 increased their risk of disability retirement, even without any sickness absence or with short-
24 term sickness absence. Health problems can select people to unemployment [31,32], and long-
25 term health problems increase the risk of disability. In the present study, the occupational class
26 differences were smaller in long-term sickness absences, implying that those with long-term
27 sicknesses have an increased risk of disability retirement, despite their occupational class.
28 However, the risk of disability retirement increased with an increasing length of sickness
29 absence more strongly in upper non-manual employees than in other social classes. Upper
30 non-manual employees have long sickness absences less frequently than manual workers do,
31 indicating that upper non-manual employees with long-term sickness absence are possibly a
32 more selected group in terms of their disability retirement risk.
33
34
35
36
37
38
39
40
41
42
43
44
45

46 The diagnoses and long-term consequences of sickness absences are known to differ between
47 occupational classes [23,36,37]. For instance, mild injuries that prevent those with physically
48 demanding jobs from working may not affect work ability among those in desk jobs. Previous
49 studies have found that socioeconomic differences in the diagnoses of sickness absences are
50 large in musculoskeletal diseases [23]. In general, our study agrees with previous findings in
51 that the association between the length of sickness absence and the risk of disability retirement
52 does not differ much between diagnostic groups of sickness absences [38]. However, in this
53
54
55
56
57
58
59
60

1 study, the length of sickness absence due to mental and behavioural disorders predicted
2 disability retirement slightly more strongly than did the length of sickness absence due to other
3 diagnoses, particularly among upper non-manual employees. Sickness absence due to mental
4 and behavioural disorders has been found to present a greater risk of disability retirement than
5 has sickness absence due to other diagnoses [4,5,16,39], but previous studies have not found
6 that the length of sickness absence predicts disability retirement differently in sickness absence
7 due to mental and behavioural disorders compared to other diagnoses [5,38]. Our finding that
8 the length of sickness absence due to mental and behavioural disorders was a stronger
9 predictor in upper non-manual employees may partly be explained by work-related factors:
10 upper non-manual employees often have psychologically demanding jobs [33,35], their
11 employers may prefer the employees to remain absent due to sickness until fully recovered
12 because it can be especially difficult to return to mentally complex work with mental health
13 problems, and positions held by higher occupations are not as easily replaceable [40].
14
15
16
17
18
19
20
21
22
23

24 The average lengths of the sickness absence spells vary between diagnostic groups and
25 occupational classes. We found that the adjustment of the diagnosis largely explained the
26 differential association between the length of sickness absence and the risk of disability
27 retirement in different occupational classes, particularly in women. However, in upper non-
28 manual employee men, the adjustment of the diagnosis did not, to a large extent, attenuate the
29 association between the length of sickness absence and the risk of disability retirement, which
30 can be explained by the fact that in upper non-manual employees, a large proportion of the
31 long-term sickness absences was due to mental and behavioural disorders. In other
32 occupational classes, the association can be explained by a more equal distribution in the
33 proportions and the average lengths of different diagnostic groups. In all, divergent diagnostic
34 profiles in different occupational classes partly explain the occupational class differences in the
35 association between the length of sickness absence and the risk of disability retirement.
36
37
38
39
40
41
42
43
44

45 **Methodological considerations**

46 A key strength of the study was the 8-year prospective and population-based cohort design,
47 based on a 70% register sample of the total Finnish non-retired working-age population. Data
48 were obtained from national registers, constituting highly reliable sources with objective register-
49 based measures, no self-report bias, practically no loss to follow-up and very little missing
50 information. In addition, we were able to utilize date-specific information on both sickness
51 absence and disability retirement. However, a limitation common to all register-based data is
52 the lack of information on, for example, health status, health behaviours or work environment
53
54
55
56
57
58
59
60

1 that could explain or mediate the observed associations. Furthermore, due to the observational
2 nature of the data, causal effects cannot be established. Confounding by previous health status
3 or other unmeasured factors may explain some of the observed associations.
4
5
6

7 **Conclusion**

8 Our results suggest that there are occupational class differences in the pathways from sickness
9 absence to disability retirement. The length of sickness absence predicts disability retirement
10 more strongly than does the diagnosis of sickness absence in all occupational classes, but the
11 diagnostic profiles vary between occupational classes and partly explain the association
12 between the length of sickness absence and the risk of disability retirement. It is crucial to
13 understand the ways in which work disability develops in different occupational classes to
14 provide more efficient preventive measures. Further research should focus on understanding
15 the mechanisms contributing to social inequalities in sickness absence and work disability due
16 to different diagnoses.
17
18
19
20
21
22
23
24

25 **FOOTNOTES**

26 **Funding:** This work is supported by the Strategic Research Council of the Academy of Finland
27 (decision number: 293103).
28

29 **Competing Interests:** None declared.
30

31 **Acknowledgements:** We want to thank participants of the annual conference of the
32 Westermarck Society, RC28 -conference, Nordic Demographic Symposium, WORK2017 -
33 conference, the annual Social policy conference and EPH -conference for the insightful
34 comments.
35
36
37

38 **Data sharing statement:** No additional data available.
39

40 **Contributorship statement:** Laura Salonen (LS), Jenni Blomgren (JB), Mikko Laaksonen (ML)
41 and Mikko Niemelä (MN) contributed to the planning, conducting and reporting of this study. LS
42 conducted the statistical analyses and wrote the first and successive drafts of the manuscript.
43 JB, ML and MN advised on the statistical approach and modelling and revised the drafts of
44 manuscripts. LS, JB and ML interpreted the results. All authors approved the final submitted
45 version.
46
47
48
49

50 **REFERENCES**

- 51 1 OECD, editor. Sickness, disability and work: breaking the barriers ; a synthesis of findings
52 across OECD countries. Paris: OECD; 2010. 165 p.
53 <http://dx.doi.org/10.1787/9789264088856-en>
54
- 55 2 Borg K, Hensing G, Alexanderson K. Predictive factors for disability pension -- An 11-year
56 follow up of young persons on sick leave due to neck, shoulder, or back diagnoses.
57
58
59

- 1 Scandinavian Journal of Public Health. 2001 Apr 1;29(2):104–12.
2 <http://journals.sagepub.com/doi/abs/10.1177/14034948010290020701#articleCitationDown>
3 [loadContainer](http://journals.sagepub.com/doi/abs/10.1177/14034948010290020701#articleCitationDown)
4
- 5 3 Bratberg E, Gjesdal S, Mæland JG. Sickness absence with psychiatric diagnoses: Individual
6 and contextual predictors of permanent disability. *Health & Place*. 2009 Mar;15(1):308–14.
7 <http://www.sciencedirect.com/science/article/pii/S1353829208000798>
8
- 9 4 Gjesdal S. Predictors of disability pension in long-term sickness absence: Results from a
10 population-based and prospective study in Norway 1994-1999. *The European Journal of*
11 *Public Health*. 2004 Dec 1;14(4):398–405. <https://www.ncbi.nlm.nih.gov/pubmed/15542877>
12
13
- 14 5 Gjesdal S, Bratberg E. Diagnosis and duration of sickness absence as predictors for disability
15 pension: Results from a three-year, multi-register based and prospective study.
16 *Scandinavian Journal of Public Health*. 2003 Aug 1;31(4):246–54.
17 <http://journals.sagepub.com/doi/abs/10.1080/14034940210165154>
18
- 19 6 Lund T, Kivimaki M, Labriola M, Villadsen E, Christensen KB. Using administrative sickness
20 absence data as a marker of future disability pension: the prospective DREAM study of
21 Danish private sector employees. *Occupational and Environmental Medicine*. 2008 Jan
22 1;65(1):28–31. <https://www.ncbi.nlm.nih.gov/pubmed/17626139>
23
- 24 7 Polvinen A, Laaksonen M, Gould R, Lahelma E, Martikainen P. The contribution of major
25 diagnostic causes to socioeconomic differences in disability retirement. *Scandinavian*
26 *Journal of Work, Environment & Health*. 2014 Jul;40(4):353–60.
27 http://www.sjweh.fi/show_abstract.php?abstract_id=3411
28
- 29 8 Wilkinson R, Pickett K. *The spirit level: why more equal societies almost always do better*.
30 London: Allen Lane; 2009. 330 p.
31
- 32 9 EU-OSHA. *Priorities for occupational safety and health research in Europe: 2013-2020*. 2013.
33 [https://osha.europa.eu/en/tools-and-publications/publications/reports/priorities-for-](https://osha.europa.eu/en/tools-and-publications/publications/reports/priorities-for-occupational-safety-and-health-research-in-europe-2013-2020)
34 [occupational-safety-and-health-research-in-europe-2013-2020](https://osha.europa.eu/en/tools-and-publications/publications/reports/priorities-for-occupational-safety-and-health-research-in-europe-2013-2020)
35
36
- 37 10 Harkonmäki K, Korkeila K, Vahtera J, Kivimäki M, Suominen S, Sillanmäki L, et al. Childhood
38 adversities as a predictor of disability retirement. *J Epidemiol Community Health*. 2007
39 Jun;61(6):479–84. <http://jech.bmj.com/content/61/6/479>
40
- 41 11 Labriola M, Lund T. Self-reported sickness absence as a risk marker of future disability
42 pension. Prospective findings from the DWECs/DREAM study 1990-2004. *International*
43 *Journal of Medical Sciences*. 2007;4(3):153–8.
44 <https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-8-426>
45
- 46 12 Laine S, Gimeno D, Virtanen M, Oksanen T, Vahtera J, Elovainio M, et al. Job strain as a
47 predictor of disability pension: the Finnish Public Sector Study. *Journal of Epidemiology &*
48 *Community Health*. 2009 Jan 1;63(1):24–30.
49 <http://jech.bmj.com/content/jech/63/1/24.full.pdf?cited-by=yes&63%2F1%2F24=>
50
- 51 13 Virtanen M, Kivimaki M, Singh-Manoux A, Gimeno D, Shipley MJ, Vahtera J, et al. Work
52 disability following major organisational change: the Whitehall II study. *Journal of*
53 *Epidemiology & Community Health*. 2010 May 1;64(5):461–4.
54 <http://jech.bmj.com/content/64/5/461.long>
55
56
57
58
59

- 1 14 Kivimäki M, Forma P, Wikström J, Halmeenmäki T, Pentti J, Elovainio M, et al. Sickness
2 absence as a risk marker of future disability pension: the 10-town study. *Journal of*
3 *Epidemiology & Community Health*. 2004 Aug 1;58(8):710–1.
4 <http://jech.bmj.com/content/58/8/710>
5
- 6 15 Jansson C, Alexanderson K. Sickness absence due to musculoskeletal diagnoses and risk
7 of diagnosis-specific disability pension: A nationwide Swedish prospective cohort study:
8 *Pain*. 2013 Jun;154(6):933–41.
9 <http://www.sciencedirect.com/science/article/pii/S0304395913000912>
10
- 11 16 Alexanderson K, Kivimaki M, Ferrie JE, Westerlund H, Vahtera J, Singh-Manoux A, et al.
12 Diagnosis-specific sick leave as a long-term predictor of disability pension: a 13-year
13 follow-up of the GAZEL cohort study. *Journal of Epidemiology & Community Health*. 2012
14 Feb 1;66(2):155–9. <http://jech.bmj.com/content/66/2/155>
15
- 16 17 Kristensen TR, Jensen SM, Kreiner S, Mikkelsen S. Socioeconomic status and duration and
17 pattern of sickness absence. A 1-year follow-up study of 2331 hospital employees. *BMC*
18 *Public Health* [Internet]. 2010 Dec [cited 2017 Jun 8];10(1). Available from:
19 <http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-10-643>
20
- 21 18 Kaikkonen R, Härkänen T, Rahkonen O, Gould R, Koskinen S. Explaining educational
22 differences in sickness absence: a population-based follow-up study. *Scandinavian Journal*
23 *of Work, Environment & Health*. 2015 Jul;41(4):338–46.
24 http://www.sjweh.fi/show_abstract.php?abstract_id=3499
25
- 26 19 Sumanen H, Rahkonen O, Pietiläinen O, Lahelma E, Roos E, Lahti J. Educational
27 differences in disability retirement among young employees in Helsinki, Finland. *The*
28 *European Journal of Public Health*. 2016 Apr;26(2):318–22.
29 <https://doi.org/10.1093/eurpub/ckv226>
30
- 31 20 Polvinen A, Laaksonen M, Gould R, Lahelma E, Leinonen T, Martikainen P. Socioeconomic
32 Differences in Cause-Specific Disability Retirement in Finland, 1988 to 2009. *Journal of*
33 *Occupational and Environmental Medicine*. 2016 Aug;58(8):840–5.
34 http://journals.lww.com/joem/Abstract/2016/08000/Socioeconomic_Differences_in_Cause_Specific.15.aspx
35
- 36 21 Haukenes I, Mykletun A, Knudsen A, Hansen H-T, Mæland J. Disability pension by
37 occupational class - the impact of work-related factors: The Hordaland Health Study
38 Cohort. *BMC Public Health*. 2011;11(1):406.
39 <https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-11-406>
40
- 41 22 Krokstad S, Johnsen R, Westin S. Social determinants of disability pension: a 10-year follow-
42 up of 62 000 people in a Norwegian county population. *International Journal of*
43 *Epidemiology*. 2002 Dec 1;31(6):1183–91.
44 <https://academic.oup.com/ije/article/31/6/1183/939535/Social-determinants-of-disability-pension-a-10>
45
- 46 23 Pekkala J, Blomgren J, Pietiläinen O, Lahelma E, Rahkonen O. Occupational class
47 differences in diagnostic-specific sickness absence: a register-based study in the Finnish
48 population, 2005–2014. *BMC Public Health* [Internet]. 2017 Dec [cited 2017 Sep 6];17(1).
49 <http://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-017-4674-0>
50

- 1 24 Sumanen H, Lahti J, Lahelma E, Pietiläinen O, Rahkonen O. 12-year trends in occupational
2 class differences in short sickness absence among young women. *Scandinavian Journal of*
3 *Social Medicine*. 2015 Jun;43(4):441–4. <https://www.ncbi.nlm.nih.gov/pubmed/25834066>
4
- 5 25 Social Insurance Institution. *Statistics on National Health Insurance* [Internet]. Helsinki; 2005.
6 https://helda.helsinki.fi/bitstream/handle/10250/31118/Sava_05.pdf?sequence=2
7
- 8 26 Statistics Finland. *Classification of Socio-economic Groups 1989* [Internet]. 1989 [cited 2017
9 Dec 5]. http://www.stat.fi/meta/luokitukset/sosioekon_asema/001-1989/index_en.html
10
- 11 27 Statistics Finland. *Statistical grouping of municipalities* [Internet]. 2017 [cited 2017 Dec 5].
12 Available from: http://www.stat.fi/meta/luokitukset/kuntaryhmitys/001-2017/index_en.html
13
- 14 28 Hosseinpoor AR, AbouZahr C. Graphical presentation of relative measures of association.
15 *The Lancet*. 2010 Apr;375(9722):1254.
16 [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(10\)60541-7/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(10)60541-7/fulltext)
17
- 18 29 Levine MAH, El-Nahas AI, Asa B. Relative risk and odds ratio data are still portrayed with
19 inappropriate scales in the medical literature. *Journal of Clinical Epidemiology*. 2010
20 Sep;63(9):1045–7. <http://www.sciencedirect.com/science/article/pii/S0895435610000429>
21
- 22 30 Polvinen A, Gould R, Lahelma E, Martikainen P. Socioeconomic differences in disability
23 retirement in Finland: the contribution of ill-health, health behaviours and working
24 conditions. *Scand J Public Health*. 2013 Jul;41(5):470–8.
25 <http://journals.sagepub.com/doi/pdf/10.1177/1403494813482400>
26
- 27 31 Schmitz H. Why are the unemployed in worse health? The causal effect of unemployment on
28 health. *Labour Economics*. 2011 Jan;18(1):71–8.
29 <http://www.sciencedirect.com/science/article/pii/S0927537110000953>
30
- 31 32 Böckerman P, Ilmakunnas P. Unemployment and self-assessed health: evidence from panel
32 data. *Health Economics*. 2009 Feb;18(2):161–79.
33 <http://onlinelibrary.wiley.com/doi/10.1002/hec.1361/abstract>
34
- 35 33 Hämmig O, Bauer GF. The social gradient in work and health: a cross-sectional study
36 exploring the relationship between working conditions and health inequalities. *BMC Public*
37 *Health* [Internet]. 2013 Dec [cited 2017 Sep 12];13(1).
38 <http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-13-1170>
39
- 40 34 Leinonen T, Pietiläinen O, Laaksonen M, Rahkonen O, Lahelma E, Martikainen P.
41 Occupational social class and disability retirement among municipal employees – the
42 contribution of health behaviors and working conditions. *Scandinavian Journal of Work,*
43 *Environment & Health*. 2011 Nov;37(6):464–72.
44 http://www.sjweh.fi/show_abstract.php?abstract_id=3182
45
- 46 35 Lahelma E, Laaksonen M, Aittomäki A. Occupational class inequalities in health across
47 employment sectors: the contribution of working conditions. *International Archives of*
48 *Occupational and Environmental Health*. 2009 Jan;82(2):185–90.
49 <https://www.ncbi.nlm.nih.gov/pubmed/18386045>
50
- 51 36 Vaez M, Rylander G, Nygren Å, Åsberg M, Alexanderson K. Sickness absence and disability
52 pension in a cohort of employees initially on long-term sick leave due to psychiatric
53 disorders in Sweden. *Social Psychiatry and Psychiatric Epidemiology*. 2007
54 May;42(5):381–8. <https://www.ncbi.nlm.nih.gov/pubmed/17450454>
55
- 56
57
58
59

