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# Contribution of compositional changes in the workforce to sickness absence trends in Finland

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ABSTRACT

In this study, we assessed whether the long-term decrease in sickness absences in Finland is explained by observed and unobserved compositional changes in the workforce. Utilizing register-based panel data on Finnish wage earners aged 30–62, we examined the annual onset of compensated sickness absence (granted after 10 weekdays) in the period 2005–2016. We applied random effects models adjusting for changes in the observed sociodemographic and occupational characteristics of the study population. We also applied fixed effects models, with corrections of the estimates for cohort ageing, to additionally account for the unobserved time-invariant characteristics of the study population over the years. Of the observed characteristics, increasing educational level partly explained the decreasing trend in sickness absences, and the further contribution of the occupational class was weak. Additionally, accounting for unobserved individual characteristics further explained the decreasing trend in sickness absences among those aged 30–47 years and led to a reverse increasing trend among those aged 48–62 years irrespective of sex and employment sector. Particularly for those over 47 years old, the decrease in sickness absences appeared to be more strongly influenced by compositional changes in characteristics that are established before fully entering the labour market — such as educational level as well as unmeasured individual characteristics that remain unchanged after childhood and early adulthood — than in the work environment or other factors contributing at working age. Sickness absence trends fluctuated during economic cycles, which did not appear to be explained by immediate changes in the observed or unobserved characteristics. Different mechanisms are likely to explain long-term sickness absence trends and trends around economic cycles. Attempts to improve work ability and labour market inclusion in long-term should rely more on increasing educational levels among the workforce and on interventions carried out early during the life course.

## 1. Introduction

Every year a large number of persons are absent from work due to ill health causing substantial costs to society, employers and the employees. Previous studies have identified various risk factors of sickness absence at the individual level, such as poor general health (Haukka et al., 2013; Mauramo et al., 2019), low socioeconomic status (Allebeck & Mastekaasa, 2004; Laaksonen et al., 2010), poor work environment (De Vries et al., 2018; Hoven & Siegrist, 2013; Lallukka et al., 2019), and economic incentives (Palme & Persson, 2020). Another way of understanding the potential causes of sickness absence is to examine its development over time and the factors contributing to the sickness absence trends. So far, studies aiming to explain the long-term changes in sickness absences at the population level have mainly focused on the contribution of societal changes, e.g. changes in legislation (Henrekson & Persson, 2004), socioeconomic conditions (Bratberg & Monstad, 2015; Markussen et al., 2011), working conditions (Lidwall & Marklund, 2011), and population health and health behaviours, e.g. alcohol consumption (Amiri & Behnezhad, 2020; Schou and Moan 2016). In addition, sickness absence levels fluctuate with economic cycles (Askildsen, Bratberg, and Nilsen 2005; Shapiro & Joseph, 1984). However, the long-term contribution of workforce composition, in terms of observed sociodemographic and occupational characteristics and unobserved individual level characteristics, and the changes in it have gained less attention. The current study aims to explore the role of observed sociodemographic and occupational characteristics and individual level unobserved characteristics in explaining the declining sickness absence rates between 2005 and 2016 in Finland.

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### 1.1. Occupational and sociodemographic determinants of sickness absence trends

In general in the Nordic countries, sickness absences are more common in the public than in private sector (Hartikainen, Solovieva, Viikari-Juntura, & Leinonen, 2022; Løkke, Eskildsen, and Wendelboe Jensen 2006), among primary-educated than among tertiary-educated (f.em. Kaikkonen et al., 2015; Piha et al., 2007) and among manual workers than among non-manual employees (f.em. Blomgren & Jäppinen, 2021; Piha et al., 2007). Since the mid-2000s, sickness absences have decreased especially among manual workers (Leinonen et al., 2018) and primary and secondary educated (Sumanen, Lahti, et al., 2015) in Finland. The occupational class and educational level differences in sickness absence, both in absolute and in relative terms, have narrowed but remained consistent during the 2000s and 2010s (Pekkala et al., 2017; Sumanen, Lahti, et al., 2015; Sumanen et al., 2017). Studies have found that both the occupational and educational composition of the population explain the differences in work disability benefits. One Norwegian study found that the differences in sickness absences between counties were explained by the differences in their occupational composition (Sterud & Johannessen, 2018Sterud and Johannessen 2018). Another Norwegian study found that accounting for population education and occupation contributed to the decline in sickness absences (Markussen et al., 2011). Furthermore, a Finnish study found that the decrease in disability retirement was likely explained by structural changes in the workforce followed by the financial crisis of 2008–2009 (Solovieva et al., 2019).

Other sociodemographic characteristics, such as age and health, are also important determinants of sickness absence. In general, the risk of sickness absence increases with age and at the population level, the sickness absences increase as the population ages (Lidwall et al., 2005). Whether this is caused by accumulated health problems or older employee's response to changing work environment such as increased pace at work, is less clear (Lidwall & Marklund, 2011). New, younger cohorts are expected to be on average healthier than older cohorts, which would decrease sickness absences as they enter the labour market.

### 1.2. Unobserved individual level characteristics influencing sickness absences

Previous studies have mainly focused on the effects of observed characteristics on sickness absence rates. However, studies that have also accounted for unobserved individual characteristics have found them to be the strongest contributors to sickness absences, even after accounting for multiple observed characteristics (Bratberg & Monstad, 2015; Hartikainen et al., 2022; Markussen et al., 2011; Melsom & Mastekaasa, 2017).

The unobserved (time-invariant) individual characteristics refer to factors that are established in childhood and young adulthood, and which remain relatively constant through adulthood. These can include genetic susceptibility (Svedberg et al., 2012), personality (Løset and Tilmann Von Soest, 2023, p. 3; Störmer & Fahr, 2013), temperament (Henderson et al., 2009), cognitive abilities (Henderson et al., 2012), childhood physical and mental health (Delaney & Smith, 2012), childhood socioeconomic environment (Helgertz & Persson, 2014; Kristensen et al., 2009; Kristensen, Bjerkedal, and Irgens 2007; Salonsalmi et al., 2019), and success in school in adolescence (Mittendorfer-Rutz et al., 2013). The magnitude of the influence of these factors on sickness absence varies across time and cohorts, and in interaction with other (time-variant) factors. In other words, labour market structure, legislation, and other environmental factors create the framework within which factors established early in life affect individual behaviour and outcomes.

