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THE DEVELOPMENT OF WORKING HOURS AND SICKNESS ABSENCE
IN MIDLIFE AND LATER CAREERS:
AN OCCUPATIONAL COHORT STUDY

Johanna Suur-Uski

ACADEMIC DISSERTATION

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Abstract

The population is ageing globally and in Europe. This change is increasing the number of retired people and poses fiscal challenges. As a response, many nations have implemented increases in the statutory pension age and made moving to early retirement less profitable. Accordingly, the labour force participation of older workers has increased during recent decades. In Europe, employees above 54 years account for a fifth of the workforce. With rising life expectancy and changing dependency ratios, it is ever more vital to understand what factors affect work ability, and how the well-being of our midlife and ageing workforce is developing. It is also important to know how work arrangements and work disability develop in this group. Among ageing employees, previous research has mostly focussed on those who exit the workforce prematurely, with few studies examining the development of working hours in later careers. Furthermore, relatively little is known about the development of sickness absence in later careers, especially considering the shift towards an older workforce.

The main aim of this study was to examine the developmental patterns of working hours and sickness absence among midlife and older public sector employees and to study social, work-, and health-related determinants of distinct developmental patterns in working hours and sickness absence.

The specific aims were: I) to characterise the development of working hours by identifying trajectories in working hours, II) to examine the development of long-term medically certified all-cause and diagnosis-specific sickness absence by identifying the developmental trajectories of long-term sickness absence, III) to examine the dual developmental trajectories of short- and long-term sickness absence, and IV) to examine the associations of social, work-, and health-related factors with the trajectory group memberships.

This study is a part of the Helsinki Health Study. The data in this study were derived from a Helsinki Health Study cohort of municipal employees aged 40, 45, 50, 55, and 60 years at phase 1 in 2000–2002. The number of participants at phase 1 was 8960, with 78% of them giving permission for City of Helsinki register linkages and 74% for external register linkage. Sickness absence data were included from the City of Helsinki personal registers in 2002–2019 and from the Social Insurance Institution of Finland in 2004–2018. The development of working hours and sickness absence was examined by two person-based longitudinal approaches, group-based trajectory modelling (GBTM) and growth mixture modelling (GMM).

After selecting the most representable trajectory model in each analysis, multiple socioeconomic and work-related factors, such as occupational class, marital status, age, shift work, and work-home satisfaction, as well as health behaviours, were included to examine their associations with working hour and sickness absence trajectories.

Distinct developmental patterns of working hours and sickness absence were identified. This study showed that the majority of municipal employees' working hours remain stable and most employees sustain working life without sickness absence. Roughly a tenth of employees were assigned to a trajectory with a high rate of sickness absence, which depending on the substudy was either marked by strongly increasing long-term sickness absence or by a persistently high rate of short-term sickness absence spells. Multiple health behaviours were associated with sickness absence trajectory membership, in particular two major modifiable lifestyle factors, physical activity and smoking, arose as determinants for trajectory membership. Socioeconomic differences were clear throughout this study, with more sickness absence among those in lower occupational classes. This finding emphasises the need to reduce socioeconomic inequalities in health. Further, when examining the contemporaneous development of short- and long-term sickness absence, both interrelationships and heterogeneity between the sickness absence trajectories were observed. Interrelationships were noticed between short- and long-term sickness absence trajectories in the dual trajectory model. If, based on their posterior probability, a participant was assigned to a no short-term sickness absence trajectory group, the likelihood of belonging to a no long-term sickness absence group was also high. However, when a participant was assigned to a high frequency short-term sickness absence trajectory group, the probability of belonging to any specific long-term sickness absence trajectory group was far less certain. This implies population heterogeneity in the development of sickness absence.

These results show how working hours develop in later careers, and how the changes are linked to social-, work-, and health-related factors. Sickness absence is not equally divided among public sector employees, but rather separate subgroups arise within this heterogeneous population. These results produce an understandable picture regarding sickness absence and its determinants in midlife and later careers. The results of this study can be utilised in occupational healthcare and in health policy with more focus on those in lower socioeconomic positions. Sickness absence provides a chance to detect risks and interrupt the unequal stacking of poor health onto a subgroup.

Tiivistelmä

Väestö ikääntyy niin maailmalla kuin Euroopassa. Tämä muutos kasvattaa eläköityneiden ihmisten määrää suhteessa työikäisiin. Vastauksena tähän, monet valtiot ovat ottaneet käyttöön eläkeiän nostoja ja vaikeuttaneet varhaiseläkkeelle siirtymistä. Näitä muutoksia mukaillen, ikääntyneiden työntekijöiden määrä on lisääntynyt viime vuosikymmeninä. Euroopassa viidesosa työvoimasta on yli 54-vuotiaita. Elinajanodotteen noustessa ja muuttuvan huoltosuhteen takia on entistä tärkeämpää ymmärtää, mitkä tekijät vaikuttavat työkykyyn ja miten keski-ikäisten ja ikääntyvien työntekijöiden hyvinvointi kehittyy. On myös tärkeää ymmärtää miten työkyvyttömyys kehittyy tässä joukossa. Ikääntyvien työntekijöiden työkykyä käsittelevä aiempi kirjallisuus on keskittynyt enemmän siihen, ketkä eläköityvät ennen aikaisesti ja harvempi tutkimus on selvittänyt, miten työtunnit kehittyvät myöhemmällä työuralla. Lisäksi sairauspoissaolojen kehityksestä työuran loppuvaiheessa tiedetään melko vähän, etenkin huomioiden tällä hetkellä tapahtuva muutos työvoiman ikärakenteessa.

Tämän tutkimuksen päätavoite on tutkia työtuntien ja sairauspoissaolojen kehityspolkuja ajassa keski-ikäisillä ja ikääntyvillä julkisen sektorin työntekijöillä. Lisäksi on tarkoitus tutkia sosiaalisia ja työhön ja terveyteen liittyviä selittäviä tekijöitä näille kehityspoluille.

Tarkemmat tutkimuskysymykset ovat: 1) miten työtunnit kehittyvät ja minkälaisia kehityspolkuja ne muodostavat, 2) miten kaikki pitkät sairauspoissaolot sekä diagnoosikohtaiset mielenterveyteen ja tuki- ja liikuntaelinsairauksiin liittyvät sairauspoissaolot kehittyvät ja minkälaisia kehityspolkuja nämä muodostavat, 3) miten kehittyvät lyhyet ja pitkät sairauspoissaolot yhdessä iän mukana ja 4) miten löytyneet kehityspolut ovat yhteydessä sosiaalisiin, työhön ja terveyteen liittyviin tekijöihin.

Tämä tutkimus on osa Helsinki Health Study-tutkimusta. Aineisto, jota tutkimus käyttää on Helsinki Health Study-kohortista, joka käsittää Helsingin kaupungin työntekijöitä, jotka olivat iältään 40, 45, 50, 55 ja 60-vuotiaita ensimmäisen kyselyaallon aikana vuosina 2000–2002. Vastaajia oli 8960 ensimmäisessä kyselyaallossa, joista 78 % antoi luvan sisäisten Helsingin kaupungin rekisterien yhdistämiseen ja 74 % ulkoisten rekisterien yhdistämiseen. Tiedot sairauspoissaoloista kerättiin Helsingin kaupungin rekistereistä vuosilta 2002–2019 ja Kelan tilastoista vuosilta 2004–2018. Työtuntien ja sairauspoissaolojen kehitystä tutkittiin henkilölähtöisillä analyysimenetelmillä,

joista käytetään nimitystä kehityspolkumalli. Tämän jälkeen tarkasteltiin valittujen kehityspolkumallien ja selittävien tekijöiden yhteyksiä. Selittävät tekijät työtuntien ja sairauspoissaolojen kehitykselle sisälsivät useita sosioekonomisia ja työhön liittyviä tekijöitä, kuten ammattiluokan, siviilisäädyn, iän, vuorotyön ja itse koetun työn ja kodin yhteensovittamisen sekä useita terveyskäyttäytymisen muuttujia.

Tutkimuksessa tunnistettiin työtuntien ja sairauspoissaolojen kehityspolkuja. Tämä tutkimus osoitti, että suurella osalla kuntatyöntekijöistä työtunnit pysyvät tasaisina ja useimmilla on hyvä työkyky ilman sairauspoissaoloja. Karkeasti noin kymmenesosa työntekijöistä sijoittui kehityspolulle, jonka kehitystä kuvaa sairauspoissaolojen selkeä kasvu iän mukana joko pitkien sairauspoissaolojen keston kasvuna tai jatkuvana lyhyiden sairauspoissaolojen korkeana määränä. Useat terveyskäyttäytymisen muuttujat liittyivät kehityspoluille kuulumiseen ja etenkin kaksi muutettavissa olevaa tekijää, fyysinen aktiivisuus ja tupakointi, nousivat esiin selittävinä tekijöinä kehityspolkuihin kuulumiselle. Sosioekonomiset erot olivat selviä ja pysyviä läpi tutkimuksen ja sairauspoissaoloja oli enemmän matalassa sosioekonomisella asemalla olevilla. Tämä löydös korostaa terveyden sosioekonomisten erojen vähentämisen merkitystä. Lisäksi, kun tutkittiin samanaikaisesti lyhyiden ja pitkien sairauspoissaolojen kehitystä, sekä yhteyksiä, että heterogeenisyyttä havaittiin. Yhteyksiä oli nähtävissä siten, että jos työntekijä sijoittui kehityspolulle, jolla oli hyvin vähän lyhyitä sairauspoissaoloja, niin todennäköisyys kuulua kehityspolulle, jolla ei ole pitkiä sairauspoissaoloja, oli suuri. Toisaalta heterogeenisyyttä havaittiin siten, että jos työntekijä sijoittui kehityspolulle, jolla oli paljon lyhyitä sairauspoissaolokausia olivat todennäköisyydet kuulua tietyille pitkien sairauspoissaolojen kehityspolulle epävarmemmat.

Tutkimuksen tulokset näyttävät, miten työtunnit kehittyvät työurien loppuvaiheessa ja miten nämä muutokset ovat yhteydessä sosiaalisiin, työhön ja terveyteen liittyviin tekijöihin. Sairauspoissaolot eivät jakaannu tasaisesti kuntatyöntekijöiden kesken vaan heterogeenisestä tutkimuspopulaatiosta nousi esiin sairauspoissaolojen kehityksen suhteen eroavia alapopulaatioita. Tutkimuksen tulokset antavat ymmärrettävää tietoa sairauspoissaoloista ja niiden selittävästä tekijöistä keski-ikäisillä ja ikääntyvillä kuntatyöntekijöillä. Tutkimuksen tulokset ovat hyödynnettävissä niin työterveyshuollossa ja perusterveydenhuollossa kuin terveystieteiden linjausten tukena ja korostavat keskittymistä työntekijöihin, jotka ovat matalammassa sosioekonomisessa asemassa. Sairauspoissaolo tarjoaa mahdollisuuden tunnistaa työkykyyn liittyviä riskejä ja vaikuttaa huonomman terveyden epätasa-arvoiseen kasautumiseen harvoille.

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Helsinki, June 2024

Johanna Suur-Uski

List of abbreviations

AIC - Akaike information criteria
BIC - Bayesian information criteria
BMI - Body mass index
CI - Confidence interval
EU - the European Union
GBTM - Group-based trajectory modelling
GMM - Growth mixture modelling
HHS - Helsinki Health Study
ICD-10 - International classification of diseases, tenth revision
MD - Mental health disorder
MET - Metabolic equivalent
MSD - Musculoskeletal disease
OR - Odds ratio
SA - Sickness absence

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List of original publications

This thesis is based on the following publications:

I **Suur-Uski J**, Pietiläinen O, Rahkonen O, Lallukka T. Trajectories of working hours in later careers and their association with social and health-related factors: a follow-up study. *European Journal of Public Health*. 2022 Feb 1;32(1):66-72. doi: 10.1093/eurpub/ckab179. PMID: 34608930; PMCID: PMC8807068.

II **Suur-Uski J**, Pietiläinen O, Salonsalmi A, Pekkala J, Fagerlund P, Rahkonen O, Lallukka T. Long-term sickness absence trajectories among ageing municipal employees - the contribution of social and health-related factors. *BMC Public Health*. 2023 Jul 26;23(1):1429. doi: 10.1186/s12889-023-16345-9. PMID: 37495983; PMCID: PMC10373243.

III **Suur-Uski J**, Fagerlund P, Granroth-Wilding H, Salonsalmi A, Rahkonen O, Lallukka T. Dual trajectories of short-term and long-term sickness absence and their social- and health-related determinants among women in the public sector. *European Journal of Public Health*. 2024 Apr 3;34(2):322-328. doi: 10.1093/eurpub/ckae023. PMID: 38379312; PMCID: PMC10990561.

The publications are referred to in the text by their Roman numerals.

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Introduction

Population ageing and increased life expectancy have made extending work careers a policy goal for many governments due to budgetary concerns. These policy reforms have meant, in particular, removing financial incentives for early retirement (Sigg & Luigi, 2016) and raising the statutory retirement age (Eiffe et al., 2024; Taylor et al., 2016). Encouraging older employees to stay in the workforce increases the working population and improves the financing of public services. Further, working can also be beneficial for functioning and well-being (Schuring et al., 2017; Van Der Noordt et al., 2014), however, this is a complex topic. In a heterogeneous group of ageing employees, working might have various effects on health, both negative, neutral, and positive, depending on the work description and individual factors (Baxter et al., 2021; Wels & Takami, 2020).

Working hours are a part of work arrangements and they refer to the time spent at work. Older employees work shorter hours, but despite recent compositional changes in the workforce, the development of working hours among ageing employees has been scarcely studied (Bell & Rutherford, 2013; Lee et al., 2007). Most studies on work arrangements focus on specific working-time arrangements, such as shift work (Harrington, 2001; Wang et al., 2011) or long working hours (Wong et al., 2019). Furthermore, the studies mostly use variable-oriented methods with predefined categories for working hours.

Sickness absence is a marker of temporary work disability (Prins, 2013), and in epidemiological research it is used as an indicator of poor health, measured by poor physical and mental functioning (Kivimäki et al., 2003). Long-term sickness absence increases with age, and age is a significant determinant of sickness absence (Hiilamo et al., 2019). One reason for this is that older employees have more chronic diseases than their younger counterparts (Cornelius et al., 2011; Dekkers-Sanchez et al., 2008; Eurofound, 2019). Other determinants of sickness absence include gender, socioeconomic status, health behaviour, and work-related factors, as well as self-perceived health (Allebeck & Mastekaasa, 2004; Hultin et al., 2010; M. Virtanen et al., 2018; Vuorio et al., 2019).

Sickness absence has mostly been previously studied among the whole working population and with conventional longitudinal methods; only recently has an interest towards person-based approach models emerged in sickness absence research (P. Virtanen et al., 2017). Person-based methods, such as group-based

trajectory modelling (GBTM), model an outcome in time without any preconceived assumptions (Nagin, 2014; Proust-Lima et al., 2017; van de Schoot et al., 2017). Such models facilitate the identification of varying developmental patterns within a population.

It is conceivable that the ageing workforce is heterogeneous, following different trajectories of working hours and sickness absence. Identifying varying developmental trajectories and then examining the trajectories' associations with social-, work-, and health-related factors could lead to increased understanding of what constitutes a sustainable work life for ageing employees.

Today, employees above 54 years old constitute a fifth of the workforce in the European Union (EU) (*Employment Rates by Sex, Age and Citizenship (%)*, 2023). This shift towards a more mature employee population might lead to changes in work arrangements or sickness absence rates. For example, despite a growing number of ageing employees, older workers face ageism which might predispose employees to sickness absence (Edge et al., 2021; Viitasalo & Nätti, 2015). Further, gender disparities exist in leaving employment as women exit labour markets earlier. Women are also more often those providing informal care to elderly parents, and providing informal care has been associated with stopping working and with sickness absence (Abrahamsen & Grøtting, 2023; Carr et al., 2016).

As the workforce is ageing and nations are under fiscal necessities to implement policies that aim to prolong working careers, there is a need for research on this theme that could aid in targeting preventive measures and facilitating healthier work life among all employees. This study aims to identify developmental patterns of working hours and sickness absence, and further to identify possible factors that support or weaken ageing employees work ability in terms of sickness absence. In addition, the focus of this study is to examine how sickness absence rates develop by age and whether it is possible to distinguish those who sustain working life without sickness absence from those with sickness absence by their social-, work-, and health-related factors. This study focusses on municipal employees, and the research questions are examined in an occupational cohort comprised mostly of women. This study examines associations and therefore is unable to determine the direction of the associations between the study's main outcomes, working hours and sickness absence, and covariates. The results of this study provide insight into different developmental patterns of working hours and sickness absence in midlife and later careers, as well as into factors associated with these developmental patterns. This study presents novel knowledge on the ageing workforce which can be utilised in occupational healthcare, health policy, and at workplaces.

