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Cause-specific sickness absence trends by occupational class and industrial sector in the context of recent labour market changes: a Finnish panel data study

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ABSTRACT

Objectives: We aimed to provide previously unestablished information on population-based differences in cause-specific sickness absence trends between occupational classes and further between industrial sectors within the different occupational classes as well as on the contribution of other socioeconomic and employment factors to these trends. We focused on the period 2005–2013, during which the labour market underwent large economic and structural changes.

Design: Register-based panel data study.

Setting: Large representative data on Finnish wage-earners aged 25–59 years.

Outcome measure: Annual risk of sickness absence (≥two weeks) based on repeated logistic regression.

Results: Between 2005 and 2013, the proportion of employees with sickness absence decreased. The change was smallest among lower non-manual employees and the overall level highest among manual workers. In musculoskeletal diseases and injuries, the level differences were particularly large, but decreased over time. In mental disorders, the level was highest among lower non-manual employees with an increasing difference over time. Sickness absence levels were generally highest in the health and social work sector. Among manual workers, however, the level in musculoskeletal diseases was highest in the manufacturing sector, where a notable temporary decrease in absences nevertheless occurred during the peak of the economic recession in 2009. Among the lower occupational classes, the decrease in absences due to musculoskeletal diseases was smallest in the trade sector. Otherwise, the differences in sickness absence between industrial sectors within the occupational classes remained relatively stable. Overall, socioeconomic and employment factors partly explained the differences in the absence levels but not in the trends.

Conclusions: Despite a general decreasing trend in sickness absence, non-manual employees in the health and social work sector are particularly disadvantaged in terms of work ability related to

mental and musculoskeletal health. Furthermore, lower grade occupations in the manufacturing and trade sectors are worse off concerning musculoskeletal health.

Strengths and limitations of this study

- We provided novel information on occupational class differences in sickness absence by focusing on changes in the cause-specific associations over time and on further variation by industrial sector within the occupational classes.
- We accounted for changes in various other socioeconomic and employment factors, including education, employment sector, income, time spent in employment, and the number of employment episodes.
- We used longitudinal population-based register data with very good statistical power and without missing information or loss to follow-up.
- The sickness absence outcome was based on national data on compensated spells that typically last at least two weeks, thereby excluding shorter spells.
- Using register-based data, the role of factors that might further contribute to occupational and sectoral differences in sickness absence, such as changes in lifestyle, work exposures, labour market conditions, health status, illness behaviour, and health selection into employment, remained open.

INTRODUCTION

The association of low occupational class with a higher likelihood of sickness absence has been established in many European countries.[1-7] The effect may vary by the diagnostic cause of work disability. For example, a study on the French GAZEL public sector employee cohort indicated that the difference in sickness absence between managers and manual workers was particularly large in musculoskeletal diseases, respiratory diseases, and injuries, and smaller but still notable in mental disorders and other diagnoses.[2] Furthermore, the association may change over time. According to a Finnish study based on a cohort employed by the City of Helsinki in the 1990s, occupational class differences in sickness absence increased particularly towards the end of the decade, i.e. at a time of declining unemployment.[8] Another study on employees of the same municipality indicated that in the more recent decades, the class differences have decreased among men and remained relatively stable among women.[9] However, little is known of occupational class differences in sickness absence trends in different disease groups or among general employed populations.

In addition to occupational class, industrial sector is closely associated with working conditions and the broader work environment, which by definition affect the ability of an individual to perform in his or her own job. A previous study from Denmark indicated that the risk of long-term sickness absence was higher than average in the health care and social services sector and lower than average in the private administration sector, but otherwise there was little variation between the sectors.[10] Accordingly, a Norwegian study indicated that the risk of long-term sickness absence was higher among women employed in health and social occupations than among the general female employed population.[11] There may also be an important interplay between occupational class and industrial sector; even within a particular occupational grade, the types of jobs may vary considerably between different sectors. Previous population-based findings from Denmark[10] and Sweden[12] have shown large differences in long-term sickness absence by particular occupational groups. Variation in sickness absence between industrial sectors within different occupational classes nevertheless remains unclear.

Despite the large number of studies that have investigated occupational class differences in sickness absence, very little is known of the association in terms of variation by disease group, interplay between occupational class and industrial sector, changes over time and their explanations, or generalization of the findings. We used large register data to examine cause-specific sickness absence trends in 2005–2013 by occupational class and industrial sector among the general population of Finnish wage earners while accounting for various other socioeconomic and employment factors. The study thus covers a period with various changes in the labour market in Finland as well as in other European countries, including ageing of the workforce, occupational restructuring, the onset of the recent economic recession, and increased policy efforts to lengthen working lives. The more particular research questions are listed below.

1. Do the trends in sickness absence due to all causes, musculoskeletal diseases, mental disorders, injuries, neoplasms, circulatory diseases, respiratory diseases, nervous diseases, or digestive diseases differ between occupational classes?
2. Do the trends in sickness absence due to the two largest disease groups, i.e. musculoskeletal diseases and mental disorders, vary between industrial sectors within different occupational classes?
3. Are the differences in cause-specific sickness absence trends by occupational class and industrial sector influenced by variation in socioeconomic and employment factors over the study period?

MATERIAL AND METHODS

Study population

We used large register data with 70% nationally representative random samples of the Finnish working aged population from three cross-sections on the last days of the years 2004, 2007 and 2010. Each of the cohorts were followed up for three calendar years to cover a nine-year study period between 2005 and 2013. The data included information on compensated sickness absences and national pensions obtained from the Finnish Social Insurance Institution, on sociodemographic factors obtained from the Finnish Longitudinal Employer-Employee Data (FLEED) of Statistics Finland, and on employment and earnings-related pensions from the Finnish Centre for Pensions, as also described in our previous study on gender differences in sickness absence (Leinonen et al., submitted 2017).

We included individuals who were employed wage-earners according to their main economic activity and socioeconomic status and aged 25–59 at baseline, i.e. at the end of the year preceding each observation year, and who on the first day of the observation year still had an ongoing employment period in the private sector, in the public sector or in both, but not in self-employment. We allowed for non-employment and self-employment later during the observation year, adjusting for these factors in the analyses. We excluded those who already had an ongoing compensated sickness absence spell at baseline or who received full pensions (full disability pensions, unemployment pensions, special pensions for farmers, or old-age pensions), emigrated or died by the end of the observation year. In order to make the populations across the study years more comparable, we also excluded those who were not living in Finland two years before baseline. The annual study populations in the period 2005–2013 were 1 097 598, 1 100 322, 1 109 041, 1 122 238, 1 117 179, 1 081 698, 1 094 294, 1 092 208, and 1 080 951 individuals.

Sickness absence outcome

As the outcome measure of this study, we used repeated dichotomous measures of whether a study person had a new onset of sickness absence (first occurrence of a spell lasting at least two weeks) in a particular calendar year based on spells compensated by the Finnish Social Insurance Institution. The compensated spells begin after a waiting period of ten working days typically paid by the employer, the absences therefore lasting at least two weeks by definition. Eligibility for the compensated sickness benefit requires that the claimant resides permanently in Finland and that compensation for earnings loss is not covered in other overruling statutory benefits including those related to occupational, traffic and military accidents. The outcome consists of both full and part-time sickness absence, but in Finland the first onset of work disability typically starts with a full sickness absence. Disease groups were classified according to the tenth revision of the International Classification of Diseases (ICD-10). We examined the largest groups separately, including 1) musculoskeletal diseases (diseases of the musculoskeletal system and connective tissue, M00–M99), 2) mental disorders (mental and behavioural disorders, F00–F99), 3) injuries (injury, poisoning and certain other consequences of external causes, S00–T98), 4) neoplasms (C00–D48), 5) circulatory diseases (I00–I99), 6) respiratory diseases (J00–J99), 7) nervous diseases (G00–G99), and 8) digestive diseases (K00–K93).

Occupational class and industrial sector

Occupational class and industrial sector were based on information measured in the year preceding each observation year and categorized according to classifications by Statistics Finland.[13] Occupational class consisted of categories 1) upper non-manual, 2) lower non-manual, and 3) manual. Industrial sector included the following categories: 1) manufacturing (manufacturing, mining and quarrying), 2) trade (wholesale and retail trade; repair of motor vehicles and motorcycles), 3) knowledge work (information and communication; financial and insurance activities; real estate activities; professional, scientific and technical activities), 4) human health and social work activities, and 5) other (agriculture, forestry and fishing; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities; construction; transportation and storage; accommodation and food service activities; administrative and support service activities; public administration and defence; compulsory social security; education; arts, entertainment and recreation; other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies; industry unknown). This classification was from year 2008. Until 2007, the classification was based on an older version from year 2002, but virtually equivalent main categories listed above could be constructed using a reclassification code provided by Statistics Finland.

Covariates

We examined various annually measured employment and sociodemographic factors as covariates. Age was divided into 5-year groups. Education and income were based on information measured in the year preceding each observation year. Education consisted of categories 1) higher tertiary, 2) lower tertiary, 3) secondary, and 4) primary. Income consisted of both wage and capital income of the individual. It was inflation-corrected and then divided into quintiles across the observation years.

Other employment factors were measured during each observation year. Employment sector was classified as 1) private, 2) public, 3) private and public, and 4) transition to self-employment. Time spent in employment was divided into 1) full year, 2) 200–364 days, and 3) 1–199 days. The cut-point of 200 days was arbitrarily chosen to define those who had been working most of the year. The number of employment episodes was divided into 1) one, 2) two, and 3) three or more.

Statistical methods

We used generalized estimation equations (GEE) based on repeated logistic regression to estimate the annual risk of having a new onset of compensated all-cause and cause-specific sickness absence in 2005–2013. The GEE models account for the within-individual correlation between repeated measurements in the three different samples followed up during periods 2005–2007, 2008–2010, or 2011–2013. Using margins derived from the logistic GEE model, we plotted trajectories of estimated proportions (‰) of employees with sickness absence including interactions of occupational class and industrial sectors within the occupational classes with categorical year. We adjusted for the annually measured covariates holding them at their mean level when plotting the trajectories. Derived from the same models, we also calculated relative differences between industrial sectors within the different occupational classes in terms of odds ratios (OR) of sickness absence over the study years (including the interaction between industrial sector and year, with those employed in the knowledge work sector as the reference group for which the OR was held at 1.00 in each year).

We pooled men and women in our analyses. Even though the overall level of sickness absence in our study population is much higher among the latter, changes over time have been relatively similar among the genders especially after accounting for their differential occupational and sectoral distributions (Leinonen et al., submitted 2017).

RESULTS

Characteristics of the study population

Over the study period between 2005 and 2013, the proportion of manual workers decreased especially in the manufacturing sector, but also in the health and social work sector (Table 1). The proportion of non-manual employees increased. Among upper non-manual employees, the increase was largest in the knowledge work sector. Among lower non-manual employees, the increase was largely attributable to an increase in the health and social work sector, while at the same time there was a decrease in the manufacturing sector. Annual distributions of the study population by all background characteristics are presented in Supplementary Table 1. Distributions over the whole study period are also presented separately for those employed in different industrial sectors within different occupational classes in Supplementary Table 2.

Table 1. Annual distribution (%) of the study population over the study period by industrial sectors across different occupational classes.

Occupational class	Year								
Industrial sector	2005	2006	2007	2008	2009	2010	2011	2012	2013
Upper non-manual	24.3	25.2	25.4	25.6	26.4	26.9	25.8	26.0	26.1
Manufacturing	3.1	3.3	3.5	3.5	3.7	3.6	3.5	3.5	3.3
Trade	1.3	1.5	1.5	1.5	1.5	1.5	1.3	1.3	1.3
Knowledge work	5.4	5.6	5.8	6.0	6.2	6.3	6.3	6.4	6.2
Health & social work	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.2	3.3
Other	11.6	11.9	11.8	11.8	12.0	12.4	11.6	11.7	11.9
Lower non-manual	40.8	40.2	40.2	40.4	40.7	41.3	42.7	42.7	43.1
Manufacturing	4.4	4.0	4.0	4.0	3.9	3.7	3.5	3.4	3.4
Trade	7.5	7.5	7.5	7.5	7.7	7.8	8.0	8.0	7.9
Knowledge work	6.0	5.8	5.7	5.9	5.8	5.8	5.9	6.0	6.2
Health & social work	11.6	11.7	11.9	12.0	12.4	12.9	12.9	13.2	13.5
Other	11.3	11.2	11.1	10.9	10.9	11.1	12.4	12.2	12.1
Manual	34.9	34.6	34.3	34.0	33.0	31.9	31.5	31.4	30.9
Manufacturing	12.5	12.3	12.1	11.9	11.3	10.3	10.3	10.2	9.8
Trade	2.3	2.2	2.2	2.2	2.2	2.1	2.2	2.1	2.2
Knowledge work	1.1	1.1	1.0	1.0	1.0	1.0	0.9	0.9	0.8
Health & social work	2.3	2.2	2.1	2.0	1.9	1.8	1.8	1.6	1.6
Other	16.7	16.8	16.9	16.9	16.6	16.7	16.5	16.6	16.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sickness absence trends by occupational class

Upper non-manual employees had the lowest and manual workers the highest overall level of sickness absence (Table 2). Among the total study population, the age- and gender-adjusted proportion of employees with any sickness absence decreased from 127.6‰ in 2005 to 108.6‰ in 2013. The annual decrease was largest between 2008 and 2009, after which the proportion somewhat increased between 2009 and 2010, followed by continued decrease. Until 2009, the annual decrease in absences was largest among manual workers. The increase in sickness absence between 2009 and 2010 was also largest among manual workers and negligible among upper non-manual employees. After 2010, the decrease was somewhat larger among upper-non-manual employees than among the lower classes. Overall, the decrease in sickness absence was smallest among lower non-manual employees.

Table 2. Age- and gender-adjusted estimated annual proportion of employees with a new onset of all-cause sickness absence (‰ and 95% CI) and the annual change (%) over particular years by occupational class.

	Occupational class							
Year	Upper non-manual		Lower non-manual		Manual		All	
2005	80.8	(79.8–81.8)	120.4	(119.5–121.3)	168.6	(167.4–169.8)	127.6	(127.0–128.3)
2006	79.6	(78.6–80.6)	121.4	(120.5–122.3)	168.6	(167.3–169.8)	127.4	(126.8–128.1)
2007	78.6	(77.6–79.6)	118.6	(117.7–119.5)	166.0	(164.8–167.2)	124.9	(124.3–125.5)
2008	75.4	(74.4–76.3)	115.6	(114.7–116.4)	157.7	156.5–158.9)	119.6	(119.0–120.2)
2009	72.8	(71.9–73.8)	112.2	(111.3–113.1)	146.2	(145.0–147.4)	113.5	(112.9–114.1)
2010	72.9	(71.9–73.8)	115.2	(114.3–116.1)	152.0	(150.7–153.2)	116.1	(115.5–116.7)
2011	70.8	(69.9–71.7)	112.2	(111.3–113.1)	147.6	(146.3–148.8)	112.9	(112.3–113.5)
2012	67.3	(66.4–68.2)	108.9	(108.0–109.8)	143.3	(142.1–144.5)	109.1	(108.5–109.7)
2013	67.5	(66.6–68.4)	108.8	(107.9–109.6)	142.1	(140.9–143.3)	108.6	(108.0–109.2)
Annual % change								
2005-2009	-2.5		-1.7		-3.3		-2.8	
2009-2010	0.1		2.7		4.0		2.3	
2010-2013	-2.5		-1.9		-2.2		-2.2	

The occupational class differences varied by the diagnostic group of sickness absence in terms of both the overall level and time trends (Figure 1). In terms of the overall level, the age- and gender-adjusted differences were particularly large in musculoskeletal diseases (model 1, panel a), injuries (panel c), and nervous diseases (panel g). The differences were somewhat smaller in mental (panel b), circulatory (panel e), respiratory (panel f), and digestive diseases (panel h), and negligible in neoplasms (panel d). In mental disorders (panel b), the proportion was highest among lower non-manual employees.

In terms of trends, the decrease in absences due to musculoskeletal diseases (panel a) and injuries (panel c) was mainly restricted to manual workers, leading to decreasing class differences particularly until 2009. Among the non-manual classes, there was actually slight increase in absences due to injuries over the study period. In mental disorders (panel b), the decrease in absences was slightly smaller among lower non-manual employees than among the other classes. In circulatory diseases (panel e), absences decreased over the study period with no clear differences between the classes. In respiratory diseases (panel f), the overall decreasing trend in absences was interrupted by an increasing trend between 2007 and 2011 that was more pronounced among lower non-manual employees than among the other classes. In digestive diseases (panel h), the decrease in absences over the study period was smallest among lower non-manual employees. In neoplasms (panel d) and nervous diseases (panel g), the changes over time were relatively small and the occupational class differences stable.

Adjustment for socioeconomic and employment factors attenuated the occupational class differences in the absence levels, but it had little effect on the varying trends between the classes (Figure 1, model 2).

Sickness absence trends by industrial sectors within occupational classes

Further differences in sickness absence between industrial sectors within the three occupational classes were examined in the two largest disease groups, i.e. musculoskeletal diseases and mental disorders. The age- and gender-adjusted as well as the fully adjusted annual proportions of sickness absence are presented in Supplementary Figure 1 and Figure 2, respectively. Although adjustment for socioeconomic and employment factors attenuated the differences in the overall level of sickness absence particularly between the high-risk health and social work sector and other sectors, it had – similarly as in the above mentioned analyses on varying trends in sickness absence between occupational classes – little influence on the varying trends between industrial sectors (Figure 2 compared to Supplementary Figure 1). All further results are thus based on the fully adjusted models.

In addition to the estimated proportions in Figure 2, we show relative differences in the risk of sickness absence between the industrial sectors presented as ORs in Figure 3. In both disease groups, the overall level of sickness absence was highest in the health and social work sector among upper (Figures 2 and 3, panels a and b) and lower (panels c and d) non-manual employees. Among manual workers, the absence level in musculoskeletal diseases (panel e) was highest in the manufacturing sector, whereas in mental disorders (panel f) there was no consistent variation between the sectors.

In addition to the overall levels, the trends in sickness absence somewhat varied between industrial sectors within the different occupational classes. In musculoskeletal diseases, the decrease in absences was smaller among lower non-manual employees (Figure 2, panel c) and manual workers (panel e) in the trade sector than in the other sectors. As a result, the excess risk in the trade sector compared to the reference group of knowledge work increased over the study period (Figure 3, panels c and e) and approached the levels found among lower non-manual employees in the health and social work sector (panel c) or among manual workers in the manufacturing sector (panel e). Furthermore, the temporary decrease in absences due to musculoskeletal diseases around year 2009 was particularly large among manual workers (Figure 2, panel e) in the manufacturing sector, which led to a temporary decrease in the excess risk found in this sector (Figure 3, panel e). Also in mental disorders, there were corresponding but smaller temporary decreases in the manufacturing sector among lower non-manual employees (Figures 2 and 3, panel d) and manual workers (panel f). Furthermore, there was no decrease over the study period in absences due to mental disorders among upper non-manual employees (Figure 2, panel b) in the manufacturing sector. The absence level was originally lowest among this group, but by the end of the study period the reduced risk compared to the reference group of knowledge work disappeared (Figure 3, panel b). Otherwise, the differences in sickness absence between industrial sectors remained relatively stable over the study period.

DISCUSSION

We used large register data on the general population of Finnish wage earners in order to provide novel information on cause-specific sickness absence trends by occupational class and industrial sector, while accounting for various other socioeconomic and employment factors. Although occupational class differences in sickness absence have been previously established,[1-9] our study is, to our knowledge, the first one to examine occupational class differences in sickness absence trends by disease group or any differences in sickness absence between industrial sectors within particular occupational classes.

We found that the proportion of employees with all-cause sickness absence lasting at least two weeks decreased between 2005 and 2013 in all of the examined occupational classes. The decrease in absences over the study period was smallest among lower non-manual employees. Upper non-manual employees had the lowest and manual workers the highest overall level of sickness absence. The occupational class differences in the overall absence levels were particularly large in musculoskeletal diseases, injuries, and nervous diseases. In the former two disease groups, the class differences nevertheless decreased over time since the decreases in absences due to these causes restricted to manual workers. In mental disorders, the absence level was highest among lower non-manual employees, who also had the smallest decrease in absences, which led to increasing class differences over time. Also in respiratory and digestive diseases, the decreases over time were more limited among lower non-manual employees. In circulatory diseases, absences decreased in all occupational classes, whereas in neoplasms and nervous diseases the changes over time where altogether small.

We also found variation in sickness absence between industrial sectors within the occupational classes, which was examined in the two largest disease groups, i.e. musculoskeletal diseases and mental disorders. The overall absence levels were generally highest in the health and social work sector. Among manual workers, however, the level in musculoskeletal diseases was highest in the manufacturing sector, where a notable temporary decrease in absences nevertheless occurred during the peak of the economic recession in 2009. Among manual workers and lower non-manual employees, the decrease in absences due to musculoskeletal diseases was smallest in the trade sector.

Occupational class differences in trends in all-cause sickness absence have been previously examined among Finnish municipal employees.[8, 9] The findings indicated that class differences in the number of sickness absence days have decreased among men since the early 2000s, but with no particular changes immediately around 2009.[9] The patterns thus somewhat differed from the ones observed in our present study based on the first onset of longer-term sickness absence among the general wage-earning population. However, an earlier study on the above mentioned municipal employees in the 1990s indicated that class differences in the number sickness absence spells lasting over three days were smaller in the recession years than in the following period of economic growth, during which absences increased more in the lower classes.[8] Accordingly, we found that the class differences were smallest in 2009, i.e. during the peak of the more recent economic recession. Moreover, we found that such changes around the time of the recession were largest in musculoskeletal diseases. We also found that the temporary sharp decline in absences in 2009 was most pronounced among manual workers employed in the manufacturing sector. This was the group in our data for which employment decreased most around the time of the recession. In addition to decreases in musculoskeletal morbidity and physically demanding work, it is thus likely that the recession itself was a driving factor behind the decline in sickness absence, especially among manual workers employed in the manufacturing sector. Employees may be less willing to be absent from work in contexts of high unemployment rates and labour market insecurity.[1, 8, 14]

We found that in injuries, the decrease in the occupational class differences was additionally attributable to the fact that, contrary to manual workers, the non-manual classes had slight increase in absences over the study period. However, these differences in the trends may not be representative of actual differences in the rates of injuries. Our sickness absence data are based on records from the Finnish Social Insurance Institution, while injury-related sickness absence may also be covered by other insurers, and the proportion covered by these other insurers may vary over time.

Our population-based finding on the higher overall level of sickness absence due to mental disorders among lower non-manual employees complements the previously unestablished information on class differences in work disability due to this common cause. Somewhat deviating from our findings, those based on French and Finnish public sector employee cohorts indicated that sickness absence[2] or any long-term (≥90 days) work disability[15] due to mental disorders was more common or at a similar level among manual workers than among lower non-manual groups. The differences nevertheless remain somewhat unclear due to a lack of statistical power in these studies. Findings based on the general Finnish population during the 2000s indicated that the risk of disability retirement, i.e. more permanent type of work disability typically succeeding sickness absence lasting for about one year, was consistently higher among manual workers in all of the large disease groups, including mental disorders.[16] Among a cohort of Finnish municipal employees, nevertheless, the number of all-cause sickness absence days has in recent years actually become higher among routine non-manual employees compared to the other classes, especially among employees under 35 years old.[9] Since mental disorders are particularly common causes of work disability among the young, this finding appears to be compatible with ours. All in all, it appears that in mental disorders, the class differences somewhat differ between shorter and longer-term work disability.