### 1.3. Economic cycles and sickness absence

Sickness absence rates also vary by economic cycles (also referred to as absence over business cycles in the literature). During economic downturns sickness absence rates tend to decrease and vice versa (Askildsen et al., 2005; Biørn et al., 2013; Blomgren et al., 2021; Bratberg & Monstad, 2015; Leigh, 1985; Pichler, 2015; Shapiro & Joseph, 1984). However, one Swedish study did not find any association between unemployment rates and long-term sickness absences (Lidwall & Marklund, 2011). Two main mechanisms explain this cyclical relationship between unemployment and sickness absence rates. First, some evidence exists showing that employees with health problems and weakened work ability are more likely to exit the workforce during economic downturns, especially in the Nordic countries where their living can be covered by an unemployment benefits scheme (Arai & Thoursie, 2005; Ose & Dyrstad, 2001; Stansfeld et al., 1999). Later on, during economic upturns, they will find employment more easily, but simultaneously have a higher risk of sickness absence as they enter employment (Leigh, 1985). The second explanation, which has gained much more support in the literature (f.em. (Askildsen et al., 2005; Fahr & Frick, 2007; Nordberg & Røed, 2009), proposes that during economic downturns employees are hesitant to have sickness absence due to fear of job loss and decreased job security (Bratberg & Monstad, 2015; Leigh, 1985; Shapiro & Joseph, 1984). Postponing sickness absence can lead to an accumulation of health problems that, once the economy starts to recover and grow, lead to an increase in sickness absences.

The various previous studies explaining the changes in sickness absences during economic up- and downturns have mainly attempted to distinguish the mechanism of individual reactive behaviour stemming from perceived possibilities in the labour market from that of individuals moving in and out of the labour market. These mechanisms are assumably more relevant in explaining sickness absence fluctuations around economic crises than the longer-term trends. However, economic crises may also influence longer-term compositional changes in the workforce by initiating or reinforcing changes in the occupational structure.

### 1.4. Sickness absences in the Finnish context

During the last 20 years, Finland has experienced large fluctuations in sickness absence rates. From 2000 to 2008 the proportion of individuals aged 16–64 receiving sickness benefits during a year increased from around 9%–11% (Blomgren, 2016; SIIF, 2023a). Following the economic crisis of 2008, sickness absences rapidly declined and then stagnated until the start of a smaller economic downturn in 2012, after which they continued to decrease until 2016. Since then, sickness absences have been increasing (Blomgren, 2016; SIIF, 2023a).

### 1.5. Study aims

This study set out to assess the possible causes for the fluctuations and the long-term decreasing sickness absence trend in Finland between 2005 and 2016. We focused on the impact of changes in the workforce composition in terms of sociodemographic and occupational characteristics and unobserved individual characteristics. Separate analyses were also conducted for women and men, different age groups and public and private sector employees. We also addressed short-term changes in sickness absence associated with the economic cycles within the study period.

## 2. Materials and methods

### 2.1. Study population

We used a large register-based data set based on a 70% random sample of the working-age population living in Finland on the last day of the year 2004. Individual level follow-up information linked together from three data sources was available annually until the end of 2016. Episodes of compensated sickness absence and national pensions were obtained from the Finnish Social Insurance Institution and episodes of employment and earnings-related pensions from the Finnish Centre for Pensions. Information on sociodemographic and employment-related factors was obtained from the FOLK data of Statistics Finland.

For this study, we included individuals who turned 30–62 years during a study year, did not receive any pension, vocational rehabilitation allowance or sickness allowance at the beginning of the year, and were employed wage-earners on the first day of the year. It was also required that the study subjects had lived in the country for over 12 years before the study year. This was done to achieve a similar selection of the study population for all years; sampling was performed in 2004, so for the year 2016, the study subjects had lived in the country 12 years before. 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. The final study population consisted of 1 629 520 single individuals contributing at least once with a total of 12 186 957 observations over the study years.

### 2.2. Sickness absence in Finland

In Finland, sickness absences of permanent residents are compensated by the Social Insurance Institution of Finland after a waiting period of 10 weekdays (including Saturday) that is typically paid by the employer. We examined whether a study person had a new onset of compensated full or part-time sickness absence during each study year. Part-time sickness absence, during which a person receives 50% of the full sickness allowance while working 40–60% of normal working time, has been available since 2007. However, the use of part-time sickness absence started very slowly. While it was steadily gained popularity still, only around 6% of all sickness allowances were granted as partial in 2016 (see SIIF 2023b). Furthermore, part-time has been predominantly preceded by an episode of full sickness absence (Leinonen et al., 2020; Viikari-Juntura et al., 2017). Moreover, part-time sickness absence is always a voluntary option for full sickness absence, i.e. users of partial sickness allowance have been initially assessed unfit for work and thus eligible for full sickness allowance (SIIF 2023c). Due to these reasons, the introduction of part-time sickness absence is expected to have little influence on the outcome consisting of new onsets of any type of sickness absence.

### 2.3. Observed background characteristics

Education and occupational class were measured at the end of the year preceding each study year. The highest achieved educational level was examined in categories 1) primary (no education after 9 years of compulsory school), 2) secondary (11–12 years of education) and 3) tertiary education (≥13 years of education). The occupational class was classified as 1) upper non-manual employees (upper-level employees with administrative, managerial, professional and related occupations), 2) lower non-manual employees (lower-level employees with administrative and clerical occupations), 3) skilled manual workers (manual workers with occupations requiring skills e.g. in agriculture, forestry, manufacturing, other production, distribution, and services), 4) unskilled manual workers (manual workers with elementary occupations), and 5) other.

The employment sector was classified based on the sector of pension-insured employment at the beginning of the study year being either private or public. If a person was simultaneously employed in both sectors, preference was given to the sector of longest employment in the preceding year, or if non-employed in that year, to public sector employment.

### 2.4. Statistical methods

Annual onset of sickness absence was examined using random effects (RE) and fixed effects (FE) panel regression analyses (Andreß et al., 2013; Rabe-Hesketh & Skrondal, 2012). The RE models account for both within- and between-individual changes in sickness absence over the study years. We controlled for observed background characteristics of the study population, that could vary over time and within the individual, to provide information on what the changes in sickness absence would be if the observed background characteristics of the study population were similar over the study years. The FE models account for within-individual changes in sickness absence over the study years, thereby controlling not only for observed background characteristics but additionally for unobserved time-invariant individual characteristics, including e.g. personal traits and earlier life-course events and circumstances. In the FE models, the individuals serve as their own controls, providing information on what the changes in sickness absence would be if the individuals were the same and their observed background characteristics were similar over the study years.

For both RE and FE regression analysis, linear probability models were applied for the binary outcome of having sickness absence (value 1) or not having it (value 0). The use of logistic FE regression would have been problematic because it excludes from the analyses study subjects whose outcome is the same at each measurement point, i.e. being either 0 or 1 in each study year. The regression coefficients of the linear probability models can be interpreted as the absolute difference in the probability of onset sickness absence between the study years. We present the results as percentage point differences with the year 2005 as the reference.