1 Review of the literature

This section first defines the main outcomes, working hours and sickness absence. The review of literature summarises research evidence on the development of working hours and sickness absence among midlife and ageing employees. I have included both conventional longitudinal and person-based longitudinal studies. Most studies have been conducted in the Nordic and other European countries.

In section 2.1, I provide an empirical background for this study and present the main outcomes and their connections. In section 2.2, I focus on studies examining working hours and their determinants among ageing employees. In section 2.3, I focus on studies examining sickness absence patterns. Regarding sickness absence studies that have utilised person-based methods, the studies are restricted to publications published within the last 20 years. Section 2.4 summarises the findings of previous studies and highlights gaps in current knowledge.

1.1 Defining the main outcomes and their connections

1.1.1 Working hours

The term *working hours* refers to the amount of time spent at work, and working hours are typically reported as weekly working hours. Working hours are a part of work arrangements. Weekly working hours vary between occupations, genders, and countries, and furthermore, older employees report shorter weekly working hours in many countries, according to Organisation for Economic Co-operation and Development statistics (OECD Stat). The average weekly working hours in the EU is 37.5 hours. The shortest average weekly working hours are reported by the Netherlands, Denmark, and Germany (33–35 hours per week) and the longest average weekly working hours by Greece, Bulgaria, Poland, and Romania (40–41 hours per week) (Eurostat, 2024). In Finland, the average weekly working hours are around the European average.

Although the main feature during later careers is that older employees are more likely to work shorter working hours, it is unclear whether there are distinct subpopulations that differ in their working hour development.

1.1.2 Sickness absence

By definition, sickness absence is granted when an employee is not able to perform their work tasks due to ill health. To understand and evaluate sickness absence in more detail, a description of work ability is given first. Ilmarinen et al. defined *work ability* as a balance between an employee's resources and the demands of their work (Ilmarinen, 2006). Society surrounds this and plays a role, as does family.

In essence, work ability means being able to work and manage within one's own job description, and *work disability* the opposite of this, a restricted ability or incapacity to perform one's normal work (Järvikoski et al., 2018). However, work ability and work disability lack uniform definitions, since these terms are used by varying professionals in varying contexts. The terms are used in both evaluating work disability and in supporting work ability, and the professionals in this field include insurance institutions, occupational healthcare personnel, employers, and scientists, as well as the public. The field of work ability considers several theories and models. Where early models have mainly focussed on the employees' health and the consequences of an illness on work ability, later, more multidimensional models consider work ability as a combination of individual, environmental, and societal causes (Gould et al., 2008).

In this dissertation, I focus on temporary work disability indicated by sickness absence. *Sickness absence* means temporary work disability due to a disease (Prins, 2013). Medical evaluation of sickness absence is based on a diagnosed or suspected illness or a disability that weakens the employee's functional capacity so that an employee is incapable of performing the tasks their work requires. Hence, the assessment of sickness absence considers both the specific illness an employee is experiencing and the occupational demands of their job (Gould et al., 2008).

Generally, sickness absence is divided into short- and long-term sickness absence. The cut-offs vary between countries and publications, with no uniform criteria (Gjesdal & Bratberg, 2003; Koskenvuori et al., 2021; Nordic Social Statistical Committee, 2015; Stapelfeldt et al., 2014). In this dissertation, short-term sickness absence is defined as ten or fewer working days (1–14 calendar days). Depending on the employer, short-term sickness absence spells lasting from one to five working days do not require a medical certificate. In this dissertation, long-term sickness absence is defined as absence lasting more than ten working days (over 14 calendar days). The definitions used in the literature vary, with some studies using a 2-week, some a 4-week, and some a 90-day cut-off for long-term

sickness absence. However, long-term sickness absence always requires a medical certificate.

In health research, sickness absence is considered to reflect the general health status of employed people. In particular, long-term sickness absence has been proven to be an indicator for current health status, as well as a predictor for future poor health in terms of recurring absence, disability pension, and mortality (Hultin et al., 2012; Kivimäki et al., 2003, 2008; Marmot et al., 1995). Overall, sickness absence is considered a reliable measure of health. The routine gathering of sickness absence data from most workplaces reduces the possibility of recall bias, and long-term sickness absence is furthermore based on a physician's examination and a clinical diagnosis, improving the validity of the absence.

The underlying reasons for sickness absence are complex (Allebeck & Mastekaasa, 2004). Factors affecting the length of sickness absence are diverse, and include societal, personal, health-related, and work-related factors. Short self-certified absence does not require a medical certificate and there is evidence that short-term sickness absence is not as strongly associated with health outcomes (Vahtera et al., 1999), but is more related to motivational factors (Janssen, 2003). Long-term sickness absence is strongly associated with health outcomes. It requires a medical certificate from a healthcare professional, and issuing a sick note is one of the most common procedures for a general practitioner (Bollag et al., 2007).

Multiple guidelines exist for the evaluation of long-term sickness absence, but the guidelines most often apply to a single disease (De Boer et al., 2016). As such, when considering that employees' return to work also depends on comorbidities, their work description, and personal, cultural, and organisational factors, as well as the quality of the healthcare system, designing universal guidelines is challenging. During the pension reform in 2017, a decision was made in Finland to produce national instructions to aid clinicians in the principles of evaluating the need for sickness absence. A Current Care Guideline on the topic was published in 2019 (Komulainen & Laukkala, 2019). As mentioned earlier, evaluating work ability requires a good understanding of both employees' health and work-related factors. In Finland, for an employee such understanding is usually best acquired at one's occupational healthcare centre. Further, in Finland, check points have been created to ensure high-quality rehabilitation and support for the employee (Valtioneuvosto, 2022). After 30 sickness allowance days, the employer must inform their occupational healthcare unit of the sickness absence. After 60 sickness allowance days, a more precise description of work disability must be provided with a medical certificate B; furthermore, after receiving sickness allowance for 60 days the Social Insurance Institution of Finland informs the employee regarding various rehabilitation options and providers. After 90 sickness allowance days, an occupational healthcare provider must evaluate the employee's work ability to ensure proper rehabilitation and to assess whether a return to work

can be facilitated with work description accommodations; furthermore, this evaluation must be sent to the Social Insurance Institution of Finland.

1.1.2.1 Sickness allowance

The Social Insurance Institution of Finland pays sickness allowance as compensation for loss of income due to illness lasting less than a full year. All residents between ages 16–67 are eligible for it. The sickness allowance is available after a waiting period of ten working days (calendar days excluding midweek holidays and Sundays). For employees, this waiting period is compensated by the employer, and during the waiting period employers must pay full salary to the employees according to the Employment Contracts Act.

Sickness absence compensated by the Social Insurance Institution of Finland always requires a medical certificate, hence, sickness absence spells derived from the Social Insurance Institution of Finland always include a diagnostic code and last at minimum 10 working days and at maximum 300 working days. During the first ten days, guidelines vary between employers on the length of sickness absence that can be self-certified.

Sickness allowance systems vary greatly between countries, and even between the Nordic countries with many similarities in society and strategies in reducing sickness absence, comparable data between countries have been sparse (Nordic Social Statistical Committee, 2015). This hinders direct comparison of sickness absence rates between countries since rules and regulations vary.

1.1.3 Conceptualisation of this study

The main study outcomes in this study are working hours, measured by self-reported working hours, and sickness absence, retrieved from national and employer registers. The relationship of overall health and working hours has been studied widely. The existing literature states that very long weekly working hours are associated with multiple diseases, such as heart conditions and stroke, and mortality (Ervasti et al., 2021; Hannerz & Soll-Johanning, 2018; Kivimäki et al., 2015). To expand on this, sickness absence is closely related to health, and long-term sickness absence in particular is used as a measure of health in terms of physical and mental functioning. Hence, it is reasonable to assume that the two outcomes, working hours and sickness absence, might be correlated. Hypothetically, working hours and sickness absence could be linked via impaired health since, depending on the disease that leads to sickness absence, workplace modifications might be required.

A temporary reduction of work ability may arise as a result of an illness. A disease, for example back pain, might reduce an employee's ability to walk and move and if the employee had a physical work description and no possibility to reduce the workload for example by reducing physical tasks or by working shorter days, an imbalance between work demands and work ability would arise. This would lead to sickness absence which can be either short or long depending on multiple individual, societal, and work-related factors. Then again, after returning to work, modification of the work tasks, such as shortening working hours, might be required to prevent further sickness absence.

A pathway to sickness absence could also arise via demanding work arrangements, such as very long working hours, that might cause psychosocial stress, weakening work ability and leading to sickness absence, which might be used to cope with work-related strain. There exists some proof for shorter workdays having a positive effect on subjective well-being (Gyllensten et al., 2017). Additionally, in order to support employees' work ability, working hours could be reduced so that requirements at work better fit the abilities of an employee. In the EU, the majority of employees with a chronic disease do not have a work description that is adapted to accommodate their health condition (Eurofound 2019). In Finland, the Finnish Institute of Occupational Health advocates for better possibilities to reduce working hours among employees over 50 years of age (Härmä, 2022). Overall, working hours and sickness absence exist in a close relationship due to the criteria according to which issuing sickness absence is evaluated.

1.1.3.1 Study outcomes

In Figure 1, I present the main outcomes and covariates of this study. The clock represents working hours that are part of work arrangements. Illness is represented as an interruption, and if the reduced well-being due to illness and the present work demands do not match and the work description cannot be altered, this will lead to sickness absence. All of these are multifactorial with socioeconomic position, health, health behaviour, and work-related factors affecting this phenomenon. For example, those in lower occupational classes tend to have more physically demanding jobs, which might affect their possibilities to work when an illness occurs, whereas those working in managerial professions might be able to work from home in case of a mild infectious disease (Lund et al., 2006). Furthermore, the psychosocial working environment also affects health and contributes to the social gradient in long-term sickness absence (Christensen et al., 2008).

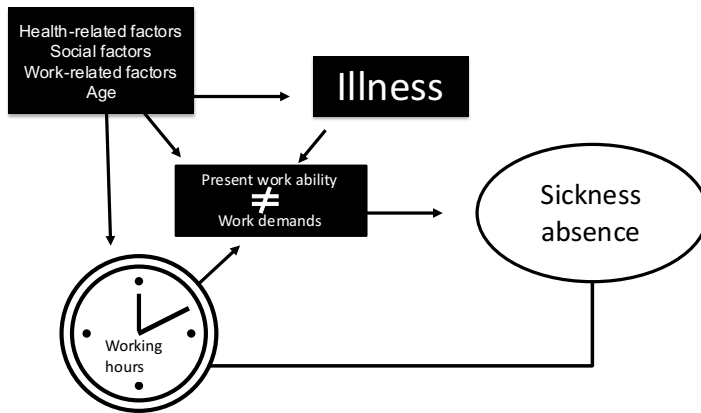


Figure 1 Simplified conceptual framework of this study

1.2 Previous research findings on working hours

The ageing society poses challenges globally because every country will experience population ageing by 2030 (Bloom et al., 2015). Fiscal pressures have driven nations to retain ageing employees in the workforce, for example, by increasing the statutory retirement age. In the EU, during the last decades the percentage of employees over 54 years in the workforce has increased; the employment rate among people aged 55–64 was 60% in 2020, while in 2006 it was only 43% (Eurostat, 2022b). In this context, many European countries have implemented policies that facilitate work-time reductions for ageing employees (Wels, 2019a). Presently in the EU, older workers (over 54 years) work shorter hours compared to their younger counterparts (OECD Stat, 2024; Sutela, 2022).

In the EU, the European Union Working Time Directive (2003/88/EC) guarantees employees the right to limit their average weekly working time to 48 hours per week including overtime (European Parliament, Council of the European Union., 2003). This is evaluated by the working hour average over a reference period of up to 4, 6, or 12 months. Overall, working overtime is less prevalent in Nordic countries (Hannerz & Soll-Johanning, 2018). In Finland, men and women work overtime equally often (Sutela, 2022), but women report working shorter hours and work part time more often than men (Suomen virallinen tilasto

(SVT), 2018). Additionally, the Nordic countries have shorter average working hours compared to other European countries (Härmä 2020). Furthermore, in many Asian countries, including high-income countries like Singapore and the Republic of Korea, working hours are even longer (Lee et al., 2007). The same report states that in many countries, after 54 years of age employees' working hours decline compared to middle-aged employees. Furthermore, among those who still remain at work after the statutory employment retirement age, the working hours decline even more when employees reach the statutory retirement (Lee et al., 2007). However, a contrary trend was noticed in Korea. In Korea, working hours were longer among older employees. Korea, among other East-Asian countries, is known for precarious job contracts and long working hours (Kim & Lee, 2023), and older employees might be forced to continue working long hours due to economic pressures. The average weekly working hours also vary by employment sectors (Eurostat, 2022a).

Long weekly working hours are typically defined as working more than 48–50 hours or over 40 hours per week, depending on the study (Kivimäki et al., 2015), with some studies even defining long weekly working hours as 55 hours or more per week (Ervasti et al., 2021; Pega et al., 2021). There is ample evidence that long working hours are deleterious on health. Long weekly working hours have been associated with multiple adverse health outcomes, such as heart conditions, stroke, and death (Kivimäki et al., 2015, 2015; Kleppa et al., 2008; Knauth, 2007; M. Virtanen et al., 2019; Wong et al., 2019). The rare and extreme consequence of overworking is called *Kairos*, a Japanese term referring to sudden death due to overwork (Ke, 2012). A recent multicohort study with cohort data from Finland, Sweden, Denmark, and the UK showed that long working hours were associated with an increased risk of cardiovascular death and diseases such as diabetes, infection, and musculoskeletal disorders, but not with all-cause mortality in a population under 65 years of age (Ervasti et al., 2021). The associations were weaker for diabetes, musculoskeletal disorders, and injuries.

Despite an ageing workforce, only a few studies have examined working hours in later careers (Bell & Rutherford, 2013). In their discussion paper, Bell and Rutherford (2013) examined the conceptions around the working hours of older people. The general thought being that many older people would like to reduce their working hours; contrary to this, there also existed a group that hoped to work longer hours. They emphasised the flexibility of the labour market as a solution to meet the needs of both those who wish to work more hours and those wishing to work fewer hours. Flexibility in relation to disability has also been emphasised in the literature, so that those with a disability could be more able to stay in the workforce.

Since long working hours are linked to adverse health outcomes, it has been questioned whether sickness absence is associated with working hours. Contrary to this, moderate evidence has been found for a negative association between long

working hours and sickness absence in a systematic literature review (Bernstrøm & Houkes, 2018). Bernstrøm et al. found supporting evidence for this negative association by examining how individuals' odds of sickness absence altered when their working hours changed. Their results on the within-individual relationship between working hours and sickness absence indicate that employees possibly regulate their working hours in parallel with their own health status (Bernstrøm, 2018). Overall, the negative association between a very long work week and low rate of sickness absence might be linked to phenomena such as staying at work when sick (presenteeism) or a strong motivational pull to work (Aronsson, 2000; Krane et al., 2014).

1.3 Previous research findings on sickness absence

Sickness absence is an indicator of employee health, and the research tradition around sickness absence is vast. Sickness absence generates costs for the employer and the state and can have a negative impact on individuals, such as reduced well-being and income as well as exiting from the workforce. From this context, reducing sickness absence has been perceived as important.

Sickness absence is considered multifactorial and many factors other than simply medical conditions are associated with sickness absence. Gender, occupational class, lifestyle factors, policy reforms, and the economic climate are shown to have an association with sickness absence (Allebeck & Mastekaasa, 2004; Dekkers-Sanchez et al., 2008; Khan & Rehnberg, 2009; Kristensen, 1991; Leinonen et al., 2016; Merkus et al., 2012; Pekkala et al., 2017a; M. Virtanen et al., 2018).

Regarding short-term sickness absence, the majority of short-term sickness absence spells are related to diseases with a good prognosis, such as mild infectious diseases and minor aches (Feeney et al., 1998; Hiironen et al., 2021). However, short-term sickness absence has also been linked to long-term sickness absence (Hultin et al., 2012) and more permanent work disability (Harkko et al., 2021; Labriola & Lund, 2007). Hultin et al. (2012) did not find an association with disability pension, but their 4–5-year follow-up might have been too short, especially among their relatively young population aged 18–47 years.