Our finding on the more limited decrease among lower non-manual employees in sickness absence due to mental, respiratory, and digestive diseases may be related to unfavourable changes in the work environment in lower non-manual occupations such as increase in psychosocial demands during the period of economic downturn. It may also be related to changes in the labour market that reduce sickness absence in the other two occupational classes. For example, manual workers may be less willing to seek medical advice and be absent from work due to job insecurity, while upper non-manual employees may have become more able to perform distant work while being ill. However, according to previous findings from Finland, trends in job quality appear to have been relatively similar between occupational classes over our study period.[17]

The generally higher absence levels that we found in the health and social work sector is in accordance with previous studies.[10, 11] Findings from Norway indicated that the higher risk of sickness absence among those employed in health and social occupations was largely explained by their unfavourable psychosocial and physical working conditions.[11] A Finnish study has also shown that compared to employees in other sectors, those in the combined sector of education, health and social work had poorer health in terms of a higher risk of hospitalization due to various disease groups including musculoskeletal diseases and mental disorders. Furthermore, the risk of hospitalization at least due to musculoskeletal diseases was higher in the manufacturing sector than in the trade and knowledge work -related sectors.[18] The present study adds to the literature by indicating that also in sickness absence, the difference between the health and social work sector and other sectors was generally found in both musculoskeletal diseases and mental disorders. However, our novel findings further indicated that this difference was only found among non-manual employees. Among manual workers, the absence level in musculoskeletal diseases was highest in the manufacturing sector.

The present study also suggests that the differences in sickness absence between industrial sectors within the occupational classes have been relatively stable since the mid-2000s, except for the above discussed temporary fluctuations around 2009 and for the smaller decrease in absences due to musculoskeletal diseases in the trade sector compared to other ones within the lower classes. Since the more unfavourable trends of the trade sector were not explained by changes in sociodemographic and employment factors, changes in working conditions or types of jobs within the sector may have contributed.

Overall, our findings indicate that the trend differences between occupational classes and industrial sectors largely depend on the disease causing work disability. In musculoskeletal diseases, the changes over time varied most. Musculoskeletal diseases may easily be considered as work-related and their diagnoses are often symptom-based. Such factors may increase the sensitivity of sickness absence occurrence to changes in the work or economic conditions among particular groups of employees. In other causes such as circulatory diseases, the decrease in absences has been more consistent across the classes, which may be related to equality in terms of decreased morbidity and improved treatment.

The strengths of this study include nationally representative samples of the population, register-based data without missing information or loss to follow-up, and longitudinal information on employment and sociodemographic factors as well as on sickness absence and its diagnostic cause. Furthermore, the very large data set allowed us to examine cause-specific sickness absence between industrial sectors within different occupational classes, thereby capturing occupational groups with relatively similar types of jobs. Our findings may be generalizable to other countries that have experienced similar labour market changes and have relatively generous sickness benefit systems.

There are nevertheless also certain limitations. Our findings are based on national data on compensated sickness absence, and thus cover spells that typically last at least two weeks. Variation between the groups may be different in shorter spells that reflect less severe morbidity. Although our results indicated that socioeconomic and employment factors partly explained the differences by occupational class and industrial sector in the overall level of cause-specific sickness absence, they did not appear to explain the varying trends. Factors that could not be measured in this study, such as changes in health, lifestyle, work exposures, and labour market conditions, are therefore likely to contribute to the differences in the trends. They may also be influenced by changes in the variation between different groups in ill-health-related selection out of work through other routes than sickness absence. Moreover, sickness absence trends may have been affected by changes in national sickness insurance legislation aiming at enhancing work participation.[19-21]

CONCLUSIONS

The proportion of employees with sickness absence exceeding two weeks decreased in Finland between 2005 and 2013. The change was smallest among lower non-manual employees. Occupational class differences in sickness absence trends nevertheless varied by disease group, and there was further variation between industrial sectors within the occupational classes. The findings indicate that certain groups of employees are particularly disadvantaged in terms of either a high overall level of sickness absence or limited decrease in sickness absence over time: preventive measures should be targeted especially at work ability related to mental and musculoskeletal health among non-manual employees in the health and social work sector and at work ability related to musculoskeletal health among those with lower grade occupations in the manufacturing and trade sectors.

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Contributors: EVJ obtained the data. SS and EVJ conceived the study. All authors designed the study. SS and TL prepared the data for analyses. TL conducted the statistical analyses. All authors contributed to interpretation of the results. TL wrote the first drafts of the article. All authors discussed and revised the drafts and prepared the final manuscript.

Competing interests: None declared.

Data sharing statement: Due to data protection regulations of the administrative sources providing the register data, the authors do not have the permission to share the data. Permissions to use the register data can be applied from the Social Insurance Institution of Finland (http://www.kela.fi/web/en/research-data-requests), the Finnish Centre for Pensions (http://www.etk.fi/en/statistics-2/statistics/producer-of-statistics/), and Statistics Finland (http://www.stat.fi/meta/tietosuoja/kayttolupa_en.html).

REFERENCES

1. Allebeck P, Mastekaasa A. Swedish Council on Technology Assessment in Health Care (SBU). Chapter 5. Risk factors for sick leave – general studies. *Scand J Public Health* 2004;32(Suppl 63):49–108.

2. Melchior M, Krieger N, Kawachi I, et al. Work Factors and Occupational Class Disparities in Sickness Absence: Findings From the GAZEL Cohort Study. *Am J Public Health* 2005;95:1206–12.

3. Christensen KB, Labriola M, Lund T, et al. Explaining the social gradient in long-term sickness absence: a prospective study of Danish employees. *J Epidemiol Community Health* 2008;62:181–3.

4. Hansen H-T, Ingebrigtsen T. Social Class and Sickness Absence in Norway. *Acta Sociologica* 2008;51:309–27.

5. Piha K, Laaksonen M, Martikainen P, et al. Interrelationships between education, occupational class, income and sickness absence. *Eur J Public Health* 2010;20:276–80.

6. d'Errico A, Costa G. Socio-demographic and work-related risk factors for medium- and long-term sickness absence among Italian workers. *Eur J Public Health* 2012;22:683–8.

7. Löve J, Hensing G, Holmgren K, et al. Explaining the social gradient in sickness absence: a study of a general working population in Sweden. *BMC Public Health* 2013;13:545.

8. Piha K, Martikainen P, Rahkonen O, et al. Trends in socioeconomic differences in sickness absence among Finnish municipal employees 1990-99. *Scand J Public Health* 2007;35:348–55.

9. Sumanen H, Lahelma E, Pietiläinen O, et al. The Magnitude of Occupational Class Differences in Sickness Absence: 15-Year Trends among Young and Middle-Aged Municipal Employees. *Int J Environ Res Public Health* 2017;14:625.

10. Lund T, Labriola M, Villadsen E. Who is at risk for long-term sickness absence? A prospective cohort study of Danish employees. *Work* 2007;28:225–30.

11. Aagestad C, Tyssen R, Sterud T. Do work-related factors contribute to differences in doctor-certified sick leave? A prospective study comparing women in health and social occupations with women in the general working population. *BMC Public Health* 2016;16:235.

12. Knutsson A, Goine H. Occupation and unemployment rates as predictors of long term sickness absence in two Swedish counties. *Soc Sci Med* 1998;47:25–31.

13. Statistics Finland. Classifications. 2017. http://tilastokeskus.fi/meta/luokitukset/index_en.html Accessed 27 April 2017.

14. Virtanen M, Kivimäki M, Elovainio M, et al. Local economy and sickness absence: prospective cohort study. *J Epidemiol Community Health* 2005;59:973–78.

15. Virtanen M, Kawachi I, Oksanen T, et al. Socio-economic differences in long-term psychiatric work disability: prospective cohort study of onset, recovery and recurrence. *Occup Environ Med* 2011;68:791–8.

16. Polvinen A, Laaksonen M, Gould R, et al. Socioeconomic Differences in Cause-Specific Disability Retirement in Finland, 1988 to 2009. *J Occup Environ Med* 2016;58:840–5.

17. Mustosmäki A, Oinas T, Anttila T. Abating inequalities? Job quality at the intersection of class and gender in Finland 1977–2013. *Acta Sociologica* 2017;60:228–45.

18. Kokkinen L, Kouvonen A, Koskinen A, et al. Differences in hospitalizations between employment industries, Finland 1976 to 2010. *Ann Epidemiol* 2014;24:598–605.

19. Kausto J, Viikari-Juntura E, Virta LJ, et al. Effectiveness of new legislation on partial sickness benefit on work participation: a quasi-experiment in Finland. *BMJ Open* 2014;4:e006685.

20. Halonen JI, Solovieva S, Pentti J, et al. Effectiveness of legislative changes obligating notification of prolonged sickness absence and assessment of remaining work ability on return to work and work participation: a natural experiment in Finland. *Occup Environ Med* 2016;73:42–50.

21. Viikari-Juntura E, Virta LJ, Kausto J, et al. Legislative change enabling use of early part-time sick leave enhanced return to work and work participation in Finland. *Scand J Work Environ Health* 2017;43:447–56.

Figure captions

Figure 1. Estimated annual proportion of employees with a new onset of cause-specific (A-H) sickness absence (‰) by occupational class. The panels are presented in different scales; Model 1 (M1): Adjusted for age and gender; Model 2 (M2): Adjusted for age, gender, education, industrial sector, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between occupational class and year: A) M1: 0.000, M2: 0.000, B) M1: 0.000, M2: 0.000, C) M1: 0.000, M2: 0.000, D) M1: 0.099, M2: 0.100, E) M1: 0.035, M2: 0.041, F) M1: 0.000, M2: 0.000, G) M1: 0.449, M2: 0.568, H) M1: 0.021, M2: 0.165.

Figure 2. Estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; Adjusted for age, gender, education, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between industrial sector and year: A) 0.550, B) 0.053, C) 0.014, D) 0.001, E) 0.000, F) 0.000.

Figure 3. Annual risk (ORs and their 95% confidence intervals) of having a new onset of sickness absence due to musculoskeletal diseases and mental disorders by industrial sector (OR=1.00 for the knowledge work sector in each year) among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. Adjusted for age, gender, education, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between industrial sector and year: A) 0.550, B) 0.053, C) 0.014, D) 0.001, E) 0.000, F) 0.000.

Supplementary material captions

Supplementary Table 1. Annual distribution (%) of the study population over the study period by background characteristics.

Supplementary Table 2. Distribution (%) of the study population by sociodemographic and employment factors among those employed in different industrial sectors within different occupational classes averaging over the whole study period.

Supplementary Figure 1. Age- and gender-adjusted estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; P-values for the interaction between industrial sector and year: A) 0.302, B) 0.006, C) 0.000, D) 0.005, E) 0.000, F) 0.004.

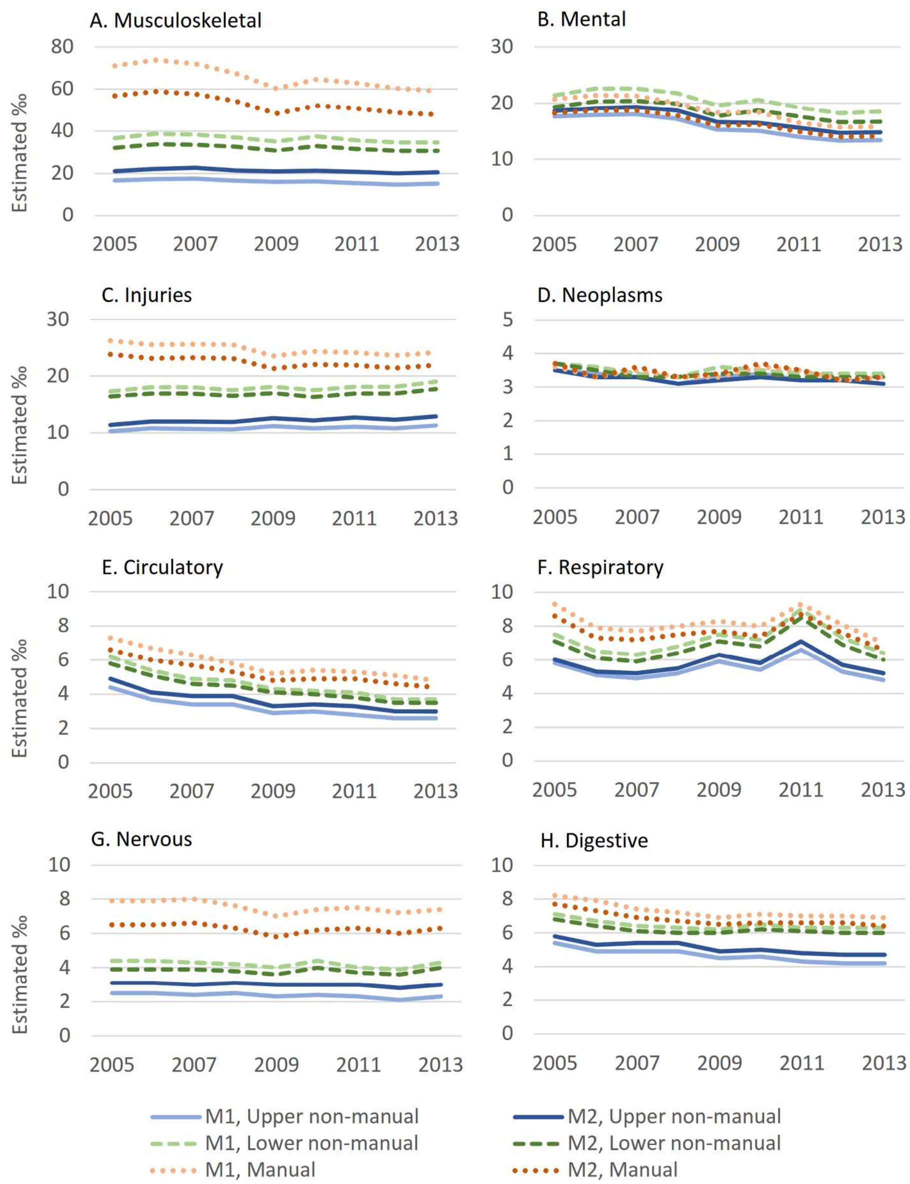

Figure 1

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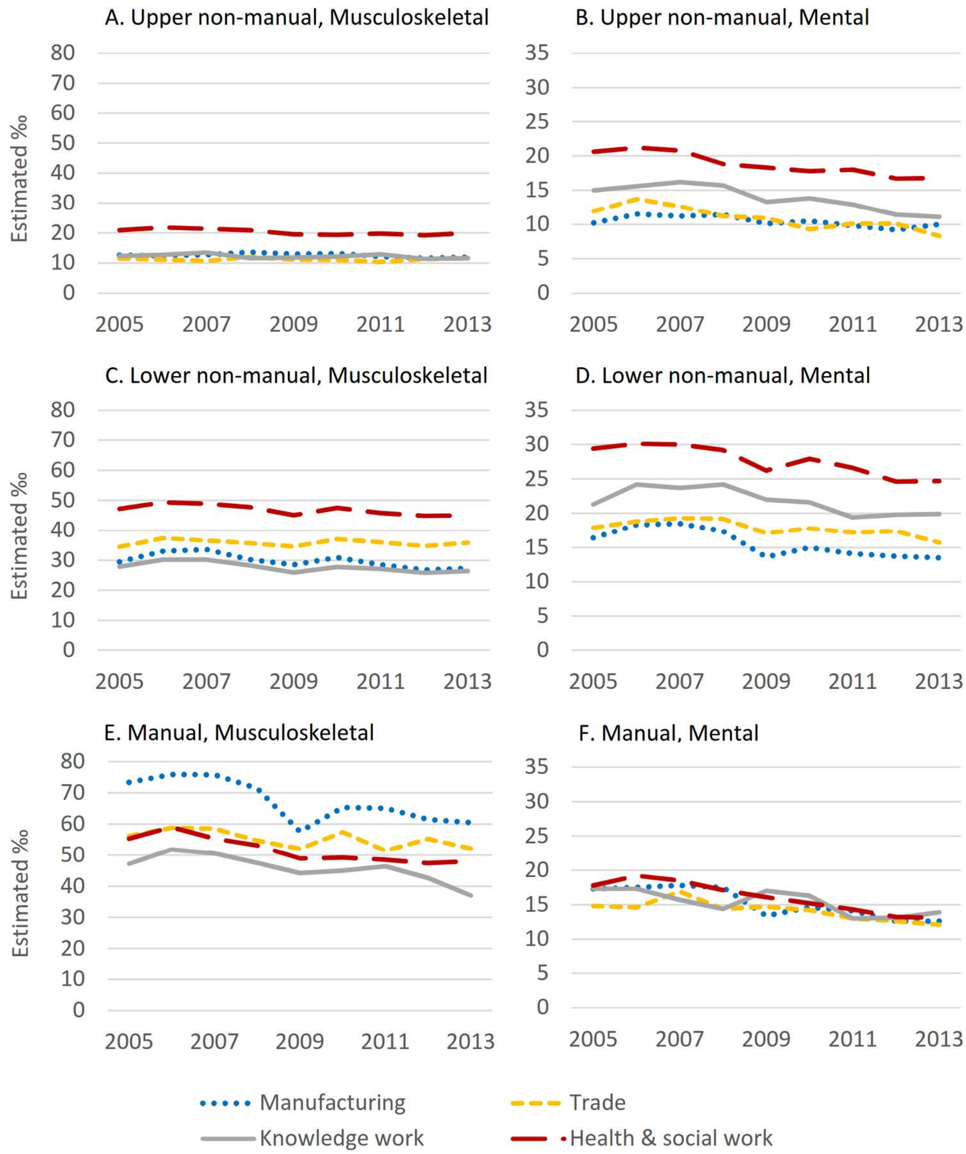

Figure 2

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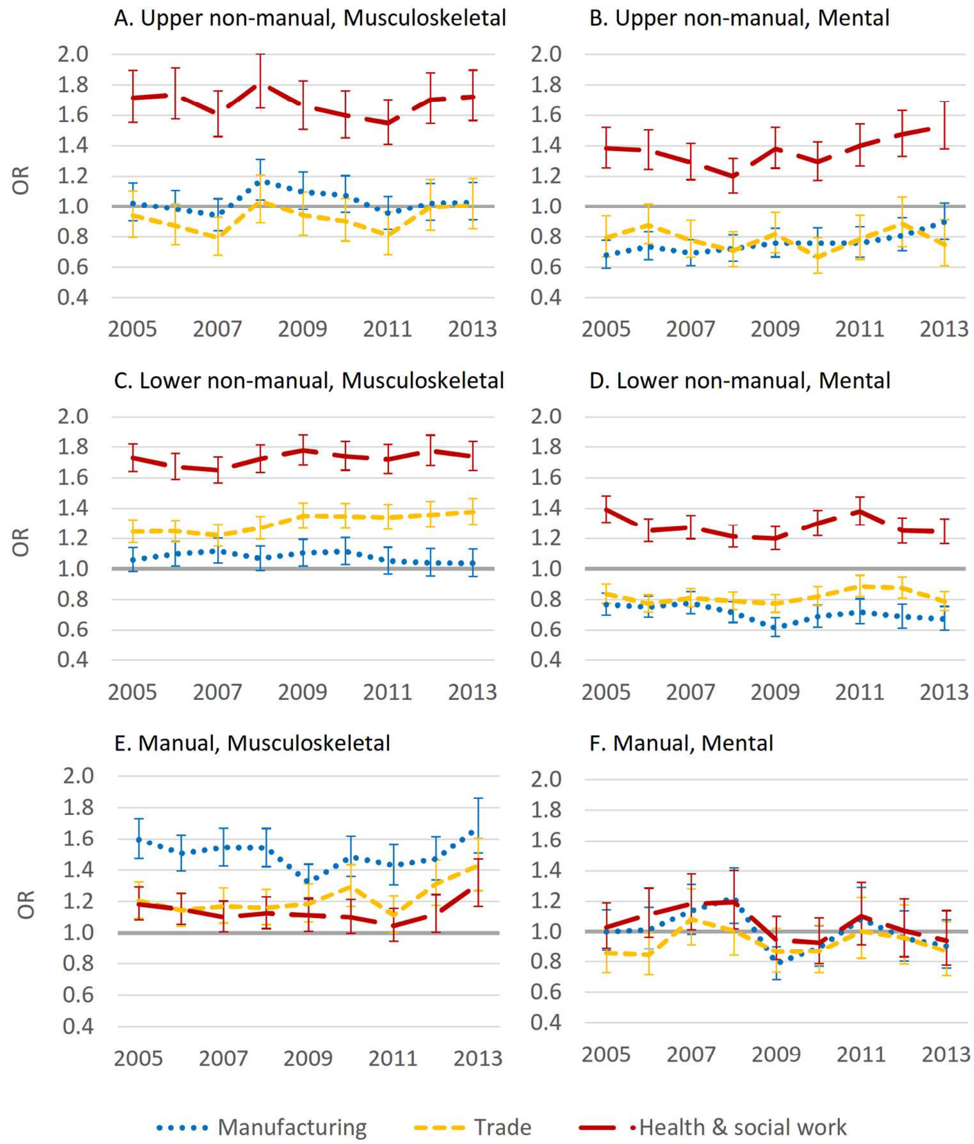

Figure 3

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Supplementary Table 1. Annual distribution (%) of the study population over the study period by background characteristics.