We first adjusted for the observed background characteristics including education and occupational class by adding them one after another to the age- and sex-adjusted RE model. We then further adjusted for unobserved time-invariant characteristics by applying the FE model. In the FE model, it is not possible to separate the effects of calendar year and age, as a unit change in one of these coincides with that of the other within the individual. To assess how cohort ageing may have affected the results, we present corrected FE estimates utilizing the observed period effects of age represented by the age coefficients from the RE analyses, which were allowed to vary by study year. These main RE and FE analyses were repeated stratifying the analyses by age group (30–47 and 48–62 years), sex, and employment sector. Two relatively broad age groups were chosen to be able to follow up the individuals for a large number of years within the age ranges. The younger group has a wider range to get more sickness absence cases, as sickness absence is less common among them than among the older.

### 2.5. Sensitivity analyses

We performed several sensitivity analyses on the main analyses. First, we assessed the sensitivity of the results to our basic method of correcting the FE estimates utilizing period effects of age. This method assumes that with a one-year increase in age *within* a cohort, the increase in the likelihood of sickness absence would be the same as that observed *between* successive cohorts with a one-year age difference. As this assumption may not be realistic, we further corrected the FE estimates by multiplying the age coefficients derived from the RE analyses with 0.75, and 1.25, i.e. assuming that the effects of age would be 25% smaller or larger, respectively.

Second, we performed the analyses including into the models interactions of also other covariates than age with the calendar year. This was done to assess whether the sickness absence trend was partially explained by changing influences of the observed characteristics on sickness absence rather than compositional changes in them.

Third, we performed the analyses including only individuals who were a part of the study population in at least two study years. As only these individuals could contribute to the coefficients of the calendar year in the FE analyses, the RE and FE models would this way be more comparable.

Fourth, we performed the analyses for a subpopulation that belonged to the examined age range of 30–62 years throughout the study period 2005–2016, i.e. those born between 1954 and 1975. This was done to assess the source of potential compositional changes influencing the sickness absence trend. By examining the same birth cohorts over the study years, any changes in the distribution of factors associated with sickness absence would be driven by changes in the inclusion or exclusion of absence-prone individuals in the wage-earner study population instead of actual changes in the prevalence of factors in the whole working-age population that are associated with sickness absence.

## 3. Results

### *3.1. Sickness absence trends across employment sectors and sex*

Changes in the age-, sex-, and employment sector distributions in the population were minor during the study period between 2005 and 2016 (Table 1). The share of 48–62 years old, women and private sector employees in the study population increased only slightly. The proportion of individuals with tertiary education increased and those with primary education decreased. The proportion of upper non-manual employees also increased, while that of manual workers decreased. These distributions are presented by age group, sex, and employment sector for the first and last study year in Appendix Table 1. The change in the educational structure was stronger among the older age group, women, and private sector employees.

The proportion of individuals with an onset of sickness absence decreased from 14.1% in 2005 to 11.1% in 2016 (Fig. 1). The sharpest decrease occurred between the years 2008 and 2009 and was followed by stagnation until 2011. In both groups aged 30–47 and 48–62 years, the proportion of those with sickness absence was higher in women than in men and in the public than in the private sector. Sickness absences nevertheless decreased in all groups.

### *3.2. Observed and unobserved characteristics contributing to sickness absence trends*

Compared to the year 2005, the age- and sex-adjusted RE model showed a sharp decline in the onset of sickness absence between 2008 and 2009, followed by a small increase until 2011, and a sharp decline again between 2011 and 2012 (Fig. 2). From thereon, a steady decline was observed. In 2016, the onset of sickness absence was 2.2 percentage points lower than in 2005. After adjusting for education and further occupational class, this difference reduced to 1.8 and 1.6 percentage points, respectively.

In the FE model, which further controlled for unobserved individual level time-invariant characteristics, sickness absences largely increased over the study years as the cohorts became older (Fig. 2). Also in the FE models, sickness absences decreased sharply between the years 2008 and 2009, and 2011 and 2012. Both declines were preceded by an increase in sickness absence. After 2012, sickness absences continued to steadily decrease. Despite these fluctuations, in general, in the age-corrected FE model, virtually no change in sickness absences was observed between 2005 and 2016. If the effect of age was assumed 25% smaller or larger than in the basic correction of the FE estimates, sickness absences were estimated to increase by 0.6 and or decrease by 0.8 percentage points, respectively (Appendix Fig. 1).

The findings regarding the contribution of the observed and unobserved characteristics remained similar when the interactions of all covariates, i.e. not only of age but with calendar year were included in the models (Appendix Fig. 2). They also remained similar when the analyses were based only on individuals with at least two observations over the study years (Appendix Fig. 3). When restricting the analyses to the cohorts that could be fully observed over the study period, controlling for unobserved characteristics explained the decrease in sickness absences somewhat less than in the main analyses (Appendix Fig. 4).

### *3.3. Age-, sex- and employment-sector-specific results*

Among the younger group aged 30–47 years, after having controlled for education in the RE models, the minor further contribution of occupational class to the declining sickness absence trend was observed mainly in the private sector (Fig. 3). Although the trend was partially explained by unobserved individual level characteristics, some decrease remained unexplained in the age-corrected FE model regardless of sex and employment sector.

Among those aged 48–62 years, the declining trend in sickness absences in the RE models started mainly after 2011, except for women in the public sector, among whom the decline was prevalent throughout the study period (Fig. 4). The explanatory role of education was largest in women and in the private sector. The occupational class had virtually no further contribution. Among men working in the public sector,