Regarding long-term sickness absence, the major diagnostic groups for long-term sickness absence are musculoskeletal diseases and mental health disorders (Blomgren & Perhoniemi, 2022; Pekkala et al., 2017a). In Finland, after 2016, there was a steep increase in long-term sickness absence due to mental health disorders. Although among 50–67-year-old employees musculoskeletal diseases remain the most common reason for long-term sickness absence, there has been an increase in long-term sickness absence due to mental health disorders in this age group as well (Blomgren & Perhoniemi, 2022).

1.3.1 Sickness absence among midlife and ageing employees

The burden of non-communicable diseases such as ischaemic heart disease and stroke predominate in older adults compared to younger people, and age is a significant determinant of multiple diseases (Vos et al., 2020). Similarly, sickness absence rates and particularly long-term sickness absence rates have been shown to grow with age in Western countries (Allebeck & Mastekaasa, 2004; Barmby et al., 2002; Marmot et al., 1995).

Age is a strong predictor of sickness absence (Allebeck & Mastekaasa, 2004). Age has also been acknowledged as a determinant of moving to disability pension; among Norwegian citizens aged less than 60 years, age was a main predictive factor for disability pension. The risk of moving from long-term sickness absence to disability pension was over 10 times higher in the 50–59 year age groups compared to the youngest age group of 16–29 years (Gjesdal & Bratberg, 2003). Similarly, in a random sample of Finns aged 25–62 years, the proportion of those transferring to disability retirement from long-term sickness absence was higher among older people (Salonen, Blomgren, et al., 2020). However, it must be said that not only the prognosis of the disease, but also the retirement system affects this as well. In Finland, for younger employees, work ability is evaluated for any work description, whereas for employees over 60 years, the vocational nature of the disability is taken into account when evaluating the entitlement to a disability pension (*Employees Pensions Act*, 2006). Only some exceptions have been noticed and mostly among those over 60 years of age. In two Finnish studies, older employees were less likely to take short-term absence from work (Tenhiälä et al., 2013) and employees over 60 years were less absent from work (Laaksonen, Mastekaasa, et al., 2010). These findings are possibly linked to the healthy worker effect, where employees with the best work ability continue in the workforce (C.-Y. Li & Sung, 1999; Wilcosky & Wing, 1987). Further, in our municipal cohort younger employees were more likely to take short-term sickness absence than older employees (Sumanen et al., 2015).

The reasons for higher sickness absence rates, especially higher long-term sickness absence rates, among older employees have been difficult to pinpoint, but it has been hypothesised that the higher prevalence of diseases at a later age contributes to these age-related differences. Shao et al. (2021) adopted a resource-based perspective to study the relationship between sickness absence and age. They came to the conclusion that decreases in both physical resources and work engagement contribute to the age–sickness absence relationship, but that the societal situation should also be considered.

A previous focus in sickness absence research of midlife and ageing employees has been on long-term sickness absence and the transition to disability pension, with most studies utilising conventional longitudinal approaches. As such, the outcome is often modelled using average values or by dividing the population into pre-determined groups. Such population average models unavoidably simplify the real clinical setup where some individuals might for example recover faster than others. Covariate-based measures often give a certain sum score or a risk ratio to summarise a possibly complex phenomenon. For example, in real life, an

association might vary between subpopulations, whereas a customary interpretation of a correlation coefficient is that it applies equally to the whole study population. In response to this, person-based measures study the development of a chosen outcome without preconceived presumptions (Nagin, 2014). These individual-centred statistical approaches seek to divide individuals into distinct groups based on personal response patterns. This can be seen as an opportunity to better examine their temporal development.

In this dissertation, I conducted a search for studies that utilise person-based methods in studying the development of sickness absence. In the first section, studies with all-cause sickness absence and disability pension are presented. Second, I present studies that examine the trajectories of the two most common diagnosis-specific groups: mental health and musculoskeletal diseases.

1.3.1.1 All-cause sickness absence trajectories

I included studies that had utilised person-based methods to examine all-cause sickness absence trajectories. I detected eight studies in total that examined all-cause sickness absence trajectories with person-based methods (Farrants & Alexanderson, 2022; Hiilamo et al., 2019; Lallukka et al., 2019; Leino-Arjas et al., 2021; Ropponen et al., 2023; Salonen, Alexanderson, et al., 2020; Ubalde-Lopez et al., 2019; P. Virtanen et al., 2017). One study was from our cohort (Hiilamo et al., 2019). Additionally, one recent study analysed the developmental patterns of part-time work and sickness absence with multi-trajectory modelling among public sector employees with shift work (Ropponen et al., 2023). One of the studies had an ageing employee cohort (Ubalde-Lopez et al., 2019). To summarise, most studies did not detect a trajectory group with a declining sickness absence trend, and most studies selected a trajectory model with three trajectory groups. Four studies using cohort data other than ours were from Finland, two from Sweden, and one from Spain. Varying determinants for the trajectories were examined. All but one Finnish study selected a three-trajectory model, with approximately a tenth of the participants being assigned to a trajectory with a high rate of absence.

Leino-Arjas et al. examined the annual long-term sickness absence with a 5-year follow-up between 1981–1985 among 6,257 44–58-year-old public sector employees (Leino-Arjas et al., 2021). Three trajectory groups were chosen as the best model, with the duration varying from almost no long-term sickness absence (around 70% of the population) to an increasing trajectory (around 10% of the population). In the increasing trajectory, the sickness absence rate rose from 20 to 180 days during the 5-year spell. In the descriptive analysis, those reporting somatic or mental health morbidity, risks in physical and psychosocial working conditions, and adverse health behaviours were more likely to be assigned to trajectories with more sickness absence.

In our own cohort, Hiilamo et al. (2019) examined the developmental trajectories of sickness absence and disability pension months with age among employees with and without common mental health disorders (Hiilamo et al.,

2019). In their analyses, the sickness absence and disability retirement outcome in the high-increasing group rose to around 10 months per year at the age of 59 years.

Virtanen et al. (2017) examined the development of sickness absence during 2003–2008 in a cohort of 5,684 middle-aged industrial and municipal employees (P. Virtanen et al., 2017). The smallest trajectory with the highest frequency of sickness absence (10% of the population) had around 60 sickness absence days per year. In relation to the sickness absence differences between public and private sectors, industrial employees had a higher sickness absence rate compared to the public sector, but this was attenuated when adjusting for socioeconomic factors.

Lallukka et al. examined the development of sickness absence trajectories and then assessed the associations between work-related factors and the trajectory membership in a representative sample of Finnish adults, $N=3,812$ (Lallukka et al., 2019). The trajectory group percentages correlated with previous studies with low sickness absence among 55% of participants, slowly increasing sickness absence among 34%, and a high sickness absence rate among 12%. This study examined the annual number of sickness absence periods and the results varied from 0 periods (low 54%) to 0.4–0.8 periods per year (high 12%). The more physical workload factors the higher the risk of being assigned to a high sickness absence trajectory.

A large Spanish study of 38,420 employees in the Spanish social system also selected three trajectory groups when analysing accumulated sickness absence days for each quarter during 2012–2014 (Ubalde-Lopez et al., 2019). The study included two cohorts, employees born 1949–1969 and 1970–1990, and the trajectories were analysed separately for men and women. Regarding women, the number of workers in each trajectory was as follows in the older cohort: ‘low-stable’ (88% of individuals) with around 10 days per quarter, ‘decreasing’ (6% of individuals) with decreasing absence rates from 60 to 10 days per quarter, and ‘increasing’ (7% of individuals) with increasing absence rates from 10 to 60 accumulated days of sickness absence per quarter. The higher proportion of sickness absence was due to mental health disorders in the increasing trajectory, and musculoskeletal disease–related absence was more common in the older cohort than in the younger cohort.

Salonen et al. (2020) analysed the developmental patterns of sickness absence and disability pension separately for men and women among Swedish employees (Salonen, Alexanderson, et al., 2020). The annual number of work disability days was used as a repeated outcome among 30–54-year-old employees, and a model with three trajectories was chosen. The percentage of participants was divided as follows in the women’s model: low stable 72% of the study population, medium stable 20%, and high increasing 8%. Overall, women, older employees, those in lower socioeconomic position, and employees born outside of Sweden were more likely to be assigned to a high increasing trajectory. Further, the study investigated how varying combinations of job demands and job control were related to sickness absence patterns. They utilised the Job Demands-Control model by Karasek (Karasek, 1979; Karasek & Theorell, 1990). In the women’s model in the high

increasing trajectory, occupations with low job demands and low job control were overrepresented.

Farrants et al. examined sickness absence and disability pension trajectories among 18–67-year-old white-collar employees (Farrants & Alexanderson, 2022). Sickness absence and disability pension were analysed between 2010–2016, and 4 trajectories emerged with 73% of the participants having no sickness absence or disability pension. However, the two high disability trajectories constituted only 1% and 2% of the population, which increases the uncertainty and reduces the credibility of these trajectories.

One recent study examined the concurrent trajectories of part-time work and mean number of sickness absence months per year among healthcare sector workers (Ropponen et al., 2023). With a large cohort of 28,969 employees, they examined the developmental patterns of sickness absence and part-time work in 10 hospitals during 2009–2019. While accounting for night work, the model selected four trajectory groups. Over 60% of the sample belonged to a path with sustained work ability and full working hours (trajectory 1), 17% to a trajectory with almost no sickness absence and an increasing probability of part-time work (trajectory 2), 18% to a path with increasing likelihood of part-time work and no sickness absence (trajectory 3), and only 4% to a path with fluctuating but increasing part-time work and the highest and increasing levels of sickness absence. Older employees were more likely to be assigned to trajectories 2–4.

1.3.1.2 Mental health disorder–related sickness absence

I identified three previous studies that had examined mental health disorder–related sickness absence trajectories (Alaie et al., 2023; Di Thiene et al., 2019; Farrants et al., 2018). All of the studies were from Sweden, two examined young employees (19–30 years) and one Swedish residents aged 16–64 years. In a prospective cohort study among 16–64-year-old Swedes, Farrants et al. examined the development of both sickness absence and disability pension due to depression (Farrants et al., 2018). Participants with onset sickness absence or disability pension in the first half of 2010 were followed for 13 months, and a model with 6 trajectory groups was selected. The largest group decreased to 0 after 4 months (43%) and the next largest decreased to 0 at 8–9 months (22%).

Overall, the study showed that the majority of sickness absence spells attributable to non-relapsing mental health disorders are temporary. A second study extracted young adults with common mental health disorders to study labour market marginalisation (Di Thiene et al., 2019). The study examined how sickness absence months and disability months behaved before mental health disorder

diagnosis and post-diagnosis. They selected a model with five trajectories, with over 60% belonging to the constant low trajectory. The study further examined trajectories of Western and non-Western immigrants. Overall, education level and psychiatric comorbidity provided information on differences between natives.

Another Swedish cohort included 1,445 twin individuals with elevated depressive and anxiety symptoms in late adolescence or young adulthood (age range: 19–30) (Alaie et al., 2023). They examined the annual net days of sickness absence during 2006–2018. The selected model included four trajectory groups: ‘high-increasing’ (6%), ‘low-increasing’ (12%), ‘high-decreasing’ (13%), and ‘low-constant’ (69%). Education and male gender had a protective likelihood for sickness absence.

1.3.1.3 Musculoskeletal disease–related and sickness absence

I found three studies that examined sickness absence trajectories due to musculoskeletal diseases (Farrants et al., 2019; Haukka et al., 2014; Rysstad et al., 2023). All of the studies were from the Nordic countries. Two of the studies examined sickness absence due to musculoskeletal diseases generally and one focussed on sickness absence due to osteoarthritis (Farrants et al., 2019). In two of the studies, the outcome was modelled by months and in one study by quarters.

Haukka et al. used self-reported information on musculoskeletal disease–related sickness absence within the past three months (Haukka et al., 2014). This resulted in selecting a model with 3 trajectory groups with 11% reporting high sickness absence. Rysstad et al. examined workers who had been on sickness absence due to musculoskeletal disease for at least 4 weeks (Rysstad et al., 2023). They analysed accumulated days of sickness absence per month from the first assessment to one year and selected a model with six trajectories. Almost a tenth of the population was assigned to a trajectory in which the sickness absence decreased but relapsed again (U-shape), and 18% belonged to a persistently high trajectory.

Farrants et al. investigated the sickness absence and disability pension patterns among individuals with sickness absence spells due to osteoarthritis (Farrants et al., 2019). They selected a model with 5 trajectory groups, and only 8% of the population belonged to a ‘late decrease trajectory’ in which the net days with sickness absence or disability pension decreased only partly and after 10 months.

The identified differences in the number of trajectory groups and their sizes can be partly explained by the participant inclusion criteria. When analysing an entire group of employees, only a small part of employees will take sickness absence, whereas when modelling only those already on sickness absence, more diversity in the development of sickness absence due to a certain disease might stand out better; however, trajectory groups smaller than 5% might be unreliable.

Table 1 Developmental trajectories of all-cause sickness absence: summary of previous research using person-oriented methods

Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Virtanen, 2017	N=5,684, 2,207 industrial and 3,477 municipal employees, Finland	Cohort study, (10-town study) follow-up 2003–2008, mean age in 2003 = 40 years	GBTM	Number of SA days and number of SA spells per calendar year	Occupational status, gender, age	Three sickness absence trajectory groups. Industrial employees' higher SA rates were due to more common 'high-range' and 'middle-range' trajectories. Adjustment for sociodemographic background attenuated industrial employees' risk of high SA.
Lallukka, 2019	N=3,812, Finnish nationally representative Health 2000 surveys, Finland	Cohort study, 2002–2008, 30–59 years old	GBTM	SA periods per year	Gender, marital status, education, BMI, alcohol, physical activity, sleep problems, social support, musculoskeletal disorders, other diseases	Three trajectory groups. Physical work was associated with the high SA trajectory, with the highest risk found for those with cumulative exposure to heavy physical work. Sitting and keyboard use without physically heavy tasks were associated with a decreased risk of SA.

SA = Sickness absence; GBTM = Group-based trajectory modelling; BMI = Body Mass Index

Table 1 continues: Developmental trajectories of all-cause sickness absence: summary of previous research using person-oriented methods

Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Ubalde-Lopez, 2019	N=38,420 workers in the Spanish social system, Spain	Cohort study, follow-up on sickness absence 2012–2014, two cohorts of employees born 1970–1990 and 1949–1969	GBTM	Accumulated SA days for each quarter in years 2012–2014	Work contract type, working time, occupational category, salary, ICD-10 code for absence	Three SA trajectory groups: low-stable (86% to 91% of individuals), decreasing (4% to 6% of individuals) and, increasing (4% to 9% of individuals). Higher proportion of SA due to mental health disorders in the increasing trajectory, musculoskeletal disorders more common among older workers
Hililamo 2019	HHS cohort (same as this thesis), Finland	Cohort study, ages 50–59 years	GBTM	SA and disability pension months	Age, sex, GHQ12, socio-demographics, chronic ill-health and lifestyle-related factors	Three trajectory groups: no SA 47% vs 63%, low SA 37% vs 26% and high SA 16% vs 8% (with and without common mental health disorders)
Salonen et al., 2020	N=2,187,639, Sweden	Prospective cohort study, 2002–2012, aged 30–59 years	GBTM	Annual number of work disability days	Age, country, education, family composition, previous work disability, job demands and job control	Three work disability trajectories for women, two for men. For women, low demands/low control was associated with high increasing SA trajectory

SA = Sickness absence; GBTM = Group-based trajectory modelling; HHS = Helsinki Health Study; GHQ12 = General Health Questionnaire

Table 1 continues: Developmental trajectories of all-cause sickness absence: summary of previous research using person-oriented methods

Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Leino-Arjas, 2021	N=6,257, municipal employees, Finland	Cohort study, aged 44–58 years	GBTM	Annual number of long-term SA days during the first five years of follow-up	Age, socioeconomic status (basic education and family income), health behaviour	Three trajectory groups for both men and women; somatic and mental health, physical and psychosocial working conditions, and health-related factors associated with SA trajectories
Farrants, 2022	N=189,321 of white-collar employees, Sweden	Population-based longitudinal cohort study, SA and disability pension data from 2010–2016, aged 18–67 years	GBTM	Mean SA and disability pension days/year in the seven years 2010–2016	Sociodemographic and work-related factors	Four trajectories. Most individuals (73%) belonged to the trajectory with 0 days during all 7 years; 2 smallest groups, 1% and 2%

SA = Sickness absence; GBTM = Group-based trajectory modelling

Table 1 continues: Developmental trajectories of all-cause sickness absence: summary of previous research using person-oriented methods