- 1 37 Gjesdal S, Ringdal PR, Haug K, Gunnar Mæland J. Long-term sickness absence and
2 disability pension with psychiatric diagnoses: A population-based cohort study. *Nordic*
3 *Journal of Psychiatry*. 2008 Jan;62(4):294–301.
4 <http://www.tandfonline.com/doi/abs/10.1080/08039480801984024?journalCode=ipsc20>
5
- 6 38 Wallman T, Wedel H, Palmer E, Rosengren A, Johansson S, Eriksson H, et al. Sick-leave
7 track record and other potential predictors of a disability pension. A population based study
8 of 8,218 men and women followed for 16 years. *BMC Public Health [Internet]*. 2009 Dec
9 [cited 2017 Sep 19];9(1). [http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-](http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-9-104)
10 [2458-9-104](http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-9-104)
11
- 12 39 Kivimäki M, Ferrie JE, Hagberg J, Head J, Westerlund H, Vahtera J, et al. Diagnosis-specific
13 sick leave as a risk marker for disability pension in a Swedish population. *Journal of*
14 *Epidemiology & Community Health*. 2007 Oct 1;61(10):915–20.
15 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2652975/>
16
- 17 40 Ekberg K, Wåhlin C, Persson J, Bernfort L, Öberg B. Early and Late Return to Work After
18 Sick Leave: Predictors in a Cohort of Sick-Listed Individuals with Common Mental
19 Disorders. *Journal of Occupational Rehabilitation*. 2015 Sep;25(3):627–37.
20 <https://link.springer.com/article/10.1007/s10926-015-9570-9>
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

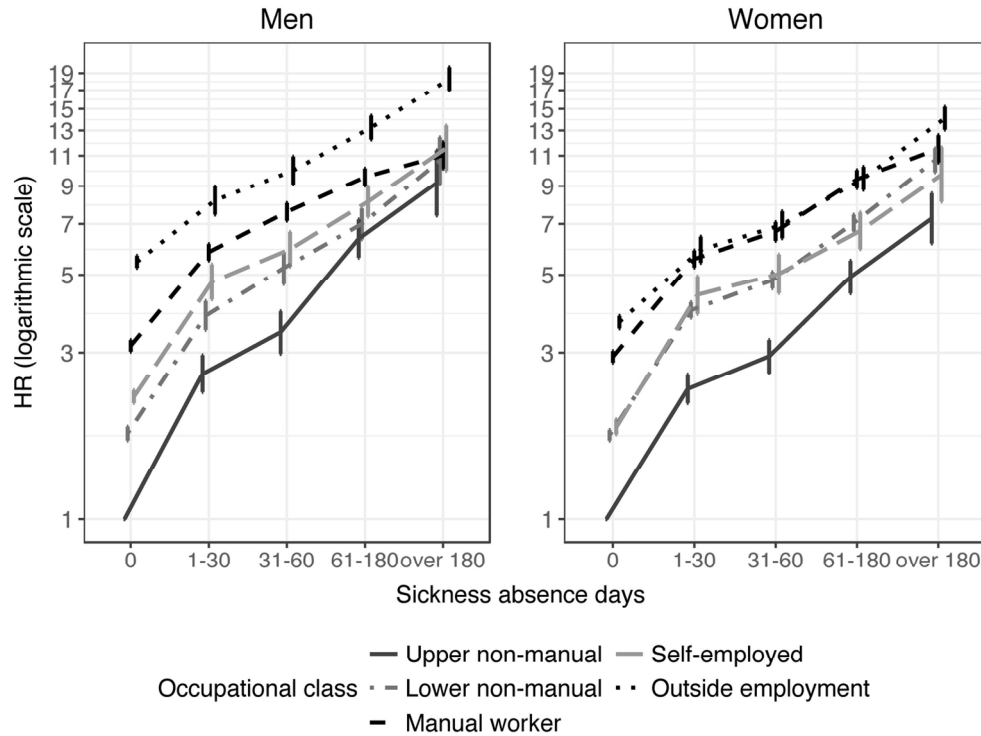
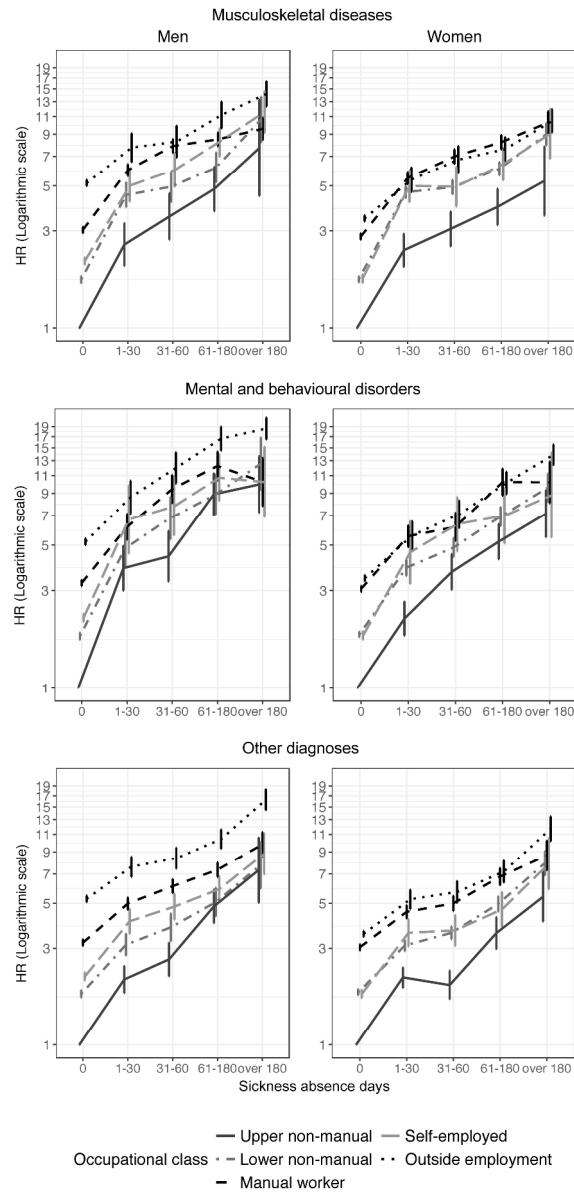


Figure 1 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95% confidence intervals according to the length of all-cause sickness absence in different occupational classes in men and women. Upper non-manual workers with no sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables.

134x101mm (300 x 300 DPI)

Only



45
46
47
48
49

Figure 2 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95% confidence intervals according to the length of diagnosis-specific sickness absence in different occupational classes in men and women. Upper non-manual workers with zero sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables.

50
51
52

292x604mm (300 x 300 DPI)

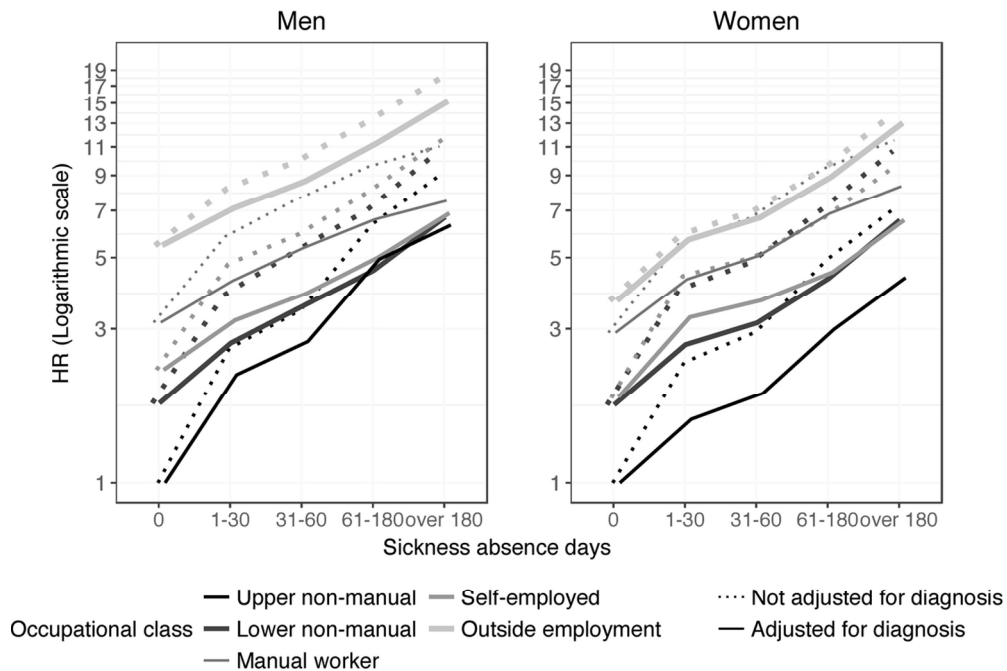


Figure 3 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 according to the length of sickness absence in different occupational classes in men and women. Upper non-manual workers with no sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables. Dotted lines represent hazard ratios when not adjusted for diagnoses, and solid lines hazard ratios after adjusting for the diagnoses.

116x79mm (300 x 300 DPI)

APPENDIX

Appendix table 1. Hazard ratios with 95% confidence intervals for the risk of disability retirement according to the length and diagnosis of sickness absence in different occupational classes in men.

	Length of sickness absence									
	0		1-30		31-60		61-180		over 180	
	HR	HR	CI	HR	CI	HR	CI	HR	CI	
<i>All diagnoses</i>										
Upper non-manual	1	2.61	2.31-2.95	3.43	2.98-3.93	6.35	5.60-7.21	9.19	7.40-11.40	
Lower non-manual	1	2.16	1.97-2.37	2.96	2.66-3.29	3.97	3.59-4.39	6.02	5.16-7.02	
Manual worker	1	1.84	1.76-1.93	2.40	2.29-2.53	3.03	2.89-3.18	3.51	3.23-3.81	
Self-employed	1	2.12	1.90-2.37	2.64	2.36-2.96	3.63	3.29-4.00	5.19	4.49-6.01	
Outside employment	1	1.49	1.37-1.63	1.82	1.67-1.99	2.41	2.25-2.59	3.35	3.12-3.59	
<i>Musculoskeletal diseases</i>										
Upper non-manual	1	2.73	2.17-3.44	3.47	2.68-4.50	4.94	3.87-6.32	7.28	4.22-12.55	
Lower non-manual	1	2.75	2.40-3.14	2.95	2.50-3.49	3.51	2.96-4.17	6.02	4.70-7.70	
Manual worker	1	2.03	1.92-2.15	2.67	2.49-2.86	2.87	2.68-3.08	3.23	2.88-3.63	
Self-employed	1	2.49	2.10-2.96	2.91	2.42-3.50	3.94	3.38-4.58	5.58	4.45-7.00	
Outside employment	1	1.55	1.33-1.80	1.71	1.44-2.02	2.18	1.89-2.52	2.73	2.39-3.13	
<i>Mental and behavioural disorders</i>										
Upper non-manual	1	4.02	3.16-5.11	4.48	3.38-5.92	8.80	6.99-11.09	9.74	7.10-13.37	
Lower non-manual	1	2.73	2.20-3.37	4.32	3.47-5.37	5.03	4.06-6.24	6.55	4.90-8.76	
Manual worker	1	2.04	1.78-2.32	2.97	2.57-3.44	3.69	3.17-4.29	3.15	2.44-4.06	
Self-employed	1	3.25	2.27-4.65	3.48	2.52-4.81	5.16	4.04-6.58	5.19	3.60-7.48	
Outside employment	1	1.65	1.38-1.97	2.28	1.94-2.69	3.14	2.77-3.57	3.49	3.11-3.92	
<i>Other diagnoses</i>										
Upper non-manual	1	2.19	1.89-2.54	2.69	2.23-3.25	5.05	4.21-6.06	6.89	4.78-9.93	
Lower non-manual	1	1.85	1.64-2.08	2.21	1.90-2.57	3.00	2.58-3.50	4.34	3.34-5.63	
Manual worker	1	1.63	1.54-1.73	1.99	1.86-2.14	2.38	2.21-2.57	3.11	2.73-3.54	
Self-employed	1	1.96	1.71-2.23	2.26	1.96-2.61	2.76	2.39-3.18	4.02	3.19-5.06	
Outside employment	1	1.49	1.34-1.66	1.62	1.44-1.82	2.01	1.81-2.22	3.13	2.80-3.49	

Adjusted for socio-demographic variables

Appendix table 2. Hazard ratios with 95% confidence intervals for the risk of disability retirement according to the length and diagnosis of sickness absence in different occupational classes in women.

	Length of sickness absence									
	0		1-30		31-60		61-180		over 180	
	HR	HR	CI	HR	CI	HR	CI	HR	CI	
<i>All diagnoses</i>										
Upper non-manual	1	2.36	2.15-2.60	2.93	2.62-3.26	4.93	4.42-5.49	7.26	6.16-8.57	
Lower non-manual	1	2.27	2.18-2.37	2.76	2.64-2.90	4.04	3.85-4.23	6.13	5.69-6.60	
Manual worker	1	1.90	1.80-1.99	2.28	2.15-2.41	3.22	3.05-3.40	3.94	3.61-4.29	
Self-employed	1	2.36	2.09-2.67	2.73	2.40-3.10	3.61	3.20-4.07	5.20	4.41-6.32	
Outside employment	1	1.60	1.48-1.74	1.89	1.74-2.06	2.57	2.39-2.76	3.84	3.58-4.12	
<i>Musculoskeletal diseases</i>										
Upper non-manual	1	2.56	2.15-3.05	3.15	2.60-3.81	4.05	3.33-4.93	5.92	4.14-8.49	
Lower non-manual	1	2.74	2.59-2.90	3.03	2.82-3.26	3.65	3.40-3.91	5.40	4.80-6.06	
Manual worker	1	1.99	1.87-2.12	2.54	2.36-2.74	3.00	2.79-3.24	3.70	3.28-4.16	
Self-employed	1	3.04	2.56-3.60	2.85	2.29-3.54	3.83	3.21-4.57	5.18	3.96-6.78	
Outside employment	1	1.57	1.37-1.79	1.99	1.71-2.30	2.30	2.02-2.62	3.11	2.75-3.52	
<i>Mental and behavioural disorders</i>										
Upper non-manual	1	2.34	1.95-2.80	3.95	3.26-4.78	5.33	4.41-6.44	7.54	5.88-9.67	
Lower non-manual	1	2.23	2.06-2.42	2.78	2.53-3.06	4.03	3.66-4.45	5.47	4.72-6.33	
Manual worker	1	1.88	1.69-2.10	2.23	1.94-2.57	3.28	2.85-3.78	3.43	2.76-4.25	
Self-employed	1	2.9	2.10-3.99	3.54	2.65-4.74	3.78	2.79-5.13	4.24	2.63-6.84	
Outside employment	1	1.55	1.33-1.81	2.03	1.74-2.36	2.93	2.61-3.29	3.94	3.53-4.39	
<i>Other diagnoses</i>										
Upper non-manual	1	2.24	2.00-2.50	2.07	1.78-2.42	3.68	3.09-4.39	5.56	4.22-7.31	
Lower non-manual	1	1.81	1.72-1.91	2.08	1.95-2.22	2.86	2.64-3.09	4.59	4.04-5.22	
Manual worker	1	1.63	1.53-1.74	1.79	1.65-1.93	2.42	2.22-2.64	2.88	2.45-3.37	
Self-employed	1	2.11	1.83-2.45	2.12	1.79-2.50	2.63	2.18-3.19	4.54	3.43-6.01	
Outside employment	1	1.5	1.36-1.67	1.61	1.43-1.81	2.09	1.86-2.35	3.42	2.99-3.90	

Adjusted for socio-demographic variables

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page no.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1, 2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	4
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-6
Bias	9	Describe any efforts to address potential sources of bias	12-13
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6, 12-13
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods	

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

taking account of sampling strategy

(e) Describe any sensitivity analyses

Continued on next page

For peer review only

Results			Page no.
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6-7
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	7
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-10
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	12-13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Sickness absence as a predictor of disability retirement in different occupational classes: a register-based study of a working-age cohort in Finland in 2007–2014

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-020491.R1
Article Type:	Research
Date Submitted by the Author:	23-Jan-2018
Complete List of Authors:	Salonen, Laura; Turun Yliopisto, Department of Social Research Blomgren, Jenni; Kela, Research Department Laaksonen, Mikko; Finnish Centre for Pensions, Niemi, Mikko; Turun Yliopisto, Department of Social Research
Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Public health, Sociology
Keywords:	SOCIAL MEDICINE, OCCUPATIONAL & INDUSTRIAL MEDICINE, PUBLIC HEALTH

SCHOLARONE™
Manuscripts

1
2
3 **Sickness absence as a predictor of disability retirement in different**
4 **occupational classes: a register-based study of a working-age cohort**
5 **in Finland in 2007–2014**
6
7
8
9

10 Salonen, Laura, Blomgren, Jenni, Laaksonen, Mikko & Niemelä, Mikko

11
12
13 Correspondence: Salonen, Laura

14 Email: iksalo@utu.fi

15 Institution: University of Turku

16 City and country: Turku, Finland

17 Postal address: Lonttistentie 27 B 24, 20100 Turku, Finland

18 Email: iksalo@utu.fi

19 Telephone number: +358 41 546 8506
20
21
22
23
24
25

26 Blomgren, Jenni

27 Email: jenni.blomgren@kela.fi

28 Institution: the Social Insurance Institution of Finland

29 City and country: Helsinki, Finland
30
31
32
33

34 Laaksonen, Mikko

35 Email: mikko.laaksonen@etk.fi

36 Institution: the Centre of Pensions

37 City and country: Helsinki, Finland
38
39
40
41

42 Niemelä, Mikko

43 Email: miarni@utu.fi

44 Department: Department of Social Research

45 Institution: University of Turku

46 City and country: Turku, Finland
47
48
49
50
51

52 Institution: the Social Insurance Institution of Finland

53 City and country: Helsinki, Finland.
54
55
56
57

58 Word count: 3160
59
60

ABSTRACT

Objectives: The objective of the study was to examine diagnosis-specific sickness absences of different lengths as predictors of disability retirement in different occupational classes.