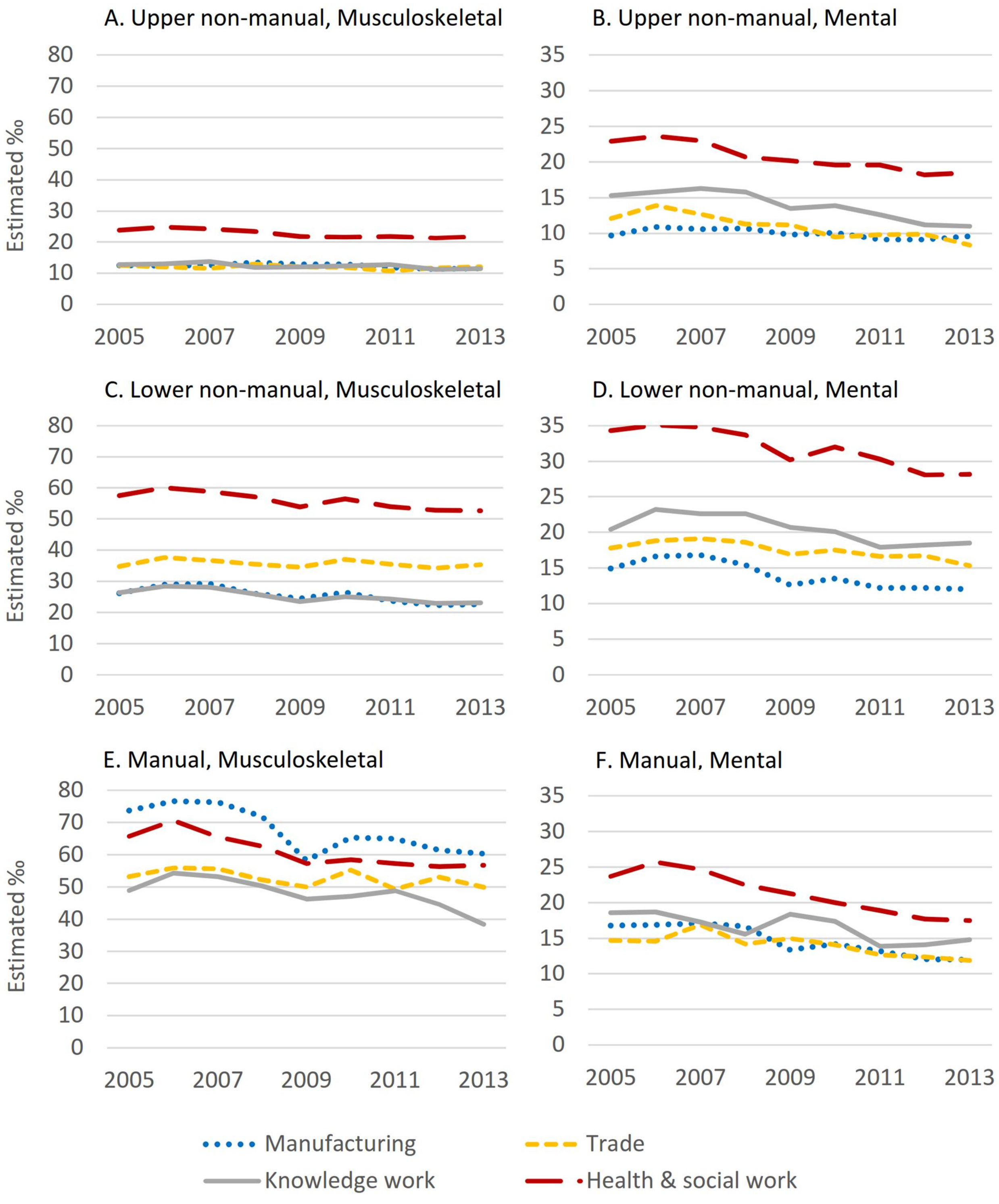
	Year								
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Age									
25-29	12.8	12.9	12.9	13.2	13.3	13.2	13.5	13.4	13.1
30-34	12.8	13.0	13.3	13.7	14.2	14.3	14.5	14.4	14.5
35-39	15.0	14.7	14.3	13.8	13.3	13.4	13.5	13.8	14.2
40-44	16.0	16.0	15.9	15.8	15.6	15.3	14.8	14.5	14.0
45-49	15.8	15.8	15.7	15.6	15.7	15.8	15.7	15.7	15.7
50-54	15.1	15.1	15.3	15.2	15.0	15.0	14.9	14.9	15.0
55-59	12.5	12.6	12.7	12.8	12.9	13.1	13.1	13.4	13.5
Gender									
Men	49.3	49.3	49.3	49.2	48.6	47.9	48.2	48.2	47.9
Women	50.7	50.7	50.7	50.8	51.4	52.1	51.9	51.8	52.1
Education									
Higher tertiary	12.7	13.1	13.3	13.7	14.5	15.0	15.4	15.7	16.1
Lower tertiary	29.7	29.8	29.8	29.8	30.0	30.4	30.4	30.4	30.5
Secondary	41.8	42.2	42.7	43.1	42.8	42.8	43.0	43.2	43.2
Primary	15.9	14.9	14.2	13.5	12.7	11.8	11.3	10.8	10.2
Occupational class									
Upper non-manual	24.3	25.2	25.4	25.6	26.4	26.9	25.8	26.0	26.1
Lower non-manual	40.8	40.2	40.2	40.4	40.7	41.3	42.7	42.7	43.1
Manual	34.9	34.6	34.3	34.0	33.0	31.9	31.5	31.4	30.9
Industrial sector									
Manufacturing	20.1	19.6	19.5	19.4	18.8	17.5	17.2	17.0	16.4
Trade	11.2	11.2	11.2	11.2	11.3	11.4	11.4	11.4	11.4
Knowledge work	12.4	12.5	12.5	12.9	13.0	13.1	13.1	13.2	13.2
Health & social work	16.7	16.8	17.0	16.9	17.3	17.8	17.8	18.0	18.5
Other	39.6	39.8	39.8	39.6	39.5	40.2	40.4	40.4	40.5

Employment sector									
Private	62.4	62.6	62.6	63.1	63.1	62.8	62.7	62.9	62.6
Public	32.2	31.8	30.4	29.7	30.2	30.6	30.1	30.3	30.6
Private and public	4.9	5.1	6.5	6.6	6.3	6.1	6.3	6.1	6.2
Transition to self-employment	0.5	0.5	0.6	0.6	0.6	0.6	0.9	0.7	0.6
Income									
Quintile 1 (highest)	17.1	17.7	18.8	19.8	20.2	21.0	21.9	21.8	21.7
Quintile 2	17.9	18.9	19.2	19.5	20.0	20.8	21.3	21.1	21.4
Quintile 3	19.2	19.9	19.7	19.6	19.8	20.5	20.5	20.3	20.5
Quintile 4	22.5	21.9	21.2	20.5	19.9	19.2	18.1	18.4	18.3
Quintile 5 (lowest)	23.3	21.6	21.1	20.6	20.1	18.4	18.3	18.5	18.1
Employed time									
Full year	90.5	90.4	90.6	90.8	90.5	91.5	91.4	91.2	91.3
200-364 days	6.8	7.0	7.1	6.9	6.5	6.1	6.4	6.5	6.3
1-199 days	2.7	2.6	2.4	2.2	3.0	2.4	2.2	2.3	2.4
Employment episodes									
1	90.0	89.5	88.2	88.3	89.2	89.3	88.5	88.9	89.1
2	7.0	7.4	8.5	8.5	7.8	7.7	8.5	8.2	8.0
3+	3.0	3.0	3.4	3.2	3.1	2.9	3.0	2.9	2.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	1 097 598	1 100 322	1 109 041	1 122 238	1 117 179	1 081 698	1 094 294	1 092 208	1 080 951

Supplementary Table 2. Distribution (%) of the study population by sociodemographic and employment factors among those employed in different industrial sectors within different occupational classes averaging over the whole study period.

	Upper non-manual					Lower non-manual					Manual				
	Manu-facturing	Trade	Know-ledge work	Health & social work	All	Manu-facturing	Trade	Know-ledge work	Health & social work	All	Manu-facturing	Trade	Know-ledge work	Health & social work	All
Age															
25-29	7.7	9.0	12.9	9.5	10.1	12.4	18.3	15.1	11.1	13.7	13.6	21.3	14.2	7.1	14.8
30-34	15.5	14.6	18.6	12.4	15.0	16.5	16.1	14.5	12.2	13.9	13.6	16.4	10.9	7.7	12.9
35-39	19.2	17.1	16.7	13.6	15.7	15.5	15.2	12.7	13.1	13.7	14.0	14.7	11.1	10.3	13.1
40-44	18.9	18.9	15.4	15.6	16.4	15.4	15.2	14.6	15.2	15.2	14.9	14.4	13.5	1.4	14.7
45-49	15.9	17.1	14.5	17.5	16.0	14.3	13.4	15.3	17.2	15.8	15.2	12.8	16.1	17.6	15.5
50-54	12.7	13.3	12.1	17.4	14.5	13.6	11.5	14.7	17.1	15.0	15.5	11.2	17.6	20.9	15.6
55-59	10.3	10.1	9.7	14.0	12.4	12.2	10.2	13.1	14.1	12.9	13.1	9.3	16.6	22.3	13.5
Gender															
Men	78.5	68.5	65.0	18.2	52.0	56.1	37.6	37.9	7.6	30.3	77.8	79.1	65.0	15.4	69.1
Women	21.5	31.6	35.0	81.8	48.0	43.9	62.4	62.1	92.4	69.7	22.2	20.9	35.0	84.6	30.9
Education															
Higher tertiary	38.2	25.2	42.4	45.0	47.7	10.9	3.0	9.1	1.2	4.7	0.4	0.4	1.6	0.6	0.5
Lower tertiary	46.4	46.7	37.6	48.4	37.0	54.2	32.6	51.2	43.4	44.2	6.5	7.8	11.0	6.7	6.9
Secondary	11.2	21.5	16.7	5.8	12.4	27.0	47.2	31.0	49.9	41.6	70.3	68.7	63.9	69.3	67.9
Primary	4.1	6.7	3.4	0.7	3.0	7.9	17.2	8.7	5.5	9.5	22.9	23.0	23.4	23.3	24.7
Employment sector															
Private	96.2	95.6	81.4	14.0	49.0	97.1	96.1	86.2	17.4	56.9	97.6	95.6	66.3	20.4	80.8
Public	0.1	0.2	12.1	72.3	41.4	0.2	0.2	9.9	73.3	36.7	0.1	1.3	27.4	71.2	14.7
Private and public	3.1	3.1	5.6	12.9	8.8	2.4	3.0	3.4	9.0	6.0	1.9	2.3	5.7	8.2	3.8
Transition to self-employment	0.6	1.1	0.9	0.9	0.8	0.4	0.7	0.5	0.3	0.5	0.4	0.8	0.6	0.2	0.7

Income															
Quintile 1 (highest)	73.3	66.4	56.7	32.6	48.7	28.8	13.0	19.8	2.0	11.7	13.1	5.0	5.5	0.9	8.1
Quintile 2	15.7	16.1	22.4	21.0	24.0	33.7	14.0	24.6	12.3	18.5	25.6	15.3	15.2	2.5	18.7
Quintile 3	5.5	7.2	9.5	21.0	12.1	19.4	15.2	24.1	29.5	23.0	27.5	22.9	22.7	8.7	22.5
Quintile 4	2.6	4.4	5.1	15.3	7.4	10.9	22.3	17.8	33.6	24.9	21.3	28.0	25.8	36.0	23.7
Quintile 5 (lowest)	3.0	5.9	6.3	10.2	7.9	7.2	35.5	13.6	22.7	21.9	12.5	28.8	30.9	51.9	27.1
Employed time															
Full year	94.9	93.2	93.6	93.2	93.3	94.3	90.9	93.1	91.5	91.8	92.9	89.8	89.1	81.6	87.9
200-364 days	3.6	5.0	4.9	5.3	5.2	4.0	6.7	5.0	6.3	5.9	4.9	7.3	7.4	11.0	8.7
1-199 days	1.5	1.8	1.5	1.5	1.5	1.7	2.4	1.9	2.2	2.3	2.2	2.9	3.5	7.4	3.4
Employment episodes															
1	94.3	92.9	90.6	82.7	87.2	95.2	92.2	93.1	86.5	89.9	95.0	92.2	88.7	83.0	89.3
2	4.9	5.8	7.4	12.5	9.3	4.0	6.1	5.6	8.2	7.1	4.2	6.4	8.3	9.0	8.0
3+	0.8	1.3	2.0	4.8	3.5	0.8	1.7	1.3	5.4	3.0	0.8	1.5	3.1	8.0	2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0



Supplementary Figure 1. Age- and gender-adjusted estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; P-values for the interaction between industrial sector and year: A) 0.302, B) 0.006, C) 0.000, D) 0.005, E) 0.000, F) 0.004.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
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, 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4, 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5-9
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-9
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	5-9
Bias	9	Describe any efforts to address potential sources of bias	18
Study size	10	Explain how the study size was arrived at	5, 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8, 9
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	na
		(*d*) If applicable, explain how loss to follow-up was addressed	na
		(*e*) Describe any sensitivity analyses	na
Results			

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	5, 6
		(b) Give reasons for non-participation at each stage	na
		(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	9, 10
		(b) Indicate number of participants with missing data for each variable of interest	na
		(c) Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	Report numbers of outcome events or summary measures over time	10, 11
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	10-13
		(*b*) Report category boundaries when continuous variables were categorized	8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10-13
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10-13
Discussion			
Key results	18	Summarise key results with reference to study objectives	13, 14
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
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	19

*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.

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Cause-specific sickness absence trends by occupational class and industrial sector in the context of recent labour market changes: a Finnish panel data study

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Cause-specific sickness absence trends by occupational class and industrial sector in the context of recent labour market changes: a Finnish panel data study

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ABSTRACT

Objectives: We aimed to provide previously unestablished information on population-based differences in cause-specific sickness absence trends between occupational classes and further between four large industrial sectors within the different occupational classes while controlling for other socioeconomic factors and employment patterns. We focused on the period 2005–2013, during which the labour market underwent large economic and structural changes in many countries.

Design: Register-based panel data study.

Setting: Large representative data sets on Finnish wage earners aged 25–59 years.

Outcome measure: Annual risk of sickness absence (> ten working days) based on repeated logistic regression.

Results: Between 2005 and 2013, the proportion of employees with sickness absence decreased. Occupational class differences in sickness absence trends varied by disease group. Overall, the decrease in absences was smallest among lower non-manual employees. Sickness absence levels were highest in the health and social work sector and in the manufacturing sector within the non-manual and manual classes, respectively. Absences due to musculoskeletal diseases decreased temporarily during the peak of the economic recession in 2009, particularly in the manufacturing sector within the manual class. The decrease in absences due to musculoskeletal diseases was smallest in the trade sector within the lower occupational classes. Overall, education, income, and employment patterns partly explained the differences in the absence levels, but not in the trends.

Conclusions: We found a complex interplay between the associations of occupational class and industrial sector with sickness absence trends. During the economic recession, absences due to musculoskeletal diseases decreased temporarily in a segment of wage earners that are known to have been hit hard by the recession. However, the trend differences were not explained by the

measured structural changes in the characteristics of the study population. Both occupational class and industrial sector should be taken into account when tackling problems of work disability.

Strengths and limitations of this study

- The large register-based data sets were representative of Finnish wage earners and did not have the problem of missing information due to non-response.
- The data had sufficient statistical power for examining cause-specific sickness absence trends by large industrial sectors within different occupational classes.
- The rich data included information on various covariates, including education, employment sector, income, time spent in employment, and the number of employment episodes.
- The data lacked information on some potentially important covariates such as health status, lifestyle factors, work exposures, and labour market conditions.
- The sickness absence outcome was based on national data on compensated spells that begin after a period of ten working days, thereby excluding shorter spells.

INTRODUCTION

The association of low occupational class with a higher likelihood of sickness absence has been established in many European countries.[1-11] The occupational class differences have been particularly large in absences due to musculoskeletal diseases, and smaller but still notable in most other disease groups. In mental disorders, the absence levels have been similar or even higher among lower non-manual employees than among manual workers.[2, 10]

In addition to occupational class, industrial sector is closely associated with working conditions and the broader work environment, which affect the ability of an individual to perform in his or her own job. A previous study from Denmark indicated that the risk of long-term sickness absence was higher than average in the health care and social services sector and lower than average in the private administration sector, but otherwise the differences between the sectors were small.[12] Accordingly, a Norwegian study indicated that the risk of long-term sickness absence was higher among women employed in health and social occupations than among the general female employed population.[13] There may also be an important interplay between occupational class and industrial sector; even within a particular occupational class, the types of jobs may vary considerably between different sectors. Previous population-based findings from Denmark[12] and Sweden[14] have shown large differences in long-term sickness absence between particular occupational groups. Variation in sickness absence between industrial sectors within different occupational classes nevertheless remains unclear.

From the start of the millennium, Finland and other European countries have experienced two key labour market changes that may have had varying consequences for the health, work ability, and illness behaviour of individuals in different occupational classes and industrial sectors. Firstly, particular sectors including manufacturing and construction were hit hard by the economic recession of the late 2000s, whereas other sectors such health and social services were less affected.[15] In Finland, the economic recession peaked in 2009. This was the only year in which the change in the GDP was negative (-6.5%). A specific feature for Finland was that there was another decline in the GDP after 2011. The manufacturing sector was affected the most: the number of wage earners employed in this sector decreased by 9.4% between 2008 and 2009, while the corresponding decrease in the total wage-earner population was 3.8%.[16] Secondly, the labour market has undergone longer-term structural changes through which employment in non-manual occupations as well as in the knowledge work and service sectors has increased.[16, 17] These economic and structural changes are likely to have been associated with changes in the types of jobs as well as in the work, employment and social conditions of individuals within particular occupational classes and industrial sectors.

Recent economic and structural changes in the labor market may have led to changes in the associations of occupational class and industrial sector with sickness absence. Previous studies from Finland indicated that during recent decades, the overall level as well as occupational class differences in sickness absence have mainly decreased.[9-11] However, the contribution of the recession of the late 2000s to changes in the occupational class differences in sickness absence remains unclear. Moreover, information on trends in sickness absence by industrial sector are altogether lacking. Further, little is known of whether occupational class and industrial sector differences in sickness absence trends can be attributed to longer-term structural changes in the labour market, such as those related to educational attainment, income, private versus public sector employment, or other employment patterns. Information on sickness absence trends and their explanations would help identify vulnerable groups in order to prevent work disability and extend working careers.

We used large register-based data sets to examine cause-specific sickness absence trends in 2005–2013 by occupational class and further by industrial sector among the general population of Finnish wage earners while accounting for other socioeconomic factors and employment patterns. We thereby aimed to explore whether occupational class and industrial sector differences in cause-specific sickness absence trends were influenced by changes in the characteristics of the wage-earner population over a period of major economic fluctuations. The more particular research questions are listed below.

1. Do the trends in sickness absence due to all causes, musculoskeletal diseases, mental disorders, injuries, neoplasms, circulatory diseases, respiratory diseases, nervous diseases, or digestive diseases differ between occupational classes?
2. Do the trends in sickness absence due to the two largest disease groups, i.e. musculoskeletal diseases and mental disorders, vary between four large industrial sectors within different occupational classes?
3. Are the occupational class and industrial sector differences in cause-specific sickness absence trends influenced by changes over the study period in education, employment sector, income, time spent in employment, and the number of employment episodes?

MATERIAL AND METHODS

Study population

We used large register-based data sets with 70% nationally representative random samples of the Finnish working aged population from three cross-sections on the last days of the years 2004, 2007, and 2010. Each of the cohorts were followed up for three calendar years to cover a nine-year study period between 2005 and 2013. The data included information on compensated sickness absences and national pensions obtained from the Social Insurance Institution of Finland, on sociodemographic factors obtained from the Finnish Longitudinal Employer-Employee Data (FLEED) of Statistics Finland, and on employment and earnings-related pensions from the Finnish Centre for Pensions, as also described in our previous study on gender differences in sickness absence.[18]

Criteria for being included in the study population were applied separately to each study year. An individual could thus be excluded in one year and included in others. We restricted the study population to those aged 25–59 on the last day of the year preceding the study year. We included individuals who were employed wage earners according to their main economic activity and socioeconomic status and did not receive full pensions (full disability pensions, unemployment pensions, special pensions for farmers, or old-age pensions) before the study year. We also required that the study person had an ongoing employment period (in the private sector, in the public sector, or in both, but not in self-employment) and did not have an ongoing compensated sickness absence spell at the beginning of the study year. The excluded were subsequently either self-employed (8.7% of the original study population), unemployed (8.0%), retired (14.1%), otherwise non-employed (9.9%), or on sick leave (0.8%). We allowed for non-employment and self-employment later during the study year, adjusting for these factors in the analyses. We nevertheless excluded those who started receiving full pensions (0.2%), emigrated (0.1%), or died (0.05%) during the study year. Finally, we excluded those who did not live in Finland two years before the end of the year preceding the study year (0.2%). We did this because we used the population samples from the end of years 2004, 2007, and 2010 to form the study population in years 2005–2007, 2008–2010, and 2011–2013, respectively; since the study population in years 2007, 2010, and 2013 by design lived in Finland two years before, we applied the same inclusion criteria for all of the years.

After all exclusions, 74.0% of the remaining individuals were included in the study population in each of the three consecutive years (calculated among those who fit the age range 25–59 in all three years). The final study population consisted of around 1.1 million individuals per study year (Supplementary Table 1).

Sickness absence outcome

In Finland, sickness absence is compensated by the Social Insurance Institution of Finland after a period of ten working days that are typically paid by the employer.[19] Only sickness absence spells compensated by the Social Insurance Institution are registered at the national level and included in our data. The outcome of this study was therefore based on sickness absence that by definition lasted around two calendar weeks or more. We used repeated dichotomous measures of whether a study person had a new onset of compensated sickness absence in a particular calendar year. The outcome included both full and part-time sickness absence, but in Finland the first onset of work disability typically starts with full sickness absence. Eligibility for the compensated sickness benefit requires that the claimant resides permanently in Finland and that compensation for earnings loss is not covered in other overruling statutory benefits including those related to occupational, traffic and military accidents.

Cause-specific sickness absence was classified according to the tenth revision of the International Classification of Diseases (ICD-10). We examined the largest groups separately, including 1) musculoskeletal diseases (diseases of the musculoskeletal system and connective tissue, M00–M99), 2) mental disorders (mental and behavioural disorders, F00–F99), 3) injuries (injury, poisoning and certain other consequences of external causes, S00–T98), 4) neoplasms (C00–D48), 5) circulatory diseases (I00–I99), 6) respiratory diseases (J00–J99), 7) nervous diseases (G00–G99), and 8) digestive diseases (K00–K93).

Occupational class and industrial sector

Occupational class and industrial sector were based on information measured in the year preceding each study year and categorized according to classifications by Statistics Finland.[20] Occupational class consisted of categories 1) upper non-manual, 2) lower non-manual, and 3) manual.

Industrial sector included the following categories: 1) manufacturing (manufacturing, mining and quarrying), 2) trade (wholesale and retail trade; repair of motor vehicles and motorcycles), 3) knowledge work (information and communication; financial and insurance activities; real estate activities; professional, scientific and technical activities), 4) human health and social work activities, and 5) other (agriculture, forestry and fishing; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities; construction; transportation and storage; accommodation and food service activities; administrative and support service activities; public administration and defence; compulsory social security; education; arts, entertainment and recreation; other service activities; activities of households as employers;

undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies; industry unknown). This classification was from year 2008. Until 2007, the classification was based on an older version from year 2002, but virtually equivalent main categories listed above could be constructed using a reclassification code provided by Statistics Finland.

When examining industrial sectors within the three occupational classes, we only show results for the four large industrial sectors 1–4. The category “other” consisted of heterogeneous smaller sectors which could not be examined separately due to small number of events.

Covariates

We examined sociodemographic factors and employment patterns as covariates. Age was divided into 5-year groups. Education and income were based on information measured in the year preceding each study year. Education consisted of categories 1) higher tertiary (Master's or equivalent level, or higher), 2) lower tertiary (Bachelor's or equivalent level), 3) secondary, and 4) primary. Tertiary education was divided into two levels, because the proportion of those with higher tertiary education in particular increased during the study period (Supplementary Table 1). Income consisted of both wage and capital income of the individual. It was inflation-corrected and then divided into quintiles across the study years.

Employment patterns were measured during each study year. Employment sector was classified as 1) private, 2) public, 3) private and public, and 4) transition to self-employment. Time spent in employment was divided into 1) full year, 2) 200–364 days, and 3) 1–199 days. The cut-point of 200 days was arbitrarily chosen to define those who were employed most of the year. The number of employment episodes was divided into 1) one, 2) two, and 3) three or more.

Statistical methods

We used generalized estimation equations (GEE) based on repeated logistic regression to estimate the annual risk of having a new onset of compensated all-cause and cause-specific sickness absence in 2005–2013. The GEE models account for the within-individual correlation between repeated measurements in the three different samples followed up during periods 2005–2007, 2008–2010, or 2011–2013.