Part-time work and sickness absence trajectories						
Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Ropponen et al., 2023	N=28,969 shift-working employees in 10 hospital districts and 11 cities, Finland	Cohort study, 2008–2019	Group-based multi-trajectory model	Mean number of SA months for the follow-up from 2009 to 2019, night work as time-varying covariate	Age, gender, night work	Group 1 61% – full-time work and no SA, Group 2 17% with slowly increasing probability of part-time work and low but mildly increasing SA, Group 3 18% – increasing part-time work and no SA, Group 4 4% with fluctuating but increasing part-time work and highest and increasing levels of SA

SA = Sickness absence; GBTM = Group-based trajectory modelling

Table 1 continues: Developmental trajectories of mental health disorder–related sickness absence: summary of previous research using person-oriented methods

Mental health disorders and sickness absence trajectories						
Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Farrants et al., 2018	N=10,327, majority of cohort women (68%), Sweden	Prospective cohort study, SA among individuals with a new sick-leave spell due to depressive episode between ages 16–64 years	GBTM	Mean days of SA and disability pension per month due to depressive episode (F32) in first 6 months of 2010 and then followed for 13 months	Age, sex, birth country, living area, family situation, education, morbidity, prescriptions, cause of death	6 trajectories of work disability. Largest trajectory group decreased to 0 after 4 months (43%) and the next largest decrease to 0 at 8–9 months (22%)
Di Thiene et al., 2019	N=28,971, Swedish adults treated in healthcare due to a CMD diagnosis in 2007, Sweden	Population-based longitudinal cohort study, young adults, aged 19–30 years	GBTM	Mean annual numbers of months with SA/DP or with unemployment benefits during 2004–2013	Sex, age, educational level, family situation, type of living area, how many years in Sweden, unemployment, comorbid psychiatric and somatic diagnosis	5 trajectories, largest constant low 62%. Young natives and immigrants showed similar trajectories of SA/DP. Education level and psychiatric comorbidity explanatory between natives

SA = Sickness absence; CMD= Common mental disorder; GBTM = Group-based trajectory modelling; DP = Disability pension

Table 1 continues: Developmental trajectories of mental health disorder–related and musculoskeletal disease–related sickness absence: summary of previous research using person-oriented methods

Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Alaie et al., 2023	1,445 twin individuals with elevated depressive/anxiety symptoms, Sweden	Prospective twin cohort study, aged 19–30 years, years 2006–2018	GBTM	Annual net days of SA	Sociodemographic factors, including age, sex, occupational sector, education level	4 trajectories: 'high-increasing' (6%), 'low-increasing' (12%), 'high-decreasing' (13%), and 'low-constant' (69%)
Musculoskeletal diseases and sickness absence trajectories						
Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Haukka et al., 2014	N=386, municipal kitchen workers, Finland	Cluster randomised controlled trial during 2002–2005, mean age 46 years	GBTM	SA inquiry, past three months	Age, musculoskeletal and multivariate pain, musculoskeletal and other somatic diseases, depressive symptoms, physical and psychosocial workload, BMI, smoking, and leisure-time physical activity at baseline	Three trajectories of SA: 'none' (41%), 'intermediate' (48%), and 'high' (11%). Number of pain sites and musculoskeletal diseases, depressive symptoms, smoking, and overweight/obesity associated with trajectory membership

SA = Sickness absence; GBTM = Group-based trajectory modelling

Table 1 continues: Developmental trajectories of musculoskeletal disease-related sickness absence: previous research using person-oriented methods

Author, year	Study population	Study design, employees aged	Main statistical methods	SA measure	Other measures / covariates	Key findings
Rysstand et al., 2022	N=549, Norway,	Cohort study, participants, with at least four weeks of musculoskeletal disease-related SA, median age 50 years	GBTM	Accumulated days of SA /month from first assessment to 1 year	Age, gender, education, prior sick leave workability, pain intensity, multisite pain, self-perceived health	6 distinct trajectories: 'fast decrease' (27% of the cohort), 'moderate decrease' (22%), 'slow decrease' (12%), 'U-shape' (7%), 'persistent moderate' (13%), and 'persistent high' (18%). Prognostic factors: previous SA, return-to-work expectancy, work ability, multisite pain, and health scores
Farrants et al., 2019	N=4,894, Sweden	Prospective cohort study, aged 16–64 years, with SA spell with a diagnosis of osteoarthritis (ICD-10 code M15–1927) that lasted for ≥21 days	GBTM	Mean number of net days of SA and/or DP per month (30-day period) in the following 13 months, from the date of day 21 of the index SA spell	Age, gender, country of birth, education, urban or rural, marital status, employment status	5 trajectories of SA/disability pension days: 'fast decrease' (36% of the cohort), 'medium fast decrease' (29%), 'slow decrease' (15%), 'fluctuating' (12%), and 'late decrease' (8%). SA/DP days at end of follow-up (late decrease and fluctuating) were more likely to be older, born outside the EU and have indicators of more severe morbidity

SA = Sickness absence; GBTM = Group-based trajectory modelling; ICD-10 = International Classification of diseases 10th revision
EU = European Union

1.4 Summary and gaps in previous research

Despite a significant age shift in the workforce and recommendations and policies aimed at making it possible for older employees to reduce their working hours, only a few studies have examined working hours in later careers. Further, there are no previous studies that have utilised person-based methods in the study of working hours among ageing employees.

Regarding sickness absence, the association between age and sickness absence has been well-documented, but few studies have utilised person-based methods and examined if there are varying patterns in the development of sickness absence among subpopulations of ageing employees. I found seven studies examining the development of all-cause sickness absence, one examining the trajectories of part-time work and sickness absence, three studies examining mental health disorder-related sickness absence, and three studies examining musculoskeletal disease-related sickness absence.

Overall, in the studies with all-cause sickness absence, the selected model most often included three trajectories, and a tenth of the participants belonged to the group with clearly more sickness absence. However, in many of the studies the follow-up was quite short (1–6 years) and the development of sickness absence was modelled in years and not by age, and were therefore lacking knowledge on how sickness absence develops by age, despite age being a significant determinant of sickness absence.

Regarding diagnosis-specific studies, they most often studied the patterns of sickness absence among those diagnosed or treated due to a certain diagnosis, and only one study on musculoskeletal diseases examined the diagnosis-specific development of sickness absence among all employees, but they focussed on kitchen workers. Further, all but one of the studies regarding mental health disorder-related sickness absence focussed on younger employees.

The studies are from Western countries and mostly with data from the Nordic countries, hence, the generalisability of the studies globally is poor. However, with the drastically ageing workforce in the Nordics and a future lack of employees, especially in the female-dominated healthcare sector, research on the development of working hours and sickness absence in the public sector is warranted.

The literature review also raises gaps in explanatory variables used in the studies. Studies using register-based data lack health questionnaire data, and many sickness absence studies have no information on short-term sickness absence, or the data are solely based on the self-reported number of sickness absence days. Further, few studies have been able to link survey data to register data and to include information on, for example, participants' own perception of their health, health behaviour, and working conditions. To summarise, the development of

working hours in later careers has not previously been studied with person-based methods and few studies have examined the development of sickness absence among ageing employees. In addition, little is known on the developmental trajectories of diagnosis-specific sickness absence among ageing employees. Further, this thesis is the first to examine the dual developmental trajectories of long-term and short-term sickness absence.

2 Aims of the thesis

The main aim of this thesis was to examine the developmental patterns of working hours and sickness absence among midlife and older public-sector employees and to study social-, work-, and health-related determinants of distinct developmental patterns in working hours and sickness absence.

The specific aims were:

- I. To examine the development of working hours by identifying trajectories in working hours and to examine the associations of social-, work-, and health-related factors with trajectory group membership.
- II. To examine the development of long-term medically certified all-cause and diagnosis-specific sickness absence by identifying the developmental trajectories of long-term sickness absence due to all causes, mental health disorders, and musculoskeletal diseases, and further to examine the associations of social-, work-, and health-related factors with trajectory group membership.
- III. To examine the dual developmental trajectories of short- and long-term sickness absence among women and to examine the associations of social-, work- and health-related factors with trajectory group membership.

3 Data and methods

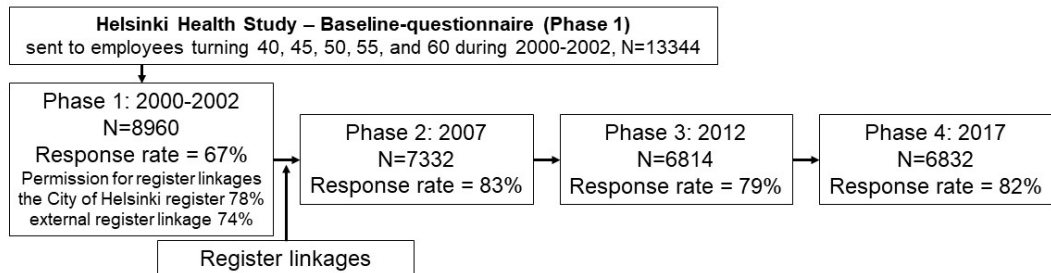
This dissertation is part of the Helsinki Health Study (HHS), an ongoing cohort of midlife and ageing employees of the City of Helsinki, Finland (Lahelma et al., 2013). The City of Helsinki is the largest employer in Finland, with around 40,000 employees. Their Occupational Healthcare Centre provides employees with preventative occupational healthcare services, as well as primary healthcare services. This study includes survey data from the HHS-study cohort and register data from the City of Helsinki personnel registers and national registers.

3.1 Survey data

Survey data were used in all three substudies. The survey includes a wide range of questions on health, work, and well-being. At baseline (Phase 1), survey questionnaires were mailed to employees turning 40, 45, 50, 55, and 60 in three consecutive years, 2000–02. The phase 1 sample consisted of 8960 employees (response rate 67%). Approximately 80% of the participants were women, corresponding with the share of women working for the City of Helsinki and elsewhere in the public sector in Finland (“Gender Equality in Public Sector Employment,” 2019). Small noticeable differences were prevalent between participants and non-participants in the Phase 1 survey (Laaksonen et al., 2008; Martikainen et al., 2007). Participants were more likely older, women, of higher occupational class and had less sickness absence; however, nonparticipation did not seriously bias the results.

The follow-up questionnaires were mailed in 2007, 2012, and 2017 to all respondents of the Phase 1 survey. Response rates for the follow-up questionnaires in 2007 (Phase 2), 2012 (Phase 3), and 2017 (Phase 4) were 83%, 79%, and 82%, respectively. In Phase 2, the differences between participants and non-respondents decreased (Lahelma et al., 2013).

Figure 2 Flowchart of the cohort participants



3.2 Register data

Unique personal identification numbers were used to link the survey data to register data. In all substudies, the survey data were linked to register data for those having consented to register linkage. In Phase 1, 78% of the participants gave permission for the City of Helsinki register linkages and 74% for external register linkage. Giving informed consent to register linkage followed generally similar patterns as survey response (Laaksonen et al., 2008).

Register data were collected from multiple sources including the City of Helsinki personnel registers and several external data sources. Information from the personnel register of the City of Helsinki included: job title, employment sector, start and end dates of sickness absence spells, information on basic education, and socioeconomic position. Information from the Finnish Centre for Pensions included information for granted disability retirements and old-age retirements (type of retirement and date of issuance). The register of the Social Insurance Institution of Finland included information on long-term sickness absence and their diagnostic codes by International Classification of Diseases 10th Revision (ICD-10).

Table 2 The data used in the study

Dataset	Outcome Data from
Sub-study I:	
Survey participants from the HHS cohort with self-reported information on weekly working hours and being employed full-time, part-time, or not working	Working hour data from questionnaires
Phase 1 2000–2002 and follow-up questionnaires in 2007, 2012, and 2017	
Sub-study II:	
Study participants aged 50–60 years during 2004–2018 and their sickness absence episodes during that time	Sickness absence data from the Social Insurance Institution of Finland
All sickness absence episodes lasting over 14 days due to different diagnostic causes from 2004 to 2018 extracted from the Social Insurance Institution of Finland	
Sub-study III:	
Study participants aged 46–55 years during 2000–2017 and their sickness absence episodes during that time	Sickness absence data from personnel register
All sickness absence episodes lasting over 14 days due to different diagnostic causes from 2000 to 2017 from the City Helsinki personnel register	

3.3 Working hours

Working hours were measured by a self-reported question about weekly working hours in all study phases. People were asked ‘How many (paid) hours per week do you work?’ with choices ‘0–10 hours per week’, ‘11–29 hours per week’, ‘30–40 hours per week’, ‘40–50 hours per week’, or ‘over 50 hours per week’. In Phase 4, the participants could also report working 0 hours.

In Substudy I, working hours were modelled linearly. I excluded people who did not report working and people who did not report working hours at each phase. In Substudy II, a mean working hours measure was calculated as a mean over study phases. Since working hours were based on self-report data, participants might have over- or underestimated working hours. However, according to previous studies, self-reported working hours have been found to be trustworthy (Imai et al., 2016).

3.4 Sickness absence

The Social Insurance Institution of Finland pays sickness allowance as compensation for loss of income due to illness lasting less than a full year after a waiting period of ten working days for which employees are compensated by the employer. During this study, at the City of Helsinki, employees could take a maximum of three days of self-certified sickness absence. A medical certificate was a prerequisite for sickness absence lasting over three working days.

In Substudy II, long-term sickness absence information was derived from the sickness allowance register of the Social Insurance Institution of Finland. We included annual information on long-term sickness absence during 2004–2018 and a diagnostic code for each sickness absence spell. The diagnostic codes for the sickness absence spells were based on (ICD-10). In addition to studying all-cause long-term sickness absence, I extracted the two most common diagnosis-specific sickness absence groups: mental health disorder–related and musculoskeletal disease–related sickness absence. The ICD-10 codes were as follows: mental health disorder–related sickness absence (F00–F99) and musculoskeletal disease–related sickness absence (M00–M99). When analysing the trajectories, days per year were converted into months for the analytical purposes as follows: 0–13 days = 0 months, 14–29 days = 1 month, 30–59 days = 2 months, etc., and 12 months was defined as 330 or more sickness absence days.

In Substudy III, the simultaneous development of short- and long-term sickness absence was analysed. For this study, I extracted sickness absence information from the personnel register of the City of Helsinki. Short-term sickness absence included self-certified sickness absence (1–3 working days at the employee’s personal notice). In Substudy III, short-term sickness absence was modelled as the number of sickness absence spells per year. Long-term sickness absence was modelled by the number of long-term sickness absence months per year. For statistical purposes, long-term sickness absence days per year were transformed to account for months per year similarly as in Substudy II.

3.5 Factors associated with trajectory membership

3.5.1 Sociodemographic factors

Age and gender

Age and gender were derived from the City of Helsinki personnel register. In Substudy I, I followed the development of working hours among both male and

female participants during the study phases. In Substudy II, employees aged 50 to 60 years during 2004–2018 were included in the analysis and the development of sickness absence was examined between ages 50–60. In Substudy III, the dual development of short-term and long-term sickness absence was examined between ages 46–55. We excluded men from the Substudy III population. The decision to focus solely on women in Substudy III was based on multiple criteria. First, the majority of municipal employees at the City of Helsinki and elsewhere in Finland are women. Second, we examined the role of the employment sector as a determinant on sickness absence trajectory groups and the largest employment sectors (social and healthcare sectors) employ mostly women. Thirdly, differences in the incidence of sickness absence have been reported between men and women (Laaksonen, Mastekaasa, et al., 2010; Mastekaasa, 2014).

Marital status

Marital status was derived from the questionnaire and divided into cohabiting and not cohabiting. Cohabiting included those reporting being married or cohabiting, non-cohabiting included those reporting being widowed, single, or divorced.

Occupational class

Occupational class was divided into four classes in Substudies I and II: professionals and managers, semi-professionals, routine non-manual employees, and manual workers. Professionals and managers included for example teachers, doctors, and managers with subordinates. Semi-professionals include occupations such as nurses and foremen. Routine non-manual employees include occupations such as child minders, assistant nurses, and manual workers, which include for example work in transport and cleaners (Lahelma et al., 2005). In Substudy III, I combined routine non-manual employees and manual employees into one occupational class. This was done because the most common occupations in these groups share similar workload characteristics. The work is usually physically demanding, and further, often includes a low decision latitude.

Income

Net income was divided into seven income levels and weighted by household size and then divided into quartiles. To further analyse the possible effect of income on working hours, household net income was derived from Phase 1 and analysed separately in Substudy I (Supplementary table).

3.5.2 Work-related factors

Employment sector

Information on the employment sector was extracted from the employer's personnel register. For Substudy III, four occupational sectors were formed: 1. healthcare (occupations in primary healthcare, hospital services), 2. social (social welfare services, elderly care), 3. education (primary school, secondary school, vocational training), and 4. other sectors (culture, leisure, rescue, financial administration, transport).