**Table 1**
Annual distribution (%) of the observed explanatory factors among the study population.

| | Year | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| Age | | | | | | | | | | | | |
| 30–47 | 57,9 | 57,4 | 56,9 | 56,6 | 56,2 | 56,0 | 55,9 | 55,6 | 55,3 | 55,1 | 54,8 | 54,6 |
| 48–62 | 42,1 | 42,6 | 43,1 | 43,5 | 43,8 | 44,0 | 44,1 | 44,4 | 44,7 | 45,0 | 45,3 | 45,4 |
| Sex | | | | | | | | | | | | |
| Men | 48,7 | 48,7 | 48,6 | 48,6 | 48,2 | 47,8 | 47,8 | 47,7 | 47,5 | 47,5 | 47,4 | 47,5 |
| Women | 51,3 | 51,3 | 51,4 | 51,4 | 51,8 | 52,2 | 52,2 | 52,3 | 52,5 | 52,5 | 52,6 | 52,5 |
| Employment sector | | | | | | | | | | | | |
| Private | 64,2 | 64,4 | 64,8 | 65,5 | 65,4 | 65,1 | 65,1 | 65,2 | 65,0 | 65,0 | 65,1 | 65,3 |
| Public | 35,8 | 35,6 | 35,2 | 34,6 | 34,6 | 34,9 | 34,9 | 34,8 | 35,0 | 35,1 | 34,9 | 34,7 |
| Education | | | | | | | | | | | | |
| Tertiary | 42,3 | 42,9 | 43,3 | 43,7 | 44,7 | 45,7 | 46,2 | 46,7 | 47,3 | 48,0 | 48,7 | 49,0 |
| Secondary | 41,0 | 41,3 | 41,7 | 42,1 | 42,0 | 42,1 | 42,3 | 42,5 | 42,6 | 42,5 | 42,6 | 42,5 |
| Primary | 16,8 | 15,9 | 15,1 | 14,2 | 13,3 | 12,2 | 11,5 | 10,8 | 10,2 | 9,5 | 8,8 | 8,5 |
| Occupational class | | | | | | | | | | | | |
| Upper non-manual | 24,0 | 24,9 | 25,2 | 25,4 | 26,2 | 26,6 | 25,8 | 26,1 | 26,1 | 26,6 | 26,8 | 27,4 |
| Lower non-manual | 39,5 | 38,9 | 38,8 | 39,1 | 39,3 | 39,5 | 41,4 | 41,2 | 41,5 | 41,1 | 40,8 | 39,9 |
| Skilled manual | 25,3 | 25,2 | 24,9 | 24,7 | 23,5 | 22,2 | 23,6 | 23,3 | 22,7 | 22,4 | 21,7 | 21,3 |
| Unskilled manual | 8,1 | 8,0 | 7,8 | 7,8 | 7,7 | 7,5 | 6,0 | 5,9 | 5,9 | 5,7 | 5,5 | 5,3 |
| Other | 3,1 | 3,0 | 3,2 | 3,1 | 3,4 | 4,2 | 3,3 | 3,6 | 3,8 | 4,2 | 5,2 | 6,1 |
| 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 |
| N | 1013520 | 1020725 | 1035347 | 1044453 | 1040937 | 1014343 | 1010125 | 1012970 | 1009368 | 1000226 | 994477 | 990466 |

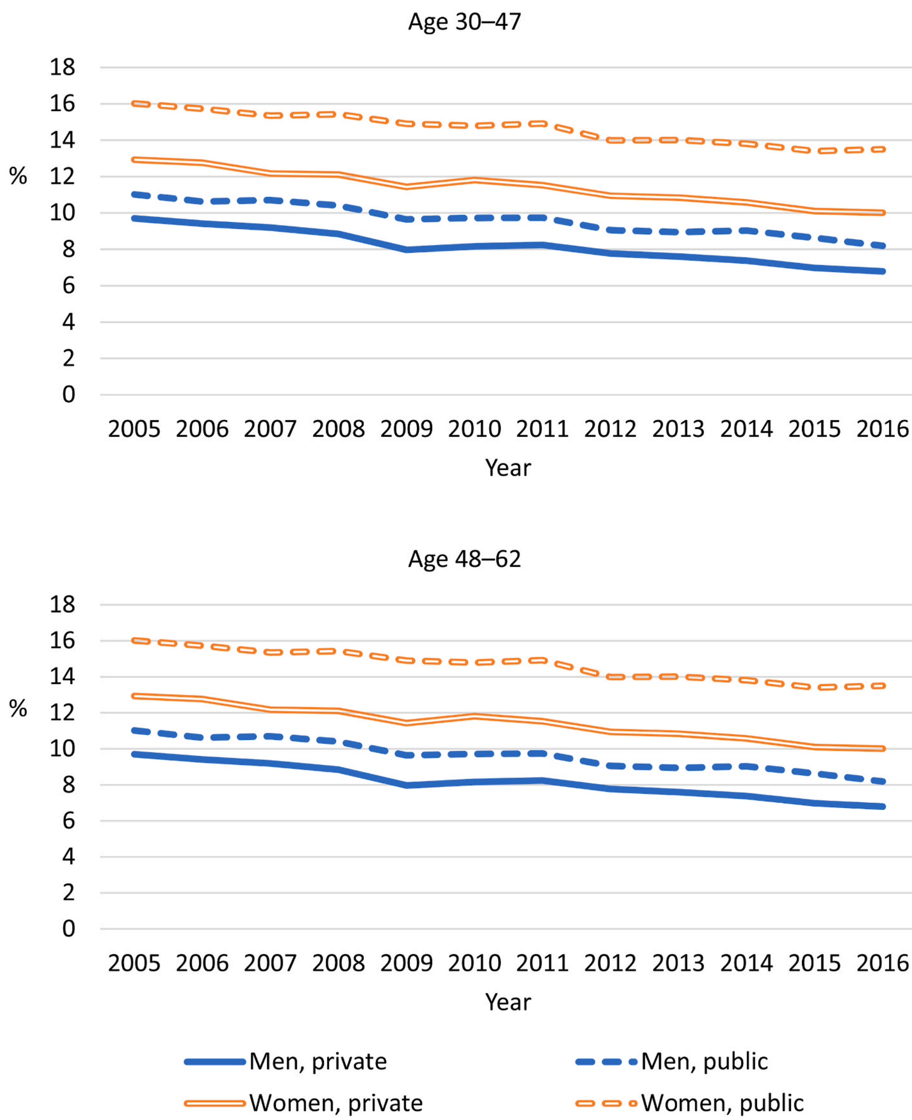


**Fig. 1.** Annual onsets of compensated sickness absence (%) by sex and employment sector for age groups 30–47 (lighter shade) and 48–62 (darker shade) years. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

neither of the observed characteristics contributed to the sickness absence trend. Furthermore, unobserved individual level characteristics had a much stronger contribution among this older age group, as an increase in sickness absences was estimated even in the age-corrected FE analysis.

## 4. Discussion

Using nationwide Finnish register data, we found a decrease in the onset of sickness absence between the study period from 2005 until 2016 in both sexes, age categories, and employment sectors. The decrease was the strongest between the years 2008 and 2009, and again between 2011 and 2012. Of the observed characteristics, mainly education explained the decreasing sickness absence trend, whereas the further role of the occupational class was small. However, unobserved individual level characteristics had the strongest contribution to the sickness absence trend.

### *4.1. Long-term decline in sickness absences*

During the study period, the proportion of tertiary educated increased and primary educated decreased, especially among the older age group, women, and private sector employees. These observations reflect the educational expansion occurring in Finland during the last few decades, especially among women (Kalenius, 2023; Kilpi-Jakonen, Erola, & Karhula, 2016; Statistics Finland, 2022). These educational changes can explain why we observed a stronger contribution of education to the declining sickness absence trend among private sector employees, women, and older persons (over 47 years). An increase in education can reflect better health and health behaviour among employees and better working conditions that would all lead to lower sickness absence rates.