Using margins derived from the logistic GEE models, we plotted trajectories of estimated proportions (‰) of employees with sickness absence including interactions of occupational class and industrial sectors within the occupational classes with categorical year. Estimated proportions demonstrate the magnitude and direction of changes in the level of sickness absence among different groups, which would not be revealed solely on the basis of information on changes in the differences between the groups. Analyses of occupational class differences were performed in each of the eight disease groups. Analyses of differences between industrial sectors within the different occupational classes were performed in the two largest disease groups, i.e. musculoskeletal diseases and mental disorders. We adjusted for the annually measured covariates holding them at their mean level when plotting the trajectories.

Derived from the same GEE models, we also calculated relative differences between industrial sectors within the different occupational classes. We used those employed in the knowledge work sector as the reference group, for which the odds ratio (OR) of sickness absence was held at 1.00 in each year.

We pooled men and women, adjusting for gender in the analyses. Even though the overall level of sickness absence was much higher among the female than the male study population, changes over time were relatively similar among the genders especially after accounting for their differential occupational and sectoral distributions.[18]

RESULTS

Characteristics of the study population

Over the study period between 2005 and 2013, the proportion of manual workers decreased especially in the manufacturing sector, but also in the health and social work sector (Table 1). The proportion of non-manual employees increased. Among upper non-manual employees, the increase was largest in the knowledge work sector. Among lower non-manual employees, the proportion increased in the health and social work sector and decreased in the manufacturing sector. Annual distributions of the study population by all background characteristics are presented in Supplementary Table 1. Average distributions over the whole study period are presented also separately for those employed in different industrial sectors within different occupational classes in Supplementary Table 2.

Table 1. Annual distribution (%) of the study population over the study period by industrial sectors across different occupational classes.

Occupational class	Year								
Industrial sector	2005	2006	2007	2008	2009	2010	2011	2012	2013
Upper non-manual	24.3	25.2	25.4	25.6	26.4	26.9	25.8	26.0	26.1
Manufacturing	3.1	3.3	3.5	3.5	3.7	3.6	3.5	3.5	3.3
Trade	1.3	1.5	1.5	1.5	1.5	1.5	1.3	1.3	1.3
Knowledge work	5.4	5.6	5.8	6.0	6.2	6.3	6.3	6.4	6.2
Health & social work	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.2	3.3
Other	11.6	11.9	11.8	11.8	12.0	12.4	11.6	11.7	11.9
Lower non-manual	40.8	40.2	40.2	40.4	40.7	41.3	42.7	42.7	43.1
Manufacturing	4.4	4.0	4.0	4.0	3.9	3.7	3.5	3.4	3.4
Trade	7.5	7.5	7.5	7.5	7.7	7.8	8.0	8.0	7.9
Knowledge work	6.0	5.8	5.7	5.9	5.8	5.8	5.9	6.0	6.2
Health & social work	11.6	11.7	11.9	12.0	12.4	12.9	12.9	13.2	13.5
Other	11.3	11.2	11.1	10.9	10.9	11.1	12.4	12.2	12.1
Manual	34.9	34.6	34.3	34.0	33.0	31.9	31.5	31.4	30.9
Manufacturing	12.5	12.3	12.1	11.9	11.3	10.3	10.3	10.2	9.8
Trade	2.3	2.2	2.2	2.2	2.2	2.1	2.2	2.1	2.2
Knowledge work	1.1	1.1	1.0	1.0	1.0	1.0	0.9	0.9	0.8
Health & social work	2.3	2.2	2.1	2.0	1.9	1.8	1.8	1.6	1.6
Other	16.7	16.8	16.9	16.9	16.6	16.7	16.5	16.6	16.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sickness absence trends by occupational class

Upper non-manual employees had the lowest and manual workers the highest overall level of sickness absence (Table 2). Among the total study population, the age- and gender-adjusted proportion of employees with any sickness absence decreased from 127.6‰ in 2005 to 108.6‰ in 2013. Until 2009, the annual decrease was largest among manual workers. Between 2009 and 2010, sickness absence increased, but only among manual workers and lower non-manual employees. After 2010, the decrease in sickness absence continued. Overall, the decrease in sickness absence was smallest among lower non-manual employees.

Table 2. Age- and gender-adjusted estimated annual proportion of employees with a new onset of all-cause sickness absence (‰ and 95% CI) and the annual change (%) over particular years by occupational class.

	Occupational class							
Year	Upper non-manual		Lower non-manual		Manual		All	
2005	80.8	(79.8–81.8)	120.4	(119.5–121.3)	168.6	(167.4–169.8)	127.6	(127.0–128.3)
2006	79.6	(78.6–80.6)	121.4	(120.5–122.3)	168.6	(167.3–169.8)	127.4	(126.8–128.1)
2007	78.6	(77.6–79.6)	118.6	(117.7–119.5)	166.0	(164.8–167.2)	124.9	(124.3–125.5)
2008	75.4	(74.4–76.3)	115.6	(114.7–116.4)	157.7	156.5–158.9)	119.6	(119.0–120.2)
2009	72.8	(71.9–73.8)	112.2	(111.3–113.1)	146.2	(145.0–147.4)	113.5	(112.9–114.1)
2010	72.9	(71.9–73.8)	115.2	(114.3–116.1)	152.0	(150.7–153.2)	116.1	(115.5–116.7)
2011	70.8	(69.9–71.7)	112.2	(111.3–113.1)	147.6	(146.3–148.8)	112.9	(112.3–113.5)
2012	67.3	(66.4–68.2)	108.9	(108.0–109.8)	143.3	(142.1–144.5)	109.1	(108.5–109.7)
2013	67.5	(66.6–68.4)	108.8	(107.9–109.6)	142.1	(140.9–143.3)	108.6	(108.0–109.2)
Annual % change								
2005-2009	-2.5		-1.7		-3.3		-2.8	
2009-2010	0.1		2.7		4.0		2.3	
2010-2013	-2.5		-1.9		-2.2		-2.2	

The occupational class differences in sickness absence varied by disease group in terms of both the overall level and time trends (Figure 1). In terms of the overall level, the differences were particularly large in musculoskeletal diseases (panel A), injuries (panel C), and nervous diseases (panel G), and negligible in neoplasms (panel D). In mental disorders (panel B), the level was highest among lower non-manual employees.

In terms of trends, the decrease in absences due to musculoskeletal diseases (panel A) and injuries (panel C) was mainly restricted to manual workers, leading to decreasing class differences particularly until 2009. In mental disorders (panel B) and digestive diseases (panel H), the decrease in absences was slightly smaller among lower non-manual employees than among the other classes. In respiratory diseases (panel F), the overall decreasing trend was interrupted by an increase in absences between 2007 and 2011, most notably so among lower non-manual employees. In circulatory diseases (panel E), absences decreased over the study period with no clear differences between the classes. In neoplasms (panel D) and nervous diseases (panel G), the changes over time were relatively small and the occupational class differences stable.

Adjustment for other socioeconomic factors and employment patterns attenuated the occupational class differences in sickness absence levels, but it had little effect on the varying trends between the classes (Figure 1, model 2 compared to model 1).

Sickness absence trends by industrial sectors within occupational classes

We examined age- and gender-adjusted (Supplementary Figure 1) as well as fully adjusted (Figure 2) annual proportions of cause-specific sickness absence by industrial sectors within the three occupational classes. Although adjustment for socioeconomic factors and employment patterns attenuated the industrial sector differences in the overall absence levels, it had little influence on the varying trends (Figure 2 compared to Supplementary Figure 1). All further results are therefore based on the fully adjusted models.

Among upper (Figures 2 and 3, panels A and B) and lower (panels C and D) non-manual employees, the overall level of sickness absence due to both musculoskeletal diseases and mental disorders was highest in the health and social work sector. Among manual workers, the absence level in musculoskeletal diseases (panel E) was highest in the manufacturing sector, whereas in mental disorders (panel F) there was no consistent variation between the sectors.

Among lower non-manual employees (Figure 2, panel C) and manual workers (panel E), the decrease in absences due to musculoskeletal diseases was smaller in the trade sector than in the other sectors. As a result, the excess risk in the trade sector compared to the reference group of knowledge work increased over the study period (Figure 3, panels C and E). The temporary decrease in absences due to musculoskeletal diseases around year 2009 was particularly large among manual workers (Figure 2, panel E) in the manufacturing sector, which led to a temporary decrease in the excess risk found in this sector (Figure 3, panel E). Also in mental disorders, there were corresponding but smaller temporary decreases around year 2009 in the manufacturing sector among lower non-manual employees (Figures 2 and 3, panel D) and manual workers (panel F). Furthermore, there was no decrease over the study period in absences due to mental disorders among upper non-manual employees (Figure 2, panel B) in the manufacturing sector. The absence level was originally lowest in this sector, but by the end of the study period, the reduced risk compared to the reference group of knowledge work disappeared (Figure 3, panel D). Otherwise, the differences in sickness absence between industrial sectors remained relatively stable over the study period.

DISCUSSION

We used large register-based data sets on the general population of Finnish wage earners in order to provide novel information on occupational class and industrial sector differences in cause-specific sickness absence trends. We accounted for the potential influence of changes in other socioeconomic factors and employment patterns on the varying trends. Although both occupational and sectoral differences in sickness absence have been previously examined,[1-14] our study is, to our knowledge, the first one to examine differences in sickness absence between industrial sectors within particular occupational classes.

We found that the proportion of employees with sickness absence lasting more than ten working days generally decreased between 2005 and 2013 in all of the examined occupational classes. All in all, the change was smallest among lower non-manual employees. Upper non-manual employees had the lowest and manual workers the highest overall level of sickness absence. The occupational class differences in the overall absence levels were particularly large in musculoskeletal diseases, injuries, and nervous diseases. In the former two disease groups, the decrease in absences nevertheless restricted to manual workers, leading to a reduction in the class differences over time. In mental disorders, in contrast, the absence level was highest and the decrease over time smallest among lower non-manual employees. This led to increasing class differences over time. Also in respiratory and digestive diseases, the decreases over time were smaller among lower non-manual employees. In circulatory diseases, absences decreased in all occupational classes, whereas in neoplasms and nervous diseases, the changes over time where altogether small.

Looking at the two largest disease groups, i.e. musculoskeletal diseases and mental disorders, we found further variation in sickness absence between four large industrial sectors despite the fact that these were examined within particular occupational classes. Among non-manual employees, the overall absence levels were highest in the health and social work sector. Among manual workers, the level in musculoskeletal diseases was highest in the manufacturing sector, where a notable temporary decrease in absences nevertheless occurred during the peak of the economic recession in 2009. Among manual workers and lower non-manual employees, the decrease in absences due to musculoskeletal diseases was smallest in the trade sector.

The contribution of the recession of the late 2000s to changes in the occupational class differences in sickness absence has not been clear. A previous study on municipal employees in the 1990s indicated that occupational class differences in the number of new all-cause sickness absence spells lasting over three days were smaller in the recession years than in the following period of economic growth.[3] Accordingly, we found that the class differences were smallest in 2009, i.e. during the peak of the more recent economic recession. Moreover, we found that changes in the class differences around the time of the recession were largest in musculoskeletal diseases. We also found that the temporary sharp decline in absences in 2009 was most pronounced among manual workers employed in the manufacturing sector. This was the group in our data for which employment decreased most around the time of the recession. In addition to decreases in musculoskeletal morbidity and physically demanding work, it is thus likely that the recession itself was a driving factor behind the decline in sickness absence, especially among manual workers employed in the manufacturing sector. Employees who were strongly affected by labour market insecurity and the threat of unemployment may have been less willing to be absent from work despite their health problems.[1, 3, 21-23] It is also possible that during the recession, affected groups of employees had stronger ill-health-related selection out of employment.[24-26] The decline in sickness absence during the recession could thus have been attributable to excess employment exit among individuals with a higher likelihood of sickness absence.[27]

We found that occupational class differences decreased also in sickness absence due to injuries. However, a corresponding change may not necessarily have occurred in actual injury rates. Absences due to some injuries such as occupational accidents were not included in our data, because these are covered by other insurers than the Social Insurance Institution of Finland (see the Material and methods section for more details). The proportion covered by these other insurers may vary over time and by occupational class. Making interpretations of trends in sickness absence due to injuries is therefore difficult.

Our finding on the smaller decrease among lower non-manual employees in sickness absence due to mental, respiratory, and digestive diseases was not explained by changes in the distribution of factors that were measured in this study, including education, income, and employment patterns. The smaller decrease in sickness absence among lower non-manual employees may therefore have been related to unobserved unfavourable changes in their work environment such as increased psychosocial demands during the period of economic downturn. It may also have been related to labour market changes that reduced sickness absence in the other two occupational classes. However, according to previous findings from Finland, trends in job quality appear to have been relatively similar between occupational classes over our study period.[28] Other findings nevertheless indicated polarization in the labour market of Finland and other Nordic countries between the mid-1990s and mid-2000s, which was interpreted as partly relating to technological advances in the period. The proportion of occupations at both the top and the bottom ends of the wage distribution increased: engineering professionals and other professionals at the top level and personal and protective services at the bottom level became more common. Accordingly, the proportion of occupations at the intermediate level of the wage distribution decreased mainly due to a reduction in office clerks, i.e. routine non-manual employees.[29]. Corresponding changes may have occurred in our study period and affected the job distributions within the occupational classes. A further notable change in the Finnish labour market is that the proportion of employees performing distant work increased from 10% in 2003 to 20% in 2013.[30] This may have contributed to the decrease in sickness absence among particular groups of employees. It is likely that upper non-manual employees are more able to perform distant work while being ill than lower non-manual employees or manual workers.

The generally higher absence levels that we found in the health and social work sector are in accordance with previous studies.[12, 13] Findings from Norway indicated that the higher risk of sickness absence among those employed in health and social occupations was largely explained by their unfavourable psychosocial and physical working conditions.[13] A Finnish study also showed that employees in the combined sector of education, health and social work had poorer health in terms of a higher risk of hospitalization compared to those in other sectors. This applied to various disease groups, including musculoskeletal diseases and mental disorders. Furthermore, the risk of hospitalization at least due to musculoskeletal diseases was higher in the manufacturing sector than in the trade and knowledge work -related sectors.[31] The present study adds to the literature by indicating that the higher level of sickness absence in the health and social work sector compared to other sectors was generally found in both musculoskeletal diseases and mental disorders. However, our novel findings further indicated that this sector difference was only found among non-manual employees. Among manual workers, the absence level in musculoskeletal diseases was highest in the manufacturing sector.

Our study also indicated that the differences in sickness absence between industrial sectors within the occupational classes were relatively stable since the mid-2000s. Exceptions included the above discussed temporary fluctuations around 2009 and the smaller decrease in absences due to musculoskeletal diseases in the trade sector compared to other ones within the lower classes. The more unfavourable trends of the trade sector were not explained by changes in the distribution of any of the measured socioeconomic factors and employment patterns. More research is needed to determine whether e.g. changes in working conditions or types of jobs within the trade sector contributed to the trends.

Overall, our findings indicated that the occupational class and industrial sector differences in sickness absence trends largely depended on the disease causing work disability. In musculoskeletal diseases, the changes over time varied most. Musculoskeletal diseases may be considered as work-related and their diagnoses are often symptom-based. Changes in the work or economic conditions may have affected how particular groups of employees cope with their symptoms and behave while being ill. In other causes such as circulatory diseases, the decrease in absences was more consistent across the classes, which may have been related to equality in terms of decreased morbidity and improved treatment.

The strengths of this study included nationally representative samples of the Finnish population and register-based data sets that did not have the problem of missing information due to non-response. The rich data comprised longitudinal information on employment and sociodemographic factors as well as on sickness absence and its diagnostic cause. Furthermore, the very large samples allowed us to examine cause-specific sickness absence between industrial sectors within different occupational classes, thereby capturing occupational groups with relatively similar types of jobs. Our findings may be generalizable to countries in which the manufacturing sector in particular was affected by the recession of the late 2000s and in which also the sickness benefit system is relatively generous.

There were nevertheless also certain limitations. Our outcome measure was based on national data on compensated sickness absence spells that begin after a period of ten working days. Sickness absence spells that did not exceed ten working days were therefore not covered. Moreover, our outcome measure was based on new onset of sickness absence. The predictors of sickness absence might be different when examining e.g. the occurrence of short-term spells, the number of spells of different lengths, or the total number of absence days.[32-36]

Although our results indicated that other socioeconomic factors and employment patterns partly explained the occupational class and industrial sector differences in the overall level of cause-specific sickness absence, they did not appear to explain the varying trends. Factors that were not measured in this study, such as changes in health, lifestyle, work exposures, and labour market conditions, were therefore likely to have contributed to the differences in the trends. Sickness absence trends may have been affected also by changes in national sickness insurance legislation aiming at enhancing work participation.[37-39]

It should be noted that the recession might have led to a larger health inequality between the employed and non-employed populations than between the different socioeconomic groups among the employed. Focusing on sickness absence among an employed population may therefore not have revealed some of the potential effects of the recent economic recession on health and health inequalities.[40-44]

CONCLUSIONS

The proportion of wage earners with sickness absence lasting more than ten working days decreased in Finland between 2005 and 2013 in all occupational classes. Overall, the change was smallest among lower non-manual employees. Occupational class differences in sickness absence trends nevertheless varied by disease group. There were notable and relatively stable differences in sickness absence between industrial sectors even when these were examined within particular occupational classes. Moreover, the association between industrial sector and sickness absence varied across the occupational classes. At the time of the economic recession of the late 2000s, there was a temporary decrease in sickness absence due to musculoskeletal diseases specifically among manual workers employed in the manufacturing sector, i.e. in a segment of wage earners that are known to have been hit hard by the recession. However, differences in the trends amongst occupational classes and industrial sectors were not explained by the measured structural changes in other socioeconomic factors or employment patterns. The complex interplay between occupational class and industrial sector should be taken into account when tackling problems of work disability.

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Contributors: EVJ obtained the data. SS and EVJ conceived the study. All authors designed the study. SS and TL prepared the data for analyses. TL conducted the statistical analyses. All authors contributed to interpretation of the results. TL wrote the first drafts of the article. All authors discussed and revised the drafts and prepared the final manuscript.

Competing interests: None declared.

Data sharing statement: Due to data protection regulations of the administrative sources providing the register data, the authors do not have the permission to share the data. Permissions to use the register data can be applied from the Social Insurance Institution of Finland (http://www.kela.fi/web/en/research-data-requests), the Finnish Centre for Pensions (http://www.etk.fi/en/statistics-2/statistics/producer-of-statistics/), and Statistics Finland (http://www.stat.fi/meta/tietosuoja/kayttolupa_en.html).

REFERENCES

1. Allebeck P, Mastekaasa A. Swedish Council on Technology Assessment in Health Care (SBU). Chapter 5. Risk factors for sick leave – general studies. *Scand J Public Health* 2004;32(Suppl 63):49–108.

2. Melchior M, Krieger N, Kawachi I, et al. Work factors and occupational class disparities in sickness absence: findings from the GAZEL cohort study. *Am J Public Health* 2005;95:1206–12.

3. Piha K, Martikainen P, Rahkonen O, et al. Trends in socioeconomic differences in sickness absence among Finnish municipal employees 1990-99. *Scand J Public Health* 2007;35:348–55.

4. Christensen KB, Labriola M, Lund T, et al. Explaining the social gradient in long-term sickness absence: a prospective study of Danish employees. *J Epidemiol Community Health* 2008;62:181–3.

5. Hansen H-T, Ingebrigtsen T. Social class and sickness absence in Norway. *Acta Sociologica* 2008;51:309–27.

6. Piha K, Laaksonen M, Martikainen P, et al. Interrelationships between education, occupational class, income and sickness absence. *Eur J Public Health* 2010;20:276–80.

7. d'Errico A, Costa G. Socio-demographic and work-related risk factors for medium- and long-term sickness absence among Italian workers. *Eur J Public Health* 2012;22:683–8.

8. Löve J, Hensing G, Holmgren K, et al. Explaining the social gradient in sickness absence: a study of a general working population in Sweden. *BMC Public Health* 2013;13:545.

9. Pekkala J, Blomgren J, Pietiläinen O, et al. Occupational class differences in long sickness absence: a register-based study of 2.1 million Finnish women and men in 1996-2013. *BMJ Open* 2017;7:e014325.

10. Pekkala J, Blomgren J, Pietiläinen O, et al. Occupational class differences in diagnostic-specific sickness absence: a register-based study in the Finnish population, 2005–2014. *BMC Public Health* 2017;17:670.

11. Sumanen H, Lahelma E, Pietiläinen O, et al. The magnitude of occupational class differences in sickness absence: 15-year trends among young and middle-aged municipal employees. *Int J Environ Res Public Health* 2017;14:625.

12. Lund T, Labriola M, Villadsen E. Who is at risk for long-term sickness absence? A prospective cohort study of Danish employees. *Work* 2007;28:225–30.

13. Aagestad C, Tyssen R, Sterud T. Do work-related factors contribute to differences in doctor-certified sick leave? A prospective study comparing women in health and social occupations with women in the general working population. *BMC Public Health* 2016;16:235.

14. Knutsson A, Goine H. Occupation and unemployment rates as predictors of long term sickness absence in two Swedish counties. *Soc Sci Med* 1998;47:25–31.

15. Bettio F, Corsi M, D'Ippoliti C, et al. The impact of the economic crisis on the situation of women and men and on gender equality policies. Synthesis report. Luxembourg: Publications Office of the European Union, 2013.

16. Statistics Finland. StatFin online service. 2017. http://www.stat.fi/tup/statfin/index_en.html Accessed 13 December 2017.

17. European Commission. Employment and social developments in Europe 2017. Luxembourg: Publications Office of the European Union, 2017.

18. Leinonen T, Viikari-Juntura E, Husgafvel-Pursiainen K, et al. Labour market segregation and gender differences in sickness absence: trends in 2005–2013 in Finland. *Ann Work Expo Health* Published online 29 December 2017.

19. The Social Insurance Institution of Finland. Sickness allowance. 2017. http://www.kela.fi/web/en/sickness-allowance Accessed 8 December 2017.

20. Statistics Finland. Classifications. 2017. https://www.stat.fi/meta/luokitukset/index_en.html Accessed 2 January 2018.

21. Askildsen JE, Bratberg E, Nilsen ØA. Unemployment, labor force composition and sickness absence: a panel data study. *Health Econ* 2005;14:1087–101.

22. Virtanen M, Kivimäki M, Elovainio M, et al. Local economy and sickness absence: prospective cohort study. *J Epidemiol Community Health* 2005;59:973–78.

23. Pfeifer C. Cyclical absenteeism among private sector, public sector and self-employed workers. *Health Econ* 2013;22:366–70.

24. Evans-Lacko S, Knapp M, McCrone P, et al. The mental health consequences of the recession: economic hardship and employment of people with mental health problems in 27 European countries. *PLoS One* 2013;8:e69792.

25. Heggebø K. Unemployment in Scandinavia during an economic crisis: cross-national differences in health selection. *Soc Sci Med* 2015;130:115–24.

26. Heggebø K, Dahl E. Unemployment and health selection in diverging economic conditions: compositional changes? Evidence from 28 European countries. *Int J Equity Health* 2015;14:121.

27. Hesselius P. Does sickness absence increase the risk of unemployment? *The Journal of Socio-Economics* 2007;36:288–310.

28. Mustosmäki A, Oinas T, Anttila T. Abating inequalities? Job quality at the intersection of class and gender in Finland 1977–2013. *Acta Sociologica* 2017;60:228–45.

29. Asplund R, Barth E, Lundborg P, et al. Polarization of the Nordic labour markets. *Finnish Economic Papers* 2011;24:87–100.