Work type

In all three substudies, work type was divided into regular daytime work or shift work. The first included regular daytime work and daytime work with on-call nightshifts. The latter included shift work, shift work with regular night shifts, and regular night work. Work type 'other' was classified as shift work.

Work-home satisfaction

Work-home satisfaction was measured by the question 'How satisfied are you with your work-home balance?' Replying satisfied or somewhat satisfied was classified as work satisfaction 'Good' and replying somewhat not satisfied or not satisfied as 'Poor' in Substudy II, whereas replying somewhat not satisfied or not satisfied was categorised as 'Dissatisfied' in Substudy III.

3.5.3 Health-related factors

In this thesis, the following health-related factors and their connection to trajectory membership were studied: self-reported smoking, alcohol consumption, leisure-time physical activity, body mass index (BMI), sleep, current pain, physical functioning, and mental functioning. The inclusion of variables varied with substudies, and a table of chosen variables in each substudy is presented below (Table 2).

Smoking

Smoking was dichotomised into non-smoking (including ex-smoking) and smoking (current smoking, daily or occasionally).

Alcohol consumption

Alcohol consumption was measured by reported alcohol consumption. In Substudy I, reported alcohol consumption was divided into non-drinkers, non-binge drinkers, and binge drinkers. If a participant replied being abstinent, they were categorised as non-drinkers. Binge drinking was indicated by drinking six or more units of alcohol at least once a week on a single occasion. In Substudy II, alcohol consumption was categorised as non-binge drinking and binge drinking.

Leisure-time physical activity

Leisure-time physical activity was estimated using the metabolic equivalent (MET) hours (Ainsworth et al., 2011) and divided into: low (<14 MET-hours/week), intermediate (≥ 14 MET-hours/week with only moderate activity), and high (≥ 14 MET-hours/week including vigorous activity).

BMI

BMI (kg/m^2) was calculated from self-reported height (m) and weight (kg). It was further categorised into healthy weight ($\text{BMI} < 25$), overweight ($25 \leq \text{BMI} < 30$), and obesity ($\text{BMI} \geq 30$).

Sleep

The Jenkins four-item questionnaire was used to indicate sleep problems (Jenkins et al., 1988; Lallukka et al., 2011). The questions were as follows: how often in the past month did you:

- 1) have trouble falling asleep?
- 2) wake up several times per night?
- 3) have trouble staying asleep (including waking up too early)?
- 4) wake up after your usual amount of sleep feeling tired or worn out?

If at least 1 of the 4 symptoms occurred at least 15 times within the month, the answer was categorised as having sleep problems.

In Substudy I, reported sleeping hours were used instead of the Jenkins sleep questionnaire. Reported sleeping hours were categorised as: less than seven hours per night, seven to eight hours, and nine or more hours per night.

Pain

Current pain was used as a covariate in Substudy I. The dichotomous variable was based on the question: 'Do you have pain at the moment?' with response alternatives of 'yes' or 'no'.

Physical and mental well-being

The well-being of employees was measured by the Short Form 36 questionnaire physical and mental functioning components in Substudy I (Ware et al., 1993, 1994). In the questionnaires, a Finnish-validated translation was used (Hagman, 1996). Statistically continuous physical (PCS) and mental (MCS) component summary scores were calculated, with higher scores indicating better functioning. The lowest quartile was assigned 'poor functioning'.

Table 3 Covariates by substudies. SA = Sickness absence

Covariate	Substudy I (Trajectories of Working Hours)	Substudy II (Trajectories of Long-term Sickness Absence)	Substudy III (Dual Trajectories of Short-term and Long-term Sickness Absence)
Age	5 age groups (40–45, etc.)	SA development between ages 50–60 years	SA development between ages 46–55 years
Occupational class	Professionals and Managers; Semi-professionals; Routine non-manual workers; Manual workers	Professionals and Managers; Semi-professionals; Routine non-manual workers; Manual workers	Professionals and Managers; Semi-professionals; Routine non-manual workers; Manual workers
Marital status	Cohabiting; Non-cohabiting	Cohabiting; Non-cohabiting	Cohabiting; Non-cohabiting
Work arrangements	Non-shift work; Shift work	Non-shift work; Shift work	Non-shift work; Shift work
Working hours	Working hours from the questionnaire	Weekly mean hours	
Work–family satisfaction		Satisfied; Not satisfied	Satisfied; Dissatisfied
Smoking	Smoker; Non-smoker	Never or quit; Daily or occasionally	Never or quit; Daily or occasionally
Alcohol consumption	Non-drinker; Non-binge drinker; Binge drinker	Binge drinking: No, Yes (weekly or more often)	
Body mass index, BMI	Healthy weight (BMI<25); Overweight (25≤BMI<30); Obesity (BMI≥30)	Healthy weight (BMI<25); Overweight (25≤BMI<30); Obesity (BMI≥30)	Healthy weight (BMI<25); Overweight (25≤BMI<30); Obesity (BMI≥30)
Leisure-time physical activity		High; Moderate; Low	High; Intermediate; Low
Sleeping hours	<7 h; 7–8 h; 9 h or more		
Sleep problems		Yes; No	Yes; No
Physical functioning	Good; Poor (lowest quartile = 'poor functioning')		

Mental functioning	Good; Poor (lowest quartile = 'poor functioning')		
Current pain	Yes; No		
Income	Income was analysed separately		

3.6 Statistical methods

This study used person-based methods in the analysis of working hours and sickness absence. Person-based approaches used in this study utilise finite mixture modelling. Finite mixture models detect patterns in time in a heterogeneous study population and by those patterns classify individuals into qualitatively different trajectory groups (Muthén & Shedden, 1999). To date, analysing developmental trajectories over time has been utilised widely in medicine and these methods are being increasingly used to study the development of sickness absence (De La Fuente et al., 2018; Lee, Kim and Brook, 2019; Witt et al., 2019, Virtanen et al. 2017).

Two common applications of finite mixture models are group-based trajectory models (GBTM) and growth mixture models (GMM). GMM is a parametric approach and allows for individual variation within the trajectory group, whereas GBTM assumes homogeneity conditional on trajectory group membership (Berlin, Parra and Williams, 2014). The finite mixture models seem to be equal in identifying the correct number of latent trajectory groups, however, GMM is mathematically more challenging (Warren et al., 2015).

3.6.1 Development of working hours

In Substudy I, the development of weekly working hours was examined with GMM. Working hours between Phases 1–4 were examined with the R package lcmm (Proust-Lima et al., 2017). The development of working hours was modelled linearly. Analyses were first carried out for men and women separately, but due to the small number of men and similarities in the models, the analysis were conducted pooled and adjusted for gender. Bayesian Information Criterion (BIC), Akaike Information Criteria (AIC), identifiability of the groups, groups' posterior probabilities and preference for models that produced trajectory groups with no less than 5% of the participants, were used to determine the best number of latent classes. A two-trajectory model was chosen according to the aforementioned criteria. The model fit with high posterior probabilities indicated a low risk of false classification.

After selecting the trajectory model and the number of trajectory groups, factors associated with the trajectory groups were examined with cross-tabulations and logistic regression models. In this way, it was possible to identify associated preventable health factors. All analyses were done in R (R Core Team, 2020).

3.6.2 Development of all-cause and diagnosis-specific long-term sickness absence

In Substudy II, an application of finite mixture model called GBTM was used. Both all-cause and diagnostic-specific long-term sickness absence were investigated. Prior to trajectory analysis, a group with no sickness absence was extracted and then added to the data as a reference group after trajectory analysis.

The development of long-term sickness absence months with age was modelled with zero-inflated Poisson regression. This was due to the large amount of zero outcomes where during multiple years the participants had no sickness absence. The optimal number of trajectory groups was based on BIC, AIC, entropy, and preference for clinically plausible models that produced trajectory groups with no less than 5% of the total sample. Next, cross-tabulations and multinomial logistic regression models were performed with the no sickness absence trajectory groups as reference. Analyses of the developmental trajectories were done in Stata (Stata Corp, 2021) and secondary analyses in R (R Core Team, 2020). Graphs for Substudy II were plotted with PRISM version 8 (GraphPad software).

3.6.3 Dual trajectories of short- and long-term sickness absence

In Substudy III, a dual version of the GBTM was utilised in order to study the joint short- and long-term sickness absence development. The decision to model their joint development was based on the assumption that, despite differing determinants, short- and long-term sickness absence could be considered as two contemporaneous but linked phenomena that reflect some underlying characteristic in terms of work ability. The idea behind this arises from studies hypothesising that short-term sickness absence precedes long-term sickness absence (Kristensen, 1991), and from findings showing that multiple short-term sickness absence spells are associated with an elevated risk of more profound work disability (Harkko et al., 2021). In conjunction, I considered that these outcomes should be studied side by side.

The dual trajectory model has three key outputs:

1. determining the ideal number of trajectory groups for both sets of measurements
2. the probability of membership in each trajectory group

3. the probabilities that link membership in trajectory groups across the two measured phenomena

The model specifies both trajectories simultaneously and just as in the single-outcome GBTM, the participants are assigned to trajectory groups with the highest posterior probability in each trajectory model.

In Substudy III, short-term sickness absence was modelled as the number of sickness absence spells per year and long-term sickness absence as months per year. Both outcomes (short- and long-term sickness absence) were modelled with zero-inflated Poisson regression because there were many participants who had zero spells or zero months of sickness absence per year during follow-up. Both outcomes were first analysed separately and in these preliminary analyses, a model with three trajectory groups was selected for both outcomes (long-term and short-term sickness absence). Outcomes were modelled up to a third-order polynomial and with one to seven trajectory groups. After this, the dual trajectory model was fitted using starting values from the two single-outcome trajectory models. Risk factors or covariates were not included in the models. Mean posterior probabilities were >0.90 in all the trajectory groups, indicating a good model fit and a low risk of false classification. Next, trajectory memberships were examined with cross-tabulations and the work-related factors associated with the trajectory groups were examined with multinomial logistic regression models. Analyses of the developmental trajectories were done in Stata (Stata Corp, 2021) and secondary analyses in R (R Core Team, 2020). Graphs were finalised with Inkscape.

3.6.4 Attrition

In all substudies, the aim was to study those who stay in the workforce. In Substudy I, this was done by including in the analysis those who reported still working, either part-time or full-time and also reported working hours. In Substudy I, the development of working hours was analysed at every questionnaire follow-up, whereas in Substudies II–III the sickness absence patterns were analysed by age with more frequent follow-ups. Throughout the study, the ‘healthy worker’ effect should be considered since those with work disability are more likely to dropout of the workforce and hence not report working or remain employed at the City of Helsinki (Wilcosky & Wing, 1987).

In both Substudies II and III, participants assigned to trajectory groups with more sickness absence were more likely to dropout during the follow-up. This is partly explained by legislative reasons since disability pension can only be granted after a person is first on long-term sickness absence. As per this reason and because dropping out was most common in the trajectory group with the highest sickness absence rate, attrition could not be considered as solely random. To account for this non-random attrition, I modelled dropout probability with dependence on two

previous responses. This was done with a postprob command in Substudies II and III which considers non-random attrition by taking the two closest years into consideration.

Further, in Substudy III, I tested whether the trajectories would change when analysing shorter time periods. The short-term sickness absence models selected were similar for models with ages 46–50 and 51–55. Long-term sickness absence trajectory models with ages 46–50 and 51–55 produced slightly smaller ‘high sickness absence’ trajectory groups. This might be due to fewer participants having had time to develop a worsening trajectory with high sickness absence.

3.7 Ethical considerations

The HHS has been approved by the Ethics committee of the Department of Public Health, University of Helsinki and by the Ethics Committee of the health authorities of the City of Helsinki. This study has been conducted in compliance with the data protection laws and regulations.

4 Results

4.1 Descriptive results

The characteristics of the participants and the prevalence of certain health behaviours can be summarised as follows (Table 4). Manual workers were the smallest occupational class. In Substudy III, they were combined with routine non-manuals, after which, ‘routine non-manual and manual employees’ were the largest occupational class. Two-thirds of the participants were cohabiting.

A fifth reported shift work. One-fifth reported smoking. Current pain was reported by 42%. Healthy BMI was reported by half, overweight by a third and obesity by less than a fifth. One-fifth reported sleep problems. Almost half were not satisfied with their work–home balance. A fifth reported low leisure-time physical activity.

Table 4 Baseline characteristics of the study population in substudies I-II

Characteristics at baseline 2000–2002	Study Population %
Women	80%
Occupational class	
Professionals and Managers	30%
Semi-professionals	20%
Routine non-manual workers	33%
Manual workers	16%
Marital status	
Cohabiting	68%
Non-cohabiting	32%
Work–home satisfaction	
Satisfied	56%
Not satisfied	44%

Work arrangements	
Non-shift work	80%
Shift work	20%
Working hours	
Weekly mean (hours)	35 hours per week
Health behaviour	
Smoking	
Smoker	20%
Non-smoker	80%
Binge drinking (six or more units)	
Rarely or never	89%
Weekly or more often	11%
Body Mass Index (BMI)	
Healthy weight	45%
Overweight	38%
Obesity	17%
Leisure-time physical activity	
High	49%
Intermediate	34%
Low	17%
Sleeping hours	
< 7 h	22%
7–8 h	75%
9 h or more	3%
Physical functioning	
Good	77%
Poor	23%
Mental functioning	
Good	78%
Poor	22%
Current pain	
Yes	42%
No	58%

4.2 Development of working hours

In Substudy I, I examined the development of weekly working hours during later work careers. A model with two trajectories was selected. The trajectory groups were named based on their developmental patterns to describe their temporal development as ‘Stable regular working hours’ (90%) and ‘Shorter and varying working hours’ (10%). Those assigned to the ‘Stable regular working hours’ trajectory group worked stable hours, and those assigned to the ‘Shorter and varying working hours’ trajectory group had in essence shorter weekly working hours with more variance. The working hours were analysed by study phases and not by age.

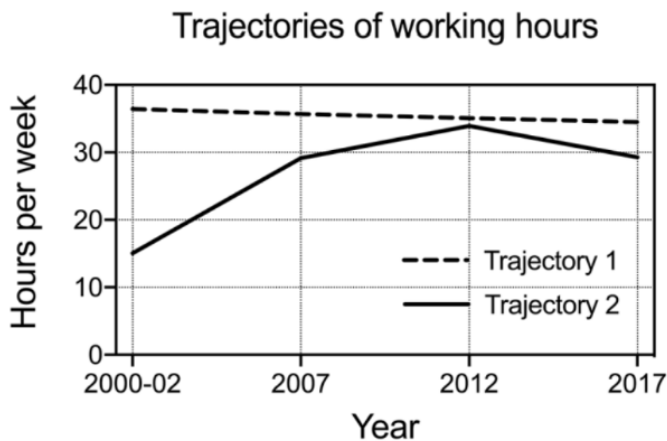


Figure 3 Trajectories of working hours among midlife and ageing employees. Trajectory group 1 = ‘Stable regular working hours’ (90%); Trajectory group 2 = ‘Shorter and varying working hours’. Adapted from Suur-Uski et al. 2021 doi:10.1093/eurpub/ckab179 (Substudy I)

Figure 3 shows the development of working hours in both trajectories during study phases 1–4. The description of baseline characteristics of the Substudy I population and characteristics of the working hour trajectories are presented in Substudy I Table 1. Those assigned to the trajectory group ‘Shorter and varying working hours’ were more often women, of older age, and from higher occupational classes. The factors associated with trajectory group membership varied, regarding health-related factors: reporting sleeping >8 hours, reporting being a non-drinker, and reporting poor mental functioning were associated with a higher likelihood of being assigned to the trajectory group ‘Shorter and varying working hours’. Smoking, BMI, physical functioning, and current pain were not associated with trajectory group membership. The odds ratios (OR) and confidence intervals (CI) are presented in the Substudy I tables.

4.3 All-cause and diagnosis-specific long-term sickness absence between ages 50–60

In Substudy II, I examined the developmental trajectories of all-cause, mental health disorder–related, and musculoskeletal disease–related long-term sickness absence among 50–60-year-old employees. The association of social, work-, and health-related factors with trajectory group membership was examined using cross-tabulations and multinomial logistic regression with the ‘no sickness absence’ trajectory group as the reference. The analysis and selection of long-term sickness absence trajectory models is described in Substudy I.

4.3.1 All-cause long-term sickness absence trajectories

Regarding all-cause long-term sickness absence, almost half of the participants (42%) were assigned to the no long-term sickness absence trajectory and 46% to the trajectory of low long-term sickness absence, in which the mean length of sickness absence was around half a month per year and slightly increased during follow-up (Figure 4). A tenth of employees belonged to a path with more strongly increasing sickness absence, and the mean length of sickness absence rose between ages 50–60 from 1 to 2 months per year. Sickness absence trajectories were named describing their development: the trajectory group with no sickness absence = ‘No sickness absence’ (42%, N=1982), trajectory group with low sickness absence = ‘Low sickness absence’ (46%, N=2183), and trajectory group with high sickness absence ‘High sickness absence’ (12%, N=564).