Further adjustment for occupational class contributed only little to the sickness absence trend. This is understandable since education and occupation are highly correlated and the possible effects of sickness absence are likely captured already in education (Piha et al., 2010; Sumanen, Pietiläinen, et al., 2015).

The long-term decline in sickness absences was mainly explained by unobserved time-invariant individual level characteristics, which is in line with previous findings (Bratberg & Monstad, 2015; Markussen et al., 2011). Among the younger age group (30–47 years), however, unobserved characteristics explained only part of the decline in sickness absence. Among the older group (47–59 years) we observed an increase in sickness absence when these characteristics were accounted for by

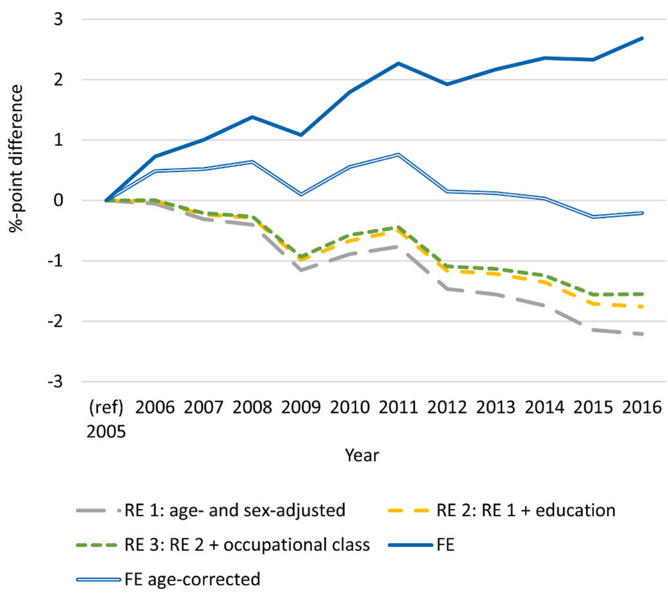


**Fig. 2.** Annual %-point differences in the onset of sickness absence in the period 2006–2016 compared to the reference year 2005 after adjusting for different observed factors with random effects (RE) models and further for unobserved factors with fixed effects (FE) models.

analysing within-individual changes. This finding is in line with a previous study from Norway showing that the rise in sickness absence over time was steeper within individuals than the rise in aggregate levels (Biørn et al., 2013). In general, the larger contribution of unobserved characteristics among the older age group may be explained by the accumulation of a higher number of characteristics during the life course that can contribute to the sickness absence trend than among the younger. These results highlight the importance of unobserved individual level characteristics, i.e. characteristics developing before fully entering the labour market, in explaining the changes in long-term sickness absences.

Based on our findings it is not fully clear whether the compositional changes explaining the declining sickness absence trend were driven by stronger exclusion over time of absence-prone individuals from the wage-earner study population or a decrease in the prevalence of characteristics in the working-age population that are associated with sickness absences. The observed but smaller influence of compositional changes in the sensitivity analyses restricting the analyses to the cohorts that could be fully observed over the study period suggests that both mechanisms were likely to play a role.

Other factors, such as changes in legislation, population health or health behaviour (especially alcohol consumption) and in work environment (Lidwall & Marklund, 2011; S. Hashemi et al., 2022), can contribute to long-term sickness absence trends. However, no major changes occurred in the Finnish legislation related to sickness benefits during our study period 2005–2016. Similarly, no major changes have happened in the general level of health and work ability over the study period according to population-level surveys (Blomgren, 2016; Koponen et al., 2018; Koskinen, Lundqvist, and Ristiluoma 2012). Further, alcohol consumption decreased during the study period (THL, 2023, p. 3; Tigerstedt et al., 2020).

### 4.2. *Economic cycles and fluctuations in sickness absence trend*

Finland had a steady increase in gross domestic product between 2005 and 2008 (Statistics Finland, 2023a). Following this period of economic upturn, Finland was heavily hit by the economic crisis in 2009, and experienced another smaller economic downturn again after 2011 (Suni & Vihriälä, 2016). During these periods, i.e. between the years 2008–2009 and 2011–2012, we observed a sharp decline in sickness absences. Education, occupational class, and unobserved time-invariant individual characteristics did not contribute to the immediate decrease in sickness absences between these years. This indicates that no large short-term fluctuations occurred in the composition of the workforce around the economic crisis, supporting the idea that the decline in sickness absences occurred because employees were hesitant of having sickness absences during the economic downturn.

We further observed an increase in the onset of sickness absence in the period 2009–2011, i.e. following the first economic shock. During this period, also the proportion of unemployed in the workforce slightly decreased (Statistics Finland, 2023b). It is possible that individuals with health problems, who dropped out of employment during the crisis, regained work during this period. However, the observed and unobserved characteristics did not explain the increase in sickness absence between 2009 and 2011. Thus, the increase in sickness absences is more likely explained by the fact that employees who remained in the workforce and avoided sickness absences during the economic crisis had accumulated health problems that after the crisis led to increased sickness absence use.

### 4.3. *Methodological considerations*

The strengths of this study include a nationally representative large cohort that could be followed up over 12 years and the use of both RE and FE analyses enabled to assess, how compositional changes in the workforce in terms of observed and unobserved characteristics have influenced sickness absence trends in Finland. The register-based data were not subject to non-response or loss to follow-up and had reliable data on key sociodemographic and employment-related factors.

The study had also certain limitations. The data did not include those who immigrated to Finland over 12 years before a given study year. The findings therefore only apply to the longer-term established Finnish workforce. The use of sickness absence may be different among the immigrant workforce – the size of which has been increasing in Finland – than among the native workforce.

Some uncertainty remains concerning how well the effects of cohort ageing could be accounted for in the FE analyses when correcting the estimates based on age coefficients derived from the RE analyses. Utilizing such period effects of age in the corrections is likely to rather have led to an over adjustment than an under adjustment of the effects of ageing in the FE analyses, as younger cohorts are expected to have been healthier than the previous ones at corresponding ages. The applied basic corrections would in this case have led to an overestimation of the declines in sickness absence in the FE models and thereby to an underestimation of the contribution of the unobserved characteristics to this trend. This was demonstrated by the contribution of unobserved characteristics appearing even larger when applying the 0.75 age correction.

Lastly, our findings only apply to trends in the onset of at least one sickness absence episode during a year. Different factors may have contributed to changes in the duration and frequency of sickness absence, which could be investigated in future studies.