Design: Register-based prospective cohort study up to 8 years of follow-up.

Participants: A 70% random sample of the non-retired Finnish population aged 25–62 at the end of 2006 was included (N=1,727,644) and linked to data on sickness absences in 2005 and data on disability retirement in 2007–2014.

Main outcome measures: Cox proportional hazards regression was utilized to analyse the association of sickness absence with the risk of all-cause disability retirement during an eight-year follow-up.

Results: The risk of disability retirement increased with increasing lengths of sickness absence in all occupational classes. A long sickness absence was a particularly strong predictor of disability retirement in upper non-manual employees as among those with over 180 sickness absence days the hazard ratio (HR) was 9.19 (95% CI 7.40–11.40), but in manual employees the HR was 3.51 (95% CI 3.23–3.81) in men. Among women the corresponding HRs were 7.26 (95% CI 6.16–8.57) and 3.94 (95% CI 3.60–4.30) respectively. Adjusting for the diagnosis of sickness absence partly attenuated the association between the length of sickness absence and the risk of disability retirement in all employed groups.

Conclusions: A long sickness absence is a strong predictor of disability retirement in all occupational classes. Preventing the accumulation of sickness absence days and designing more efficient policies for different occupational classes may be crucial to reduce the number of transitions to early retirement due to disability.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- A strength of this study was the 8-year prospective and population-based cohort design, based on a 70% register sample of the total Finnish non-retired working-age population.
- Data were obtained from national registers, constituting highly reliable sources with objective register-based measures, no self-report bias, practically no loss to follow-up and very little missing information
- We were able to utilize date-specific information on both sickness absence and disability retirement.
- A limitation to this study was the lack of information on, for example, health status, health behaviours or work environment that could explain or mediate the observed associations.
- Due to the observational nature of the data, causal effects cannot be established.

INTRODUCTION

Large numbers of employees leave the labour market early due to health problems [1]. In particular, those in disadvantaged social positions have an increased risk of problems with health and work ability [2–7]. Both inequalities in health and a loss of workforce due to health problems cause substantial costs for societies [1,8]. To extend working lives, which has become an important target in many OECD countries [9], identifying those with an increased risk of work disability is crucial.

Previous studies have discovered several sociodemographic, work-environmental and health-related predictors of work disability [10–13]. One of the strongest early markers of disability retirement is sickness absence [14]. The risk of disability retirement has been shown to depend on both the duration and the diagnosis of sickness absence. In particular, long-term sickness absence [4,5] and sickness absence due to musculoskeletal diseases [15]; mental and behavioural disorders [16]; and diseases of the nervous, respiratory, and circulatory systems [5] indicate a high risk of disability retirement.

However, to our knowledge, there are no studies focusing on whether this association varies by occupational class. There are large occupational class differences in both sickness absences of various lengths [17,18] and the risk of disability retirement [19–22], but no studies have been conducted on whether the length of sickness absence

1
2
3 predicts disability retirement differently in different occupational classes. The differences
4 between occupational classes are substantial in sickness absence due to
5 musculoskeletal diseases, but they are smaller in sickness absence due to mental and
6 behavioural disorders [23,24]. The varying diagnostic profiles of the occupational
7 classes may confound the association between the length of sickness absence and the
8 risk of disability retirement. This emphasizes the need to consider both the length and
9 diagnosis of sickness absence when occupational class differences in the risk of
10 disability retirement are examined.
11
12
13
14
15

16
17 Thus, to fill the gap in previous research, the aim of this study was to examine
18 diagnosis-specific sickness absences of different lengths as predictors of disability
19 retirement in different occupational classes. We examined, first, how the length of all-
20 cause sickness absence predicts disability retirement in different occupational classes
21 and. Second, the diagnosis of sickness absence was treated as an effect modifier in
22 order to study how the length of sickness absence due to musculoskeletal diseases,
23 mental and behavioural disorders or other diagnoses predicts disability retirement in
24 different occupational classes. Third, we treated the diagnosis as a confounder and
25 studied whether the differences in the diagnoses of sickness absences explain the
26 occupational class differences in the association between the length of sickness
27 absence and disability retirement.
28
29
30
31
32
33
34
35

36 **METHODS**

37 **Study population**

38 Our data were drawn from several linked registers of the Social Insurance Institution of
39 Finland (Kela), the Finnish Centre for Pensions and Statistic Finland. A 70% random
40 sample of the non-retired Finnish population aged 25–62 years at the end of 2006 was
41 retrieved from the population data file of Kela (N=1,727,644). Data on
42 sociodemographic characteristics in 2006, new medically certified sickness absence
43 episodes longer than ten working days starting in 2005 and new disability pensions from
44 2007 to 2014 were linked using the participants' personal identification numbers.
45
46
47
48
49
50
51

52 **Measurement of disability retirement**

53 Data on disability retirement were retrieved from the registers of the Finnish Centre for
54 Pensions (earnings-related pensions) and Kela (basic level national pensions). In
55 Finland, the disability retirement system covers all permanent residents. Disability
56
57
58
59
60

1
2
3 pensions can be granted to persons aged 18–62 (earnings-related scheme) or 16–64
4 (national pension scheme), if their work disability is medically assessed to be long-term
5 (at least one year) or permanent. Transferring to full- or part-time disability pensions
6 between 1 January 2007 and 31 December 2014 was analysed in this study.
7
8
9

10 **Measurement of sickness absence**

11 Sickness absence was measured through sickness allowance, derived from the register
12 of Kela. In Finland, sickness allowance is paid to compensate for short-term by work
13 incapacity lasting up to approximately one year, after which a disability pension can be
14 granted. Sickness allowance may be paid after a waiting period of ten consecutive
15 working days of work incapacity (Sundays and midweek holidays are not counted as
16 working days). A sickness certificate from a physician is required. All new registered
17 sickness allowance spells that started during the time period 1 January 2005 to 31
18 December 2005 were included, and each spell was followed until its end. All, including
19 possible multiple spells, were totalled per diagnostic category (see below) per person.
20 Since disability retirement is usually followed by one year of sickness absence, we
21 started the follow-up at 1 January 2007.
22
23
24
25
26
27
28
29
30

31 The diagnostic groups were chosen based on statistics of the two most prevalent
32 diagnostic causes of sickness absence in 2005 [25]. Three diagnostic groups for
33 sickness absences were used: musculoskeletal diseases (M00–M99), mental and
34 behavioural disorders (F00–F99) and other diagnoses (the rest of the diagnostic
35 groups). The length of sickness absence was calculated as the total number of days in
36 each diagnostic group, and they were categorized as follows: 0 days, 1–30 days, 31–60
37 days, 61–180 days and over 180 days, per diagnostic group (Table 1).
38
39
40
41
42
43
44

45 **Measurement of occupational class**

46 Information on occupational class at the end of 2006 was drawn from the register of
47 Statistic Finland [26] and categorized into five classes: upper non-manual employees,
48 lower non-manual employees, manual workers, self-employed (including self-employed
49 and owners of companies with salaried employees) and those classified as being
50 outside employment. The latter group included long-term unemployed persons (58.1%),
51 students (20.1%) and missing or unknown (21.8%). Pensioners in 2006 were excluded
52
53
54
55
56
57
58
59
60

1
2
3 from this study at the baseline since the study focused on new disability retirements
4 from January 2007 onwards.
5
6

7 **Other covariates**

9 Information on gender, age, marital status and level of urbanisation at the end of 2006
10 was drawn from the registers of Kela. The analyses were performed separately for men
11 and women, as there are known gender differences in patterns of both sickness
12 absence and disability retirement [24,27,28]. Age was categorized into four groups in
13 10-year intervals. Marital status was categorized into three groups: never married,
14 married and “other”, which included those who were divorced or widowed and those
15 with missing information. The level of urbanisation was categorized into urban, densely
16 populated and rural according to classifications of Statistic Finland [29]. The
17 distributions of the covariates are shown in Table 1.
18
19
20
21
22
23

24 **Statistical methods**

25 Each individual in the study population was followed from 1 January 2007 until the start
26 of a disability pension, the start of another type of pension, age 63 (the first potential
27 old-age retirement age), death or the end of the study period on 31 December 2014.
28 The mean follow-up time was 7.0 years. Differences in the risk of disability retirement
29 during 2007–2014 by occupational class and length of sickness absence were analysed
30 with Cox proportional hazards regression. All analyses were conducted separately for
31 men and women and were adjusted for age, marital status and level of urbanisation of
32 the home municipality at the end of 2006 (later referred to as sociodemographic
33 variables). The results are presented as hazard ratios (HR) with their 95% confidence
34 intervals (CI). The statistical significance of interactions between the length of sickness
35 absence and occupational class was tested by the Wald test. The analyses were
36 conducted using the Stata 14.2 software.
37
38
39
40
41
42
43
44
45
46
47

48 **Ethical considerations**

49 The study used secondary data retrieved from registers, and thus no ethics approval
50 was required according to Finnish law. Good scientific practice and data protection
51 regulations were followed in the collection, use and reporting of the data. Kela, the
52 Finnish Centre for Pensions and Statistics Finland provided permission to use the
53 anonymous register-based data.
54
55
56
57
58
59
60

RESULTS

Population characteristics

During the 8-year follow-up, a total of 123,736 persons transferred to disability retirement, including 7.0% of men and 7.3% of women (Table 1). A higher percentage of women (12.5%) than men (8.9%) had at least one spell of sickness absence (SA) that started in 2005. Both the prevalence of sickness absence and the proportion of those experiencing disability retirement were higher among those in lower occupational classes and among those who were of older age, those whose marital status was other than married or never married, and those who lived in rural municipalities. Additionally, the same groups had a higher median number of sickness absence days. In every diagnostic group of sickness absence, the proportion of persons with a new disability retirement was higher among those with longer sickness absences.

Table 1 Distributions of the study population in 2006 (N=1,727,644), prevalence and length of sickness absence (SA) beginning in 2005 and proportion of participants experiencing a disability retirement (DR) in 2007-2014.

	Men				Women			
	Distr. (%)	SA in 2005 (%)	SA days in 2005 ¹ (median)	New DR in 2007-2014 (%)	Distr. (%)	SA in 2005 (%)	SA days in 2005 ¹ (median)	New DR in 2007-2014 (%)
Occupational class								
Upper non-manual	19.6	5.3	31	2.6	18.3	7.2	31	3.3
Lower non-manual	17.7	8.1	32	4.3	41.4	11.9	33	6.5
Manual worker	35.0	12.2	34	8.1	17.7	13.8	35	10.6
Self-employed	12.2	7.0	42	7.1	6.9	7.8	40	7.3
Outside employment	15.5	8.1	60	13.2	15.7	9.0	50	10.3
Age								
25-34	25.9	5.9	33	2.4	25.0	7.1	33	2.4
35-44	27.9	8.5	34	4.2	27.6	10.0	33	4.5
45-54	28.3	10.6	37	11.6	28.9	12.7	35	11.7
55-62	17.9	11.0	40	11.0	18.5	13.5	37	11.0
Marital status								
Never married	35.6	7.3	36	6.1	27.6	8.3	33	5.7
Married	52.2	9.3	35	6.5	55.5	11.0	34	7.1
Other	12.3	11.6	40	12.1	16.9	14.6	36	11.5
Level of urbanisation								
Urban	57.5	8.3	35	6.3	59.3	10.2	34	6.8
Densely populated	16.0	9.5	36	7.7	15.6	11.2	35	7.7
Rural	26.5	9.6	36	8.2	25.1	11.4	36	8.2
No. of SA days in 2005; All								
0	91.1		0	6.1	87.5		0	5.9
1-30	3.7		19	12.0	5.4		19	13.0
31-60	2.3		42	15.8	3.5		42	15.8
61-180	2.1		90	21.3	2.7		88	22.2
over 180	0.7		296	30.7	0.9		284	32.6
No. of SA days in 2005; MSD²								
0	97.1		0	6.7	97.3		0	6.7
1-30	1.3		19	15.3	1.8		19	17.9
31-60	0.7		43	19.1	1.0		44	20.5
61-180	0.7		90	22.2	0.9		91	24.8
over 180	0.2		297	30.8	0.2		294	34.7
No. of SA days in 2005; Mental³								
0	98.9		0	6.9	97.3		0	7.0
1-30	0.4		19	14.2	1.0		20	14.0
31-60	0.3		43	19.4	0.6		43	18.0
61-180	0.3		93	27.3	0.5		93	24.4
over 180	0.2		319	33.3	0.2		303.5	32.9
No. of SA days in 2005; Other⁴								
0	95.0		0	6.7	93.7		0	6.9
1-30	2.3		20	11.0	3.1		20	11.6
31-60	1.3		42	13.7	1.9		41	13.1
61-180	1.0		89	18.0	1.1		85	17.5
over 180	0.3		289	28.9	0.3		265	28.5
<i>All</i>	<i>100</i>	<i>8.9</i>	<i>36</i>	<i>7.0</i>	<i>100</i>	<i>12.5</i>	<i>35</i>	<i>7.3</i>
N	867,585	76,817		60,932	860,059	107,475		62,804

¹ Those with new sickness absence spell that started in 2005, ² Musculoskeletal diseases, ³ Mental and behavioural disorders, ⁴ Other diagnoses

[Figure 1]

1
2
3
4 Hazard ratios (HRs) for the risk of disability retirement for different lengths of sickness absence
5 in different occupational classes are shown in Figure 1, and the reference group is upper non-
6 manual employees with no new sickness absence spells, starting in 2005. Due to their
7 multiplicative nature and to enable direct visual comparability, the HRs are plotted on a
8 logarithmic scale [30,31]. In addition, Appendix tables 1 and 2 show the hazard ratios for
9 disability retirement calculated with a separate reference group for each occupational class.
10
11
12
13
14
15

16 In general, the longer the sickness absence is, the higher the risk of all-cause disability
17 retirement is in all occupational classes and in both genders. Upper non-manual employees had
18 the lowest risk of disability retirement in men and women. Among men, those outside
19 employment clearly had the highest risk of disability retirement, while among women the risk
20 was highest for manual workers and those outside employment. Lower non-manual workers
21 and self-employed workers were between these classes. The interaction terms between the
22 occupational class and the length of sickness absence on the risk of disability retirement were
23 statistically significant in both men (p-values from the Wald test $p < 0.001$) and in women
24 ($p < 0.001$) when comparing each occupational class separately to upper non-manual employees
25 (Appendix tables 1 and 2).
26
27
28
29
30
31
32
33
34
35
36
37
38
39

40 [Figure 2]
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

40 Among upper non-manual employees, the risk of disability retirement increased slightly more
41 steeply with increasing length of sickness absence than in other occupational classes (Figure 1,
42 Appendix tables 1 and 2). In upper non-manual men with over 180 days of sickness absence,
43 the HR of disability retirement was almost 10-fold (HR 9.19 95% CI 7.40–11.40) compared to
44 those with no sickness absence, whereas in manual workers, the same HR was 3.51 (95% CI
45 3.23–3.81) (Appendix table 1). Among women, the pattern was similar, but the occupational
46 class differences were not as large as in men, with the HR being 7.26 (95% CI 6.16–8.57) in
47 upper non-manual employees and 3.94 (95% CI 3.6–4.3) in manual workers, accordingly
48 (Appendix table 2).
49
50
51
52
53
54
55
56
57
58
59
60

1 Figure 2 shows the HRs for all-cause disability retirement in different diagnostic groups, again
2 calculated with upper non-manual employees without sickness absence as the reference group
3 (see Appendix tables 1 and 2 for separate reference groups). In every diagnostic group, the
4 association between the length of sickness absence and the risk of disability retirement was
5 largely similar. However, there was an indication that the association between increasing length
6 of sickness absence and the risk of disability retirement was slightly stronger in sickness
7 absence due to mental and behavioural disorders than in other diagnostic groups. In upper non-
8 manual employee men with over 180 days of sickness absence due to mental and behavioural
9 disorders, the HR of disability retirement was 9.74 (95% CI 7.10–13.37) compared to upper
10 non-manual employees with no sickness absence due to the same diagnostic category, and the
11 same HR was 7.28 (95% CI 4.22–12.55) when the sickness absence was due to
12 musculoskeletal diseases and 6.89 (95% CI 4.78–9.93) due to other diagnoses (Appendix
13 tables 1 and 2). Additionally, in women, a long sickness absence due to mental and behavioural
14 disorders predicted disability retirement more strongly, especially in upper non-manual
15 employees.