30. Sutela H, Lehto A-M. Työolojen muutokset 1977–2013 [Changes in working conditions 1977–2013]. Helsinki: Tilastokeskus, 2014.

31. Kokkinen L, Kouvonen A, Koskinen A, et al. Differences in hospitalizations between employment industries, Finland 1976 to 2010. *Ann Epidemiol* 2014;24:598–605.

32. Melchior M, Niedhammer I, Berkman LF, et al. Do psychosocial work factors and social relations exert independent effects on sickness absence? A six year prospective study of the GAZEL cohort. *J Epidemiol Community Health* 2003;57:285–93.

33. Alavinia SM, van den Berg TIJ, van Duivenbooden C, et al. Impact of work-related factors, lifestyle, and work ability on sickness absence among Dutch construction workers. *Scand J Work Environ Health* 2009;35:325–33.

34. Kristensen TR, Jensen SM, Kreiner S, et al. Socioeconomic status and duration and pattern of sickness absence. A 1-year follow-up study of 2331 hospital employees. *BMC Public Health* 2010;10:643.

35. Laaksonen M1, Pitkäniemi J, Rahkonen O, et al. Work arrangements, physical working conditions, and psychosocial working conditions as risk factors for sickness absence: Bayesian analysis of prospective data. *Ann Epidemiol* 2010;20:332–8.

36. Magnavita N, Garbarino S. Is absence related to work stress? A repeated cross-sectional study on a special police force. *Am J Ind Med* 2013;56:765–75.

37. Kausto J, Viikari-Juntura E, Virta LJ, et al. Effectiveness of new legislation on partial sickness benefit on work participation: a quasi-experiment in Finland. *BMJ Open* 2014;4:e006685.

38. Halonen JI, Solovieva S, Pentti J, et al. Effectiveness of legislative changes obligating notification of prolonged sickness absence and assessment of remaining work ability on return to work and work participation: a natural experiment in Finland. *Occup Environ Med* 2016;73:42–50.

39. Viikari-Juntura E, Virta LJ, Kausto J, et al. Legislative change enabling use of early part-time sick leave enhanced return to work and work participation in Finland. *Scand J Work Environ Health* 2017;43:447–56.

40. Bacigalupe A, Esnaola S, Martín U. The impact of the Great Recession on mental health and its inequalities: the case of a Southern European region, 1997–2013. *Int J Equity Health* 2016;15:17.

41. Bruggink J-W, de Goeij MCM, Otten F, et al. Changes between pre-crisis and crisis period in socioeconomic inequalities in health and stimulant use in Netherlands. *Eur J Public Health* 2016;26:772–7.

42. Frasquilho D, Matos MG, Salonna F, et al. Mental health outcomes in times of economic recession: a systematic literature review. *BMC Public Health* 2016;16:115.

43. Parmar D, Stavropoulou C, Ioannidis JPA. Health outcomes during the 2008 financial crisis in Europe: systematic literature review. *BMJ* 2016;354:i4588.

44. Nelson K, Tøge AG. Health trends in the wake of the financial crisis—increasing inequalities? *Scand J Public Health* 2017;45(Suppl 18):22–9.

Figure captions

Figure 1. Estimated annual proportion of employees with a new onset of cause-specific (A-H) sickness absence (‰) by occupational class. The panels are presented in different scales; Model 1 (M1): Adjusted for age and gender; Model 2 (M2): Adjusted for age, gender, education, industrial sector, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between occupational class and year: A) M1: 0.000, M2: 0.000, B) M1: 0.000, M2: 0.000, C) M1: 0.000, M2: 0.000, D) M1: 0.099, M2: 0.100, E) M1: 0.035, M2: 0.041, F) M1: 0.000, M2: 0.000, G) M1: 0.449, M2: 0.568, H) M1: 0.021, M2: 0.165.

Figure 2. Estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; Adjusted for age, gender, education, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between industrial sector and year: A) 0.550, B) 0.053, C) 0.014, D) 0.001, E) 0.000, F) 0.000.

Figure 3. Annual risk (ORs and their 95% confidence intervals) of having a new onset of sickness absence due to musculoskeletal diseases and mental disorders by industrial sector (OR=1.00 for the knowledge work sector in each year) among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. Adjusted for age, gender, education, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between industrial sector and year: A) 0.550, B) 0.053, C) 0.014, D) 0.001, E) 0.000, F) 0.000.

Supplementary material captions

Supplementary Table 1. Annual distribution (%) of the study population over the study period by background characteristics.

Supplementary Table 2. Distribution (%) of the study population by sociodemographic and employment factors among those employed in different industrial sectors within different occupational classes averaging over the whole study period.

Supplementary Figure 1. Age- and gender-adjusted estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; P-values for the interaction between industrial sector and year: A) 0.302, B) 0.006, C) 0.000, D) 0.005, E) 0.000, F) 0.004.

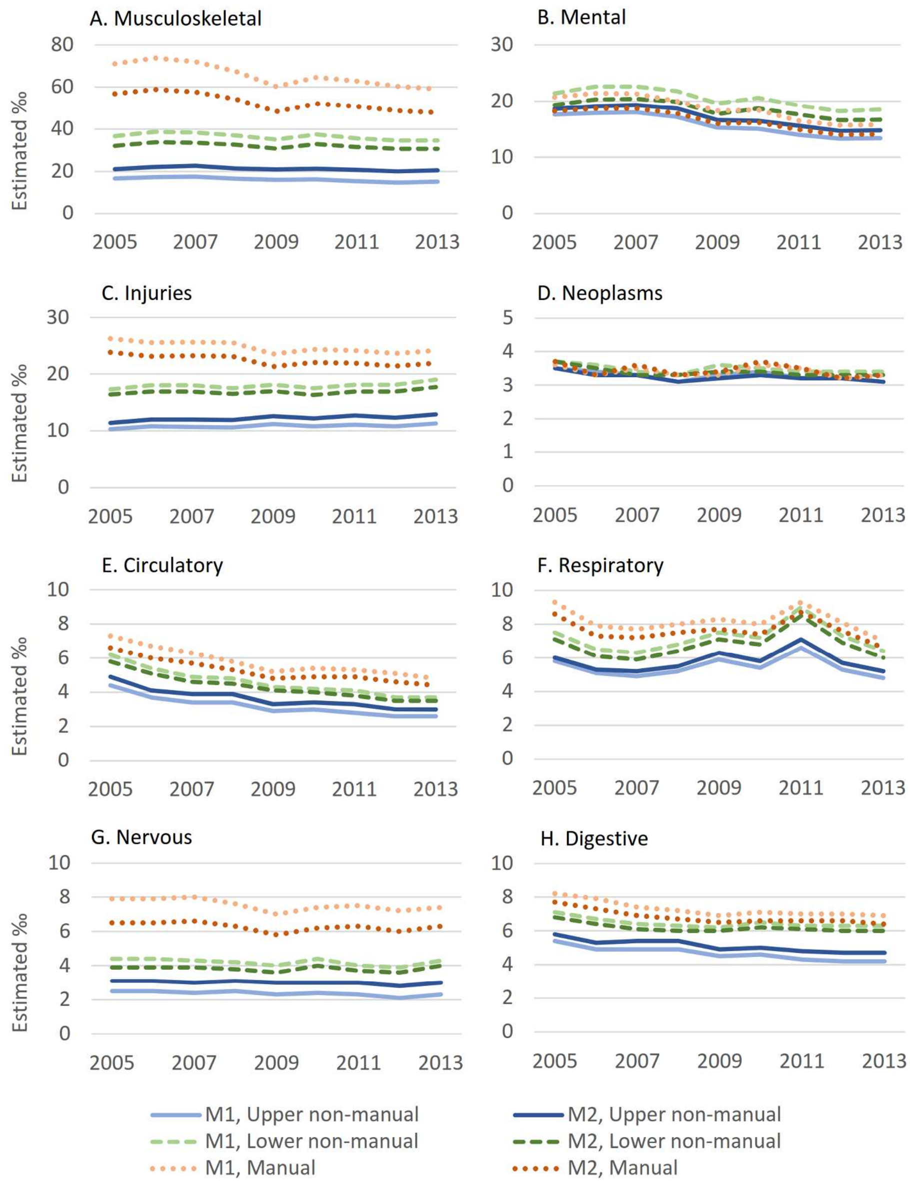

Figure 1

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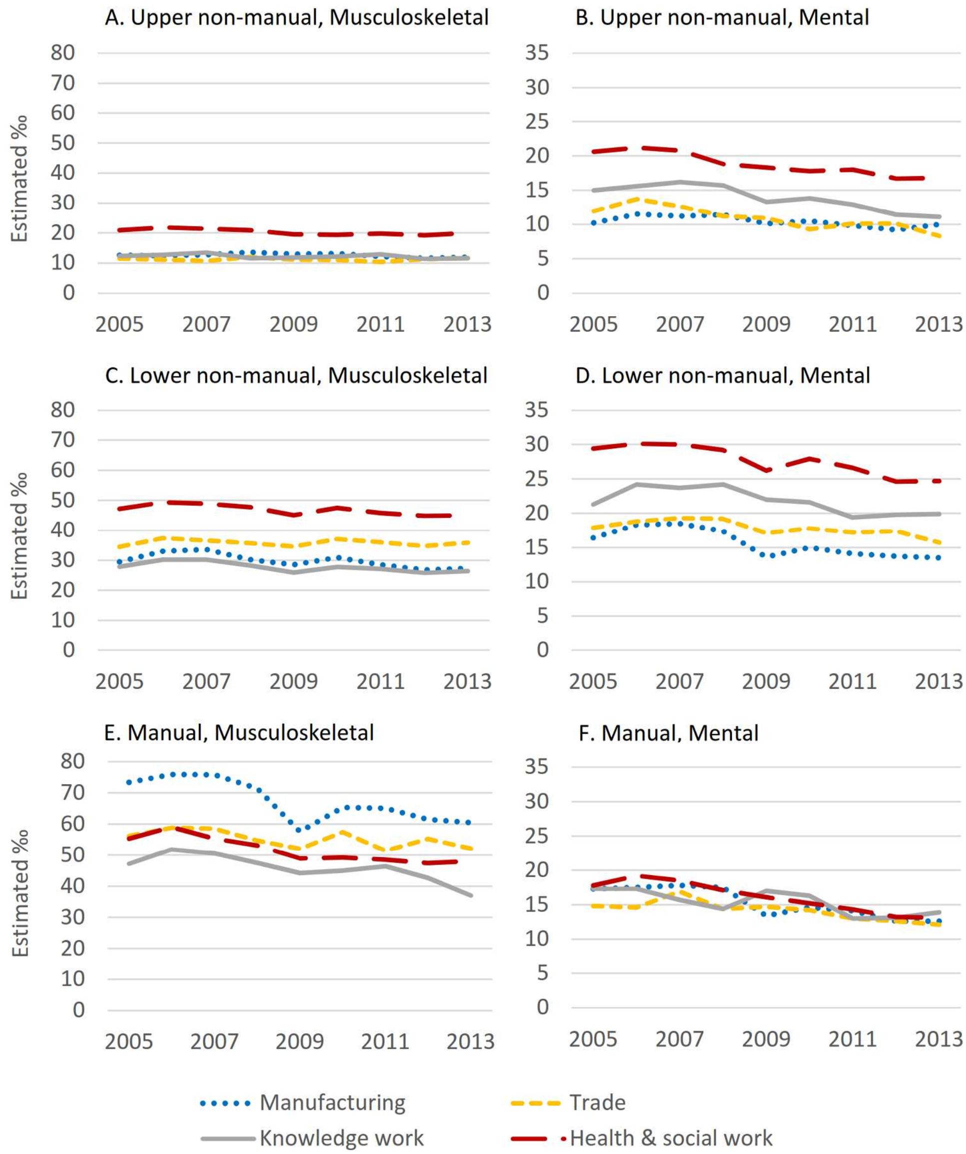

Figure 2

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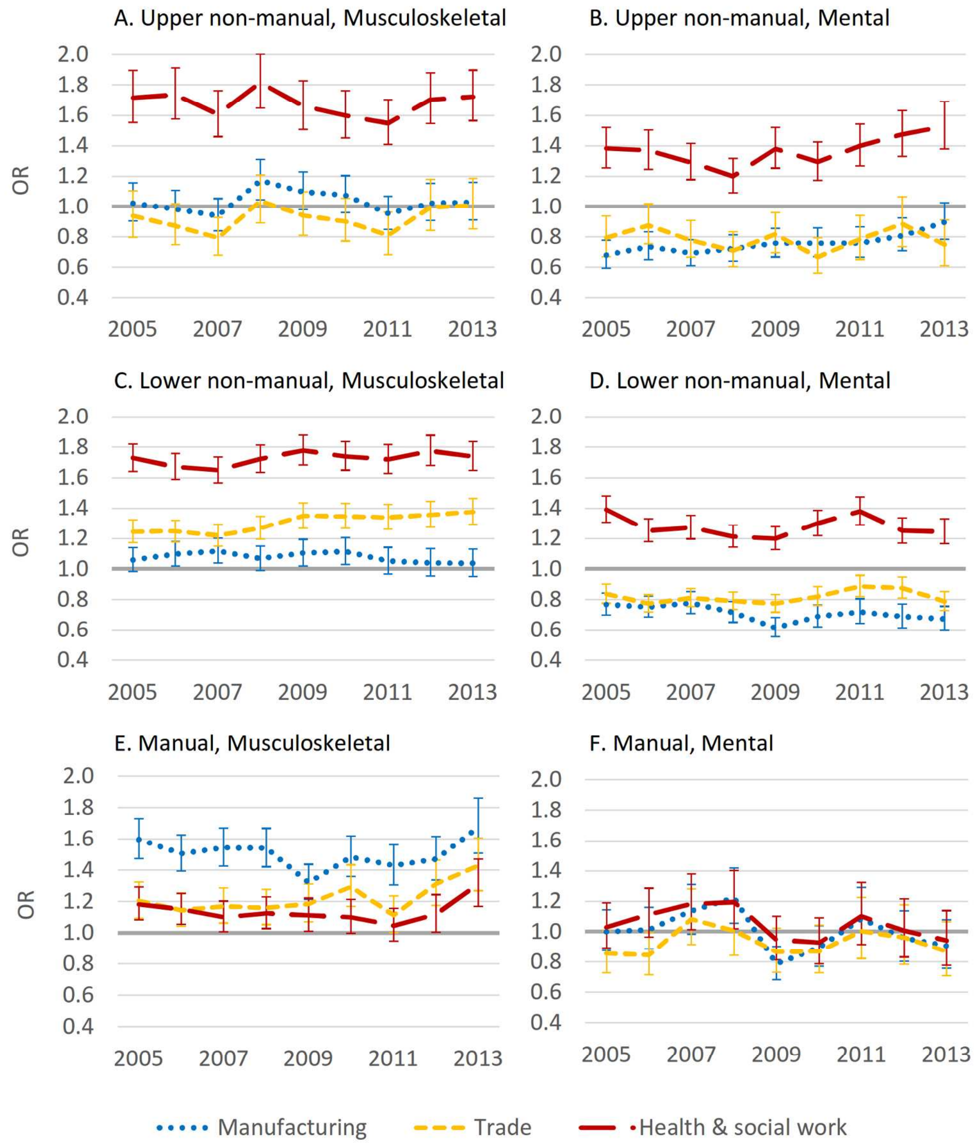

Figure 3

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Supplementary Table 1. Annual distribution (%) of the study population over the study period by background characteristics.

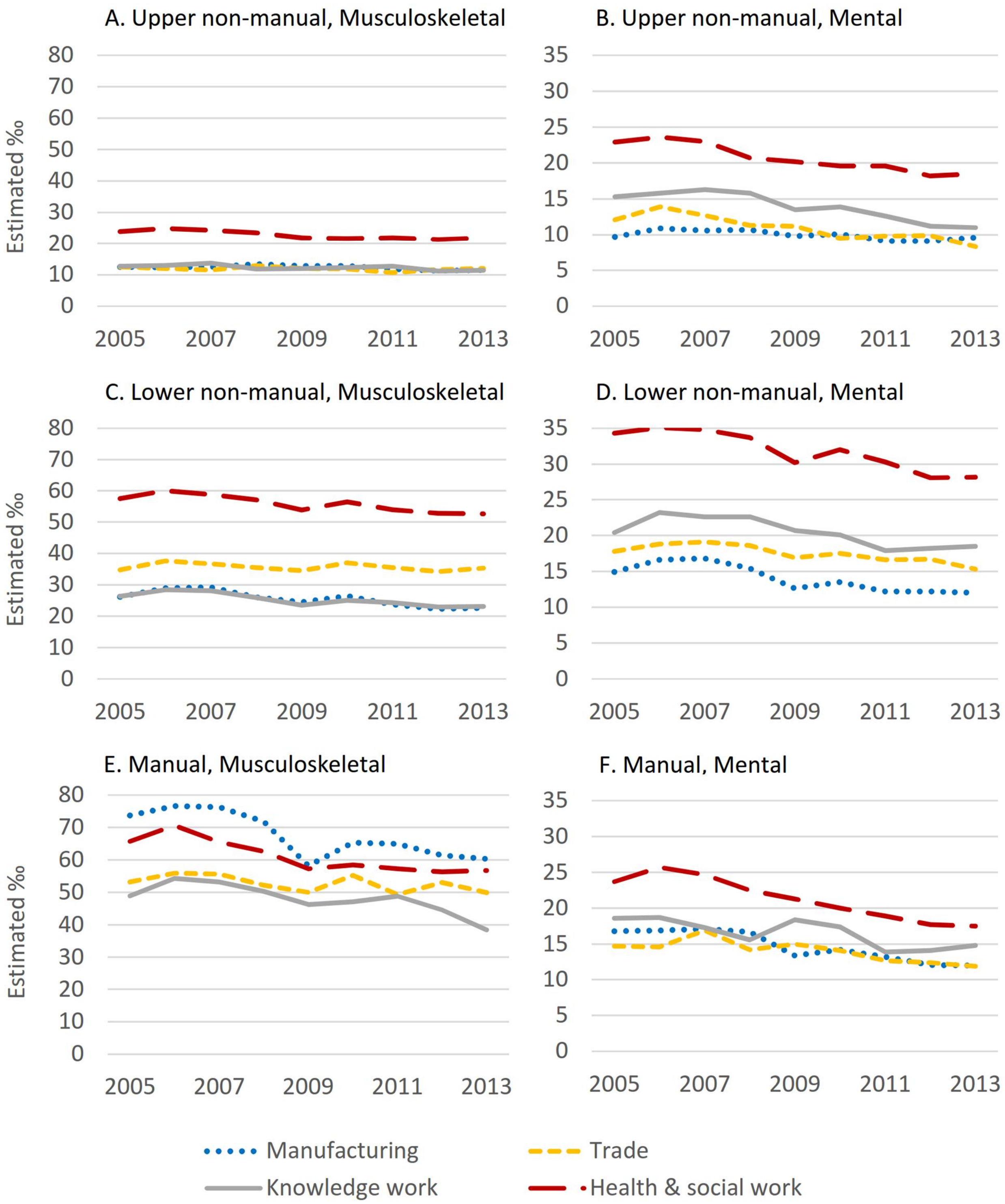
	Year								
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Age									
25-29	12.8	12.9	12.9	13.2	13.3	13.2	13.5	13.4	13.1
30-34	12.8	13.0	13.3	13.7	14.2	14.3	14.5	14.4	14.5
35-39	15.0	14.7	14.3	13.8	13.3	13.4	13.5	13.8	14.2
40-44	16.0	16.0	15.9	15.8	15.6	15.3	14.8	14.5	14.0
45-49	15.8	15.8	15.7	15.6	15.7	15.8	15.7	15.7	15.7
50-54	15.1	15.1	15.3	15.2	15.0	15.0	14.9	14.9	15.0
55-59	12.5	12.6	12.7	12.8	12.9	13.1	13.1	13.4	13.5
Gender									
Men	49.3	49.3	49.3	49.2	48.6	47.9	48.2	48.2	47.9
Women	50.7	50.7	50.7	50.8	51.4	52.1	51.9	51.8	52.1
Education									
Higher tertiary	12.7	13.1	13.3	13.7	14.5	15.0	15.4	15.7	16.1
Lower tertiary	29.7	29.8	29.8	29.8	30.0	30.4	30.4	30.4	30.5
Secondary	41.8	42.2	42.7	43.1	42.8	42.8	43.0	43.2	43.2
Primary	15.9	14.9	14.2	13.5	12.7	11.8	11.3	10.8	10.2
Occupational class									
Upper non-manual	24.3	25.2	25.4	25.6	26.4	26.9	25.8	26.0	26.1
Lower non-manual	40.8	40.2	40.2	40.4	40.7	41.3	42.7	42.7	43.1
Manual	34.9	34.6	34.3	34.0	33.0	31.9	31.5	31.4	30.9
Industrial sector									
Manufacturing	20.1	19.6	19.5	19.4	18.8	17.5	17.2	17.0	16.4
Trade	11.2	11.2	11.2	11.2	11.3	11.4	11.4	11.4	11.4
Knowledge work	12.4	12.5	12.5	12.9	13.0	13.1	13.1	13.2	13.2
Health & social work	16.7	16.8	17.0	16.9	17.3	17.8	17.8	18.0	18.5
Other	39.6	39.8	39.8	39.6	39.5	40.2	40.4	40.4	40.5

Employment sector									
Private	62.4	62.6	62.6	63.1	63.1	62.8	62.7	62.9	62.6
Public	32.2	31.8	30.4	29.7	30.2	30.6	30.1	30.3	30.6
Private and public	4.9	5.1	6.5	6.6	6.3	6.1	6.3	6.1	6.2
Transition to self-employment	0.5	0.5	0.6	0.6	0.6	0.6	0.9	0.7	0.6
Income									
Quintile 1 (highest)	17.1	17.7	18.8	19.8	20.2	21.0	21.9	21.8	21.7
Quintile 2	17.9	18.9	19.2	19.5	20.0	20.8	21.3	21.1	21.4
Quintile 3	19.2	19.9	19.7	19.6	19.8	20.5	20.5	20.3	20.5
Quintile 4	22.5	21.9	21.2	20.5	19.9	19.2	18.1	18.4	18.3
Quintile 5 (lowest)	23.3	21.6	21.1	20.6	20.1	18.4	18.3	18.5	18.1
Employed time									
Full year	90.5	90.4	90.6	90.8	90.5	91.5	91.4	91.2	91.3
200-364 days	6.8	7.0	7.1	6.9	6.5	6.1	6.4	6.5	6.3
1-199 days	2.7	2.6	2.4	2.2	3.0	2.4	2.2	2.3	2.4
Employment episodes									
1	90.0	89.5	88.2	88.3	89.2	89.3	88.5	88.9	89.1
2	7.0	7.4	8.5	8.5	7.8	7.7	8.5	8.2	8.0
3+	3.0	3.0	3.4	3.2	3.1	2.9	3.0	2.9	2.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	1 097 598	1 100 322	1 109 041	1 122 238	1 117 179	1 081 698	1 094 294	1 092 208	1 080 951

Supplementary Table 2. Distribution (%) of the study population by sociodemographic and employment factors among those employed in different industrial sectors within different occupational classes averaging over the whole study period.