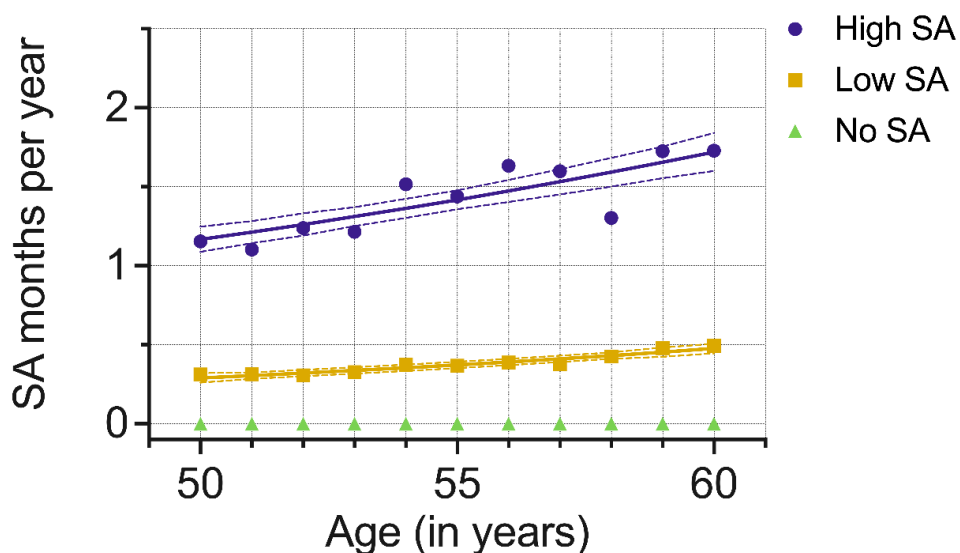


Figure 4 All-cause long-term (>10 working days) sickness absence (SA) trajectories' averages and estimates with 95% confidence intervals identified in the group-based trajectory modelling (GBTM) (N=2,747). Follow-up between 50–60 years of age. Sickness absence by age from the model. The 'No SA' trajectory group (directly observed from the data) was added after GBTM (N=4,729). 'No SA' (42%, n=1,982), 'Low SA' (46%, n=2,183), and 'High SA' (12%, n=564). Adapted from Suur-Uski et al. 2023 doi.org/10.1186/s12889-023-16345-9 (Substudy II) SA = Sickness Absence

Cross-tabulations are presented in Substudy II. Multinomial logistic regression models were used to analyse associations of covariates with trajectory group membership (Table 5). From social and work-related factors, lower occupational class and reporting shift work were associated with a higher, and male gender with a lower, likelihood of belonging to the 'Low sickness absence' and 'High sickness absence' trajectories, compared to the 'No sickness absence' trajectory. From health-related outcomes, smoking, overweight, obesity, and sleep problems were associated with a higher likelihood of belonging to the 'Low sickness absence' and 'High sickness absence' trajectories compared to 'No sickness absence'. A higher likelihood of being assigned to the 'High sickness absence' trajectory compared to 'No sickness absence' was associated with replies: not satisfied with work-home balance compared to satisfied, binge drinking weekly or more often, and moderate or low leisure-time physical activity compared to high leisure-time physical activity.

Table 5 All-cause long-term (>10 working days) sickness absence (SA) trajectories: the associations between socioeconomic, work-related, and health-related factors with SA trajectory membership. Multinomial logistic regression model with odds ratios (ORs) and their 95% confidence intervals (CIs). Adapted from Suur-Uski et al. 2023 doi.org/10.1186/s12889-023-16345-9 (Substudy II) SA = Sickness Absence

All-cause long-term sickness absence	Model adjusted for gender		Model adjusted for gender and occupational class		Full model ¹
	Low SA	High SA	Low SA	High SA	
Reference group: No SA trajectory	OR (95% CI)		OR (95% CI)		OR (95% CI)
Gender Men (Ref. Women)	0.66 (0.57–0.76)	0.53 (0.51–0.55)	0.70 (0.61–0.81)	0.56 (0.53–0.61)	0.71 (0.61–0.82)
Occupational class Semi-professionals (Ref. Professionals and managers)			1.34 (1.14–1.58)	1.87 (1.66–2.01)	1.25 (1.07–1.47)
Routine non-manual workers			1.88 (1.63–2.18)	2.99 (2.59–3.45)	1.55 (1.35–1.78)
Manual workers			2.50 (2.24–2.80)	5.28 (4.71–5.92)	1.97 (1.77–2.20)
Shift work (Ref. Non-shift work)					1.16 (1.02–1.31)
Working hours (weekly mean)					0.99 (0.98–1.00)
Work-home satisfaction Not satisfied (Ref. Satisfied)					1.08 (0.95–1.23)
Marital status Non-cohabiting (Ref. Cohabiting)					1.11 (0.96–1.28)
Smoking Currently or occasionally (Ref. Never or quit)					1.32 (1.16–1.50)
Binge drinking Weekly or more often (Ref. Rarely or never)					1.05 (0.90–1.23)
BMI Overweight (25≤BMI<30) (Ref. Healthy weight (BMI<25))					1.16 (1.02–1.33)
Obesity (BMI≥30)					1.45 (1.25–1.67)
Leisure-time physical activity Moderate (Ref. High)					1.02 (0.89–1.16)
Low					0.88 (0.76–1.03)
Sleep problems Yes (Ref. No)					1.25 (1.11–1.41)

¹ Full model adjusted for: start year in the follow-up, gender, work-related factors, occupational class, marital status and health behaviour, intercepts not shown.

SA = Sickness absence; BMI = Body mass index; OR = Odds ratio; CI = Confidence interval

4.3.2 Mental health disorder–related long-term sickness absence trajectories

Regarding mental health disorder–related long-term sickness absence model, the trajectory groups were named: no mental health disorder–related sickness absence = ‘No MD sickness absence’ (85%, n=4,032), low mental health disorder–related sickness absence = ‘Low MD sickness absence’ (10%, n=482), and high mental health disorder–related sickness absence = ‘High MD sickness absence’ (5%, n=215) (Figure 5). In this model, the group with a low rate of sickness absence showed no clear increase with age compared to the group with the highest rate of sickness absence; rising from less than 1 to 2 months per year between ages 50–60.

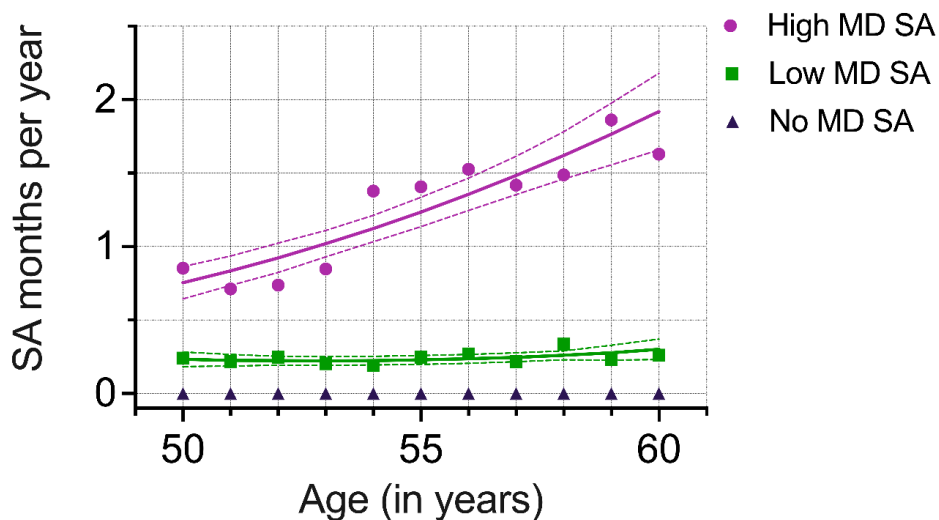


Figure 5 Mental health disorder–related long-term (>10 working days) sickness absence (SA) trajectories’ averages and estimates with 95% confidence intervals identified in the group-based trajectory modelling (GBTM) (N=697). Follow-up between 50–60 years of age. Fitted SA rate by age from the GBTM model. The ‘No MD SA’ trajectory group was added after GBTM (N=4,729). ‘No MD SA’ (85%, n=4,032), ‘Low MD SA’ (10%, n=482) and ‘High MD SA’ (5%, n=215). Adapted from Suur-Uuski et al. 2023 doi.org/10.1186/s12889-023-16345-9 (Substudy II) SA = Sickness absence; MD = Mental health disorder

Regarding socioeconomic and work-related factors, male gender was associated with a lower, and sleep problems with a higher, likelihood of being assigned to the ‘Low MD sickness absence’ and ‘High MD sickness absence’ trajectories compared to ‘No MD SA’ (Table 2 in Substudy II). Lower occupational class was associated with a higher likelihood of being assigned to the ‘High MD sickness absence’ trajectory, whereas working hours were negatively associated with the ‘High MD

sickness absence' trajectory compared to the 'No MD sickness absence' trajectory. Of health-related factors, reporting smoking and leisure-time physical inactivity were positively associated with the 'High MD sickness absence' trajectory, compared to the 'No MD sickness absence' trajectory. ORs are presented in Substudy II Table 2.

4.3.3 Musculoskeletal disease–related long-term sickness absence

Following previous procedures, those with no long-term sickness absence due to musculoskeletal diseases formed the group 'No MSD sickness absence', prior to the trajectory analysis. For musculoskeletal disease–related sickness absence, a two-group trajectory was selected, and the group 'No MSD sickness absence' was added after analysis as reference: 'No MSD sickness absence' (73%, n=3456), 'Low MSD sickness absence' (20%, n=930), 'High MSD sickness absence' (7%, n=343) (Figure 6). Compared to the mental health disorder model, in the 'Low MSD sickness absence' trajectory group sickness absence increased more with age and the trajectory group with the highest sickness absence increased less, only to approximately 1.25 months of absence per year.

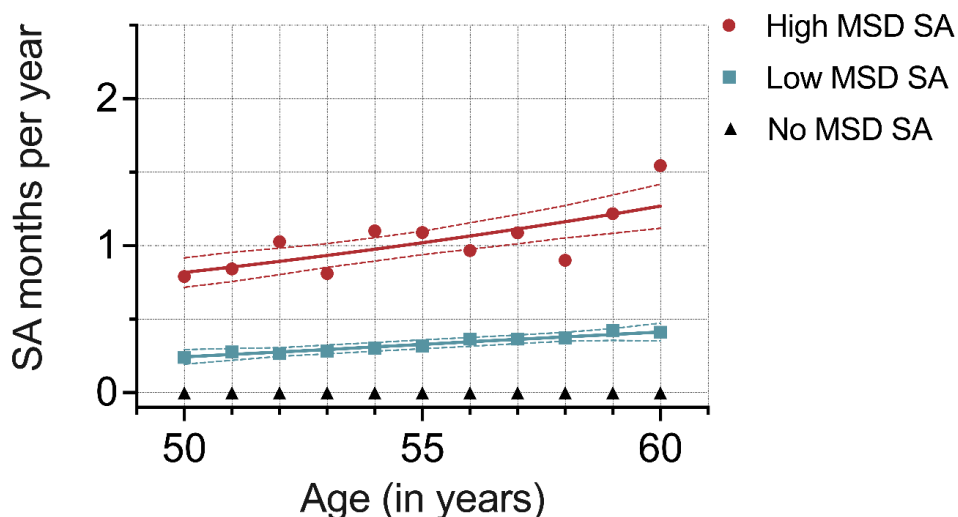


Figure 6 Musculoskeletal disease–related long-term (>10 working days) sickness absence (SA) trajectories' averages and estimates with 95% confidence intervals identified in the group-based trajectory modelling (GBTM) (N=1273). Follow-up between 50–60 years of age. Fitted SA rate by age from the model. The 'No MSD SA' trajectory group was added after GBTM (N=4729). 'No MSD SA' (73%, n=3456), 'Low MSD SA' (20%, n=930), 'High MSD SA' (7%, n=343). Adapted from Suur-Uski et al. 2023 doi.org/10.1186/s12889-023-16345-9 (Substudy II) SA = Sickness absence; MSD = Musculoskeletal disease

In the musculoskeletal disorder–related model, the following socioeconomic and work-related factors: being a woman, from a lower occupational class, reporting smoking, obesity, and sleep problems were associated with a higher likelihood of being assigned to either trajectory with sickness absence compared with ‘No MSD sickness absence’. Reporting overweight, obesity, and leisure-time physical inactivity were associated with higher, and binge drinking with lower, likelihoods of belonging to the ‘High MSD sickness absence’ trajectory compared with ‘No MSD sickness absence’.

4.4 Dual trajectories of short-term and long-term sickness absence

In Substudy III, I examined the dual developmental of short-term and long-term sickness absence trajectories. The selected dual model included three trajectory groups for both outcomes, and the chosen model is presented in Figure 7. The frequency of short-term sickness absence spells showed no variation with age, but was divided into groups by the frequency of spells, whereas the long-term sickness absence trajectories with sickness absence showed a clear increase with age. The length of absence over tripled in the trajectory group ‘High long-term sickness absence’.

In the short-term sickness absence model, the trajectory group ‘No short-term sickness absence’ accounted for half of the participants, and the rate of sickness absence spell was around 1 spell/year. In the second largest group, ‘Low frequency short-term sickness absence’ (40%), the frequency of spells was around 3 spells/year. Only 10% of the participants belonged to a trajectory group in which the frequency of spells was much higher, around 7 spells/year: ‘High frequency short-term sickness absence’. No change with age was noticed in the frequency of short-term sickness absence spells in any of the trajectory groups.

In the long-term sickness absence trajectory model, the majority of participants belonged to a trajectory with no long-term sickness absence during ages 46–55. Almost a third of the participants (27%) had around a month of sickness absence, and the amount of sickness absence increased with age in this trajectory group. A minority of participants had strongly increasing sickness absence, with individuals in the trajectory group ‘High long-term sickness absence’ (8%) having sickness absence that rose from one month to four months per year during follow-up.

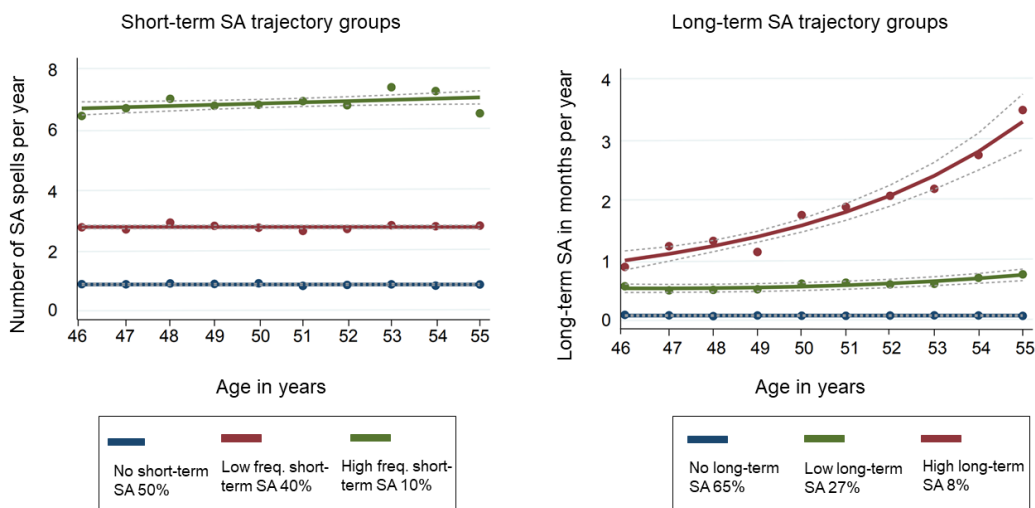


Figure 7 The developmental trajectories of sickness absence (SA) of women employed at the City of Helsinki between ages 46–55 (N=3206). Left panel: the developmental trajectories for the number of short-term SA spells per year during ages 46–55: ‘no short-term SA’ (50%), ‘low frequency short-term SA’ (40%), and ‘high frequency short-term SA’ (10%). Right panel: the developmental trajectories of the number of long-term SA months per year during ages 46–55: ‘no long-term SA’ (65%), ‘low long-term SA’ (27%), ‘high long-term SA’ (8%). SA = Sickness absence, freq. = frequency

In the dual trajectory model, in addition to trajectory groups, the model creates a summary table of the investigated interrelationships. This makes it possible to study the heterogeneity of the sickness absence patterns with the joint and conditional probabilities of trajectory groups’ memberships. For example, it quantifies the probabilities of a person belonging to each long-term sickness absence trajectory group, conditional on their belonging to each short-term sickness absence group. These probabilities are presented in Table 6.