26
27
28 [Figure 3]
29
30
31
32

33 To assess how the different diagnostic profiles of sickness absence in different occupational
34 classes affect the total association between length of sickness absence and disability retirement
35 seen above in Figure 1, we calculated the HRs after adjusting for the diagnosis of sickness
36 absence (Figure 3). In general, adjusting for the diagnosis somewhat attenuated the association
37 of increasing lengths of sickness absence with risk of disability retirement in every occupational
38 class. However, in men, the length of sickness absence continued to predict disability retirement
39 more strongly among upper non-manual employees than it did in other occupational classes. In
40 women, the occupational class differences in the strength of association between the increasing
41 length of sickness absence and the risk of disability retirement were largely explained by the
42 occupational class differences after controlling for the diagnosis of sickness absence.

52 DISCUSSION

54 Main findings

55 Our results indicate that the length of sickness absence was associated with a higher risk of
56 disability retirement in all occupational classes, especially in upper non-manual employees.
57
58

1 Even short-term sickness absence spells (those less than 31 days long) were associated with a
2 higher risk of disability retirement compared to having no sickness absence days. Furthermore,
3 very long term sickness absence spells (those longer than 180 days) were associated with a
4 clearly higher risk of disability retirement. There was an indication that the length of sickness
5 absence due to mental and behavioural disorders predicted disability retirement slightly more
6 strongly than the length of sickness absence due to other diagnoses, with the association again
7 being stronger in upper non-manual employees than in other occupational classes. The
8 diagnosis of sickness absence partly explained the differential association between the length of
9 sickness absence and the risk of disability retirement in different occupational classes.
10
11
12
13
14
15

16 **Interpretation of the results**

17
18 In this study, we found that manual workers and those outside employment clearly had a higher
19 risk of disability retirement than did the other occupational classes, especially among those with
20 no sickness absence or with short-term sickness absence. Among those with a long-term
21 sickness absence, the occupational class differences were narrower. The unemployed, which
22 was the largest subgroup in those outside employment, and manual workers generally had
23 poorer health [21,32–35] and health behaviour [32,36], physically more strenuous jobs
24 [21,32,36] and less job control [21,32,36,37] than did higher occupational classes, which
25 increased their risk of disability retirement, even without any sickness absence or with short-
26 term sickness absence. Health problems can select people to unemployment [33,34], and long-
27 term health problems increase the risk of disability. In the present study, the occupational class
28 differences were smaller in long-term sickness absences, implying that those with long-term
29 sicknesses have an increased risk of disability retirement, despite their occupational class.
30 However, the risk of disability retirement increased with an increasing length of sickness
31 absence more strongly in upper non-manual employees than in other social classes. Upper
32 non-manual employees have long sickness absences less frequently than manual workers do,
33 indicating that upper non-manual employees with long-term sickness absence are possibly a
34 more selected group in terms of their disability retirement risk.
35
36
37
38
39
40
41
42
43
44
45
46
47

48 The diagnoses and long-term consequences of sickness absences are known to differ between
49 occupational classes [23,38,39]. This may be related to differences in work tasks and working
50 conditions between the occupational classes. Some illnesses may be directly caused by work-
51 related hazards. Furthermore, some health problems that prevent those with physically
52 demanding jobs from working may not affect work ability among those in desk jobs. Previous
53 studies have found that socioeconomic differences in the diagnoses of sickness absences are
54
55
56
57
58
59
60

1 large in musculoskeletal diseases [23]. In general, our study agrees with previous findings in
2 that the association between the length of sickness absence and the risk of disability retirement
3 does not differ much between diagnostic groups of sickness absences [40]. However, in this
4 study, there was an indication that the length of sickness absence due to mental and
5 behavioural disorders predicted disability retirement slightly more strongly than did the length of
6 sickness absence due to other diagnoses, particularly among upper non-manual employees.
7 Sickness absence due to mental and behavioural disorders has been found to present a greater
8 risk of disability retirement than has sickness absence due to other diagnoses [4,5,16,41], but
9 previous studies have not found that the length of sickness absence predicts disability
10 retirement differently in sickness absence due to mental and behavioural disorders compared to
11 other diagnoses [5,40]. Our finding on the indication that the length of sickness absence due to
12 mental and behavioural disorders was a stronger predictor in upper non-manual employees
13 may partly be explained by work-related factors: upper non-manual employees often have
14 psychologically demanding jobs [35,37], their employers may prefer the employees to remain
15 absent due to sickness until fully recovered because it can be especially difficult to return to
16 mentally complex work with mental health problems, and positions held by higher occupations
17 are not as easily replaceable [42].

18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
The average lengths of the sickness absence spells vary between diagnostic groups and occupational classes. We found that the adjustment of the diagnosis largely explained the differential association between the length of sickness absence and the risk of disability retirement in different occupational classes, particularly in women. However, in upper non-manual employee men, the adjustment of the diagnosis did not, to a large extent, attenuate the association between the length of sickness absence and the risk of disability retirement, which can be explained by the fact that in upper non-manual employees, a large proportion of the long-term sickness absences were due to mental and behavioural disorders. In other occupational classes, the association can be explained by a more equal distribution in the proportions and the average lengths of different diagnostic groups. In all, divergent diagnostic profiles in different occupational classes partly explain the occupational class differences in the association between the length of sickness absence and the risk of disability retirement.

51 **Methodological considerations**

52
53 A key strength of the study was the 8-year prospective and population-based cohort design,
54 based on a 70% register sample of the total Finnish non-retired working-age population. Data
55 were obtained from national registers, constituting highly reliable sources with objective register-

1 based measures, no self-report bias, practically no loss to follow-up and very little missing
2 information. In addition, we were able to utilize date-specific information on both sickness
3 absence and disability retirement. However, a limitation common to all register-based data is
4 the lack of information on, for example, health status, health behaviours or physical and
5 psychosocial work environment that could explain or mediate the observed associations.
6 Furthermore, due to the observational nature of the data, causal effects cannot be established.
7 Confounding by previous health status or other unmeasured factors may explain some of the
8 observed associations. The use of relatively broad diagnostic groups instead of more exact
9 diagnoses prohibits from drawing too generalised conclusions from the results.
10
11
12
13
14
15
16

17 **Conclusion**

18 Our results suggest that there are occupational class differences in the pathways from sickness
19 absence to disability retirement. The length of sickness absence predicts disability retirement
20 more strongly than does the diagnosis of sickness absence in all occupational classes, but the
21 diagnostic profiles vary between occupational classes and partly explain the association
22 between the length of sickness absence and the risk of disability retirement. It is crucial to
23 understand the ways in which work disability develops in different occupational classes to
24 provide more efficient preventive measures. Further research should focus on understanding
25 the mechanisms contributing to social inequalities in sickness absence and work disability due
26 to different diagnoses.
27
28
29
30
31
32
33
34

35 **FOOTNOTES**

36 **Funding:** This work is supported by the Strategic Research Council of the Academy of Finland
37 (decision number: 293103).
38

39 **Competing Interests:** None declared.
40

41 **Contributions:** Corresponding author (LS), JB, ML and MN contributed to the planning,
42 conducting and reporting of this study. LS conducted the statistical analyses and wrote the first
43 and successive drafts of the manuscript. JB, ML and MN advised on the statistical approach
44 and modelling and revised the drafts of manuscripts. LS, JB and ML interpreted the results. All
45 authors approved the final submitted version.
46
47
48
49

50 **Data sharing statement:** No additional data available.

51 **Acknowledgements:** We want to thank participants of the annual conference of the
52 Westermarck Society, RC28 -conference, Nordic Demographic Symposium, WORK2017 -
53 conference, the annual Social policy conference and EPH -conference for the insightful
54 comments.
55
56
57
58
59
60

REFERENCES

1. OECD, editor. *Sickness, disability and work: breaking the barriers ; a synthesis of findings across OECD countries*. Paris: OECD; 2010. 165 p. (Sickness, disability and work : breaking the barriers).
2. Borg K, Hensing G, Alexanderson K. Predictive factors for disability pension -- An 11-year follow up of young persons on sick leave due to neck, shoulder, or back diagnoses. *Scandinavian Journal of Public Health*. 2001 Apr 1;29(2):104–12.
3. Bratberg E, Gjesdal S, Mæland JG. Sickness absence with psychiatric diagnoses: Individual and contextual predictors of permanent disability. *Health & Place*. 2009 Mar;15(1):308–14.
4. Gjesdal S. Predictors of disability pension in long-term sickness absence: Results from a population-based and prospective study in Norway 1994-1999. *The European Journal of Public Health*. 2004 Dec 1;14(4):398–405.
5. Gjesdal S, Bratberg E. Diagnosis and duration of sickness absence as predictors for disability pension: Results from a three-year, multi-register based and prospective study. *Scandinavian Journal of Public Health*. 2003 Aug 1;31(4):246–54.
6. Lund T, Kivimäki M, Labriola M, Villadsen E, Christensen KB. Using administrative sickness absence data as a marker of future disability pension: the prospective DREAM study of Danish private sector employees. *Occupational and Environmental Medicine*. 2008 Jan 1;65(1):28–31.
7. Polvinen A, Laaksonen M, Gould R, Lahelma E, Martikainen P. The contribution of major diagnostic causes to socioeconomic differences in disability retirement. *Scandinavian Journal of Work, Environment & Health*. 2014 Jul;40(4):353–60.
8. Wilkinson R, Pickett K. *The spirit level: why more equal societies almost always do better*. London: Allen Lane; 2009. 330 p.
9. EU-OSHA. *Priorities for occupational safety and health research in Europe: 2013-2020*. 2013.
10. Harkonmäki K, Korkeila K, Vahtera J, Kivimäki M, Suominen S, Sillanmäki L, et al. Childhood adversities as a predictor of disability retirement. *J Epidemiol Community Health*. 2007 Jun;61(6):479–84.
11. Labriola M, Lund T. Self-reported sickness absence as a risk marker of future disability pension. Prospective findings from the DWECS/DREAM study 1990-2004. *International Journal of Medical Sciences*. 2007;4(3):153–8.
12. Laine S, Gimeno D, Virtanen M, Oksanen T, Vahtera J, Elovainio M, et al. Job strain as a predictor of disability pension: the Finnish Public Sector Study. *Journal of Epidemiology & Community Health*. 2009 Jan 1;63(1):24–30.

13. Virtanen M, Kivimäki M, Singh-Manoux A, Gimeno D, Shipley MJ, Vahtera J, et al. Work disability following major organisational change: the Whitehall II study. *Journal of Epidemiology & Community Health*. 2010 May 1;64(5):461–4.
14. Kivimäki M, Forma P, Wikström J, Halmeenmäki T, Pentti J, Elovainio M, et al. Sickness absence as a risk marker of future disability pension: the 10-town study. *Journal of Epidemiology & Community Health*. 2004 Aug 1;58(8):710–1.
15. Jansson C, Alexanderson K. Sickness absence due to musculoskeletal diagnoses and risk of diagnosis-specific disability pension: A nationwide Swedish prospective cohort study: *Pain*. 2013 Jun;154(6):933–41.
16. Alexanderson K, Kivimäki M, Ferrie JE, Westerlund H, Vahtera J, Singh-Manoux A, et al. Diagnosis-specific sick leave as a long-term predictor of disability pension: a 13-year follow-up of the GAZEL cohort study. *Journal of Epidemiology & Community Health*. 2012 Feb 1;66(2):155–9.
17. Kristensen TR, Jensen SM, Kreiner S, Mikkelsen S. Socioeconomic status and duration and pattern of sickness absence. A 1-year follow-up study of 2331 hospital employees. *BMC Public Health*. 2010 Dec;10(1).
18. Kaikkonen R, Härkänen T, Rahkonen O, Gould R, Koskinen S. Explaining educational differences in sickness absence: a population-based follow-up study. *Scandinavian Journal of Work, Environment & Health*. 2015 Jul;41(4):338–46.
19. Sumanen H, Rahkonen O, Pietiläinen O, Lahelma E, Roos E, Lahti J. Educational differences in disability retirement among young employees in Helsinki, Finland. *The European Journal of Public Health*. 2016 Apr;26(2):318–22.
20. Polvinen A, Laaksonen M, Gould R, Lahelma E, Leinonen T, Martikainen P. Socioeconomic Differences in Cause-Specific Disability Retirement in Finland, 1988 to 2009: *Journal of Occupational and Environmental Medicine*. 2016 Aug;58(8):840–5.
21. Haukenes I, Mykletun A, Knudsen A, Hansen H-T, Mæland J. Disability pension by occupational class - the impact of work-related factors: The Hordaland Health Study Cohort. *BMC Public Health*. 2011;11(1):406.
22. Krokstad S, Johnsen R, Westin S. Social determinants of disability pension: a 10-year follow-up of 62 000 people in a Norwegian county population. *International Journal of Epidemiology*. 2002 Dec 1;31(6):1183–91.
23. Pekkala J, Blomgren J, Pietiläinen O, Lahelma E, Rahkonen O. Occupational class differences in diagnostic-specific sickness absence: a register-based study in the Finnish population, 2005–2014. *BMC Public Health*. 2017 Dec;17(1).
24. Sumanen H, Lahti J, Lahelma E, Pietiläinen O, Rahkonen O. 12-year trends in occupational class differences in short sickness absence among young women. *Scandinavian Journal of Social Medicine*. 2015 Jun;43(4):441–4.
25. Social Insurance Institution. Statistics on National Health Insurance [Internet]. Helsinki; 2005. Available from: https://helda.helsinki.fi/bitstream/handle/10250/3118/Sava_05.pdf?sequence=2

- 1 26. Statistics Finland. Classification of Socio-economic Groups 1989 [Internet]. 1989 [cited
2 2017 Dec 5]. Available from: [http://www.stat.fi/meta/luokitukset/sosioekon_asema/001-
4 1989/index_en.html](http://www.stat.fi/meta/luokitukset/sosioekon_asema/001-
3 1989/index_en.html)
- 5 27. Gjesdal S, Bratberg E, Mæland JG. Gender differences in disability after sickness absence
6 with musculoskeletal disorders: five-year prospective study of 37,942 women and 26,307
7 men. *BMC Musculoskeletal Disorders*. 2011 Dec;12(1).
- 8 28. Sterud T. Work-related gender differences in physician-certified sick leave: a prospective
9 study of the general working population in Norway. *Scandinavian Journal of Work,
10 Environment & Health*. 2014 Jul;40(4):361–9.
- 11 29. Statistics Finland. Statistical grouping of municipalities [Internet]. 2017 [cited 2017 Dec 5].
12 Available from: http://www.stat.fi/meta/luokitukset/kuntaryhmitys/001-2017/index_en.html
- 13 30. Hosseinpoor AR, AbouZahr C. Graphical presentation of relative measures of association.
14 *The Lancet*. 2010 Apr;375(9722):1254.
- 15 31. Levine MAH, El-Nahas AI, Asa B. Relative risk and odds ratio data are still portrayed with
16 inappropriate scales in the medical literature. *Journal of Clinical Epidemiology*. 2010
17 Sep;63(9):1045–7.
- 18 32. Polvinen A, Gould R, Lahelma E, Martikainen P. Socioeconomic differences in disability
19 retirement in Finland: the contribution of ill-health, health behaviours and working
20 conditions. *Scand J Public Health*. 2013 Jul;41(5):470–8.
- 21 33. Schmitz H. Why are the unemployed in worse health? The causal effect of unemployment
22 on health. *Labour Economics*. 2011 Jan;18(1):71–8.
- 23 34. Böckerman P, Ilmakunnas P. Unemployment and self-assessed health: evidence from
24 panel data. *Health Economics*. 2009 Feb;18(2):161–79.
- 25 35. Hämmig O, Bauer GF. The social gradient in work and health: a cross-sectional study
26 exploring the relationship between working conditions and health inequalities. *BMC Public
27 Health*. 2013 Dec;13(1).
- 28 36. Leinonen T, Pietiläinen O, Laaksonen M, Rahkonen O, Lahelma E, Martikainen P.
29 Occupational social class and disability retirement among municipal employees – the
30 contribution of health behaviors and working conditions. *Scandinavian Journal of Work,
31 Environment & Health*. 2011 Nov;37(6):464–72.
- 32 37. Lahelma E, Laaksonen M, Aittomäki A. Occupational class inequalities in health across
33 employment sectors: the contribution of working conditions. *International Archives of
34 Occupational and Environmental Health*. 2009 Jan;82(2):185–90.
- 35 38. Vaez M, Rylander G, Nygren Å, Åsberg M, Alexanderson K. Sickness absence and
36 disability pension in a cohort of employees initially on long-term sick leave due to
37 psychiatric disorders in Sweden. *Social Psychiatry and Psychiatric Epidemiology*. 2007
38 May;42(5):381–8.
- 39 39. Gjesdal S, Ringdal PR, Haug K, Gunnar Mæland J. Long-term sickness absence and
40 disability pension with psychiatric diagnoses: A population-based cohort study. *Nordic
41 Journal of Psychiatry*. 2008 Jan;62(4):294–301.
- 42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59

- 1 40. Wallman T, Wedel H, Palmer E, Rosengren A, Johansson S, Eriksson H, et al. Sick-leave
2 track record and other potential predictors of a disability pension. A population based study
3 of 8,218 men and women followed for 16 years. BMC Public Health. 2009 Dec ;9(1).
4
- 5 41. Kivimäki M, Ferrie JE, Hagberg J, Head J, Westerlund H, Vahtera J, et al. Diagnosis-
6 specific sick leave as a risk marker for disability pension in a Swedish population. Journal
7 of Epidemiology & Community Health. 2007 Oct 1;61(10):915–20.
8
- 9 42. Ekberg K, Wåhlin C, Persson J, Bernfort L, Öberg B. Early and Late Return to Work After
10 Sick Leave: Predictors in a Cohort of Sick-Listed Individuals with Common Mental
11 Disorders. Journal of Occupational Rehabilitation. 2015 Sep;25(3):627–37.
12
13
14
15