## 5. Conclusions

Our findings demonstrated that sickness absences declined from 2005 until 2016 in both sexes, age groups, and employment sectors in Finland. In general, the decline was mostly explained by unobserved individual level characteristics, especially among the older age group. Of the observed characteristics, the increase in the educational level of the workforce had the strongest contribution to the sickness absence trend, especially among over 47 years old women working in the private sector. During the economic crisis, we observed fluctuations in sickness absences that did not appear to be explained by immediate changes in the observed or unobserved characteristics. Different mechanisms are likely to explain the short-term changes in sickness absence near

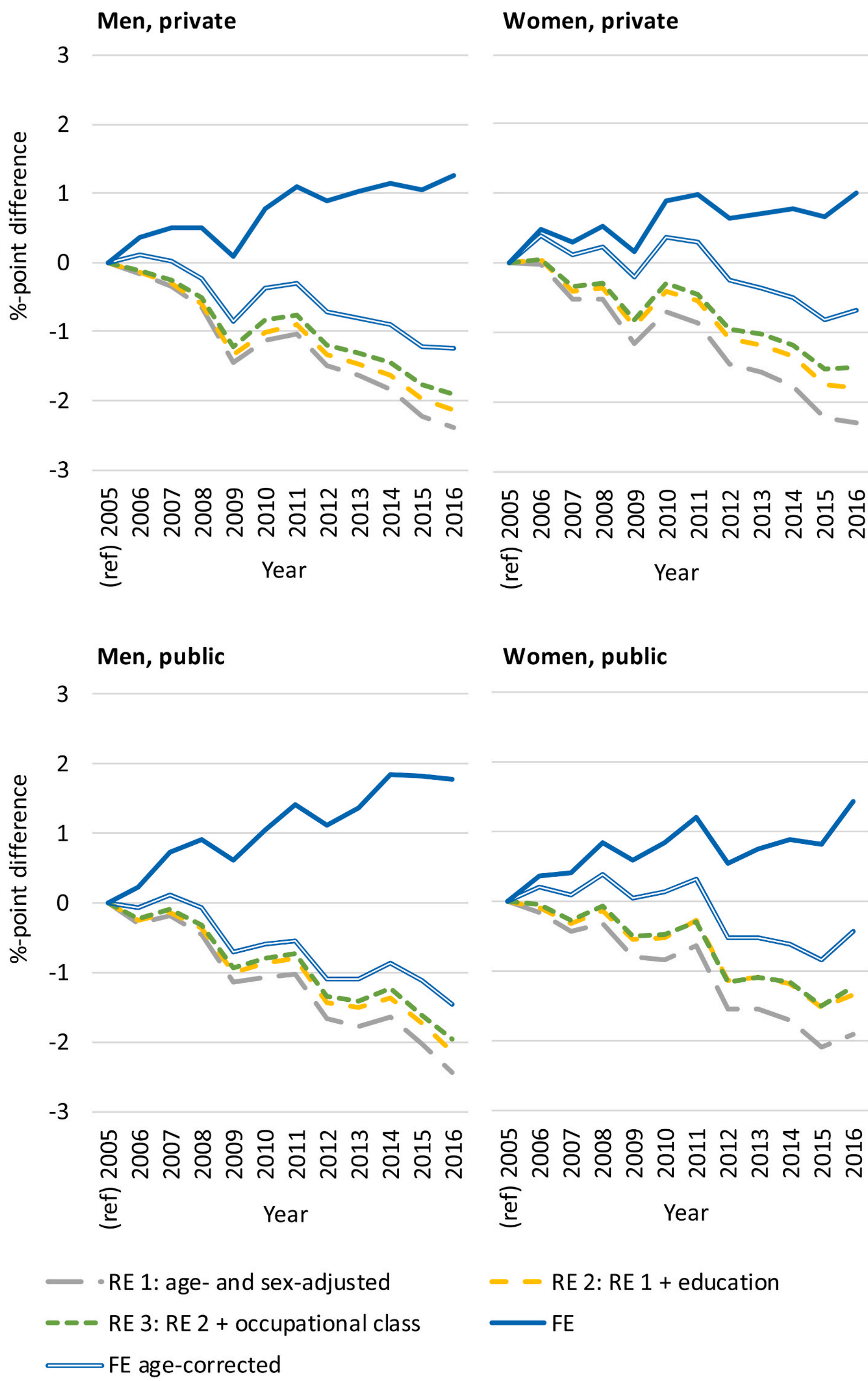


**Fig. 3.** Annual %-point differences in the onset of sickness absence in the period 2006–2016 compared to the reference year 2005 after adjusting for different observed factors with random effects (RE) models and further for unobserved factors with fixed effects (FE) models by sex and employment sector for age group 30–47 years.

economic shocks and the longer-term changes in sickness absence. To decrease sickness absences in the long-term, in addition to investments in health and the work environment, interventions should be targeted in early life course before the individuals fully enter the labour market.

## Declaration of competing interest

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### Relationships

There are no additional relationships to disclose.

### Patents and intellectual property

There are no patents to disclose.