	Upper non-manual					Lower non-manual					Manual				
	Manu-fac-turing	Trade	Know-ledge work	Health & social work	All	Manu-fac-turing	Trade	Know-ledge work	Health & social work	All	Manu-fac-turing	Trade	Know-ledge work	Health & social work	All
Age															
25-29	7.7	9.0	12.9	9.5	10.1	12.4	18.3	15.1	11.1	13.7	13.6	21.3	14.2	7.1	14.8
30-34	15.5	14.6	18.6	12.4	15.0	16.5	16.1	14.5	12.2	13.9	13.6	16.4	10.9	7.7	12.9
35-39	19.2	17.1	16.7	13.6	15.7	15.5	15.2	12.7	13.1	13.7	14.0	14.7	11.1	10.3	13.1
40-44	18.9	18.9	15.4	15.6	16.4	15.4	15.2	14.6	15.2	15.2	14.9	14.4	13.5	1.4	14.7
45-49	15.9	17.1	14.5	17.5	16.0	14.3	13.4	15.3	17.2	15.8	15.2	12.8	16.1	17.6	15.5
50-54	12.7	13.3	12.1	17.4	14.5	13.6	11.5	14.7	17.1	15.0	15.5	11.2	17.6	20.9	15.6
55-59	10.3	10.1	9.7	14.0	12.4	12.2	10.2	13.1	14.1	12.9	13.1	9.3	16.6	22.3	13.5
Gender															
Men	78.5	68.5	65.0	18.2	52.0	56.1	37.6	37.9	7.6	30.3	77.8	79.1	65.0	15.4	69.1
Women	21.5	31.6	35.0	81.8	48.0	43.9	62.4	62.1	92.4	69.7	22.2	20.9	35.0	84.6	30.9
Education															
Higher tertiary	38.2	25.2	42.4	45.0	47.7	10.9	3.0	9.1	1.2	4.7	0.4	0.4	1.6	0.6	0.5
Lower tertiary	46.4	46.7	37.6	48.4	37.0	54.2	32.6	51.2	43.4	44.2	6.5	7.8	11.0	6.7	6.9
Secondary	11.2	21.5	16.7	5.8	12.4	27.0	47.2	31.0	49.9	41.6	70.3	68.7	63.9	69.3	67.9
Primary	4.1	6.7	3.4	0.7	3.0	7.9	17.2	8.7	5.5	9.5	22.9	23.0	23.4	23.3	24.7
Employment sector															
Private	96.2	95.6	81.4	14.0	49.0	97.1	96.1	86.2	17.4	56.9	97.6	95.6	66.3	20.4	80.8
Public	0.1	0.2	12.1	72.3	41.4	0.2	0.2	9.9	73.3	36.7	0.1	1.3	27.4	71.2	14.7
Private and public	3.1	3.1	5.6	12.9	8.8	2.4	3.0	3.4	9.0	6.0	1.9	2.3	5.7	8.2	3.8
Transition to self-employment	0.6	1.1	0.9	0.9	0.8	0.4	0.7	0.5	0.3	0.5	0.4	0.8	0.6	0.2	0.7

Income															
Quintile 1 (highest)	73.3	66.4	56.7	32.6	48.7	28.8	13.0	19.8	2.0	11.7	13.1	5.0	5.5	0.9	8.1
Quintile 2	15.7	16.1	22.4	21.0	24.0	33.7	14.0	24.6	12.3	18.5	25.6	15.3	15.2	2.5	18.7
Quintile 3	5.5	7.2	9.5	21.0	12.1	19.4	15.2	24.1	29.5	23.0	27.5	22.9	22.7	8.7	22.5
Quintile 4	2.6	4.4	5.1	15.3	7.4	10.9	22.3	17.8	33.6	24.9	21.3	28.0	25.8	36.0	23.7
Quintile 5 (lowest)	3.0	5.9	6.3	10.2	7.9	7.2	35.5	13.6	22.7	21.9	12.5	28.8	30.9	51.9	27.1
Employed time															
Full year	94.9	93.2	93.6	93.2	93.3	94.3	90.9	93.1	91.5	91.8	92.9	89.8	89.1	81.6	87.9
200-364 days	3.6	5.0	4.9	5.3	5.2	4.0	6.7	5.0	6.3	5.9	4.9	7.3	7.4	11.0	8.7
1-199 days	1.5	1.8	1.5	1.5	1.5	1.7	2.4	1.9	2.2	2.3	2.2	2.9	3.5	7.4	3.4
Employment episodes															
1	94.3	92.9	90.6	82.7	87.2	95.2	92.2	93.1	86.5	89.9	95.0	92.2	88.7	83.0	89.3
2	4.9	5.8	7.4	12.5	9.3	4.0	6.1	5.6	8.2	7.1	4.2	6.4	8.3	9.0	8.0
3+	0.8	1.3	2.0	4.8	3.5	0.8	1.7	1.3	5.4	3.0	0.8	1.5	3.1	8.0	2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0



Supplementary Figure 1. Age- and gender-adjusted estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; P-values for the interaction between industrial sector and year: A) 0.302, B) 0.006, C) 0.000, D) 0.005, E) 0.000, F) 0.004.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
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, 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4, 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5, 6
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-10
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
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	6-10
Bias	9	Describe any efforts to address potential sources of bias	18, 19
Study size	10	Explain how the study size was arrived at	6, 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9, 10
		(*b*) Describe any methods used to examine subgroups and interactions	9, 10
		(*c*) Explain how missing data were addressed	na
		(*d*) If applicable, explain how loss to follow-up was addressed	na
		(*e*) Describe any sensitivity analyses	na
Results			

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	na
		(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	10, 11
		(b) Indicate number of participants with missing data for each variable of interest	na
		(c) Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	Report numbers of outcome events or summary measures over time	11, 12
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	11-14
		(*b*) Report category boundaries when continuous variables were categorized	9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	11-14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	14, 15
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
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	20

*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.

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Cause-specific sickness absence trends by occupational class and industrial sector in the context of recent labour market changes: a Finnish panel data study

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Cause-specific sickness absence trends by occupational class and industrial sector in the context of recent labour market changes: a Finnish panel data study

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ABSTRACT

Objectives: We aimed to provide previously unestablished information on population-based differences in cause-specific sickness absence trends between occupational classes and further between four large industrial sectors within the different occupational classes while controlling for other socioeconomic factors and employment patterns. We focused on the period 2005–2013, during which the labour market underwent large economic and structural changes in many countries.

Design: Register-based panel data study.

Setting: Large representative data sets on Finnish wage earners aged 25–59 years.

Outcome measure: Annual risk of sickness absence (> ten working days) based on repeated logistic regression.

Results: Between 2005 and 2013, the proportion of employees with sickness absence decreased. Occupational class differences in sickness absence trends varied by disease group. Overall, the decrease in absences was smallest among lower non-manual employees. Sickness absence levels were highest in the health and social work sector and in the manufacturing sector within the non-manual and manual classes, respectively. Absences due to musculoskeletal diseases decreased temporarily during the peak of the economic recession in 2009, particularly in the manufacturing sector within the manual class. The decrease in absences due to musculoskeletal diseases was smallest in the trade sector within the lower occupational classes. Overall, education, income, and employment patterns partly explained the differences in the absence levels, but not in the trends.

Conclusions: We found a complex interplay between the associations of occupational class and industrial sector with sickness absence trends. During the economic recession, absences due to musculoskeletal diseases decreased temporarily in a segment of wage earners that are known to have been hit hard by the recession. However, the trend differences were not explained by the

measured structural changes in the characteristics of the study population. Both occupational class and industrial sector should be taken into account when tackling problems of work disability.

Strengths and limitations of this study

- The large register-based data sets were representative of Finnish wage earners and did not have the problem of missing information due to non-response.
- The data had sufficient statistical power for examining cause-specific sickness absence trends by large industrial sectors within different occupational classes.
- The rich data included information on various covariates, including education, employment sector, income, time spent in employment, and the number of employment episodes.
- The data lacked information on some potentially important covariates such as health status, lifestyle factors, work exposures, and labour market conditions.
- The sickness absence outcome was based on national data on compensated spells that begin after a period of ten working days, thereby excluding shorter spells.

INTRODUCTION

The association of low occupational class with a higher likelihood of sickness absence has been established in many European countries.[1-11] The occupational class differences have been particularly large in absences due to musculoskeletal diseases, and smaller but still notable in most other disease groups. In mental disorders, the absence levels have been similar or even higher among lower non-manual employees than among manual workers.[2, 10]

In addition to occupational class, industrial sector is closely associated with working conditions and the broader work environment, which affect the ability of an individual to perform in his or her own job. A previous study from Denmark indicated that the risk of long-term sickness absence was higher than average in the health care and social services sector and lower than average in the private administration sector, but otherwise the differences between the sectors were small.[12] Accordingly, a Norwegian study indicated that the risk of long-term sickness absence was higher among women employed in health and social occupations than among the general female employed population.[13] There may also be an important interplay between occupational class and industrial sector; even within a particular occupational class, the types of jobs may vary considerably between different sectors. Previous population-based findings from Denmark[12] and Sweden[14] have shown large differences in long-term sickness absence between particular occupational groups. Variation in sickness absence between industrial sectors within different occupational classes nevertheless remains unclear.

From the start of the millennium, Finland and other European countries have experienced two key labour market changes that may have had varying consequences for the health, work ability, and illness behaviour of individuals in different occupational classes and industrial sectors. Firstly, particular sectors including manufacturing and construction were hit hard by the economic recession of the late 2000s, whereas other sectors such health and social services were less affected.[15] In Finland, the economic recession peaked in 2009. This was the only year in which the change in the GDP was negative (-6.5%). A specific feature for Finland was that there was another decline in the GDP growth after 2011. The manufacturing sector was affected the most: the number of wage earners employed in this sector decreased by 9.4% between 2008 and 2009, while the corresponding decrease in the total wage-earner population was 3.8%.[16] Secondly, the labour market has undergone longer-term structural changes through which employment in non-manual occupations as well as in the knowledge work and service sectors has increased.[16, 17] These economic and structural changes are likely to have been associated with changes in the types of jobs as well as in the work, employment and social conditions of individuals within particular occupational classes and industrial sectors.

Recent economic and structural changes in the labor market may have led to changes in the associations of occupational class and industrial sector with sickness absence. Previous studies from Finland indicated that during recent decades, the overall level as well as occupational class differences in sickness absence have mainly decreased.[9-11] However, the contribution of the recession of the late 2000s to changes in the occupational class differences in sickness absence remains unclear. Moreover, information on trends in sickness absence by industrial sector are altogether lacking. Further, little is known of whether occupational class and industrial sector differences in sickness absence trends can be attributed to longer-term structural changes in the labour market, such as those related to educational attainment, income, private versus public sector employment, or other employment patterns. Information on sickness absence trends and their explanations would help identify vulnerable groups in order to prevent work disability and extend working careers.

We used large register-based data sets to examine cause-specific sickness absence trends in 2005–2013 by occupational class and further by industrial sector among the general population of Finnish wage earners while accounting for other socioeconomic factors and employment patterns. We thereby aimed to explore whether occupational class and industrial sector differences in cause-specific sickness absence trends were influenced by changes in the characteristics of the wage-earner population over a period of major economic fluctuations. The more particular research questions are listed below.

1. Do the trends in sickness absence due to all causes, musculoskeletal diseases, mental disorders, neoplasms, circulatory diseases, respiratory diseases, or digestive diseases differ between occupational classes?
2. Do the trends in sickness absence due to the two largest disease groups, i.e. musculoskeletal diseases and mental disorders, vary between four large industrial sectors within different occupational classes?
3. Are the occupational class and industrial sector differences in cause-specific sickness absence trends influenced by changes over the study period in education, employment sector, income, time spent in employment, and the number of employment episodes?

MATERIAL AND METHODS

Study population

We used large register-based data sets with 70% nationally representative random samples of the Finnish working aged population from three cross-sections on the last days of the years 2004, 2007, and 2010. Each of the cohorts were followed up for three calendar years to cover a nine-year study period between 2005 and 2013. The data included information on compensated sickness absences and national pensions obtained from the Social Insurance Institution of Finland, on sociodemographic factors obtained from the Finnish Longitudinal Employer-Employee Data (FLEED) of Statistics Finland, and on employment and earnings-related pensions from the Finnish Centre for Pensions, as also described in our previous study on gender differences in sickness absence.[18]

Criteria for being included in the study population were applied separately to each study year. An individual could thus be excluded in one year and included in others. We restricted the study population to those aged 25–59 on the last day of the year preceding the study year. We included individuals who were employed wage earners according to their main economic activity and socioeconomic status and did not receive full pensions (full disability pensions, unemployment pensions, special pensions for farmers, or old-age pensions) before the study year. We also required that the study person had an ongoing employment period (in the private sector, in the public sector, or in both, but not in self-employment) and did not have an ongoing compensated sickness absence spell at the beginning of the study year. The excluded were subsequently either self-employed (8.7% of the original study population), unemployed (8.0%), retired (14.1%), otherwise non-employed (9.9%), or on sick leave (0.8%). We allowed for non-employment and self-employment later during the study year, adjusting for these factors in the analyses. We nevertheless excluded those who started receiving full pensions (0.2%), emigrated (0.1%), or died (0.05%) during the study year. Finally, we excluded those who did not live in Finland two years before the end of the year preceding the study year (0.2%). We did this because we used the population samples from the end of years 2004, 2007, and 2010 to form the study population in years 2005–2007, 2008–2010, and 2011–2013, respectively; since the study population in years 2007, 2010, and 2013 by design lived in Finland two years before, we applied the same inclusion criteria for all of the years.

After all exclusions, 74.0% of the remaining individuals were included in the study population in each of the three consecutive years (calculated among those who fit the age range 25–59 in all three years). The final study population consisted of around 1.1 million individuals per study year (Supplementary Table 1).

Sickness absence outcome

For permanent Finnish residents, sickness absence is compensated by the Social Insurance Institution of Finland after a period of ten working days that are typically paid by the employer.[19] Only sickness absence spells compensated by the Social Insurance Institution are registered at the national level and included in our data. The outcome of this study was therefore based on sickness absence that by definition lasted around two calendar weeks or more. We used repeated dichotomous measures of whether a study person had a new onset of compensated sickness absence in a particular calendar year. The outcome included both full and part-time sickness absence, but in Finland the first onset of work disability typically starts with full sickness absence.

Cause-specific sickness absence was classified according to the tenth revision of the International Classification of Diseases (ICD-10). We examined six large groups separately, including 1) musculoskeletal diseases (diseases of the musculoskeletal system and connective tissue, M00–M99), 2) mental disorders (mental and behavioural disorders, F00–F99), 3) neoplasms (C00–D48), 4) circulatory diseases (I00–I99), 5) respiratory diseases (J00–J99), and 6) digestive diseases (K00–K93). We did not examine the large disease group consisting of injuries, because absences due to some injuries, including occupational, traffic and military accidents, are covered by other insurers than the Social Insurance Institution of Finland and therefore not included in our data.

Occupational class and industrial sector

Occupational class and industrial sector were based on information measured in the year preceding each study year and categorized according to classifications by Statistics Finland.[20] Occupational class consisted of categories 1) upper non-manual, 2) lower non-manual, and 3) manual.

Industrial sector included the following categories: 1) manufacturing (manufacturing, mining and quarrying), 2) trade (wholesale and retail trade; repair of motor vehicles and motorcycles), 3) knowledge work (information and communication; financial and insurance activities; real estate activities; professional, scientific and technical activities), 4) human health and social work activities, and 5) other (agriculture, forestry and fishing; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities; construction; transportation and storage; accommodation and food service activities; administrative and support service activities; public administration and defence; compulsory social security; education; arts, entertainment and recreation; other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies; industry unknown). This classification was from year

2008. Until 2007, the classification was based on an older version from year 2002, but virtually equivalent main categories listed above could be constructed using a reclassification code provided by Statistics Finland.

When examining industrial sectors within the three occupational classes, we only show results for the four large industrial sectors 1–4. The category "other" consisted of heterogeneous smaller sectors which could not be examined separately due to small number of events.

Covariates

We examined sociodemographic factors and employment patterns as covariates. Age was divided into 5-year groups. Education and income were based on information measured in the year preceding each study year. Education consisted of categories 1) higher tertiary (Master's or equivalent level, or higher), 2) lower tertiary (Bachelor's or equivalent level), 3) secondary, and 4) primary. Tertiary education was divided into two levels, because the proportion of those with higher tertiary education in particular increased during the study period (Supplementary Table 1). Income consisted of both wage and capital income of the individual. It was inflation-corrected and then divided into quintiles across the study years.

Employment patterns were measured during each study year. Employment sector was classified as 1) private, 2) public, 3) private and public, and 4) transition to self-employment. Time spent in employment was divided into 1) full year, 2) 200–364 days, and 3) 1–199 days. The cut-point of 200 days was arbitrarily chosen to define those who were employed most of the year. The number of employment episodes was divided into 1) one, 2) two, and 3) three or more.

Statistical methods

We used generalized estimation equations (GEE) based on repeated logistic regression to estimate the annual risk of having a new onset of compensated all-cause and cause-specific sickness absence in 2005–2013. The GEE models account for the within-individual correlation between repeated measurements in the three different samples followed up during periods 2005–2007, 2008–2010, or 2011–2013.

Using margins derived from the logistic GEE models, we plotted trajectories of estimated proportions (‰) of employees with sickness absence including interactions of occupational class and industrial sectors within the occupational classes with categorical year. Estimated proportions demonstrate the magnitude and direction of changes in the level of sickness absence among different groups, which would not be revealed solely on the basis of information on changes in the differences between the groups. Analyses of occupational class differences were performed in each of the six disease groups. Analyses of differences between industrial sectors within the different occupational classes were performed in the two largest disease groups, i.e. musculoskeletal diseases and mental disorders. We adjusted for the annually measured covariates holding them at their mean level when plotting the trajectories.

Derived from the same GEE models, we also calculated relative differences between industrial sectors within the different occupational classes. We used those employed in the knowledge work sector as the reference group, for which the odds ratio (OR) of sickness absence was held at 1.00 in each year.

We pooled men and women, adjusting for gender in the analyses. Even though the overall level of sickness absence was much higher among the female than the male study population, changes over time were relatively similar among the genders especially after accounting for their differential occupational and sectoral distributions.[18]

RESULTS

Characteristics of the study population

Over the study period between 2005 and 2013, the proportion of manual workers decreased especially in the manufacturing sector, but also in the health and social work sector (Table 1). The proportion of non-manual employees increased. Among upper non-manual employees, the increase was largest in the knowledge work sector. Among lower non-manual employees, the proportion increased in the health and social work sector and decreased in the manufacturing sector. Annual distributions of the study population by all background characteristics are presented in Supplementary Table 1. Average distributions over the whole study period are presented also separately for those employed in different industrial sectors within different occupational classes in Supplementary Table 2.

Table 1. Annual distribution (%) of the study population over the study period by industrial sectors across different occupational classes.

Occupational class	Year								
Industrial sector	2005	2006	2007	2008	2009	2010	2011	2012	2013
Upper non-manual	24.3	25.2	25.4	25.6	26.4	26.9	25.8	26.0	26.1
Manufacturing	3.1	3.3	3.5	3.5	3.7	3.6	3.5	3.5	3.3
Trade	1.3	1.5	1.5	1.5	1.5	1.5	1.3	1.3	1.3
Knowledge work	5.4	5.6	5.8	6.0	6.2	6.3	6.3	6.4	6.2
Health & social work	2.9	2.9	2.9	2.9	3.0	3.1	3.1	3.2	3.3
Other	11.6	11.9	11.8	11.8	12.0	12.4	11.6	11.7	11.9
Lower non-manual	40.8	40.2	40.2	40.4	40.7	41.3	42.7	42.7	43.1
Manufacturing	4.4	4.0	4.0	4.0	3.9	3.7	3.5	3.4	3.4
Trade	7.5	7.5	7.5	7.5	7.7	7.8	8.0	8.0	7.9
Knowledge work	6.0	5.8	5.7	5.9	5.8	5.8	5.9	6.0	6.2
Health & social work	11.6	11.7	11.9	12.0	12.4	12.9	12.9	13.2	13.5
Other	11.3	11.2	11.1	10.9	10.9	11.1	12.4	12.2	12.1
Manual	34.9	34.6	34.3	34.0	33.0	31.9	31.5	31.4	30.9
Manufacturing	12.5	12.3	12.1	11.9	11.3	10.3	10.3	10.2	9.8
Trade	2.3	2.2	2.2	2.2	2.2	2.1	2.2	2.1	2.2
Knowledge work	1.1	1.1	1.0	1.0	1.0	1.0	0.9	0.9	0.8
Health & social work	2.3	2.2	2.1	2.0	1.9	1.8	1.8	1.6	1.6
Other	16.7	16.8	16.9	16.9	16.6	16.7	16.5	16.6	16.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sickness absence trends by occupational class

Upper non-manual employees had the lowest and manual workers the highest overall level of sickness absence (Table 2). Among the total study population, the age- and gender-adjusted proportion of employees with any sickness absence decreased from 127.6‰ in 2005 to 108.6‰ in 2013. Until 2009, the annual decrease was largest among manual workers. Between 2009 and 2010, sickness absence increased, but only among manual workers and lower non-manual employees.

After 2010, the decrease in sickness absence continued. Overall, the decrease in sickness absence was smallest among lower non-manual employees.

Table 2. Age- and gender-adjusted estimated annual proportion of employees with a new onset of all-cause sickness absence (‰ and 95% CI) and the annual change (%) over particular years by occupational class.

	Occupational class							
Year	Upper non-manual		Lower non-manual		Manual		All	
2005	80.8	(79.8–81.8)	120.4	(119.5–121.3)	168.6	(167.4–169.8)	127.6	(127.0–128.3)
2006	79.6	(78.6–80.6)	121.4	(120.5–122.3)	168.6	(167.3–169.8)	127.4	(126.8–128.1)
2007	78.6	(77.6–79.6)	118.6	(117.7–119.5)	166.0	(164.8–167.2)	124.9	(124.3–125.5)
2008	75.4	(74.4–76.3)	115.6	(114.7–116.4)	157.7	156.5–158.9)	119.6	(119.0–120.2)
2009	72.8	(71.9–73.8)	112.2	(111.3–113.1)	146.2	(145.0–147.4)	113.5	(112.9–114.1)
2010	72.9	(71.9–73.8)	115.2	(114.3–116.1)	152.0	(150.7–153.2)	116.1	(115.5–116.7)
2011	70.8	(69.9–71.7)	112.2	(111.3–113.1)	147.6	(146.3–148.8)	112.9	(112.3–113.5)
2012	67.3	(66.4–68.2)	108.9	(108.0–109.8)	143.3	(142.1–144.5)	109.1	(108.5–109.7)
2013	67.5	(66.6–68.4)	108.8	(107.9–109.6)	142.1	(140.9–143.3)	108.6	(108.0–109.2)
Annual % change								
2005-2009	-2.5		-1.7		-3.3		-2.8	
2009-2010	0.1		2.7		4.0		2.3	
2010-2013	-2.5		-1.9		-2.2		-2.2	

The occupational class differences in sickness absence varied by disease group in terms of both the overall level and time trends (Figure 1). In terms of the overall level, the differences were particularly large in musculoskeletal diseases (panel A) and negligible in neoplasms (panel C). In mental disorders (panel B), the level was highest among lower non-manual employees.