16 Figure 1 legend:

17 Figure 1 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95%
18 confidence intervals according to the length of all-cause sickness absence in different
19 occupational classes in men and women. Upper non-manual workers with no sickness
20 allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all
21 sociodemographic variables.
22
23
24
25
26

27 Figure 2 legend:

28 Figure 2 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95%
29 confidence intervals according to the length of diagnosis-specific sickness absence in different
30 occupational classes in men and women. Upper non-manual workers with zero sickness
31 allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all
32 sociodemographic variables.
33
34
35
36
37

38 Figure 3 legend:

39 Figure 3 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 according to
40 the length of sickness absence in different occupational classes in men and women. Upper non-
41 manual workers with no sickness allowance days is the reference group. Hazard ratios on
42 logarithmic scale. All adjusted for all sociodemographic variables. Dotted lines represent hazard
43 ratios when not adjusted for diagnoses, and solid lines hazard ratios after adjusting for the
44 diagnoses.
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

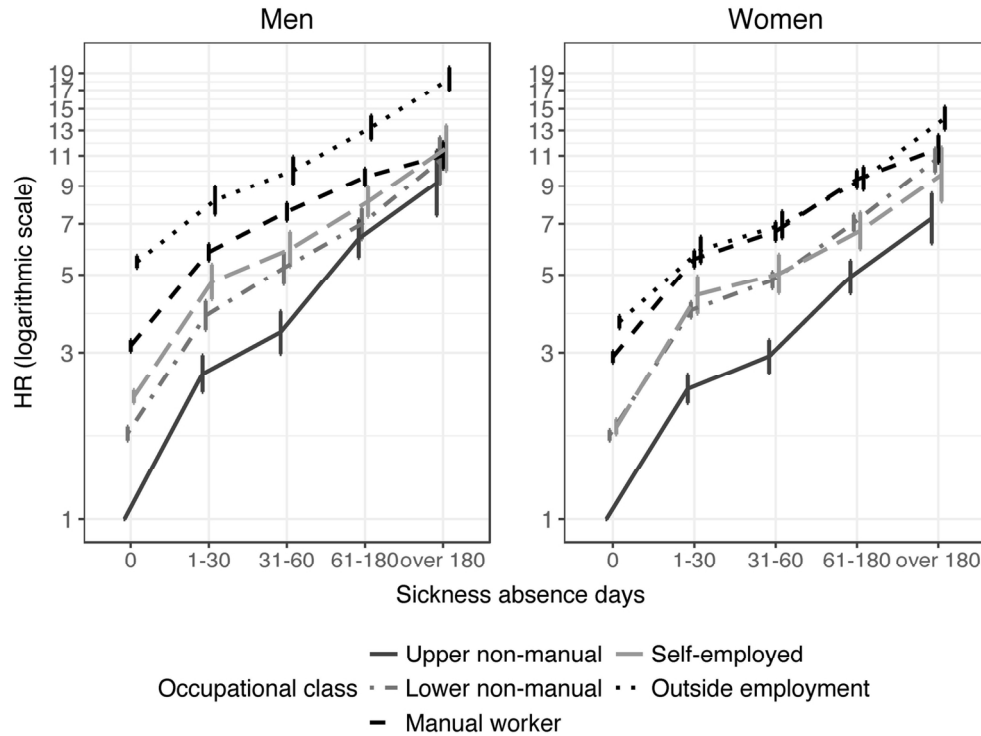
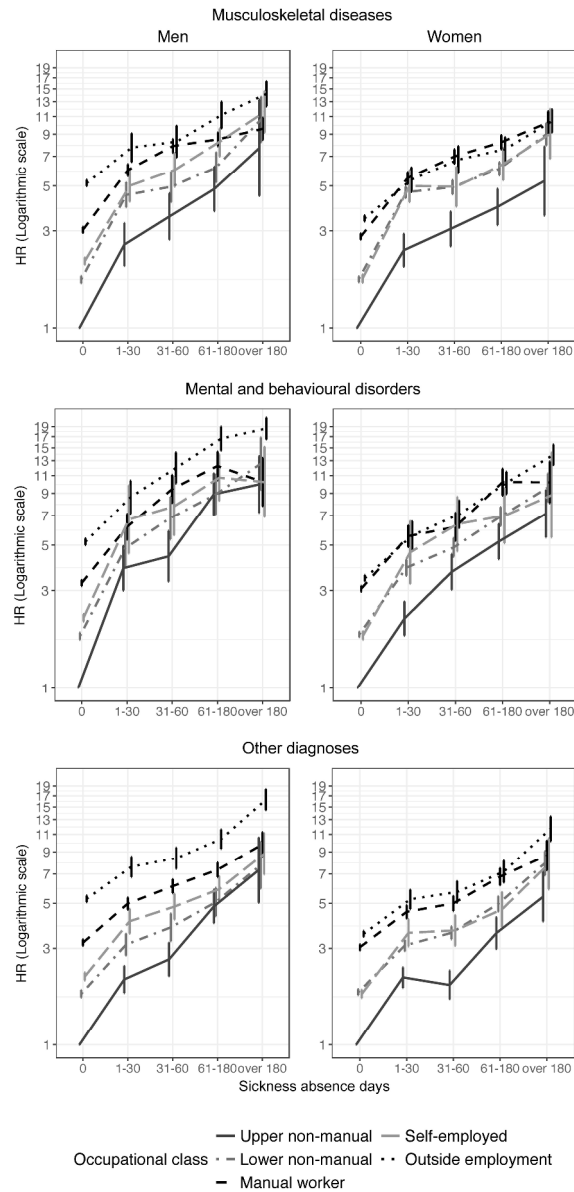


Figure 1 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95% confidence intervals according to the length of all-cause sickness absence in different occupational classes in men and women. Upper non-manual workers with no sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables.

134x101mm (300 x 300 DPI)

Only



45
46
47
48
49

Figure 2 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95% confidence intervals according to the length of diagnosis-specific sickness absence in different occupational classes in men and women. Upper non-manual workers with zero sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables.

50
51
52
53
54
55
56
57
58
59
60

292x604mm (300 x 300 DPI)

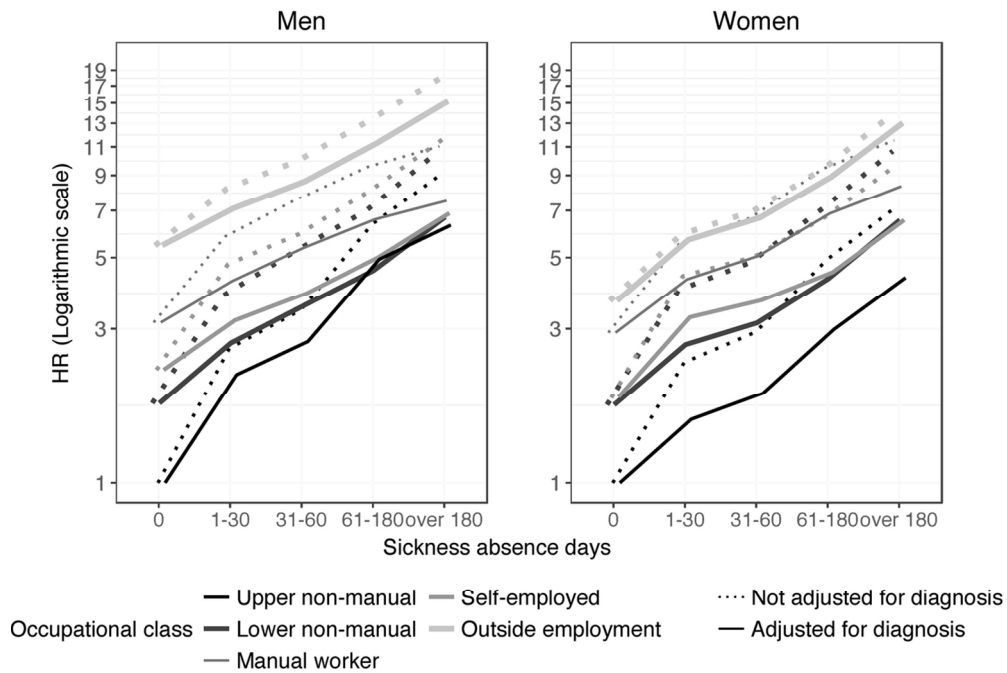


Figure 3 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 according to the length of sickness absence in different occupational classes in men and women. Upper non-manual workers with no sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables. Dotted lines represent hazard ratios when not adjusted for diagnoses, and solid lines hazard ratios after adjusting for the diagnoses.

116x79mm (300 x 300 DPI)

Appendix table 1. Hazard ratios with 95% confidence intervals for the risk of disability retirement according to the length and diagnosis of sickness absence in different occupational classes in men.

	Length of sickness absence										Interaction p-value from the Wald test ¹
	0		1-30		31-60		61-180		over 180		
	HR	HR	CI	HR	CI	HR	CI	HR	CI		
<i>All diagnoses</i>											
Upper non-manual	1	2.61	2.31-2.95	3.43	2.98-3.93	6.35	5.60-7.21	9.19	7.40-11.40		
Lower non-manual	1	2.16	1.97-2.37	2.96	2.66-3.29	3.97	3.59-4.39	6.02	5.16-7.02	p<0.001	
Manual worker	1	1.84	1.76-1.93	2.40	2.29-2.53	3.03	2.89-3.18	3.51	3.23-3.81	p<0.001	
Self-employed	1	2.12	1.90-2.37	2.64	2.36-2.96	3.63	3.29-4.00	5.19	4.49-6.01	p<0.001	
Outside employment	1	1.49	1.37-1.63	1.82	1.67-1.99	2.41	2.25-2.59	3.35	3.12-3.59	p<0.001	
<i>Musculoskeletal diseases</i>											
Upper non-manual	1	2.73	2.17-3.44	3.47	2.68-4.50	4.94	3.87-6.32	7.28	4.22-12.55		
Lower non-manual	1	2.75	2.40-3.14	2.95	2.50-3.49	3.51	2.96-4.17	6.02	4.70-7.70	p<0.001	
Manual worker	1	2.03	1.92-2.15	2.67	2.49-2.86	2.87	2.68-3.08	3.23	2.88-3.63	p<0.001	
Self-employed	1	2.49	2.10-2.96	2.91	2.42-3.50	3.94	3.38-4.58	5.58	4.45-7.00	p<0.001	
Outside employment	1	1.55	1.33-1.80	1.71	1.44-2.02	2.18	1.89-2.52	2.73	2.39-3.13	p<0.001	
<i>Mental and behavioural disorders</i>											
Upper non-manual	1	4.02	3.16-5.11	4.48	3.38-5.92	8.80	6.99-11.09	9.74	7.10-13.37		
Lower non-manual	1	2.73	2.20-3.37	4.32	3.47-5.37	5.03	4.06-6.24	6.55	4.90-8.76	p<0.001	
Manual worker	1	2.04	1.78-2.32	2.97	2.57-3.44	3.69	3.17-4.29	3.15	2.44-4.06	p<0.001	
Self-employed	1	3.25	2.27-4.65	3.48	2.52-4.81	5.16	4.04-6.58	5.19	3.60-7.48	p<0.001	
Outside employment	1	1.65	1.38-1.97	2.28	1.94-2.69	3.14	2.77-3.57	3.49	3.11-3.92	p<0.001	
<i>Other diagnoses</i>											
Upper non-manual	1	2.19	1.89-2.54	2.69	2.23-3.25	5.05	4.21-6.06	6.89	4.78-9.93		
Lower non-manual	1	1.85	1.64-2.08	2.21	1.90-2.57	3.00	2.58-3.50	4.34	3.34-5.63	p<0.001	
Manual worker	1	1.63	1.54-1.73	1.99	1.86-2.14	2.38	2.21-2.57	3.11	2.73-3.54	p<0.001	
Self-employed	1	1.96	1.71-2.23	2.26	1.96-2.61	2.76	2.39-3.18	4.02	3.19-5.06	p<0.001	
Outside employment	1	1.49	1.34-1.66	1.62	1.44-1.82	2.01	1.81-2.22	3.13	2.80-3.49	p<0.001	

Adjusted for socio-demographic variables.¹ Wald test for the interaction term between occupational class and length of sickness absence on disability retirement.

Appendix table 2. Hazard ratios with 95% confidence intervals for the risk of disability retirement according to the length and diagnosis of sickness absence in different occupational classes in women.

	Length of sickness absence										Interaction p-value from the Wald test ¹
	0		1-30		31-60		61-180		over 180		
	HR	HR	CI	HR	CI	HR	CI	HR	CI		
<i>All diagnoses</i>											
Upper non-manual	1	2.36	2.15-2.60	2.93	2.62-3.26	4.93	4.42-5.49	7.26	6.16-8.57		
Lower non-manual	1	2.27	2.18-2.37	2.76	2.64-2.90	4.04	3.85-4.23	6.13	5.69-6.60	p<0.001	
Manual worker	1	1.90	1.80-1.99	2.28	2.15-2.41	3.22	3.05-3.40	3.94	3.61-4.29	p<0.001	
Self-employed	1	2.36	2.09-2.67	2.73	2.40-3.10	3.61	3.20-4.07	5.20	4.41-6.32	p<0.001	
Outside employment	1	1.60	1.48-1.74	1.89	1.74-2.06	2.57	2.39-2.76	3.84	3.58-4.12	p<0.001	
<i>Musculoskeletal diseases</i>											
Upper non-manual	1	2.56	2.15-3.05	3.15	2.60-3.81	4.05	3.33-4.93	5.92	4.14-8.49		
Lower non-manual	1	2.74	2.59-2.90	3.03	2.82-3.26	3.65	3.40-3.91	5.40	4.80-6.06	p<0.001	
Manual worker	1	1.99	1.87-2.12	2.54	2.36-2.74	3.00	2.79-3.24	3.70	3.28-4.16	p<0.001	
Self-employed	1	3.04	2.56-3.60	2.85	2.29-3.54	3.83	3.21-4.57	5.18	3.96-6.78	p<0.001	
Outside employment	1	1.57	1.37-1.79	1.99	1.71-2.30	2.30	2.02-2.62	3.11	2.75-3.52	p<0.001	
<i>Mental and behavioural disorders</i>											
Upper non-manual	1	2.34	1.95-2.80	3.95	3.26-4.78	5.33	4.41-6.44	7.54	5.88-9.67		
Lower non-manual	1	2.23	2.06-2.42	2.78	2.53-3.06	4.03	3.66-4.45	5.47	4.72-6.33	p<0.001	
Manual worker	1	1.88	1.69-2.10	2.23	1.94-2.57	3.28	2.85-3.78	3.43	2.76-4.25	p<0.001	
Self-employed	1	2.9	2.10-3.99	3.54	2.65-4.74	3.78	2.79-5.13	4.24	2.63-6.84	p<0.001	
Outside employment	1	1.55	1.33-1.81	2.03	1.74-2.36	2.93	2.61-3.29	3.94	3.53-4.39	p<0.001	
<i>Other diagnoses</i>											
Upper non-manual	1	2.24	2.00-2.50	2.07	1.78-2.42	3.68	3.09-4.39	5.56	4.22-7.31		
Lower non-manual	1	1.81	1.72-1.91	2.08	1.95-2.22	2.86	2.64-3.09	4.59	4.04-5.22	p<0.001	
Manual worker	1	1.63	1.53-1.74	1.79	1.65-1.93	2.42	2.22-2.64	2.88	2.45-3.37	p<0.001	
Self-employed	1	2.11	1.83-2.45	2.12	1.79-2.50	2.63	2.18-3.19	4.54	3.43-6.01	p<0.001	
Outside employment	1	1.5	1.36-1.67	1.61	1.43-1.81	2.09	1.86-2.35	3.42	2.99-3.90	p<0.001	

Adjusted for socio-demographic variables. ¹Wald test for the interaction term between occupational class and length of sickness absence on disability retirement.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page no.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	4-5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-6
Bias	9	Describe any efforts to address potential sources of bias	2, 13
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6-7
		(b) Describe any methods used to examine subgroups and interactions	6-7
		(c) Explain how missing data were addressed	4-6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	4, 6

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

(e) Describe any sensitivity analyses

6-7

Continued on next page

For peer review only

Results			Page no.
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	4
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	4-6 4, 6
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9-10
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Sickness absence as a predictor of disability retirement in different occupational classes: a register-based study of a working-age cohort in Finland in 2007–2014

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-020491.R2
Article Type:	Research
Date Submitted by the Author:	18-Feb-2018
Complete List of Authors:	Salonen, Laura; Turun Yliopisto, Department of Social Research Blomgren, Jenni; Kela, Research Department Laaksonen, Mikko; Finnish Centre for Pensions, Niemi, Mikko; Turun Yliopisto, Department of Social Research
Primary Subject Heading:	Occupational and environmental medicine
Secondary Subject Heading:	Public health, Sociology
Keywords:	SOCIAL MEDICINE, OCCUPATIONAL & INDUSTRIAL MEDICINE, PUBLIC HEALTH

SCHOLARONE™
Manuscripts

1
2
3 **Sickness absence as a predictor of disability retirement in different**
4 **occupational classes: a register-based study of a working-age cohort**
5 **in Finland in 2007–2014**
6
7
8
9

10 Salonen, Laura, Blomgren, Jenni, Laaksonen, Mikko & Niemelä, Mikko

11
12
13 Correspondence: Salonen, Laura

14 Email: iksalo@utu.fi

15 Institution: University of Turku

16 City and country: Turku, Finland

17 Postal address: Lonttistentie 27 B 24, 20100 Turku, Finland

18 Email: iksalo@utu.fi

19 Telephone number: +358 41 546 8506
20
21
22
23
24
25

26 Blomgren, Jenni

27 Email: jenni.blomgren@kela.fi

28 Institution: the Social Insurance Institution of Finland

29 City and country: Helsinki, Finland
30
31
32
33

34 Laaksonen, Mikko

35 Email: mikko.laaksonen@etk.fi

36 Institution: the Centre of Pensions

37 City and country: Helsinki, Finland
38
39
40
41

42 Niemelä, Mikko

43 Email: miarni@utu.fi

44 Department: Department of Social Research

45 Institution: University of Turku

46 City and country: Turku, Finland
47
48
49
50
51

52 Institution: the Social Insurance Institution of Finland

53 City and country: Helsinki, Finland.
54
55
56
57

58 Word count: 3252
59
60

ABSTRACT

Objectives: The objective of the study was to examine diagnosis-specific sickness absences of different lengths as predictors of disability retirement in different occupational classes.