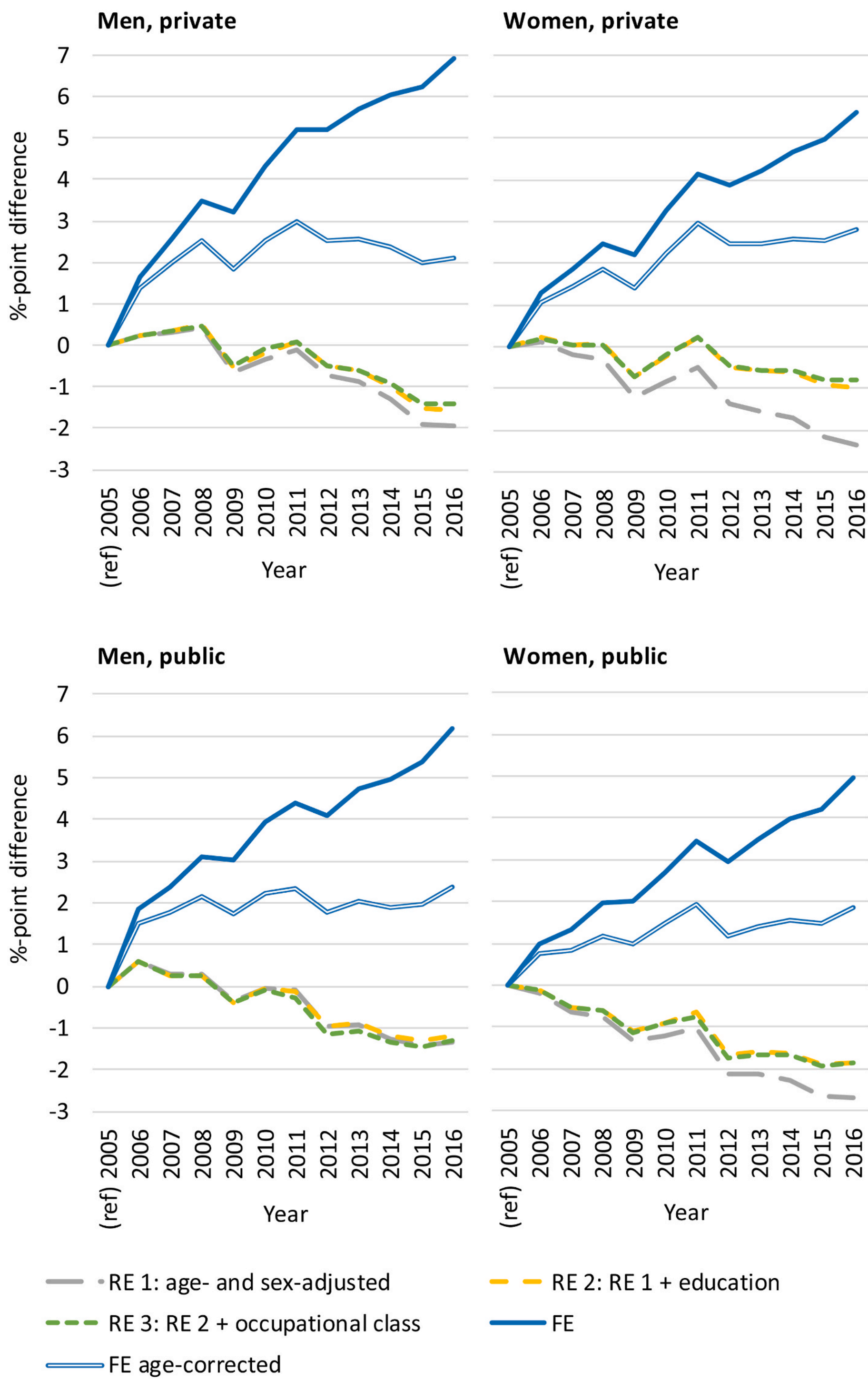



**Fig. 4.** Annual %-point differences in the onset of sickness absence in the period 2006–2016 compared to the reference year 2005 after adjusting for different observed factors with random effects (RE) models and further for unobserved factors with fixed effects (FE) models by sex and employment sector for age group 48–62 years.

*Other activities*

There are no additional activities to disclose.

**Ethical statement**

Not applicable to administrative register data pseudonymized for research purposes.

**Financial disclosure**

The authors have no financial interests to disclose.

**Data sharing statement**

The data from Statistics Finland, the Finnish Centre for Pensions and the Social Insurance Institution of Finland are not publicly available, but permission to access register data can be applied by researchers (https://www.findata.fi/en/services/data-permits/).

## Authors statement

All authors: Conceptualization, reviewing; **Taina Leinonen:** Data curation, Formal analysis, Investigation, Methodology, Visualization; **Laura Salonen:** Writing - original draft and review & editing.

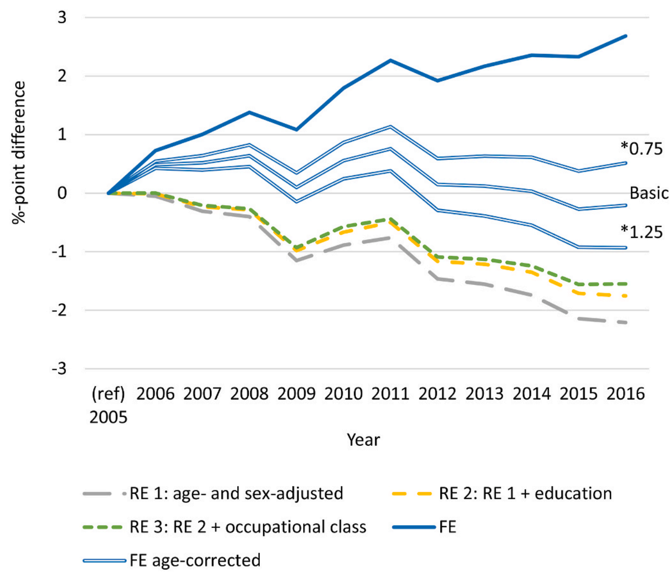
## Data availability

The authors do not have permission to share data.

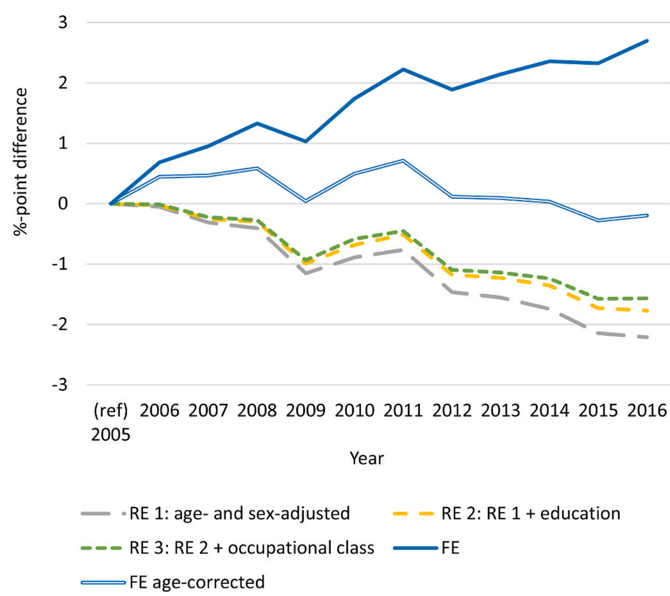
## Appendix

**Appendix Table 1**
Distribution (%) of the observed explanatory factors among the study population in the first and last year of the study period by age group, sex, and employment sector.