In terms of trends, the decrease in absences due to musculoskeletal diseases (panel A) was mainly restricted to manual workers, leading to decreasing class differences particularly until 2009. In mental disorders (panel B) and digestive diseases (panel F), the decrease in absences was slightly smaller among lower non-manual employees than among the other classes. In respiratory diseases (panel E), the overall decreasing trend was interrupted by an increase in absences between 2007 and 2011, most notably so among lower non-manual employees. In circulatory diseases (panel D), absences decreased over the study period with no clear differences between the classes. In neoplasms (panel C), the changes over time were relatively small.

Adjustment for other socioeconomic factors and employment patterns attenuated the occupational class differences in sickness absence levels, but it had little effect on the varying trends between the classes (Figure 1, model 2 compared to model 1).

Sickness absence trends by industrial sectors within occupational classes

We examined age- and gender-adjusted (Supplementary Figure 1) as well as fully adjusted (Figure 2) annual proportions of cause-specific sickness absence by industrial sectors within the three occupational classes. Although adjustment for socioeconomic factors and employment patterns attenuated the industrial sector differences in the overall absence levels, it had little influence on the varying trends (Figure 2 compared to Supplementary Figure 1). All further results are therefore based on the fully adjusted models.

Among upper (Figures 2 and 3, panels A and B) and lower (panels C and D) non-manual employees, the overall level of sickness absence due to both musculoskeletal diseases and mental disorders was highest in the health and social work sector. Among manual workers, the absence level in musculoskeletal diseases (panel E) was highest in the manufacturing sector, whereas in mental disorders (panel F) there was no consistent variation between the sectors.

Among lower non-manual employees (Figure 2, panel C) and manual workers (panel E), the decrease in absences due to musculoskeletal diseases was smaller in the trade sector than in the other sectors. As a result, the excess risk in the trade sector compared to the reference group of knowledge work increased over the study period (Figure 3, panels C and E). The temporary decrease in absences due to musculoskeletal diseases around year 2009 was particularly large among manual workers (Figure 2, panel E) in the manufacturing sector, which led to a temporary decrease in the excess risk found in this sector (Figure 3, panel E). Also in mental disorders, there were corresponding but smaller temporary decreases around year 2009 in the manufacturing sector among lower non-manual employees (Figures 2 and 3, panel D) and manual workers (panel F). Furthermore, there was no decrease over the study period in absences due to mental disorders among upper non-manual employees (Figure 2, panel B) in the manufacturing sector. The absence level was originally lowest in this sector, but by the end of the study period, the reduced risk compared to the reference group of knowledge work disappeared (Figure 3, panel D). Otherwise, the differences in sickness absence between industrial sectors remained relatively stable over the study period.

DISCUSSION

We used large register-based data sets on the general population of Finnish wage earners in order to provide novel information on occupational class and industrial sector differences in cause-specific sickness absence trends. We accounted for the potential influence of changes in other socioeconomic factors and employment patterns on the varying trends. Although both occupational and sectoral differences in sickness absence have been previously examined,[1-14] our study is, to our knowledge, the first one to examine differences in sickness absence between industrial sectors within particular occupational classes.

We found that the proportion of employees with sickness absence lasting more than ten working days generally decreased between 2005 and 2013 in all of the examined occupational classes. All in all, the change was smallest among lower non-manual employees. Upper non-manual employees had the lowest and manual workers the highest overall level of sickness absence. The occupational class differences in the overall absence levels were particularly large in musculoskeletal diseases. In this disease group, the decrease in absences nevertheless restricted to manual workers, leading to a reduction in the class differences over time. In mental disorders, in contrast, the absence level was highest and the decrease over time smallest among lower non-manual employees. This led to increasing class differences over time. Also in respiratory and digestive diseases, the decreases over time were smallest among lower non-manual employees. In circulatory diseases, absences decreased in all occupational classes, whereas in neoplasms, the changes over time where altogether small.

Looking at the two largest disease groups, i.e. musculoskeletal diseases and mental disorders, we found further variation in sickness absence between four large industrial sectors despite the fact that these were examined within particular occupational classes. Among non-manual employees, the overall absence levels were highest in the health and social work sector. Among manual workers, the level in musculoskeletal diseases was highest in the manufacturing sector, where a notable temporary decrease in absences nevertheless occurred during the peak of the economic recession in 2009. Among manual workers and lower non-manual employees, the decrease in absences due to musculoskeletal diseases was smallest in the trade sector.

The contribution of the recession of the late 2000s to changes in the occupational class differences in sickness absence has not been clear. A previous study on municipal employees in the 1990s indicated that occupational class differences in the number of new all-cause sickness absence spells lasting over three days were smaller in the recession years than in the following period of economic growth.[3] Accordingly, we found that the class differences were smallest in 2009, i.e. during the peak of the more recent economic recession. Moreover, we found that changes in the class differences around the time of the recession were largest in musculoskeletal diseases. We also found that the temporary sharp decline in absences in 2009 was most pronounced among manual workers employed in the manufacturing sector. This was the group in our data for which employment decreased most around the time of the recession. In addition to decreases in musculoskeletal morbidity and physically demanding work, it is thus likely that the recession itself was a driving factor behind the decline in sickness absence, especially among manual workers employed in the manufacturing sector. Employees who were strongly affected by labour market insecurity and the threat of unemployment may have been less willing to be absent from work despite their health problems.[1, 3, 21-23] It is also possible that during the recession, affected groups of employees had stronger ill-health-related selection out of employment.[24-26] The decline in sickness absence during the recession could thus have been attributable to excess employment exit among individuals with a higher likelihood of sickness absence.[27]

Our finding on the smaller decrease among lower non-manual employees in sickness absence due to mental, respiratory, and digestive diseases was not explained by changes in the distribution of factors that were measured in this study, including education, income, and employment patterns. The smaller decrease in sickness absence among lower non-manual employees may therefore have been related to unobserved unfavourable changes in their work environment such as increased psychosocial demands during the period of economic downturn. It may also have been related to labour market changes that reduced sickness absence in the other two occupational classes. However, according to previous findings from Finland, trends in job quality appear to have been relatively similar between occupational classes over our study period.[28] Other findings nevertheless indicated polarization in the labour market of Finland and other Nordic countries between the mid-1990s and mid-2000s, which was interpreted as partly relating to technological advances in the period. The proportion of occupations at both the top and the bottom ends of the wage distribution increased: engineering professionals and other professionals at the top level and personal and protective services at the bottom level became more common. Accordingly, the proportion of occupations at the intermediate level of the wage distribution decreased mainly due to a reduction in office clerks, i.e. routine non-manual employees.[29]. Corresponding changes may have occurred in our study period and affected the job distributions within the occupational classes. A further notable change in the Finnish labour market is that the proportion of employees performing distant work increased from 10% in 2003 to 20% in 2013.[30] This may have contributed to the decrease in sickness absence among particular groups of employees. It is likely that upper non-manual employees are more able to perform distant work while being ill than lower non-manual employees or manual workers.

The generally higher absence levels that we found in the health and social work sector are in accordance with previous studies.[12, 13] Findings from Norway indicated that the higher risk of sickness absence among those employed in health and social occupations was largely explained by their unfavourable psychosocial and physical working conditions.[13] A Finnish study also showed that employees in the combined sector of education, health and social work had poorer health in terms of a higher risk of hospitalization compared to those in other sectors. This applied to various disease groups, including musculoskeletal diseases and mental disorders. Furthermore, the risk of hospitalization at least due to musculoskeletal diseases was higher in the manufacturing sector than in the trade and knowledge work -related sectors.[31] The present study adds to the literature by indicating that the higher level of sickness absence in the health and social work sector compared to other sectors was generally found in both musculoskeletal diseases and mental disorders. However, our novel findings further indicated that this sector difference was only found among non-manual employees. Among manual workers, the absence level in musculoskeletal diseases was highest in the manufacturing sector.

Our study also indicated that the differences in sickness absence between industrial sectors within the occupational classes were relatively stable since the mid-2000s. Exceptions included the above discussed temporary fluctuations around 2009 and the smaller decrease in absences due to musculoskeletal diseases in the trade sector compared to other ones within the lower classes. The more unfavourable trends of the trade sector were not explained by changes in the distribution of any of the measured socioeconomic factors and employment patterns. More research is needed to determine whether e.g. changes in working conditions or types of jobs within the trade sector contributed to the trends.

Overall, our findings indicated that the occupational class and industrial sector differences in sickness absence trends largely depended on the disease causing work disability. In musculoskeletal diseases, the changes over time varied most. Musculoskeletal diseases may be considered as work-related and their diagnoses are often symptom-based. Changes in the work or economic conditions may have affected how particular groups of employees cope with their symptoms and behave while being ill. In other causes such as circulatory diseases, the decrease in absences was more consistent across the classes, which may have been related to equality in terms of decreased morbidity and improved treatment.

The strengths of this study included nationally representative samples of the Finnish population and register-based data sets that did not have the problem of missing information due to non-response. The rich data comprised longitudinal information on employment and sociodemographic factors as well as on sickness absence and its diagnostic cause. Furthermore, the very large samples allowed us to examine cause-specific sickness absence between industrial sectors within different occupational classes, thereby capturing occupational groups with relatively similar types of jobs. Our findings may be generalizable to countries in which the manufacturing sector in particular was affected by the recession of the late 2000s and in which also the sickness benefit system is relatively generous.

There were nevertheless also certain limitations. Our outcome measure was based on national data on compensated sickness absence spells that begin after a period of ten working days. Sickness absence spells that did not exceed ten working days were therefore not covered. Moreover, our outcome measure was based on new onset of sickness absence. The predictors of sickness absence might be different when examining e.g. the occurrence of short-term spells, the number of spells of different lengths, or the total number of absence days.[32-36]

Although our results indicated that other socioeconomic factors and employment patterns partly explained the occupational class and industrial sector differences in the overall level of cause-specific sickness absence, they did not appear to explain the varying trends. Factors that were not measured in this study, such as changes in health, lifestyle, work exposures, and labour market conditions, were therefore likely to have contributed to the differences in the trends. Sickness absence trends may have been affected also by changes in national sickness insurance legislation aiming at enhancing work participation.[37-39]

It should be noted that the recession might have led to a larger health inequality between the employed and non-employed populations than between the different socioeconomic groups among the employed. Focusing on sickness absence among an employed population may therefore not have revealed some of the potential effects of the recent economic recession on health and health inequalities.[40-44]

CONCLUSIONS

The proportion of wage earners with sickness absence lasting more than ten working days decreased in Finland between 2005 and 2013 in all occupational classes. Overall, the change was smallest among lower non-manual employees. Occupational class differences in sickness absence trends nevertheless varied by disease group. There were notable and relatively stable differences in sickness absence between industrial sectors even when these were examined within particular occupational classes. Moreover, the association between industrial sector and sickness absence varied across the occupational classes. At the time of the economic recession of the late 2000s, there was a temporary decrease in sickness absence due to musculoskeletal diseases specifically among manual workers employed in the manufacturing sector, i.e. in a segment of wage earners that are known to have been hit hard by the recession. However, differences in the trends amongst occupational classes and industrial sectors were not explained by the measured structural changes in other socioeconomic factors or employment patterns. The complex interplay between occupational class and industrial sector should be taken into account when tackling problems of work disability.

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Contributors: EVJ obtained the data. SS and EVJ conceived the study. TL, SS, EVJ, and KHP designed the study. SS and TL prepared the data for analyses. TL conducted the statistical analyses.

TL, SS, EVJ, and KHP contributed to interpretation of the results. TL wrote the first drafts of the article. TL, SS, EVJ, and KHP discussed and revised the drafts and prepared the final manuscript.

Competing interests: None declared.

Ethics approval: The researchers used fully anonymous register data. Research using such data does not need to undergo review by an ethics committee according to Finnish legislation. Statistics Finland linked its data to those of the Social Insurance Institution of Finland and the Finnish Centre for Pensions, after which the data were anonymized and stored by Statistics Finland. The researchers analyzed the anonymous data using a remote access system. All output extracted from the system was approved by Statistics Finland to ensure compliance with data protection regulations. The data can only be accessed by the individual researchers who have obtained permission from each of the administrative sources providing the data.

Data sharing statement: Due to data protection regulations of the administrative sources providing the register data, the authors do not have the permission to share the data. Permissions to use the register data can be applied from the Social Insurance Institution of Finland (http://www.kela.fi/web/en/research-data-requests), the Finnish Centre for Pensions (http://www.etk.fi/en/statistics-2/statistics/producer-of-statistics/), and Statistics Finland (http://www.stat.fi/meta/tietosuoja/kayttolupa_en.html).

REFERENCES

1. Allebeck P, Mastekaasa A. Swedish Council on Technology Assessment in Health Care (SBU). Chapter 5. Risk factors for sick leave – general studies. *Scand J Public Health* 2004;32(Suppl 63):49–108.

2. Melchior M, Krieger N, Kawachi I, et al. Work factors and occupational class disparities in sickness absence: findings from the GAZEL cohort study. *Am J Public Health* 2005;95:1206–12.

3. Piha K, Martikainen P, Rahkonen O, et al. Trends in socioeconomic differences in sickness absence among Finnish municipal employees 1990-99. *Scand J Public Health* 2007;35:348–55.

4. Christensen KB, Labriola M, Lund T, et al. Explaining the social gradient in long-term sickness absence: a prospective study of Danish employees. *J Epidemiol Community Health* 2008;62:181–3.

5. Hansen H-T, Ingebrigtsen T. Social class and sickness absence in Norway. *Acta Sociologica* 2008;51:309–27.

6. Piha K, Laaksonen M, Martikainen P, et al. Interrelationships between education, occupational class, income and sickness absence. *Eur J Public Health* 2010;20:276–80.

7. d'Errico A, Costa G. Socio-demographic and work-related risk factors for medium- and long-term sickness absence among Italian workers. *Eur J Public Health* 2012;22:683–8.

8. Löve J, Hensing G, Holmgren K, et al. Explaining the social gradient in sickness absence: a study of a general working population in Sweden. *BMC Public Health* 2013;13:545.

9. Pekkala J, Blomgren J, Pietiläinen O, et al. Occupational class differences in long sickness absence: a register-based study of 2.1 million Finnish women and men in 1996-2013. *BMJ Open* 2017;7:e014325.

10. Pekkala J, Blomgren J, Pietiläinen O, et al. Occupational class differences in diagnostic-specific sickness absence: a register-based study in the Finnish population, 2005–2014. *BMC Public Health* 2017;17:670.

11. Sumanen H, Lahelma E, Pietiläinen O, et al. The magnitude of occupational class differences in sickness absence: 15-year trends among young and middle-aged municipal employees. *Int J Environ Res Public Health* 2017;14:625.

12. Lund T, Labriola M, Villadsen E. Who is at risk for long-term sickness absence? A prospective cohort study of Danish employees. *Work* 2007;28:225–30.

13. Aagestad C, Tyssen R, Sterud T. Do work-related factors contribute to differences in doctor-certified sick leave? A prospective study comparing women in health and social occupations with women in the general working population. *BMC Public Health* 2016;16:235.

14. Knutsson A, Goine H. Occupation and unemployment rates as predictors of long term sickness absence in two Swedish counties. *Soc Sci Med* 1998;47:25–31.

15. Bettio F, Corsi M, D'Ippoliti C, et al. The impact of the economic crisis on the situation of women and men and on gender equality policies. Synthesis report. Luxembourg: Publications Office of the European Union, 2013.

16. Statistics Finland. StatFin online service. 2017. http://www.stat.fi/tup/statfin/index_en.html Accessed 13 December 2017.

17. European Commission. Employment and social developments in Europe 2017. Luxembourg: Publications Office of the European Union, 2017.

18. Leinonen T, Viikari-Juntura E, Husgafvel-Pursiainen K, et al. Labour market segregation and gender differences in sickness absence: trends in 2005–2013 in Finland. *Ann Work Expo Health* Published online 29 December 2017.

19. The Social Insurance Institution of Finland. Sickness allowance. 2017. http://www.kela.fi/web/en/sickness-allowance Accessed 8 December 2017.

20. Statistics Finland. Classifications. 2017. https://www.stat.fi/meta/luokitukset/index_en.html Accessed 2 January 2018.

21. Askildsen JE, Bratberg E, Nilsen ØA. Unemployment, labor force composition and sickness absence: a panel data study. *Health Econ* 2005;14:1087–101.

22. Virtanen M, Kivimäki M, Elovainio M, et al. Local economy and sickness absence: prospective cohort study. *J Epidemiol Community Health* 2005;59:973–78.

23. Pfeifer C. Cyclical absenteeism among private sector, public sector and self-employed workers. *Health Econ* 2013;22:366–70.

24. Evans-Lacko S, Knapp M, McCrone P, et al. The mental health consequences of the recession: economic hardship and employment of people with mental health problems in 27 European countries. *PLoS One* 2013;8:e69792.

25. Heggebø K. Unemployment in Scandinavia during an economic crisis: cross-national differences in health selection. *Soc Sci Med* 2015;130:115–24.

26. Heggebø K, Dahl E. Unemployment and health selection in diverging economic conditions: compositional changes? Evidence from 28 European countries. *Int J Equity Health* 2015;14:121.

27. Hesselius P. Does sickness absence increase the risk of unemployment? *The Journal of Socio-Economics* 2007;36:288–310.

28. Mustosmäki A, Oinas T, Anttila T. Abating inequalities? Job quality at the intersection of class and gender in Finland 1977–2013. *Acta Sociologica* 2017;60:228–45.

29. Asplund R, Barth E, Lundborg P, et al. Polarization of the Nordic labour markets. *Finnish Economic Papers* 2011;24:87–100.

30. Sutela H, Lehto A-M. Työolojen muutokset 1977–2013 [Changes in working conditions 1977–2013]. Helsinki: Tilastokeskus, 2014.

31. Kokkinen L, Kouvonen A, Koskinen A, et al. Differences in hospitalizations between employment industries, Finland 1976 to 2010. *Ann Epidemiol* 2014;24:598–605.

32. Melchior M, Niedhammer I, Berkman LF, et al. Do psychosocial work factors and social relations exert independent effects on sickness absence? A six year prospective study of the GAZEL cohort. *J Epidemiol Community Health* 2003;57:285–93.

33. Alavinia SM, van den Berg TIJ, van Duivenbooden C, et al. Impact of work-related factors, lifestyle, and work ability on sickness absence among Dutch construction workers. *Scand J Work Environ Health* 2009;35:325–33.

34. Kristensen TR, Jensen SM, Kreiner S, et al. Socioeconomic status and duration and pattern of sickness absence. A 1-year follow-up study of 2331 hospital employees. *BMC Public Health* 2010;10:643.

35. Laaksonen M1, Pitkäniemi J, Rahkonen O, et al. Work arrangements, physical working conditions, and psychosocial working conditions as risk factors for sickness absence: Bayesian analysis of prospective data. *Ann Epidemiol* 2010;20:332–8.

36. Magnavita N, Garbarino S. Is absence related to work stress? A repeated cross-sectional study on a special police force. *Am J Ind Med* 2013;56:765–75.

37. Kausto J, Viikari-Juntura E, Virta LJ, et al. Effectiveness of new legislation on partial sickness benefit on work participation: a quasi-experiment in Finland. *BMJ Open* 2014;4:e006685.

38. Halonen JI, Solovieva S, Pentti J, et al. Effectiveness of legislative changes obligating notification of prolonged sickness absence and assessment of remaining work ability on return to work and work participation: a natural experiment in Finland. *Occup Environ Med* 2016;73:42–50.

39. Viikari-Juntura E, Virta LJ, Kausto J, et al. Legislative change enabling use of early part-time sick leave enhanced return to work and work participation in Finland. *Scand J Work Environ Health* 2017;43:447–56.

40. Bacigalupe A, Esnaola S, Martín U. The impact of the Great Recession on mental health and its inequalities: the case of a Southern European region, 1997–2013. *Int J Equity Health* 2016;15:17.

41. Bruggink J-W, de Goeij MCM, Otten F, et al. Changes between pre-crisis and crisis period in socioeconomic inequalities in health and stimulant use in Netherlands. *Eur J Public Health* 2016;26:772–7.

42. Frasquilho D, Matos MG, Salonna F, et al. Mental health outcomes in times of economic recession: a systematic literature review. *BMC Public Health* 2016;16:115.

43. Parmar D, Stavropoulou C, Ioannidis JPA. Health outcomes during the 2008 financial crisis in Europe: systematic literature review. *BMJ* 2016;354:i4588.

44. Nelson K, Tøge AG. Health trends in the wake of the financial crisis—increasing inequalities? *Scand J Public Health* 2017;45(Suppl 18):22–9.

Figure captions

Figure 1. Estimated annual proportion of employees with a new onset of cause-specific (A-F) sickness absence (‰) by occupational class. The panels are presented in different scales; Model 1 (M1): Adjusted for age and gender; Model 2 (M2): Adjusted for age, gender, education, industrial sector, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between occupational class and year: A) M1: 0.000, M2: 0.000, B) M1: 0.000, M2: 0.000, C) M1: 0.099, M2: 0.100, D) M1: 0.035, M2: 0.041, E) M1: 0.000, M2: 0.000, F) M1: 0.021, M2: 0.165.

Figure 2. Estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; Adjusted for age, gender, education, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between industrial sector and year: A) 0.550, B) 0.053, C) 0.014, D) 0.001, E) 0.000, F) 0.000.

Figure 3. Annual risk (ORs and their 95% confidence intervals) of having a new onset of sickness absence due to musculoskeletal diseases and mental disorders by industrial sector (OR=1.00 for the knowledge work sector in each year) among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. Adjusted for age, gender, education, employment sector, income, time spent in employment, and the number of employment episodes; P-values for the interaction between industrial sector and year: A) 0.550, B) 0.053, C) 0.014, D) 0.001, E) 0.000, F) 0.000.

Supplementary material captions

Supplementary Table 1. Annual distribution (%) of the study population over the study period by background characteristics.

Supplementary Table 2. Distribution (%) of the study population by sociodemographic and employment factors among those employed in different industrial sectors within different occupational classes averaging over the whole study period.

Supplementary Figure 1. Age- and gender-adjusted estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; P-values for the interaction between industrial sector and year: A) 0.302, B) 0.006, C) 0.000, D) 0.005, E) 0.000, F) 0.004.