Design: Register-based prospective cohort study up to 8 years of follow-up.

Participants: A 70% random sample of the non-retired Finnish population aged 25–62 at the end of 2006 was included (N=1,727,644) and linked to data on sickness absences in 2005 and data on disability retirement in 2007–2014.

Main outcome measures: Cox proportional hazards regression was utilized to analyse the association of sickness absence with the risk of all-cause disability retirement during an eight-year follow-up.

Results: The risk of disability retirement increased with increasing lengths of sickness absence in all occupational classes. A long sickness absence was a particularly strong predictor of disability retirement in upper non-manual employees as among those with over 180 sickness absence days the hazard ratio (HR) was 9.19 (95% CI 7.40–11.40), but in manual employees the HR was 3.51 (95% CI 3.23–3.81) in men. Among women the corresponding HRs were 7.26 (95% CI 6.16–8.57) and 3.94 (95% CI 3.60–4.30) respectively. Adjusting for the diagnosis of sickness absence partly attenuated the association between the length of sickness absence and the risk of disability retirement in all employed groups.

Conclusions: A long sickness absence is a strong predictor of disability retirement in all occupational classes. Preventing the accumulation of sickness absence days and designing more efficient policies for different occupational classes may be crucial to reduce the number of transitions to early retirement due to disability.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- A strength of this study was the 8-year prospective and population-based cohort design, based on a 70% register sample of the total Finnish non-retired working-age population.
- Data were obtained from national registers, constituting highly reliable sources with objective register-based measures, no self-report bias, practically no loss to follow-up and very little missing information
- We were able to utilize date-specific information on both sickness absence and disability retirement.
- A limitation to this study was the lack of information on, for example, health status, health behaviours or work environment that could explain or mediate the observed associations.
- Due to the observational nature of the data, causal effects cannot be established.

INTRODUCTION

Large numbers of employees leave the labour market early due to health problems [1]. In particular, those in disadvantaged social positions have an increased risk of problems with health and work ability [2–7]. Both inequalities in health and a loss of workforce due to health problems cause substantial costs for societies [1,8]. To extend working lives, which has become an important target in many OECD countries [9], identifying those with an increased risk of work disability is crucial.

Previous studies have discovered several sociodemographic, work-environmental and health-related predictors of work disability [10–13]. One of the strongest early markers of disability retirement is sickness absence [14]. The risk of disability retirement has been shown to depend on both the duration and the diagnosis of sickness absence. In particular, long-term sickness absence [4,5] and sickness absence due to musculoskeletal diseases [15]; mental and behavioural disorders [16]; and diseases of the nervous, respiratory, and circulatory systems [5] indicate a high risk of disability retirement.

However, to our knowledge, there are no studies focusing on whether this association varies by occupational class. There are large occupational class differences in both sickness absences of various lengths [17,18] and the risk of disability retirement [19–22], but no studies have been conducted on whether the length of sickness absence

1
2
3 predicts disability retirement differently in different occupational classes. The differences
4 between occupational classes are substantial in sickness absence due to
5 musculoskeletal diseases, but they are smaller in sickness absence due to mental and
6 behavioural disorders [23,24]. The varying diagnostic profiles of the occupational
7 classes may confound the association between the length of sickness absence and the
8 risk of disability retirement. This emphasizes the need to consider both the length and
9 diagnosis of sickness absence when occupational class differences in the risk of
10 disability retirement are examined.
11
12
13
14
15

16
17 Thus, to fill the gap in previous research, the aim of this study was to examine
18 diagnosis-specific sickness absences of different lengths as predictors of disability
19 retirement in different occupational classes. We examined, first, how the length of all-
20 cause sickness absence predicts disability retirement in different occupational classes
21 and. Second, the diagnosis of sickness absence was treated as an effect modifier in
22 order to study how the length of sickness absence due to musculoskeletal diseases,
23 mental and behavioural disorders or other diagnoses predicts disability retirement in
24 different occupational classes. Third, we treated the diagnosis as a confounder and
25 studied whether the differences in the diagnoses of sickness absences explain the
26 occupational class differences in the association between the length of sickness
27 absence and disability retirement.
28
29
30
31
32
33
34
35

36 **METHODS**

37 **Study population**

38 Our data were drawn from several linked registers of the Social Insurance Institution of
39 Finland (Kela), the Finnish Centre for Pensions and Statistic Finland. A 70% random
40 sample of the non-retired Finnish population aged 25–62 years at the end of 2006 was
41 retrieved from the population data file of Kela (N=1,727,644). Data on
42 sociodemographic characteristics in 2006, new medically certified sickness absence
43 episodes longer than ten working days starting in 2005 and new disability pensions from
44 2007 to 2014 were linked using the participants' personal identification numbers.
45
46
47
48
49
50
51

52 **Measurement of disability retirement**

53 Data on disability retirement were retrieved from the registers of the Finnish Centre for
54 Pensions (earnings-related pensions) and Kela (basic level national pensions). In
55 Finland, the disability retirement system covers all permanent residents. Disability
56
57
58
59
60

1
2
3 pensions can be granted to persons aged 18–62 (earnings-related scheme) or 16–64
4 (national pension scheme), if their work disability is medically assessed to be long-term
5 (at least one year) or permanent. Transferring to full- or part-time disability pensions
6 between 1 January 2007 and 31 December 2014 was analysed in this study.
7
8
9

10 **Measurement of sickness absence**

11 Sickness absence was measured through sickness allowance, derived from the register
12 of Kela. In Finland, sickness allowance is paid to compensate for short-term by work
13 incapacity lasting up to approximately one year, after which a disability pension can be
14 granted. Sickness allowance may be paid after a waiting period of ten consecutive
15 working days of work incapacity (Sundays and midweek holidays are not counted as
16 working days). A sickness certificate from a physician is required. All new registered
17 sickness allowance spells that started during the time period 1 January 2005 to 31
18 December 2005 were included, and each spell was followed until its end. All, including
19 possible multiple spells, were totalled per diagnostic category (see below) per person.
20 Since disability retirement is usually followed by one year of sickness absence, we
21 started the follow-up at 1 January 2007.
22
23
24
25
26
27
28
29
30

31 The diagnostic groups were chosen based on statistics of the two most prevalent
32 diagnostic causes of sickness absence in 2005 [25]. Three diagnostic groups for
33 sickness absences were used: musculoskeletal diseases (M00–M99), mental and
34 behavioural disorders (F00–F99) and other diagnoses (the rest of the diagnostic
35 groups). The length of sickness absence was calculated as the total number of days in
36 each diagnostic group, and they were categorized as follows: 0 days, 1–30 days, 31–60
37 days, 61–180 days and over 180 days, per diagnostic group (Table 1).
38
39
40
41
42
43
44

45 **Measurement of occupational class**

46 Information on occupational class at the end of 2006 was drawn from the register of
47 Statistic Finland [26] and categorized into five classes: upper non-manual employees,
48 lower non-manual employees, manual workers, self-employed (including self-employed
49 and owners of companies with salaried employees) and those classified as being
50 outside employment. The latter group included long-term unemployed persons (58.1%),
51 students (20.1%) and missing or unknown (21.8%). Pensioners in 2006 were excluded
52
53
54
55
56
57
58
59
60

1
2
3 from this study at the baseline since the study focused on new disability retirements
4 from January 2007 onwards.
5
6

7 **Other covariates**

8 Information on gender, age, marital status and level of urbanisation at the end of 2006
9 was drawn from the registers of Kela. The analyses were performed separately for men
10 and women, as there are known gender differences in patterns of both sickness
11 absence and disability retirement [24,27,28]. Age was categorized into four groups in
12 10-year intervals. Marital status was categorized into three groups: never married,
13 married and “other”, which included those who were divorced or widowed and those
14 with missing information. The level of urbanisation was categorized into urban, densely
15 populated and rural according to classifications of Statistic Finland [29]. The
16 distributions of the covariates are shown in Table 1.
17
18
19
20
21
22
23
24

25 **Statistical methods**

26 Each individual in the study population was followed from 1 January 2007 until the start
27 of a disability pension, the start of another type of pension, age 63 (the first potential
28 old-age retirement age), death or the end of the study period on 31 December 2014.
29 The mean follow-up time was 7.0 years. Differences in the risk of disability retirement
30 during 2007–2014 by occupational class and length of sickness absence were analysed
31 with Cox proportional hazards regression. All analyses were conducted separately for
32 men and women and were adjusted for age, marital status and level of urbanisation of
33 the home municipality at the end of 2006 (later referred to as sociodemographic
34 variables). The results are presented as hazard ratios (HR) with their 95% confidence
35 intervals (CI). The statistical significance of interactions between the length of sickness
36 absence and occupational class was tested by the Wald test by including the length of
37 sickness absence in the interaction model as a 5-category variable. The analyses were
38 conducted using the Stata 14.2 software.
39
40
41
42
43
44
45
46
47
48

49 **Ethical considerations**

50 The study used secondary data retrieved from registers, and thus no ethics approval
51 was required according to Finnish law. Good scientific practice and data protection
52 regulations were followed in the collection, use and reporting of the data. Kela, the
53
54
55
56
57
58
59
60

1
2
3 Finnish Centre for Pensions and Statistics Finland provided permission to use the
4 anonymous register-based data.
5
6

7 **RESULTS**

8 **Population characteristics**

9
10 During the 8-year follow-up, a total of 123,736 persons transferred to disability
11 retirement, including 7.0% of men and 7.3% of women (Table 1). A higher percentage
12 of women (12.5%) than men (8.9%) had at least one spell of sickness absence (SA)
13 that started in 2005. Both the prevalence of sickness absence and the proportion of
14 those experiencing disability retirement were higher among those in lower occupational
15 classes and among those who were of older age, those whose marital status was other
16 than married or never married, and those who lived in rural municipalities. Additionally,
17 the same groups had a higher median number of sickness absence days. In every
18 diagnostic group of sickness absence, the proportion of persons with a new disability
19 retirement was higher among those with longer sickness absences.
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

Table 1 Distributions of the study population in 2006 (N=1,727,644), prevalence and length of sickness absence (SA) beginning in 2005 and proportion of participants experiencing a disability retirement (DR) in 2007-2014.

	Men				Women			
	Distr. (%)	SA in 2005 (%)	SA days in 2005 ¹ (median)	New DR in 2007-2014 (%)	Distr. (%)	SA in 2005 (%)	SA days in 2005 ¹ (median)	New DR in 2007-2014 (%)
Occupational class								
Upper non-manual	19.6	5.3	31	2.6	18.3	7.2	31	3.3
Lower non-manual	17.7	8.1	32	4.3	41.4	11.9	33	6.5
Manual worker	35.0	12.2	34	8.1	17.7	13.8	35	10.6
Self-employed	12.2	7.0	42	7.1	6.9	7.8	40	7.3
Outside employment	15.5	8.1	60	13.2	15.7	9.0	50	10.3
Age								
25-34	25.9	5.9	33	2.4	25.0	7.1	33	2.4
35-44	27.9	8.5	34	4.2	27.6	10.0	33	4.5
45-54	28.3	10.6	37	11.6	28.9	12.7	35	11.7
55-62	17.9	11.0	40	11.0	18.5	13.5	37	11.0
Marital status								
Never married	35.6	7.3	36	6.1	27.6	8.3	33	5.7
Married	52.2	9.3	35	6.5	55.5	11.0	34	7.1
Other	12.3	11.6	40	12.1	16.9	14.6	36	11.5
Level of urbanisation								
Urban	57.5	8.3	35	6.3	59.3	10.2	34	6.8
Densely populated	16.0	9.5	36	7.7	15.6	11.2	35	7.7
Rural	26.5	9.6	36	8.2	25.1	11.4	36	8.2
No. of SA days in 2005; All								
0	91.1		0	6.1	87.5		0	5.9
1-30	3.7		19	12.0	5.4		19	13.0
31-60	2.3		42	15.8	3.5		42	15.8
61-180	2.1		90	21.3	2.7		88	22.2
over 180	0.7		296	30.7	0.9		284	32.6
No. of SA days in 2005; MSD²								
0	97.1		0	6.7	97.3		0	6.7
1-30	1.3		19	15.3	1.8		19	17.9
31-60	0.7		43	19.1	1.0		44	20.5
61-180	0.7		90	22.2	0.9		91	24.8
over 180	0.2		297	30.8	0.2		294	34.7
No. of SA days in 2005; Mental³								
0	98.9		0	6.9	97.3		0	7.0
1-30	0.4		19	14.2	1.0		20	14.0
31-60	0.3		43	19.4	0.6		43	18.0
61-180	0.3		93	27.3	0.5		93	24.4
over 180	0.2		319	33.3	0.2		303.5	32.9
No. of SA days in 2005; Other⁴								
0	95.0		0	6.7	93.7		0	6.9
1-30	2.3		20	11.0	3.1		20	11.6
31-60	1.3		42	13.7	1.9		41	13.1
61-180	1.0		89	18.0	1.1		85	17.5
over 180	0.3		289	28.9	0.3		265	28.5
<i>All</i>	<i>100</i>	<i>8.9</i>	<i>36</i>	<i>7.0</i>	<i>100</i>	<i>12.5</i>	<i>35</i>	<i>7.3</i>
N	867,585	76,817		60,932	860,059	107,475		62,804

¹ Those with new sickness absence spell that started in 2005, ² Musculoskeletal diseases, ³ Mental and behavioural disorders, ⁴ Other diagnoses

[Figure 1]

1
2
3
4 Hazard ratios (HRs) for the risk of disability retirement for different lengths of sickness absence
5 in different occupational classes are shown in Figure 1, and the reference group is upper non-
6 manual employees with no new sickness absence spells, starting in 2005. Due to their
7 multiplicative nature and to enable direct visual comparability, the HRs are plotted on a
8 logarithmic scale [30,31]. In addition, Appendix tables 1 and 2 show the hazard ratios for
9 disability retirement calculated with a separate reference group for each occupational class.
10
11
12
13
14
15

16 In general, the longer the sickness absence is, the higher the risk of all-cause disability
17 retirement is in all occupational classes and in both genders. Upper non-manual employees had
18 the lowest risk of disability retirement in men and women. Among men, those outside
19 employment clearly had the highest risk of disability retirement, while among women the risk
20 was highest for manual workers and those outside employment. Lower non-manual workers
21 and self-employed workers were between these classes. The interaction terms between the
22 occupational class and the length of sickness absence on the risk of disability retirement were
23 statistically significant in both men (p-values from the Wald test $p < 0.001$) and in women
24 ($p < 0.001$) when comparing each occupational class separately to upper non-manual employees
25 (Appendix tables 1 and 2).
26
27
28
29
30
31
32
33

34 Among upper non-manual employees, the risk of disability retirement increased slightly more
35 steeply with increasing length of sickness absence than in other occupational classes (Figure 1,
36 Appendix tables 1 and 2). In upper non-manual men with over 180 days of sickness absence,
37 the HR of disability retirement was almost 10-fold (HR 9.19 95% CI 7.40–11.40) compared to
38 those with no sickness absence, whereas in manual workers, the same HR was 3.51 (95% CI
39 3.23–3.81) (Appendix table 1). Among women, the pattern was similar, but the occupational
40 class differences were not as large as in men, with the HR being 7.26 (95% CI 6.16–8.57) in
41 upper non-manual employees and 3.94 (95% CI 3.6–4.3) in manual workers, accordingly
42 (Appendix table 2).
43
44
45
46
47
48
49

50 [Figure 2]
51
52
53
54

55 Figure 2 shows the HRs for all-cause disability retirement in different diagnostic groups, again
56 calculated with upper non-manual employees without sickness absence as the reference group
57
58
59
60

(see Appendix tables 1 and 2 for separate reference groups). In every diagnostic group, the association between the length of sickness absence and the risk of disability retirement was largely similar. However, there was an indication that the association between increasing length of sickness absence and the risk of disability retirement was slightly stronger in sickness absence due to mental and behavioural disorders than in other diagnostic groups.

The association between the length of diagnosis-specific sickness absence and the risk of disability retirement was similar in all occupational classes. However, in upper non-manual employee men with over 180 days of sickness absence due to mental and behavioural disorders, the HR of disability retirement was 9.74 (95% CI 7.10–13.37) compared to upper non-manual employees with no sickness absence due to the same diagnostic category, and the same HR was 7.28 (95% CI 4.22–12.55) when the sickness absence was due to musculoskeletal diseases and 6.89 (95% CI 4.78–9.93) due to other diagnoses (Appendix tables 1 and 2). Additionally, in women there was an indication that a long sickness absence due to mental and behavioural disorders predicted disability retirement more strongly, especially in upper non-manual employees. A similar indication, but to a lesser extent, was found in lower non-manual employees. However, in other occupational classes there were no diagnostic group differences in the association between those with no sickness absence (own occupational class as a reference group) and those with over 180 sickness absence days (Appendix tables 1 and 2).