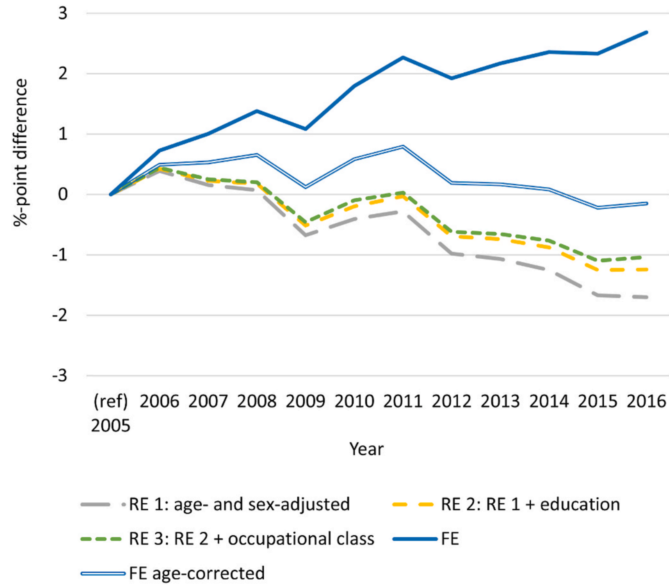
| | Men 2005 | Men 2016 | Women 2005 | Women 2016 |
|---|---|---|---|---|
| Age 30–47 | | | | |
| Private | | | | |
| Education | | | | |
| Tertiary | 34,5 | 37,9 | 48,1 | 54,4 |
| Secondary | 50,6 | 51,7 | 40,2 | 39,8 |
| Primary | 15,0 | 10,4 | 11,7 | 5,8 |
| Occupational class | | | | |
| Upper non-manual | 21,2 | 25,6 | 16,4 | 21,0 |
| Lower non-manual | 24,8 | 23,7 | 54,8 | 52,2 |
| Skilled manual | 44,3 | 37,9 | 17,6 | 13,5 |
| Unskilled manual | 6,5 | 5,1 | 7,3 | 4,9 |
| Other | 3,3 | 7,7 | 4,0 | 8,5 |
| Total | 100,0 | 100,0 | 100,0 | 100,0 |
| N | 241850 | 225603 | 155615 | 152779 |
| Public | | | | |
| Education | | | | |
| Tertiary | 58,6 | 61,7 | 59,4 | 67,5 |
| Secondary | 34,4 | 34,6 | 35,8 | 30,4 |
| Primary | 7,0 | 3,7 | 4,8 | 2,2 |
| Occupational class | | | | |
| Upper non-manual | 43,7 | 45,5 | 32,1 | 36,0 |
| Lower non-manual | 31,4 | 38,0 | 52,4 | 53,9 |
| Skilled manual | 16,3 | 11,9 | 5,7 | 2,4 |
| Unskilled manual | 6,8 | 2,0 | 7,4 | 4,6 |
| Other | 1,8 | 2,7 | 2,5 | 3,0 |
| Total | 100,0 | 100,0 | 100,0 | 100,0 |
| N | 54415 | 42667 | 134760 | 119672 |
| Age 48–62 | | | | |
| Private | | | | |
| Education | | | | |
| Tertiary | 29,3 | 34,9 | 29,0 | 46,0 |
| Secondary | 41,5 | 49,8 | 38,0 | 41,7 |
| Primary | 29,2 | 15,3 | 33,1 | 12,2 |
| Occupational class | | | | |
| Upper non-manual | 20,4 | 23,3 | 11,9 | 18,2 |
| Lower non-manual | 22,1 | 21,5 | 53,8 | 52,8 |
| Skilled manual | 47,0 | 43,0 | 19,5 | 14,7 |
| Unskilled manual | 6,6 | 4,3 | 11,2 | 7,0 |
| Other | 3,8 | 7,9 | 3,7 | 7,3 |
| Total | 100,0 | 100,0 | 100,0 | 100,0 |
| N | 148376 | 155929 | 105073 | 112869 |
| Public | | | | |
| Education | | | | |
| Tertiary | 57,1 | 58,6 | 45,3 | 56,5 |
| Secondary | 27,6 | 33,5 | 38,9 | 38,6 |
| Primary | 15,3 | 7,9 | 15,8 | 4,9 |
| Occupational class | | | | |
| Upper non-manual | 46,9 | 45,9 | 26,8 | 30,5 |
| Lower non-manual | 23,6 | 28,1 | 53,4 | 55,6 |
| Skilled manual | 18,7 | 20,5 | 5,1 | 3,0 |
| Unskilled manual | 8,8 | 2,6 | 12,7 | 8,6 |
| Other | 2,0 | 3,0 | 2,1 | 2,3 |
| Total | 100,0 | 100,0 | 100,0 | 100,0 |
| N | 48773 | 45836 | 124658 | 135111 |



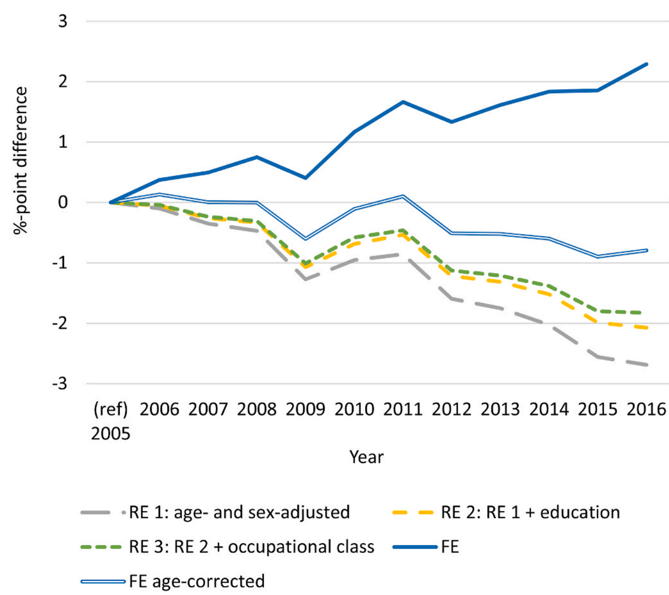

**Appendix Fig. 1.** Annual %-point differences in the onset of sickness absence in the period 2006–2016 compared to the reference year 2005 after adjusting for different observed factors with random effects (RE) models and further for unobserved factors with fixed effects (FE) models, applying different magnitudes of age correction for the FE estimates.




**Appendix Fig. 2.** Annual %-point differences in the onset of sickness absence in the period 2006–2016 compared to the reference year 2005 after adjusting for different observed factors with random effects (RE) models and further for unobserved factors with fixed effects (FE) models, including interactions of all covariates with calendar year.




**Appendix Fig. 3.** Annual %-point differences in the onset of sickness absence in the period 2006–2016 compared to the reference year 2005 after adjusting for different observed factors with random effects (RE) models and further for unobserved factors with fixed effects (FE) models, including only observations of individuals who were a part of the study population in at least two study years (98.9% of all observations and 91.8% of all study subjects).




**Appendix Fig. 4.** Annual %-point differences in the onset of sickness absence in the period 2006–2016 compared to the reference year 2005 after adjusting for different observed factors with random effects (RE) models and further for unobserved factors with fixed effects (FE) models, including only observations of individuals who were born in 1954–1975 (69.7% of all observations and 55.5% of all study subjects).

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