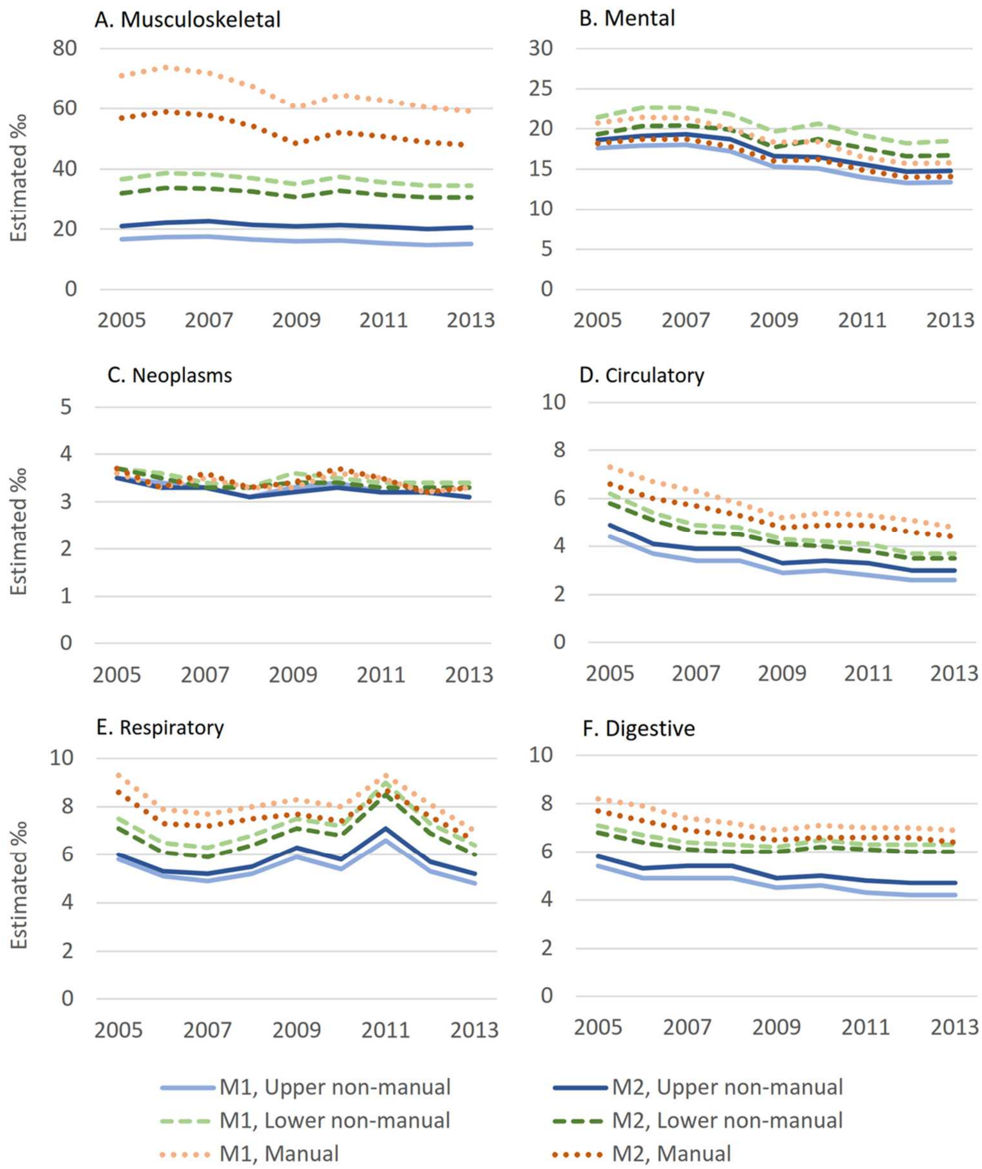

Figure 1

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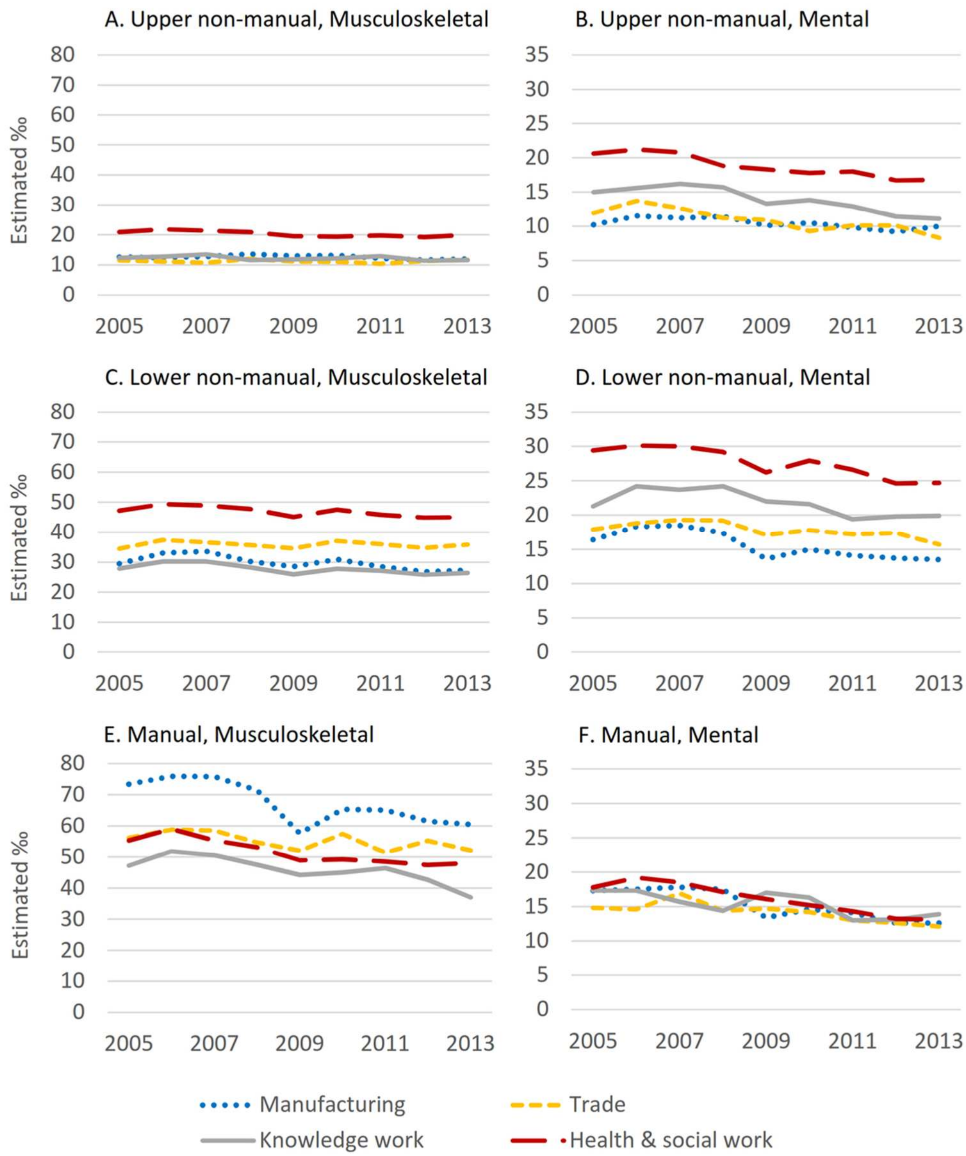

Figure 2

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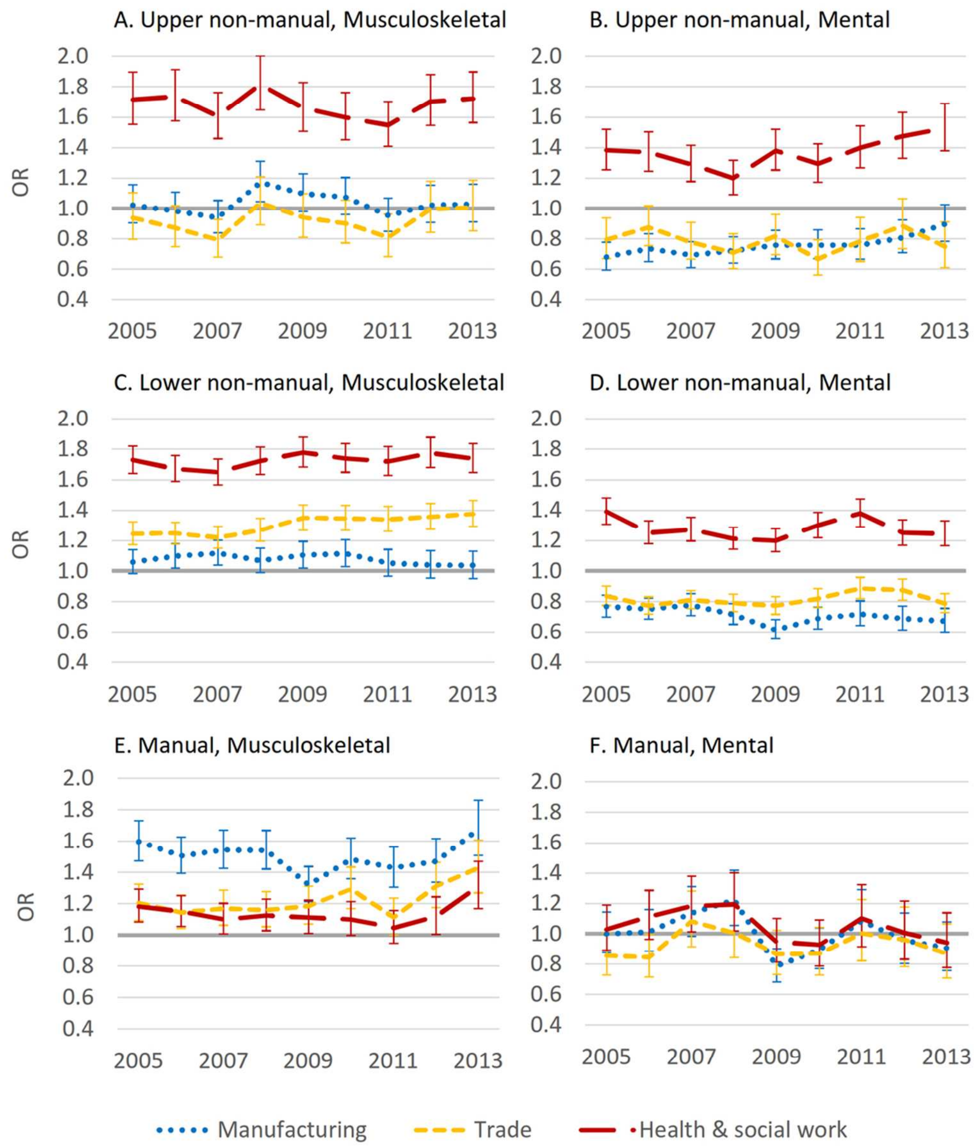

Figure 3

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Supplementary Table 1. Annual distribution (%) of the study population over the study period by background characteristics.

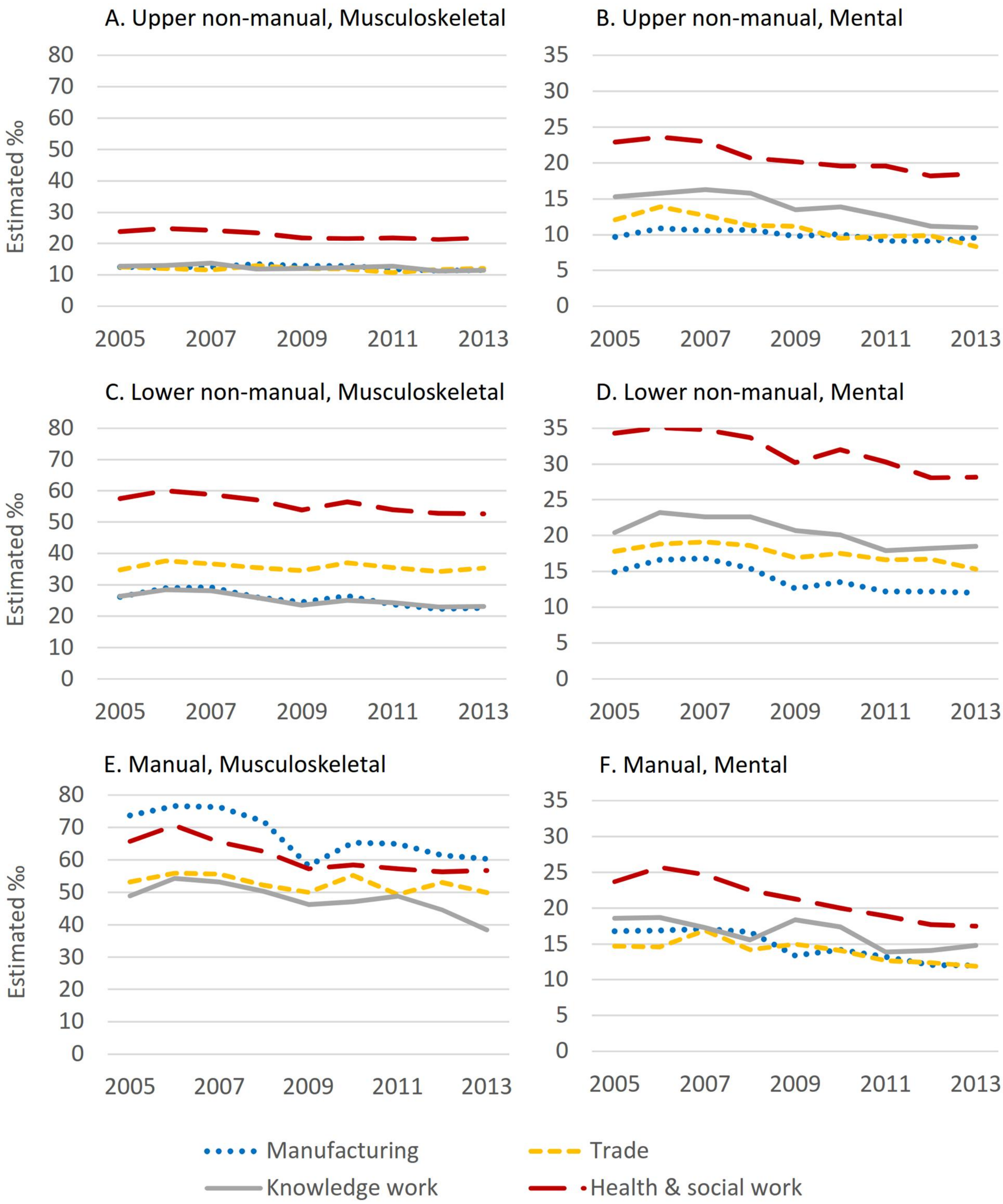
	Year								
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Age									
25-29	12.8	12.9	12.9	13.2	13.3	13.2	13.5	13.4	13.1
30-34	12.8	13.0	13.3	13.7	14.2	14.3	14.5	14.4	14.5
35-39	15.0	14.7	14.3	13.8	13.3	13.4	13.5	13.8	14.2
40-44	16.0	16.0	15.9	15.8	15.6	15.3	14.8	14.5	14.0
45-49	15.8	15.8	15.7	15.6	15.7	15.8	15.7	15.7	15.7
50-54	15.1	15.1	15.3	15.2	15.0	15.0	14.9	14.9	15.0
55-59	12.5	12.6	12.7	12.8	12.9	13.1	13.1	13.4	13.5
Gender									
Men	49.3	49.3	49.3	49.2	48.6	47.9	48.2	48.2	47.9
Women	50.7	50.7	50.7	50.8	51.4	52.1	51.9	51.8	52.1
Education									
Higher tertiary	12.7	13.1	13.3	13.7	14.5	15.0	15.4	15.7	16.1
Lower tertiary	29.7	29.8	29.8	29.8	30.0	30.4	30.4	30.4	30.5
Secondary	41.8	42.2	42.7	43.1	42.8	42.8	43.0	43.2	43.2
Primary	15.9	14.9	14.2	13.5	12.7	11.8	11.3	10.8	10.2
Occupational class									
Upper non-manual	24.3	25.2	25.4	25.6	26.4	26.9	25.8	26.0	26.1
Lower non-manual	40.8	40.2	40.2	40.4	40.7	41.3	42.7	42.7	43.1
Manual	34.9	34.6	34.3	34.0	33.0	31.9	31.5	31.4	30.9
Industrial sector									
Manufacturing	20.1	19.6	19.5	19.4	18.8	17.5	17.2	17.0	16.4
Trade	11.2	11.2	11.2	11.2	11.3	11.4	11.4	11.4	11.4
Knowledge work	12.4	12.5	12.5	12.9	13.0	13.1	13.1	13.2	13.2
Health & social work	16.7	16.8	17.0	16.9	17.3	17.8	17.8	18.0	18.5
Other	39.6	39.8	39.8	39.6	39.5	40.2	40.4	40.4	40.5

Employment sector									
Private	62.4	62.6	62.6	63.1	63.1	62.8	62.7	62.9	62.6
Public	32.2	31.8	30.4	29.7	30.2	30.6	30.1	30.3	30.6
Private and public	4.9	5.1	6.5	6.6	6.3	6.1	6.3	6.1	6.2
Transition to self-employment	0.5	0.5	0.6	0.6	0.6	0.6	0.9	0.7	0.6
Income									
Quintile 1 (highest)	17.1	17.7	18.8	19.8	20.2	21.0	21.9	21.8	21.7
Quintile 2	17.9	18.9	19.2	19.5	20.0	20.8	21.3	21.1	21.4
Quintile 3	19.2	19.9	19.7	19.6	19.8	20.5	20.5	20.3	20.5
Quintile 4	22.5	21.9	21.2	20.5	19.9	19.2	18.1	18.4	18.3
Quintile 5 (lowest)	23.3	21.6	21.1	20.6	20.1	18.4	18.3	18.5	18.1
Employed time									
Full year	90.5	90.4	90.6	90.8	90.5	91.5	91.4	91.2	91.3
200-364 days	6.8	7.0	7.1	6.9	6.5	6.1	6.4	6.5	6.3
1-199 days	2.7	2.6	2.4	2.2	3.0	2.4	2.2	2.3	2.4
Employment episodes									
1	90.0	89.5	88.2	88.3	89.2	89.3	88.5	88.9	89.1
2	7.0	7.4	8.5	8.5	7.8	7.7	8.5	8.2	8.0
3+	3.0	3.0	3.4	3.2	3.1	2.9	3.0	2.9	2.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	1 097 598	1 100 322	1 109 041	1 122 238	1 117 179	1 081 698	1 094 294	1 092 208	1 080 951

Supplementary Table 2. Distribution (%) of the study population by sociodemographic and employment factors among those employed in different industrial sectors within different occupational classes averaging over the whole study period.

	Upper non-manual					Lower non-manual					Manual				
	Manu-fac-turing	Trade	Know-ledge work	Health & social work	All	Manu-fac-turing	Trade	Know-ledge work	Health & social work	All	Manu-fac-turing	Trade	Know-ledge work	Health & social work	All
Age															
25-29	7.7	9.0	12.9	9.5	10.1	12.4	18.3	15.1	11.1	13.7	13.6	21.3	14.2	7.1	14.8
30-34	15.5	14.6	18.6	12.4	15.0	16.5	16.1	14.5	12.2	13.9	13.6	16.4	10.9	7.7	12.9
35-39	19.2	17.1	16.7	13.6	15.7	15.5	15.2	12.7	13.1	13.7	14.0	14.7	11.1	10.3	13.1
40-44	18.9	18.9	15.4	15.6	16.4	15.4	15.2	14.6	15.2	15.2	14.9	14.4	13.5	1.4	14.7
45-49	15.9	17.1	14.5	17.5	16.0	14.3	13.4	15.3	17.2	15.8	15.2	12.8	16.1	17.6	15.5
50-54	12.7	13.3	12.1	17.4	14.5	13.6	11.5	14.7	17.1	15.0	15.5	11.2	17.6	20.9	15.6
55-59	10.3	10.1	9.7	14.0	12.4	12.2	10.2	13.1	14.1	12.9	13.1	9.3	16.6	22.3	13.5
Gender															
Men	78.5	68.5	65.0	18.2	52.0	56.1	37.6	37.9	7.6	30.3	77.8	79.1	65.0	15.4	69.1
Women	21.5	31.6	35.0	81.8	48.0	43.9	62.4	62.1	92.4	69.7	22.2	20.9	35.0	84.6	30.9
Education															
Higher tertiary	38.2	25.2	42.4	45.0	47.7	10.9	3.0	9.1	1.2	4.7	0.4	0.4	1.6	0.6	0.5
Lower tertiary	46.4	46.7	37.6	48.4	37.0	54.2	32.6	51.2	43.4	44.2	6.5	7.8	11.0	6.7	6.9
Secondary	11.2	21.5	16.7	5.8	12.4	27.0	47.2	31.0	49.9	41.6	70.3	68.7	63.9	69.3	67.9
Primary	4.1	6.7	3.4	0.7	3.0	7.9	17.2	8.7	5.5	9.5	22.9	23.0	23.4	23.3	24.7
Employment sector															
Private	96.2	95.6	81.4	14.0	49.0	97.1	96.1	86.2	17.4	56.9	97.6	95.6	66.3	20.4	80.8
Public	0.1	0.2	12.1	72.3	41.4	0.2	0.2	9.9	73.3	36.7	0.1	1.3	27.4	71.2	14.7
Private and public	3.1	3.1	5.6	12.9	8.8	2.4	3.0	3.4	9.0	6.0	1.9	2.3	5.7	8.2	3.8
Transition to self-employment	0.6	1.1	0.9	0.9	0.8	0.4	0.7	0.5	0.3	0.5	0.4	0.8	0.6	0.2	0.7

Income															
Quintile 1 (highest)	73.3	66.4	56.7	32.6	48.7	28.8	13.0	19.8	2.0	11.7	13.1	5.0	5.5	0.9	8.1
Quintile 2	15.7	16.1	22.4	21.0	24.0	33.7	14.0	24.6	12.3	18.5	25.6	15.3	15.2	2.5	18.7
Quintile 3	5.5	7.2	9.5	21.0	12.1	19.4	15.2	24.1	29.5	23.0	27.5	22.9	22.7	8.7	22.5
Quintile 4	2.6	4.4	5.1	15.3	7.4	10.9	22.3	17.8	33.6	24.9	21.3	28.0	25.8	36.0	23.7
Quintile 5 (lowest)	3.0	5.9	6.3	10.2	7.9	7.2	35.5	13.6	22.7	21.9	12.5	28.8	30.9	51.9	27.1
Employed time															
Full year	94.9	93.2	93.6	93.2	93.3	94.3	90.9	93.1	91.5	91.8	92.9	89.8	89.1	81.6	87.9
200-364 days	3.6	5.0	4.9	5.3	5.2	4.0	6.7	5.0	6.3	5.9	4.9	7.3	7.4	11.0	8.7
1-199 days	1.5	1.8	1.5	1.5	1.5	1.7	2.4	1.9	2.2	2.3	2.2	2.9	3.5	7.4	3.4
Employment episodes															
1	94.3	92.9	90.6	82.7	87.2	95.2	92.2	93.1	86.5	89.9	95.0	92.2	88.7	83.0	89.3
2	4.9	5.8	7.4	12.5	9.3	4.0	6.1	5.6	8.2	7.1	4.2	6.4	8.3	9.0	8.0
3+	0.8	1.3	2.0	4.8	3.5	0.8	1.7	1.3	5.4	3.0	0.8	1.5	3.1	8.0	2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0



Supplementary Figure 1. Age- and gender-adjusted estimated annual proportion of employees with a new onset of sickness absence due to musculoskeletal diseases and mental disorders (‰) by industrial sector among A-B) upper non-manual employees, C-D) lower non-manual employees, and E-F) manual workers. The panels are presented in different scales; P-values for the interaction between industrial sector and year: A) 0.302, B) 0.006, C) 0.000, D) 0.005, E) 0.000, F) 0.004.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
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, 3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4, 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5, 6
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-10
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6-10
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-10
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	6-10
Bias	9	Describe any efforts to address potential sources of bias	18, 19
Study size	10	Explain how the study size was arrived at	6, 7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9, 10
		(*b*) Describe any methods used to examine subgroups and interactions	9, 10
		(*c*) Explain how missing data were addressed	na
		(*d*) If applicable, explain how loss to follow-up was addressed	na
		(*e*) Describe any sensitivity analyses	na
Results			

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	na
		(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	10, 11
		(b) Indicate number of participants with missing data for each variable of interest	na
		(c) Summarise follow-up time (eg, average and total amount)	na
Outcome data	15*	Report numbers of outcome events or summary measures over time	11, 12
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	11-14
		(*b*) Report category boundaries when continuous variables were categorized	9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	11-14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	14, 15
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
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	19

*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.