[Figure 3]

To assess how the different diagnostic profiles of sickness absence in different occupational classes affect the total association between length of sickness absence and disability retirement seen above in Figure 1, we calculated the HRs after adjusting for the diagnosis of sickness absence (Figure 3). In general, adjusting for the diagnosis somewhat attenuated the association of increasing lengths of sickness absence with risk of disability retirement in every occupational class. However, in men, the length of sickness absence continued to predict disability retirement more strongly among upper non-manual employees than it did in other occupational classes. In women, the occupational class differences in the strength of association between the increasing length of sickness absence and the risk of disability retirement were largely explained by the occupational class differences after controlling for the diagnosis of sickness absence.

DISCUSSION

Main findings

Our results indicate that the length of sickness absence was associated with a higher risk of disability retirement in all occupational classes, especially in upper non-manual employees. Even short-term sickness absence spells (those less than 31 days long) were associated with a higher risk of disability retirement compared to having no sickness absence days. Furthermore, very long term sickness absence spells (those longer than 180 days) were associated with a clearly higher risk of disability retirement. There was an indication that the length of sickness absence due to mental and behavioural disorders predicted disability retirement slightly more strongly than the length of sickness absence due to other diagnoses, with the association again being stronger in upper non-manual employees than in other occupational classes. The diagnosis of sickness absence partly explained the differential association between the length of sickness absence and the risk of disability retirement in different occupational classes.

Interpretation of the results

In this study, we found that manual workers and those outside employment clearly had a higher risk of disability retirement than did the other occupational classes, especially among those with no sickness absence or with short-term sickness absence. Among those with a long-term sickness absence, the occupational class differences were narrower. The unemployed, which was the largest subgroup in those outside employment, and manual workers generally had poorer health [21,32–35] and health behaviour [32,36], physically more strenuous jobs [21,32,36] and less job control [21,32,36,37] than did higher occupational classes, which increased their risk of disability retirement, even without any sickness absence or with short-term sickness absence. Health problems can select people to unemployment [33,34], and long-term health problems increase the risk of disability. In the present study, the occupational class differences were smaller in long-term sickness absences, implying that those with long-term sicknesses have an increased risk of disability retirement, despite their occupational class. However, the risk of disability retirement increased with an increasing length of sickness absence more strongly in upper non-manual employees than in other social classes. Upper non-manual employees have long sickness absences less frequently than manual workers do, indicating that upper non-manual employees with long-term sickness absence are possibly a more selected group in terms of their disability retirement risk.

1 The diagnoses and long-term consequences of sickness absences are known to differ between
2 occupational classes [23,38,39]. This may be related to differences in work tasks and working
3 conditions between the occupational classes. Some illnesses may be directly caused by work-
4 related hazards. Furthermore, some health problems that prevent those with physically
5 demanding jobs from working may not affect work ability among those in desk jobs. Previous
6 studies have found that socioeconomic differences in the diagnoses of sickness absences are
7 large in musculoskeletal diseases [23]. In general, our study agrees with previous findings in
8 that the association between the length of sickness absence and the risk of disability retirement
9 does not differ much between diagnostic groups of sickness absences [40]. However, in this
10 study, there was an indication that the length of sickness absence due to mental and
11 behavioural disorders predicted disability retirement slightly more strongly than did the length of
12 sickness absence due to other diagnoses, particularly among upper non-manual employees.
13 Sickness absence due to mental and behavioural disorders has been found to present a greater
14 risk of disability retirement than has sickness absence due to other diagnoses [4,5,16,41], but
15 previous studies have not found that the length of sickness absence predicts disability
16 retirement differently in sickness absence due to mental and behavioural disorders compared to
17 other diagnoses [5,40]. Our finding on the indication that the length of sickness absence due to
18 mental and behavioural disorders was a stronger predictor in upper non-manual employees
19 may partly be explained by work-related factors: upper non-manual employees often have
20 psychologically demanding jobs [35,37], their employers may prefer the employees to remain
21 absent due to sickness until fully recovered because it can be especially difficult to return to
22 mentally complex work with mental health problems, and positions held by higher occupations
23 are not as easily replaceable [42].

24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40 The average lengths of the sickness absence spells vary between diagnostic groups and
41 occupational classes. We found that the adjustment of the diagnosis largely explained the
42 differential association between the length of sickness absence and the risk of disability
43 retirement in different occupational classes, particularly in women. However, in upper non-
44 manual employee men, the adjustment of the diagnosis did not, to a large extent, attenuate the
45 association between the length of sickness absence and the risk of disability retirement, which
46 can be explained by the fact that in upper non-manual employees, a large proportion of the
47 long-term sickness absences were due to mental and behavioural disorders. In other
48 occupational classes, the association can be explained by a more equal distribution in the
49 proportions and the average lengths of different diagnostic groups. In all, divergent diagnostic
50
51
52
53
54
55
56
57
58
59
60

1 profiles in different occupational classes partly explain the occupational class differences in the
2 association between the length of sickness absence and the risk of disability retirement.
3
4
5

6 **Methodological considerations**

7 A key strength of the study was the 8-year prospective and population-based cohort design,
8 based on a 70% register sample of the total Finnish non-retired working-age population. Data
9 were obtained from national registers, constituting highly reliable sources with objective register-
10 based measures, no self-report bias, practically no loss to follow-up and very little missing
11 information. In addition, we were able to utilize date-specific information on both sickness
12 absence and disability retirement. However, a limitation common to all register-based data is
13 the lack of information on, for example, health status, health behaviours or physical and
14 psychosocial work environment that could explain or mediate the observed associations.
15 Furthermore, due to the observational nature of the data, causal effects cannot be established.
16 Confounding by previous health status or other unmeasured factors may explain some of the
17 observed associations. The use of relatively broad diagnostic groups instead of more exact
18 diagnoses prohibits from drawing too generalised conclusions from the results.
19
20
21
22
23
24
25
26
27
28

29 **Conclusion**

30 Our results suggest that there are occupational class differences in the pathways from sickness
31 absence to disability retirement. The length of sickness absence predicts disability retirement
32 more strongly than does the diagnosis of sickness absence in all occupational classes, but the
33 diagnostic profiles vary between occupational classes and partly explain the association
34 between the length of sickness absence and the risk of disability retirement. It is crucial to
35 understand the ways in which work disability develops in different occupational classes to
36 provide more efficient preventive measures. Further research should focus on understanding
37 the mechanisms contributing to social inequalities in sickness absence and work disability due
38 to different diagnoses.
39
40
41
42
43
44
45
46

47 **FOOTNOTES**

48 **Funding:** This work is supported by the Strategic Research Council of the Academy of Finland
49 (decision number: 293103).

50 **Competing Interests:** None declared.

51 **Contributions:** LS, JB, ML and MN contributed to the planning, conducting and reporting of this
52 study. LS conducted the statistical analyses and wrote the first and successive drafts of the
53 manuscript. JB, ML and MN advised on the statistical approach and modelling and revised the
54
55
56
57
58
59
60

1 drafts of manuscripts. LS, JB and ML interpreted the results. All authors approved the final
2 submitted version.
3

4 **Data sharing statement:** No additional data available.

5
6 **Acknowledgements:** We want to thank participants of the annual conference of the
7 Westermarck Society, RC28 -conference, Nordic Demographic Symposium, WORK2017 -
8 conference, the annual Social policy conference and EPH -conference for the insightful
9 comments.
10
11
12
13
14
15
16
17

18 REFERENCES

- 19 1. OECD, editor. *Sickness, disability and work: breaking the barriers ; a synthesis of findings*
20 *across OECD countries*. Paris: OECD; 2010. 165 p. (Sickness, disability and work :
21 *breaking the barriers*).
22
- 23 2. Borg K, Hensing G, Alexanderson K. Predictive factors for disability pension -- An 11-year
24 follow up of young persons on sick leave due to neck, shoulder, or back diagnoses.
25 *Scandinavian Journal of Public Health*. 2001 Apr 1;29(2):104–12.
26
- 27 3. Bratberg E, Gjesdal S, Mæland JG. Sickness absence with psychiatric diagnoses:
28 Individual and contextual predictors of permanent disability. *Health & Place*. 2009
29 Mar;15(1):308–14.
30
- 31 4. Gjesdal S. Predictors of disability pension in long-term sickness absence: Results from a
32 population-based and prospective study in Norway 1994-1999. *The European Journal of*
33 *Public Health*. 2004 Dec 1;14(4):398–405.
34
- 35 5. Gjesdal S, Bratberg E. Diagnosis and duration of sickness absence as predictors for
36 disability pension: Results from a three-year, multi-register based and prospective study.
37 *Scandinavian Journal of Public Health*. 2003 Aug 1;31(4):246–54.
38
- 39 6. Lund T, Kivimaki M, Labriola M, Villadsen E, Christensen KB. Using administrative
40 sickness absence data as a marker of future disability pension: the prospective DREAM
41 study of Danish private sector employees. *Occupational and Environmental Medicine*. 2008
42 Jan 1;65(1):28–31.
43
- 44 7. Polvinen A, Laaksonen M, Gould R, Lahelma E, Martikainen P. The contribution of major
45 diagnostic causes to socioeconomic differences in disability retirement. *Scandinavian*
46 *Journal of Work, Environment & Health*. 2014 Jul;40(4):353–60.
47
- 48 8. Wilkinson R, Pickett K. *The spirit level: why more equal societies almost always do better*.
49 London: Allen Lane; 2009. 330 p.
50
- 51 9. EU-OSHA. *Priorities for occupational safety and health research in Europe: 2013-2020*.
52 2013.
53
54
55
56
57
58
59
60

10. Harkonmäki K, Korkeila K, Vahtera J, Kivimäki M, Suominen S, Sillanmäki L, et al. Childhood adversities as a predictor of disability retirement. *J Epidemiol Community Health*. 2007 Jun;61(6):479–84.
11. Labriola M, Lund T. Self-reported sickness absence as a risk marker of future disability pension. Prospective findings from the DWECs/DREAM study 1990-2004. *International Journal of Medical Sciences*. 2007;4(3):153–8.
12. Laine S, Gimeno D, Virtanen M, Oksanen T, Vahtera J, Elovainio M, et al. Job strain as a predictor of disability pension: the Finnish Public Sector Study. *Journal of Epidemiology & Community Health*. 2009 Jan 1;63(1):24–30.
13. Virtanen M, Kivimäki M, Singh-Manoux A, Gimeno D, Shipley MJ, Vahtera J, et al. Work disability following major organisational change: the Whitehall II study. *Journal of Epidemiology & Community Health*. 2010 May 1;64(5):461–4.
14. Kivimäki M, Forma P, Wikström J, Halmeenmäki T, Pentti J, Elovainio M, et al. Sickness absence as a risk marker of future disability pension: the 10-town study. *Journal of Epidemiology & Community Health*. 2004 Aug 1;58(8):710–1.
15. Jansson C, Alexanderson K. Sickness absence due to musculoskeletal diagnoses and risk of diagnosis-specific disability pension: A nationwide Swedish prospective cohort study: *Pain*. 2013 Jun;154(6):933–41.
16. Alexanderson K, Kivimäki M, Ferrie JE, Westerlund H, Vahtera J, Singh-Manoux A, et al. Diagnosis-specific sick leave as a long-term predictor of disability pension: a 13-year follow-up of the GAZEL cohort study. *Journal of Epidemiology & Community Health*. 2012 Feb 1;66(2):155–9.
17. Kristensen TR, Jensen SM, Kreiner S, Mikkelsen S. Socioeconomic status and duration and pattern of sickness absence. A 1-year follow-up study of 2331 hospital employees. *BMC Public Health*. 2010 Dec;10(1).
18. Kaikkonen R, Härkänen T, Rahkonen O, Gould R, Koskinen S. Explaining educational differences in sickness absence: a population-based follow-up study. *Scandinavian Journal of Work, Environment & Health*. 2015 Jul;41(4):338–46.
19. Sumanen H, Rahkonen O, Pietiläinen O, Lahelma E, Roos E, Lahti J. Educational differences in disability retirement among young employees in Helsinki, Finland. *The European Journal of Public Health*. 2016 Apr;26(2):318–22.
20. Polvinen A, Laaksonen M, Gould R, Lahelma E, Leinonen T, Martikainen P. Socioeconomic Differences in Cause-Specific Disability Retirement in Finland, 1988 to 2009: *Journal of Occupational and Environmental Medicine*. 2016 Aug;58(8):840–5.
21. Haukenes I, Mykletun A, Knudsen A, Hansen H-T, Mæland J. Disability pension by occupational class - the impact of work-related factors: The Hordaland Health Study Cohort. *BMC Public Health*. 2011;11(1):406.
22. Krokstad S, Johnsen R, Westin S. Social determinants of disability pension: a 10-year follow-up of 62 000 people in a Norwegian county population. *International Journal of Epidemiology*. 2002 Dec 1;31(6):1183–91.

- 1 23. Pekkala J, Blomgren J, Pietiläinen O, Lahelma E, Rahkonen O. Occupational class
2 differences in diagnostic-specific sickness absence: a register-based study in the Finnish
3 population, 2005–2014. *BMC Public Health*. 2017 Dec;17(1).
- 4
5 24. Sumanen H, Lahti J, Lahelma E, Pietiläinen O, Rahkonen O. 12-year trends in
6 occupational class differences in short sickness absence among young women.
7 *Scandinavian Journal of Social Medicine*. 2015 Jun;43(4):441–4.
- 8
9 25. Social Insurance Institution. Statistics on National Health Insurance [Internet]. Helsinki;
10 2005. Available from:
11 https://helda.helsinki.fi/bitstream/handle/10250/31118/Sava_05.pdf?sequence=2
- 12
13 26. Statistics Finland. Classification of Socio-economic Groups 1989 [Internet]. 1989 [cited
14 2017 Dec 5]. Available from: [http://www.stat.fi/meta/luokitukset/sosioekon_asema/001-](http://www.stat.fi/meta/luokitukset/sosioekon_asema/001-1989/index_en.html)
15 [1989/index_en.html](http://www.stat.fi/meta/luokitukset/sosioekon_asema/001-1989/index_en.html)
- 16
17 27. Gjesdal S, Bratberg E, Mæland JG. Gender differences in disability after sickness absence
18 with musculoskeletal disorders: five-year prospective study of 37,942 women and 26,307
19 men. *BMC Musculoskeletal Disorders*. 2011 Dec;12(1).
- 20
21 28. Sterud T. Work-related gender differences in physician-certified sick leave: a prospective
22 study of the general working population in Norway. *Scandinavian Journal of Work,*
23 *Environment & Health*. 2014 Jul;40(4):361–9.
- 24
25 29. Statistics Finland. Statistical grouping of municipalities [Internet]. 2017 [cited 2017 Dec 5].
26 Available from: http://www.stat.fi/meta/luokitukset/kuntaryhmitys/001-2017/index_en.html
- 27
28 30. Hosseinpoor AR, AbouZahr C. Graphical presentation of relative measures of association.
29 *The Lancet*. 2010 Apr;375(9722):1254.
- 30
31 31. Levine MAH, El-Nahas AI, Asa B. Relative risk and odds ratio data are still portrayed with
32 inappropriate scales in the medical literature. *Journal of Clinical Epidemiology*. 2010
33 Sep;63(9):1045–7.
- 34
35 32. Polvinen A, Gould R, Lahelma E, Martikainen P. Socioeconomic differences in disability
36 retirement in Finland: the contribution of ill-health, health behaviours and working
37 conditions. *Scand J Public Health*. 2013 Jul;41(5):470–8.
- 38
39 33. Schmitz H. Why are the unemployed in worse health? The causal effect of unemployment
40 on health. *Labour Economics*. 2011 Jan;18(1):71–8.
- 41
42 34. Böckerman P, Ilmakunnas P. Unemployment and self-assessed health: evidence from
43 panel data. *Health Economics*. 2009 Feb;18(2):161–79.
- 44
45 35. Hämmig O, Bauer GF. The social gradient in work and health: a cross-sectional study
46 exploring the relationship between working conditions and health inequalities. *BMC Public*
47 *Health*. 2013 Dec;13(1).
- 48
49 36. Leinonen T, Pietiläinen O, Laaksonen M, Rahkonen O, Lahelma E, Martikainen P.
50 Occupational social class and disability retirement among municipal employees – the
51 contribution of health behaviors and working conditions. *Scandinavian Journal of Work,*
52 *Environment & Health*. 2011 Nov;37(6):464–72.
- 53
54
55
56
57
58
59