Table 6 The linkage between short-term and long-term SA trajectory groups presented by conditional and joint probabilities from the group-based dual trajectory model. Conditional probability describes how likely an individual is to be in each long-term SA trajectory group if a person is known to be in a given short-term SA trajectory group. Joint probability describes how likely overall it is for a person to fall into any combination of the short- and long-term SA trajectory groups. Joint probability membership is presented for every trajectory group combination, altogether nine joint probabilities that sum up to one. The names express the trajectory groups’ name and the percentage (%). SA = Sickness absence

Probability of long-term SA trajectory group (k) conditional on short-term SA trajectory group (j) [$\pi_{k j}$]				
Long-term SA trajectory group	Short-term SA trajectory group			
	No short-term SA (50%)	Low frequency short-term SA (40%)	High frequency short-term SA (10%)	
No long-term SA (65%)	0.85	0.50	0.24	
Low long-term SA (27%)	0.12	0.39	0.53	
High long-term SA (8%)	0.03	0.11	0.23	
	1	1	1	
Probability of short-term SA trajectory group (j) conditional on long-term SA trajectory group (k) [$\pi_{j k}$]				
Long-term SA trajectory group	Short-term SA trajectory group			
	No short-term SA (50%)	Low frequency short-term SA (40%)	High frequency short-term SA (10%)	
No long-term SA (65%)	0.66	0.31	0.04	1
Low long-term SA (27%)	0.22	0.58	0.20	1
High long-term SA (8%)	0.20	0.52	0.28	1
Joint probability of short-term SA trajectory groups (j) and long-term SA trajectory groups (k) [π_{kj}]				
Long-term SA trajectory group	Short-term SA trajectory group			
	No short-term SA (50%)	Low frequency short-term SA (40%)	High frequency short-term SA (10%)	
No long-term SA (65%)	0.43	0.20	0.02	
Low long-term SA (27%)	0.06	0.16	0.05	
High long-term SA (8%)	0.02	0.04	0.02	
				1

This table can be described as follows: if assigned to a no short-term sickness absence trajectory group, there was an 85% chance of being assigned to a long-term trajectory with no sickness absence. Similarly, if assigned to a no long-term sickness absence trajectory group, the likelihood of being assigned to a no short-term sickness absence group was 66%. This means that there exists a high interrelationship between those groups with no sickness absence. Uncertainty was noticed in the trajectory groups with high sickness absence rates. When assigned to the trajectory group with a high number of short-term sickness absence spells, the probabilities of being assigned no long-term sickness absence and high long-term sickness absence were equal, 24% and 23%, respectively. This means that there exists population heterogeneity, and not all long-term sickness absence paths can be foretold by participants' short-term sickness absence patterns. The last section of the conditional membership table presents the joint probability membership, in other words, the total nine possible configurations that sum up to one. From the table, we can see that the most likely combinations were being assigned to the no long-term sickness absence trajectory and no short-term (43%) or low frequency short-term trajectory groups (20%) or low frequency short-term and low long-term sickness absence groups (16%).

Thus, the prevalence of certain socioeconomic, work and health determinants can be summarised as follows: those in lower occupational classes were more prevalent in trajectories with higher sickness absence rates. Reporting smoking, sleep problems, higher BMI, and low leisure-time physical activity were more common in trajectories with sickness absence. Similarly, reporting shift work and being dissatisfied with one's work-home balance were more prevalent in trajectory groups with higher sickness absence.

I further examined the association of trajectory group membership and employment sector by multinomial logistic regression and found an association between employment sector and trajectory group membership. In the short-term sickness absence model, working in the social sector was associated with a higher likelihood of being assigned to 'low frequency short-term sickness absence' and 'high frequency short-term sickness absence' trajectory groups when compared to employment sector 'other'. Working in healthcare was also associated with a higher likelihood of being assigned to the 'high frequency short-term sickness absence' trajectory group compared to employment sector 'other'. In the long-term sickness absence model, both the healthcare and social sectors were associated with a higher likelihood of being assigned to the 'high long-term sickness absence' trajectory group compared to employment sector 'other' (supplementary tables Substudy III).

5 Discussion

5.1 Main results

This thesis examined the development of working hours and sickness absence among midlife and ageing public sector employees. The main findings of this study are that changes in working hours in one's later career are rare and that a majority of midlife and ageing municipal employees take no or little sickness absence, and among them there is no increase in sickness absence with age. More broadly, the findings of this study are as follows.

First, most employees worked stable hours and only some people, comprising around 10% of the cohort, reduced their working hours. Further, the percentage of participants working above 40 hours per week was small (8%).

Second, the sickness absence rate does not consistently increase with age, on the contrary, the majority of midlife and ageing employees have no or a low rate of sickness absence. Only among a smaller percentage of employees does the sickness absence rate increase with age, not supporting the idea of older employees having generally more sickness absence.

Third, short- and long-term sickness absence patterns were interconnected, but heterogeneity regarding their relationship was also noticed. Uncertainty existed in the development of sickness absence, especially if the other sickness absence outcome was poor. For example, if there was a high frequency of short-term sickness absence spells, it was equally likely to have no long-term sickness absence or a high rate of long-term sickness absence. Interestingly, I found no variation in the number of short-term spells with age. There were three stable trajectory groups of annual short-term sickness absence spells that were well separated from each other by the frequency of spells per year.

Fourth, as for factors associated with trajectory group membership, those reporting shorter working hours were more likely to be women, from older age groups compared to the youngest age group, from a higher occupational class, report long sleeping hours, higher alcohol consumption, and poor mental functioning. Regarding sickness absence trajectory groups and their determinants, women, those in lower occupational classes, in shift work, and with unhealthy health behaviours were associated with a higher likelihood of being assigned to the trajectory groups with sickness absence in which the sickness absence rate also

increased with age. In the dual trajectory model, I noticed that two employment sectors that are dominated by women — working in healthcare and social care — appeared to be more prone to sickness absence than other employment sectors.

5.2 Comparison and interpretation of the findings

5.2.1 Working hours among ageing employees

Only a few previous studies have examined the development of working hours in later careers (Bell & Rutherford, 2013; Wels, 2019a, 2019b, 2020). In this study, the majority of employees worked stable hours and a small proportion of employees were assigned to a trajectory with shorter, more varying working hours (10%). This finding differs from other countries such as Korea where almost half of employees work over 48 hours weekly; however, this study included solely municipal employees in one Nordic country, Finland (Lee et al., 2007). Only a few employees reported working over 40 hours per week (8%), which reflects the general picture of shorter working hours in the EU and especially in the Nordics compared to other countries. Our municipal cohort could also affect this since the majority of the cohort was working in permanent job contracts (>90%) and the cohort lacks participants with shorter job contracts and more precarious job descriptions.

Only a small percentage of employees worked shorter hours and this trajectory with varying working hours can be thought of as an umbrella under which multiple reasons for shorter working hours exist. Some employees may choose shortening working hours, whereas for some it might be a necessity due to poor health. Older employees were more likely to be assigned to the shorter working hours trajectory group. This is understandable as societies have aimed to facilitate reduced working hours for older employees (Wels, 2019a). Possible ways for this are partial old-age pension or partial disability pension. In Finland, at the time of this study, employees could move to part-time pension if certain criteria were fulfilled. Until 2017, while receiving part-time pension, employees had to cut down working hours, but after 2017 this has not been mandated. In 2021, roughly 13,000 people started on partial old-age pension (Kannisto, 2022), compared to 44,000 people moving to old-age pension and 17,500 to disability pension (Eläketurvakeskus, 2022).

Partial disability pension is another way by which employees can reduce their workload and it can be applied if employees' work ability is not sufficient for their regular workload due to an illness or disability, but the work ability allows them to cope with part-time work. Partial disability pension is granted from authorised pension providers (such as Ilmarinen or Keva). The Social Insurance Institution of Finland does not grant partial disability pension in Finland. To date in Finland, around 20,000 people retire on a disability pension each year and around a third of new disability pensions are partial disability pensions. While on partial disability

pension, almost 80% of people work (Finnish Centre for Pensions, 2023). Further, partial disability pension is relatively stable and it is rare to transfer from partial disability pension to full disability pension (Polvinen & Laaksonen, 2022). A recent study by Poutanen et al. (2023) examined the heterogeneous population of people with partial work ability and discovered that musculoskeletal and mental health disorders were highlighted in one of the groups, described with a trend of moving from employment to unemployment (Poutanen et al., 2023). Partial disability pension is associated with higher age and assisting healthcare occupations, and it is more common among women and in lower occupational classes (Finnish Centre for Pensions, 2023).

Those in the highest occupational class were more likely to be assigned to the shorter working hours trajectory. Previous studies have indicated that those in higher socioeconomic position are more likely to be active in the workforce after statutory retirement age (Bjuhr et al., 2023; M. Virtanen et al., 2017), whereas through Europe, those with lower education have a higher risk of leaving the workforce to disability retirement or by unemployment (Schuring et al., 2019). Additionally, those at both ends of the hierarchical occupational classes have been shown to be the latest to retire, but for differing reasons (Radl, 2013). Employees with low pension entitlements retire rather late if there is no disability, which might indicate a financial necessity to keep working, whereas those in higher socioeconomic position retire late because they are both motivated to stay in the workforce but especially because they are more sheltered from labour market constraints. Virtanen et al. further examined the development of public sector employees' possibilities for work-time control and their likelihood to extend employment beyond retirement. Compared to those with low self-evaluated possibilities for work-time control, both those with either all the time high and those with an improved work-time control were around 1.5 times more likely to work beyond pensionable age, respectively (M. Virtanen et al., 2022).

Overall, reducing working hours is most likely linked to multiple reasons and no uniform determinants for this exists; however, health is one factor associated with working hour arrangements (Pagán, 2009). Employees with health problems are more likely to work shorter working hours (Nielsen et al., 2021). Additionally, a more recent study has continued with studying the changes in working hours and the simultaneous changes in self-rated health (Ervasti et al., 2022). Ervasti et al. (2022) examined the combined development of self-rated health and working less than 35 hours per week, but instead of self-reported data they utilised the employer's data on the working hours of 5,947 shift-working healthcare employees. They utilised multi-trajectory modelling and found three clusters: one of which with declining good health and stable hours, one with sustained good health but slightly decreasing probability of shorter work weeks, and a third in which working hours were short and decreasing and health status fairly good, but declining. In this study,

those with poorer mental health more often belonged to a trajectory with shorter working hours. It can be hypothesised that this is the result of employees with poorer mental functioning being 'forced' to reduce working hours. A Belgian study also found an association between working time reductions and depressive symptoms and a worsening self-perceived health (Wels, 2020). A Korean study among both employed and self-employed participants came to a contradicting conclusion with their results supporting the hypothesis that 'long working time is associated with decreased psychological well-being of waged employees' (Park & Kim, 2021). However, in their data only approximately 20% worked less than 40 hours per week and over half of the participants worked 48 to over 60 hours per week and the results are not comparable to ours.

Sleep was associated with trajectory membership. Those reporting sleeping over eight hours per night were more likely and those reporting sleeping less than seven hours were less likely to be assigned to a trajectory with shorter and varying working hours. This finding might be due to multiple reasons. Working shorter hours might better facilitate time to sleep, on the other hand, those reporting less sleep might be better suited to their work characteristics since individual differences exist in sleeping behaviour (Härmä, 1995). A recent meta-analysis and systematic review found that previous studies support the association between short sleep duration and mental health disorders, but that the association between long sleep duration and mental health disorders requires further validation (Zhang et al., 2023). An umbrella review has further analysed varying health outcomes, concluding that both short and long sleep duration are associated with cognitive and other chronic diseases (Amiri & Behnezhad, 2020; J. Li et al., 2022). Regarding shorter working hours, Ervasti et al. used the Jenkin's four-item sleep questionnaire to indicate sleep problems and noticed that sleep problems were associated with working less than 35 hours per week (Ervasti et al., 2022).

The substudy on working hour development was the only one where I included reported pain as a covariate. Pain was included because in the professions with physical work descriptions, working hours might have to be reduced or people might move to partial disability pension, a great proportion of which are due to musculoskeletal disorders, due to pain (Finnish Centre for Pensions, 2023). Further, according to a meta-analysis, longer working hours are associated with musculoskeletal pain (Amiri, 2023). Increased job demands, shorter recovery times, and sleep problems related to long working hours are considered to contribute to this. In this study, current pain was not associated with working hours trajectory group membership and reporting pain was equally prevalent in both trajectory groups. This might indicate that our population was too small to detect differences in reported pain or that the population was heterogenous in their reasons for shorter working hours. Further, in the meta-analysis, some of the studies were performed in Asian countries with longer working hours (Miyamoto et

al., 2008), whereas this study analysed the development of working hours among municipal employees, among whom working over 40 hours per week was rare (8%).

5.2.2 Sickness absence trajectories

The findings from this study emphasise that most ageing employees maintain a good work ability without sickness absence spells. This is an important message in societies where ageism towards older employees exists (Previtali et al., 2022). The percentage of employees with a clearly increasing rate of sickness absence corresponded with previous studies, with around 10% of the participants belonging to such a trajectory. The worsening trajectory of high and increasing rates of sickness absence seemed to begin at an earlier age, because the frequency of short-term sickness absence in the high short-term sickness absence trajectory group was already high at age 46, and long-term sickness absence clearly increased from the beginning of the follow-up.

This study examined both all-cause and two diagnostic-specific long-term sickness absence trajectories. Regarding mental health disorder–related long-term sickness absence, no previous studies have analysed developmental trajectories of sickness absence with GBTM in the general workforce, but have rather focussed on employees who report having depressive or anxiety symptoms or on employees who receive treatment for mental health disorders (Alaie et al., 2023; Di Thiene et al., 2019; Farrants et al., 2018). When comparing trajectories with the highest rates of sickness absence, the increase in months during follow-up was steepest in the mental health disorder–related sickness absence model. This is most likely linked to longer times to recuperate from such disorders. Mental health disorders significantly incapacitate work ability globally and already typically occur at a young age (Blomgren & Perhoniemi, 2022).

Regarding musculoskeletal disease–related sickness absence, the rate of sickness absence increased in both the high sickness absence trajectory and low sickness absence trajectory. In the low sickness absence trajectory, sickness absence rose more clearly with age than in the all-cause and mental health disorder–related absence models. The increase became more apparent in our cohort after 55 years of age. This supports the idea that musculoskeletal disease–related sickness absence increases with age.

The dual development of short- and long-term sickness absence showed that these outcomes are interconnected, and that heterogeneity exists in the development of working hours. No previous study has, to the best of my knowledge, utilised this method in the study of sickness absence. Studying the development of short-term spells in conjunction with time showed that the frequency of short-term sickness absence spells remained stable with age. Hypothetically, this could mean that the rate of short-term spells is more related to person-related factors than, for

example, diseases accumulated with age. Consistency in the annual frequency of short-term sickness absence reflects a broad comprehension of sickness absence: short-term sickness absence is typically self-certified or due to minor illnesses or at the onset of a more serious ailment. Additionally, short-term sickness absence spells are more associated with motivational factors (Janssen, 2003), however, occupational class differences are also likely to partly explain this. Those in higher occupational classes might have better possibilities to modify working tasks and work while sick whereas among those in lower occupational classes infectious diseases might more straight forwardly lead to sickness absence.

The joint likelihood of the trajectory model shows that estimating the long-term sickness absence development by one's short-term sickness absence spells is not straightforward, and the results of this study do not encourage us to solely foretell one's long-term sickness absence by their short-term sickness absence rate. When a person is assigned to a trajectory with no short-term sickness absence, the likelihood of being assigned to a trajectory with a high level of long-term sickness absence was very low. However, a person's chances were much more uncertain when assigned into a trajectory of high frequency of short-term sickness absence spells, with equal chances of belonging to a high long-term and no long-term sickness absence trajectory. Overall, from these results it can be stated that the risk of sickness absence and a worsening work ability with age is not divided equally across the entire ageing workforce. The joint and conditional probabilities provide a statistical summary of these associations.

5.2.2.1 Factors related to sickness absence trajectories

I examined both socioeconomic, work-, and health-related factors associated with the sickness absence trajectories. To summarise these findings, work arrangements, occupational class, and multiple health behaviours, such as sleep, arose as significant determinants of the trajectory groups.