- 1 37. Lahelma E, Laaksonen M, Aittomäki A. Occupational class inequalities in health across
2 employment sectors: the contribution of working conditions. *International Archives of*
3 *Occupational and Environmental Health*. 2009 Jan;82(2):185–90.
- 4
5 38. Vaez M, Rylander G, Nygren Å, Åsberg M, Alexanderson K. Sickness absence and
6 disability pension in a cohort of employees initially on long-term sick leave due to
7 psychiatric disorders in Sweden. *Social Psychiatry and Psychiatric Epidemiology*. 2007
8 May;42(5):381–8.
- 9
10 39. Gjesdal S, Ringdal PR, Haug K, Gunnar Mæland J. Long-term sickness absence and
11 disability pension with psychiatric diagnoses: A population-based cohort study. *Nordic*
12 *Journal of Psychiatry*. 2008 Jan;62(4):294–301.
- 13
14 40. Wallman T, Wedel H, Palmer E, Rosengren A, Johansson S, Eriksson H, et al. Sick-leave
15 track record and other potential predictors of a disability pension. A population based study
16 of 8,218 men and women followed for 16 years. *BMC Public Health*. 2009 Dec ;9(1).
- 17
18 41. Kivimäki M, Ferrie JE, Hagberg J, Head J, Westerlund H, Vahtera J, et al. Diagnosis-
19 specific sick leave as a risk marker for disability pension in a Swedish population. *Journal*
20 *of Epidemiology & Community Health*. 2007 Oct 1;61(10):915–20.
- 21
22 42. Ekberg K, Wåhlin C, Persson J, Bernfort L, Öberg B. Early and Late Return to Work After
23 Sick Leave: Predictors in a Cohort of Sick-Listed Individuals with Common Mental
24 Disorders. *Journal of Occupational Rehabilitation*. 2015 Sep;25(3):627–37.
- 25
26
27
28

29 Figure 1 legend:

30
31 Figure 1 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95%
32 confidence intervals according to the length of all-cause sickness absence in different
33 occupational classes in men and women. Upper non-manual workers with no sickness
34 allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all
35 sociodemographic variables.
36
37
38

39
40
41 Figure 2 legend:

42
43 Figure 2 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95%
44 confidence intervals according to the length of diagnosis-specific sickness absence in different
45 occupational classes in men and women. Upper non-manual workers with zero sickness
46 allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all
47 sociodemographic variables.
48
49

50
51
52 Figure 3 legend:

53
54 Figure 3 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 according to
55 the length of sickness absence in different occupational classes in men and women. Upper non-
56 manual workers with no sickness allowance days is the reference group. Hazard ratios on
57
58
59

1 logarithmic scale. All adjusted for all sociodemographic variables. Dotted lines represent hazard
2 ratios when not adjusted for diagnoses, and solid lines hazard ratios after adjusting for the
3 diagnoses.
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

For peer review only

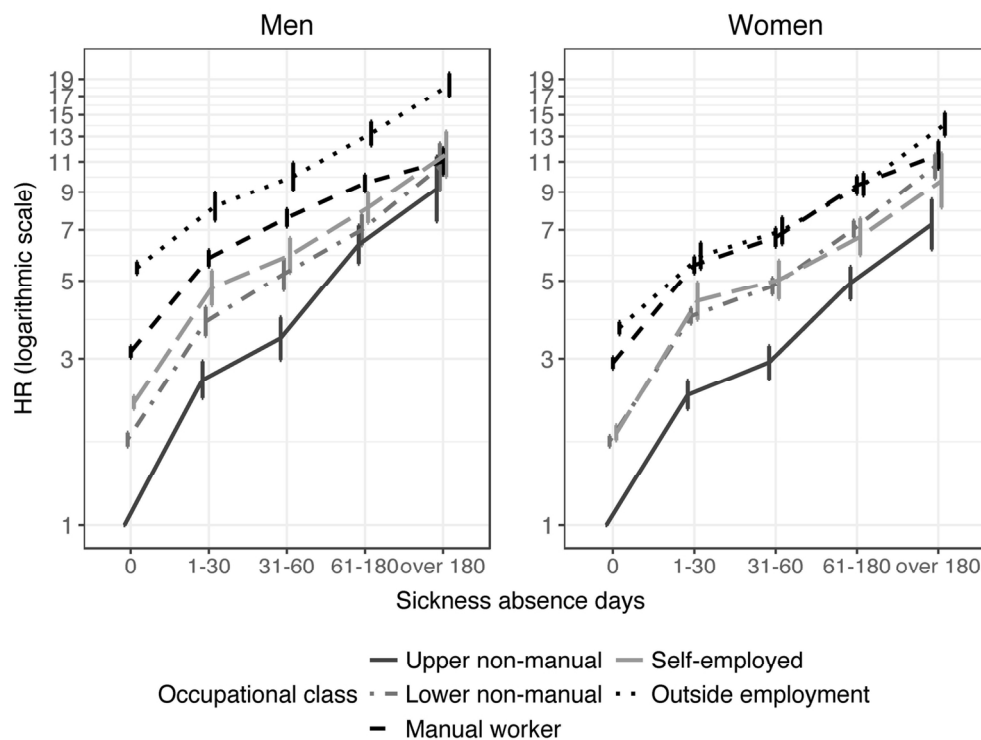


Figure 1 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95% confidence intervals according to the length of all-cause sickness absence in different occupational classes in men and women. Upper non-manual workers with no sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables.

134x101mm (300 x 300 DPI)

Only

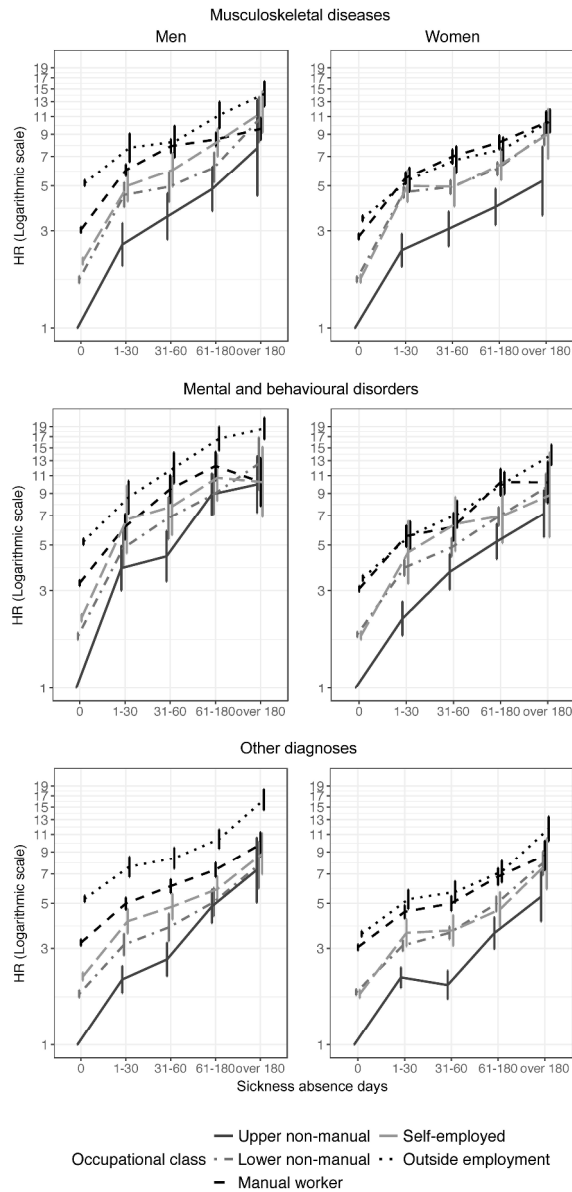


Figure 2 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 with their 95% confidence intervals according to the length of diagnosis-specific sickness absence in different occupational classes in men and women. Upper non-manual workers with zero sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables.

292x604mm (300 x 300 DPI)

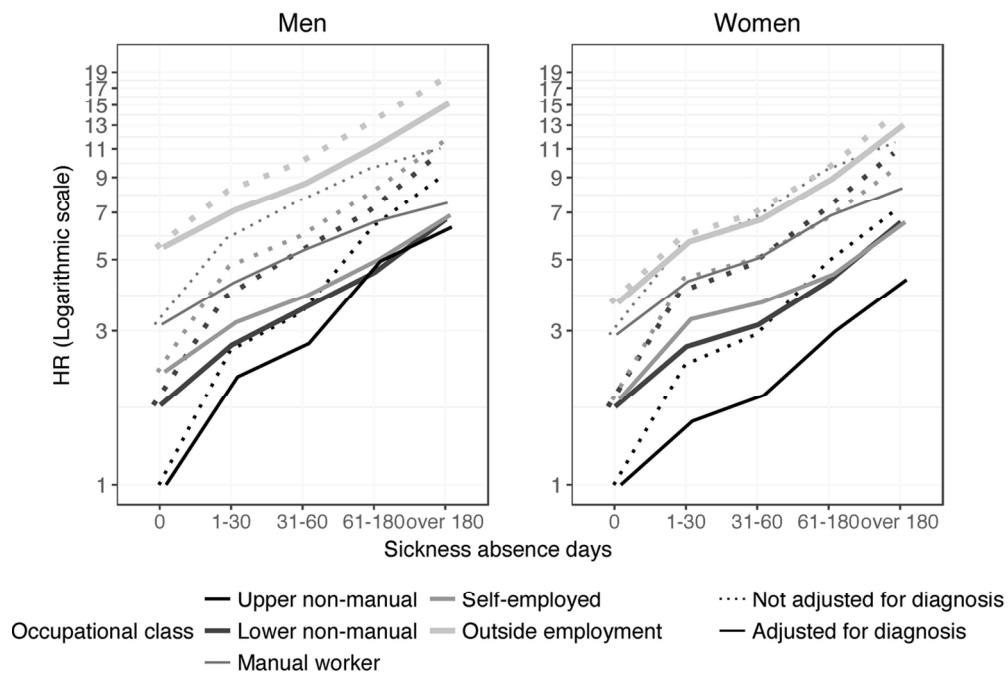


Figure 3 Hazard ratios for the risk of all-cause disability retirement in 2007–2014 according to the length of sickness absence in different occupational classes in men and women. Upper non-manual workers with no sickness allowance days is the reference group. Hazard ratios on logarithmic scale. All adjusted for all sociodemographic variables. Dotted lines represent hazard ratios when not adjusted for diagnoses, and solid lines hazard ratios after adjusting for the diagnoses.

116x79mm (300 x 300 DPI)

Appendix table 1. Hazard ratios with 95% confidence intervals for the risk of disability retirement according to the length and diagnosis of sickness absence in different occupational classes in men.

	Length of sickness absence										Interaction p-value from the Wald test ¹
	0		1-30		31-60		61-180		over 180		
	HR	HR	CI	HR	CI	HR	CI	HR	CI		
<i>All diagnoses</i>											
Upper non-manual	1	2.61	2.31-2.95	3.43	2.98-3.93	6.35	5.60-7.21	9.19	7.40-11.40		
Lower non-manual	1	2.16	1.97-2.37	2.96	2.66-3.29	3.97	3.59-4.39	6.02	5.16-7.02	p<0.001	
Manual worker	1	1.84	1.76-1.93	2.40	2.29-2.53	3.03	2.89-3.18	3.51	3.23-3.81	p<0.001	
Self-employed	1	2.12	1.90-2.37	2.64	2.36-2.96	3.63	3.29-4.00	5.19	4.49-6.01	p<0.001	
Outside employment	1	1.49	1.37-1.63	1.82	1.67-1.99	2.41	2.25-2.59	3.35	3.12-3.59	p<0.001	
<i>Musculoskeletal diseases</i>											
Upper non-manual	1	2.73	2.17-3.44	3.47	2.68-4.50	4.94	3.87-6.32	7.28	4.22-12.55		
Lower non-manual	1	2.75	2.40-3.14	2.95	2.50-3.49	3.51	2.96-4.17	6.02	4.70-7.70	p<0.001	
Manual worker	1	2.03	1.92-2.15	2.67	2.49-2.86	2.87	2.68-3.08	3.23	2.88-3.63	p<0.001	
Self-employed	1	2.49	2.10-2.96	2.91	2.42-3.50	3.94	3.38-4.58	5.58	4.45-7.00	p<0.001	
Outside employment	1	1.55	1.33-1.80	1.71	1.44-2.02	2.18	1.89-2.52	2.73	2.39-3.13	p<0.001	
<i>Mental and behavioural disorders</i>											
Upper non-manual	1	4.02	3.16-5.11	4.48	3.38-5.92	8.80	6.99-11.09	9.74	7.10-13.37		
Lower non-manual	1	2.73	2.20-3.37	4.32	3.47-5.37	5.03	4.06-6.24	6.55	4.90-8.76	p<0.001	
Manual worker	1	2.04	1.78-2.32	2.97	2.57-3.44	3.69	3.17-4.29	3.15	2.44-4.06	p<0.001	
Self-employed	1	3.25	2.27-4.65	3.48	2.52-4.81	5.16	4.04-6.58	5.19	3.60-7.48	p<0.001	
Outside employment	1	1.65	1.38-1.97	2.28	1.94-2.69	3.14	2.77-3.57	3.49	3.11-3.92	p<0.001	
<i>Other diagnoses</i>											
Upper non-manual	1	2.19	1.89-2.54	2.69	2.23-3.25	5.05	4.21-6.06	6.89	4.78-9.93		
Lower non-manual	1	1.85	1.64-2.08	2.21	1.90-2.57	3.00	2.58-3.50	4.34	3.34-5.63	p<0.001	
Manual worker	1	1.63	1.54-1.73	1.99	1.86-2.14	2.38	2.21-2.57	3.11	2.73-3.54	p<0.001	
Self-employed	1	1.96	1.71-2.23	2.26	1.96-2.61	2.76	2.39-3.18	4.02	3.19-5.06	p<0.001	
Outside employment	1	1.49	1.34-1.66	1.62	1.44-1.82	2.01	1.81-2.22	3.13	2.80-3.49	p<0.001	

Adjusted for socio-demographic variables.¹ Wald test for the interaction term between occupational class and length of sickness absence on disability retirement.

Appendix table 2. Hazard ratios with 95% confidence intervals for the risk of disability retirement according to the length and diagnosis of sickness absence in different occupational classes in women.

	Length of sickness absence										Interaction p-value from the Wald test ¹
	0		1-30		31-60		61-180		over 180		
<i>All diagnoses</i>	HR	HR	CI	HR	CI	HR	CI	HR	CI		
Upper non-manual	1	2.36	2.15-2.60	2.93	2.62-3.26	4.93	4.42-5.49	7.26	6.16-8.57		
Lower non-manual	1	2.27	2.18-2.37	2.76	2.64-2.90	4.04	3.85-4.23	6.13	5.69-6.60	p<0.001	
Manual worker	1	1.90	1.80-1.99	2.28	2.15-2.41	3.22	3.05-3.40	3.94	3.61-4.29	p<0.001	
Self-employed	1	2.36	2.09-2.67	2.73	2.40-3.10	3.61	3.20-4.07	5.20	4.41-6.32	p<0.001	
Outside employment	1	1.60	1.48-1.74	1.89	1.74-2.06	2.57	2.39-2.76	3.84	3.58-4.12	p<0.001	
<i>Musculoskeletal diseases</i>											
Upper non-manual	1	2.56	2.15-3.05	3.15	2.60-3.81	4.05	3.33-4.93	5.92	4.14-8.49		
Lower non-manual	1	2.74	2.59-2.90	3.03	2.82-3.26	3.65	3.40-3.91	5.40	4.80-6.06	p<0.001	
Manual worker	1	1.99	1.87-2.12	2.54	2.36-2.74	3.00	2.79-3.24	3.70	3.28-4.16	p<0.001	
Self-employed	1	3.04	2.56-3.60	2.85	2.29-3.54	3.83	3.21-4.57	5.18	3.96-6.78	p<0.001	
Outside employment	1	1.57	1.37-1.79	1.99	1.71-2.30	2.30	2.02-2.62	3.11	2.75-3.52	p<0.001	
<i>Mental and behavioural disorders</i>											
Upper non-manual	1	2.34	1.95-2.80	3.95	3.26-4.78	5.33	4.41-6.44	7.54	5.88-9.67		
Lower non-manual	1	2.23	2.06-2.42	2.78	2.53-3.06	4.03	3.66-4.45	5.47	4.72-6.33	p<0.001	
Manual worker	1	1.88	1.69-2.10	2.23	1.94-2.57	3.28	2.85-3.78	3.43	2.76-4.25	p<0.001	
Self-employed	1	2.9	2.10-3.99	3.54	2.65-4.74	3.78	2.79-5.13	4.24	2.63-6.84	p<0.001	
Outside employment	1	1.55	1.33-1.81	2.03	1.74-2.36	2.93	2.61-3.29	3.94	3.53-4.39	p<0.001	
<i>Other diagnoses</i>											
Upper non-manual	1	2.24	2.00-2.50	2.07	1.78-2.42	3.68	3.09-4.39	5.56	4.22-7.31		
Lower non-manual	1	1.81	1.72-1.91	2.08	1.95-2.22	2.86	2.64-3.09	4.59	4.04-5.22	p<0.001	
Manual worker	1	1.63	1.53-1.74	1.79	1.65-1.93	2.42	2.22-2.64	2.88	2.45-3.37	p<0.001	
Self-employed	1	2.11	1.83-2.45	2.12	1.79-2.50	2.63	2.18-3.19	4.54	3.43-6.01	p<0.001	
Outside employment	1	1.5	1.36-1.67	1.61	1.43-1.81	2.09	1.86-2.35	3.42	2.99-3.90	p<0.001	

Adjusted for socio-demographic variables. ¹Wald test for the interaction term between occupational class and length of sickness absence on disability retirement.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page no.
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	4-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4-6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4-6
Bias	9	Describe any efforts to address potential sources of bias	2, 13
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	6-7 6-7 4-6 4, 6

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

(e) Describe any sensitivity analyses

6-7

Continued on next page

For peer review only

Results			Page no.
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	4
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	4-6 4, 6
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	7
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9-10
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.