From socioeconomic factors, I detected a well-known association between higher occupational class and lower sickness absence rate (Pekkala et al., 2017a, 2017b). Previous studies have shown that a large proportion of occupational class differences in sickness absence is related to working conditions, such as physically strenuous work (Laaksonen, Piha, et al., 2010). The occupational differences regarding mental health-related sickness absence are, however, not as clear (Pekkala et al., 2017a). Employees in higher occupational classes generally have better opportunities to change working tasks if needed (Brauner et al., 2019). In addition, those in the lower occupational classes are also more likely to exit employment via disability pension. This phenomenon is hence also most likely visualised in the higher likelihood of being assigned to a trajectory with more

sickness absence, since sickness absence must precede disability pension in Finland.

Marital status was analysed in all of the substudies. Marital status was included as a covariate because a previous study found that being unmarried was a predictor of sickness absence (Duijts et al., 2007), and marital status is considered to have an association with health and mortality (Ben-Shlomo et al., 1993). Regarding sickness absence, marital status was not associated with trajectory membership in Substudy II. In Substudy III, reporting non-cohabiting seemed to be more prevalent in the trajectories with more sickness absence, but strong conclusions should be avoided based on simple percentages without adjusting for other factors.

Work–family balance has been associated with sickness absence (Jansen, 2006). Further, previous studies have found evidence between work–family balance and mental health (Borgmann et al., 2019). In this study, work–family balance was measured with a self-evaluated question. Reporting being dissatisfied in combining paid work and family was more prevalent in trajectory groups with sickness absence. Nielsen et al. have proposed this *perceived work–family conflict* to better reflect the burden of multiple roles compared to for example the number of young children. This resonates with the diversity in family situations in real life, as in addition to children, elderly parents or relatives might also need informal care (Nilsen et al., 2017). Further, in our cohort, long-term sickness absence due to mental health disorders has been associated with dissatisfaction in combining work and family among female municipal employees (Kaila-Kangas et al., 2023).

Regarding employees' work type, the association between sickness absence trajectory group and working shift work varied depending on the sickness absence outcome. In the all-cause model, those reporting shift work were more likely to be assigned to a trajectory with either low or high sickness absence rate compared to those with no long-term sickness absence. No association was noticed between mental health disorder–related long-term sickness absence and shift work, and in the musculoskeletal disease model only the low musculoskeletal disease–related sickness absence trajectory was associated with shift work. The association between shift work and health outcomes has been thoroughly examined, and a systematic review by Merkus et. al. has also examined the association between shift work and sick leave (Merkus et al., 2012). Their conclusion was that fixed evening work among female healthcare workers is associated with sickness absence. In our study, a significant proportion of participants work in healthcare (around a fourth of participants in Substudy III) and our results are in line with the review with a higher likelihood of shift workers being assigned to high sickness absence rate trajectory groups. Regarding shift work, there were no consistent associations in diagnosis-specific sickness absence models (OR 1.26 [95% CI 1.06–1.50] for low musculoskeletal disease–related sickness absence), but our population could have been too small to detect differences. Reporting shorter working hours was

associated with having a higher likelihood of being assigned to the highest sickness absence trajectory group in the all-cause and mental health disorder–related model in Substudy II.

The connections between sickness absence and health outcomes and long working hours and health outcomes have been widely studied. The association between working hours and sickness absence has also been examined, but lacks a consensus. The summary of a recent systematic literature review states that support exists for a negative association of long working hours and sickness absence (Bernstrøm & Houkes, 2018). The authors hypothesise this to be linked to either the healthy worker effect and/or high motivation and refraining from being absent while ill. Evidence on working part-time and sickness absence was inconclusive.

A previous multicohort study with data from the UK, Finland, and France investigated the association of sickness absence and lifestyle factors with the following conclusion: high BMI, low physical activity, smoking, heavy episodic drinking, and obesity were associated with sickness absence with a high or moderate ratio (M. Virtanen et al., 2018). In the study, smoking was associated with sickness absence due to depressive disorders, external causes, circulatory diseases, and respiratory diseases. In line with this, in this study smoking was associated with a higher likelihood of being assigned to trajectories with long-term sickness absence. The association was clear and existed in both all-cause and musculoskeletal disease–related models, whereas for mental health disorders the association was only statistically significant for the higher sickness absence trajectory group. In Substudy III, smoking was twice as prevalent in the high frequency short-term and high long-term sickness absence trajectory groups.

Virtanen et al. (2018) concluded that heavy episodic drinking was associated with sickness absence due to depressive disorders and external causes. In Substudy II, binge drinking was associated with a higher likelihood of being assigned to either the all-cause long-term sickness absence trajectory with sickness absence or to the trajectories with a low rate of musculoskeletal- and mental health disorder–related sickness absence.

Both low leisure-time physical activity and high BMI (either overweight or obesity) were associated with trajectories with a higher sickness absence rate in Substudy II. Similar differences in prevalence were noticeable in Substudy III, with the prevalence of those reporting BMI obese doubling and those reporting a high level of physical activity dropping to half in the high sickness absence trajectories, both for short-term and long-term sickness absence. Overall, these findings resonate with previous studies (M. Virtanen et al., 2018).

Lastly, sleep was associated with sickness absence trajectories, with more sleep problems among those with more sickness absence. Sleep problems were associated with sickness absence in the all-cause sickness absence trajectory model, including after adjusting for other covariates. Sleep was a distinctive determinant of both

working hour and sickness absence development in this study. Previous studies have found an association between poor sleep quality and sickness absence (Nose et al., 2021), as well as between sleep problems and the risk of long-term sickness absence (Åkerstedt et al., 2020), however, contrary findings have also been found. In a recent meta-analysis, researchers found no statistically evident association between sickness absence and sleep among nurses (Gohar et al., 2021).

5.3 Methodological considerations

A large cohort dataset with the possibility to link self-reported information to registers and a long follow-up are key strengths of this study. All the data were obtained from questionnaires or reliable national registers and employer registers of the City of Helsinki, which increases the validity of the investigated sickness absence trajectories. The data on sickness absence were obtained from reliable registers, for Substudy II from the Social Insurance Institution of Finland registers and for Substudy III from the City of Helsinki employer registers. In Substudy II, the sickness absence data included the diagnostic codes for sickness absence, and I was able to examine diagnosis-specific sickness absence.

Choosing the study population is challenging when examining only sickness absence, instead of both permanent and temporary work disability. When dealing with work ability, attrition must be considered since exiting to other workplaces (Substudy III), to unemployment, or to disability retirement affects our analysis. I chose not to exclude participants who exited during follow-up of sickness absence since this would shift the study to examining those who stayed employees at the City of Helsinki. This led to the fact that in the group with the highest sickness absence rate, the likelihood of dropping out of the study was more common. This was considered to happen not at random and was adjusted for by a drop-out function in the sickness absence models.

Overall, I examined the development of working hours and sickness absence among municipal employees – this study setup leads to that at the beginning the participant had at least some work ability. The healthy worker effect, meaning that only those with enough work ability stay in the workforce and those with more permanent work disability exit the data, should hence be considered in all of the substudies (Wilcosky & Wing, 1987). This was especially important regarding sickness absence trajectories. My decision to model sickness absence instead of both sickness absence and work disability as an outcome most likely attenuated the increase in work disability. If I would have included permanent work disability in the outcome, the smallest trajectory with the poorest development would most likely have increased more, as in a paper by Hiilamo et al. (2019) where sickness absence and disability months rose to 10 to 11 months per year during follow-up.

With this in mind, I still consider that the method I chose to analyse sickness absence is justified since it understandably characterises the sickness absence development and the magnitude of the varying trajectory groups among municipal employees. Those who retired to disability pension were able to add to the data until the moment of their exit into retirement.

Like every statistical method, finite mixture models are not perfect, and they represent a simplification of real life. In reality, no participant truly follows the exact trajectory, but the trajectory groups characterise temporal development of a chosen outcome. The development of working hours was analysed with GMM by study phases. With only four time points and a novel method, I did not require a response at every time point. I investigated whether the linear development of working hours and rate of sickness absence could have been analysed together. However, changes in working hours were rare and the stable working hours contributed strongly to the model, compared to sickness absence outcomes. In retrospect, the chosen analysis method in Substudy I could have been improved by mimicking a study by Ropponen et al. where multi-trajectory modelling was used to analyse sickness absence and part-time employment status (Ropponen et al., 2023). In Substudy I, this method could have been considered to obtain more measurement points, to be able to study the development by age, and to link the work-status trajectories to the health and well-being of the participants measured by sickness absence. In this case, the analysis should have focussed on whether an employee was working full-time or part-time, with annual data for this from employer registers.

In analysing long-term sickness absence, annual sickness absence days were converted into months. Though I first analysed the trajectories in R using sickness absence days as the outcome, I chose to also examine the developmental patterns in Stata since Nagin's procedure for GBTM is more commonly used in SAS and Stata. In Stata, days as an outcome had convergence issues, hence, simplifying the outcome produced converged models and the long-term sickness absence was analysed in months in both Substudies II and III. Overall, the transition to Stata provided further validation since the analysis in Substudy II was then done twice, utilising two slightly different models in two different statistical programmes and the results from both were very similar.

The choosing of factors varied between the substudies. In Substudy I, the outcome working hours was considered to reflect the general health status of the employees, hence, a wide range of health-related outcomes were included that were not used later, such as physical and mental functioning scores and the prevalence of pain. In contrast, in Substudy III a novel method for statistical analysis was used and hence, only a few most significant health-related factors were included in the cross-tabulations. Overall, caution should be used when examining varying factors' associations with trajectory membership. Membership in the trajectory group is

based on which group the participants have the highest posterior probability of belonging to. Conclusions on the trajectories' determinants should therefore be approached cautiously. Overall, causality cannot be assessed.

Previous studies have analysed our cohort and stated that despite small differences between participants and non-participants, nonparticipation does not seriously bias the results (Laaksonen et al., 2008). A strength of this study was also that the development of sickness absence trajectories was analysed by age. Sickness absence trajectories plotted with age provide a visual and easily interpretable characterisation of sickness absence development in relation to age. Finally, a strength in this study was that using the dual model, I was able to examine both short-term and long-term sickness absence development simultaneously and to produce new information on the interconnections of these outcomes.

5.4 Overview of the development of working hours and sickness absence among ageing employees

Overall, this study showed that among municipal employees working hours develop stably and that most sustain work ability without sickness absence in later careers. The findings of this study reflect previous findings obtained in other European countries. Europe, with regulated working hours and the EU working-hour directive, can be characterised with relatively normal working hours. In this study, the working hours are somewhat even more conservative. When assessing the results from the global viewpoint, working hour patterns examined in this study do not reflect, for example, working hour development in later careers in Asia. However, with a rapidly changing and greying workforce in the EU, information is required to understand determinants of the working hour patterns.

A major contribution of this study was that both mental health disorder-related and musculoskeletal disease-related long-term sickness absence were analysed with person-based methods in a multi-occupational cohort of employees. These results revealed that age was linked to sickness absence due to musculoskeletal diseases among two subpopulations since sickness absence rates increased in two of the trajectory groups, with a steep increase throughout the study in the 'high sickness absence trajectory' group and with a clearly visible increase in 'the low sickness absence trajectory' group after 55 years. Together, these trajectory groups constituted 27% of the participants. These findings could indicate that even in modern society where care has been focussed to prevent chronic musculoskeletal diseases and to improve work ergonomics, this has not been achieved or that simultaneously other changes have occurred that have undermined this development, such as the obesity pandemic.

Further, even if mental health disorders have not yet become the most common long-term sickness absence diagnosis among older employees, the steep increase of

sickness absence in the mental health disorder model in ‘high mental health disorder sickness absence’ trajectory group was distinctive. The results of this study support the findings from national registers, according to which an acute challenge of mental health among employees is at hand. The steep increase in mental health disorder–related sickness absence can indicate that the prognosis of mental health disorders is poor in the modern world in terms of sickness absence or that the treatment of mental health problems among working-aged people is insufficient, compared to for example treatment of musculoskeletal diseases. Further, according to previous studies that have utilised our cohort: employees with high physical workloads and mental health problems have a clearly higher risk for both mental health– and musculoskeletal disease–related sickness absence (Halonen et al., 2021). This emphasises that modifying working arrangements, for example by reducing working hours is necessary, as well as correctly timed interventions.

The lack of changes in short-term absence with age was either indicative of either short-term absence being just the first episode which is then transformed into long-term absence or then some factors also exist in the individual background that result in more frequent absences. Since individual’s in the social care employment sector had a higher likelihood of being assigned to a high frequency short-term sickness absence trajectory, this raises questions on whether ethical dilemmas or demanding psychosocial environments within this sector lead to coping behaviour with short sickness absence spells to recuperate. Overall, I think it is important in sickness absence research to consider factors other than simply age, gender, and health behaviours. Analysing employees’ attitudes and norms in relation to sickness absence development could unlock information that helps to understand differences between developmental patterns. Qualitative research methods should be utilised in researching the employees’ conceptions of health and work ability. Further, the possible reasons for clear occupational differences in short-term sickness absence should be examined. How much are those employees who can work less during the day while ill truly sick without it showing in the sickness absence records? This is of interest especially now in Finland with political pressure towards the first sickness absence day being without pay.

Lastly, occupational class differences arose as a significant determinant in all of the substudies. Elsewhere, there is ample evidence highlighting a connection between socioeconomic inequality and sickness absence. In previous studies, occupational class differences in working hours and sickness absence have remained clear and persistent after adjustments for multiple family-, work-, and health-related factors. Seeking to reduce sickness absence would hence also mean affecting socioeconomic inequalities. In my opinion, sickness absence reduction in terms of reducing socioeconomic health inequality could best be achieved by enabling rapid access to high-quality healthcare and rehabilitation equally to those

employed and outside the workforce, as well as by enforcing and facilitating safe working environments.

5.4.1 Implementation of the results

This was a longitudinal cohort study without an intervention. From an economic and health point of view, policy changes or interventions in occupational healthcare would be most significant when targeted towards those with the highest rate of sickness absence, with the aim being to reduce sickness absence rates. The results of this study invite the discussion of whether modifiable lifestyle factors would be the best course of action in reducing sickness absence. Possible intervention could be directed, for example, towards increasing physical activity or to smoking cessation. Both of which are lifestyle interventions that can be and are already supported in many Finnish workplaces and also at the City of Helsinki (Helsingin kaupunki, 2023b). The employer can economically support the employee in smoking cessation by providing medications to support quitting smoking or restrict smoking during working hours at the workplace. Increasing physical activity and reducing sitting time during work among employees can also be sought to be achieved in multiple ways (Helsingin kaupunki, 2023a). The employer can support physical activity via coupons or by supporting the purchase of a commuting bike, and further, multiple employers such as the City of Helsinki have integrated physical activity programmes into the IT systems that discourage prolonged sedentary work stretches by reminding employees to stretch and get out of one's chair for a while. Further, since other social-, work-, and health-related factors were also associated with trajectory membership, the findings of this study support the idea that work ability is a complicated phenomenon linked to both individual and work-related factors, as well as to society.

The City of Helsinki has participated in the HHS since 2000. During that time, research results and new information on occupational health has been provided to the City of Helsinki human resources, supervisors, and occupational healthcare. At the City of Helsinki, multiple measures have been made to support and maintain employees' health and to improve the City's well-being strategies. In the current work well-being programme, the strategic focus has been for example on pre-emptively assessing and supporting work well-being, as well as educating supervisors in strength-oriented coaching (Helsingin kaupunki, 2022). Regarding modifiable lifestyle factors, the City of Helsinki has multiple channels and initiatives for supporting employees' lifestyle choices. For example, the City of Helsinki offers coaching on physical activity and collaborates with Painonhallintatalo and Helsinki University Hospital.

At the population level, societal changes to our everyday environment make a larger impact on our health than secondary prevention such as lifestyle intervention given by a healthcare specialist. In line with this, a more interdisciplinary view has been taken on studying differences in physical activity and in finding ways to increase it. The current consensus on this is that increasing physical activity is best accomplished by incorporating physical activity into everyday life, for example, by removing obstacles (either fiscal, personal, or environmental) and improving accessibility (Muukkonen, 2022). As a society, there is much work to be done in this endeavour.

Conclusions

Working hours remain steady in later careers, with most employees working stable hours. A tenth of the municipal employees had reduced and varying working hours, and less than a tenth of the employees worked over 40 hours per week. Despite policies that aim to facilitate reducing working hours at later ages, working shorter hours is rather rare. The trajectory group with shorter hours seemed to be heterogenous with higher occupational class, long sleeping hours, high alcohol consumption, and poor mental functioning being associated with working hour trajectory group membership.

Sickness absence did not consistently increase with age, rather, the development of sickness absence was marked by separate subpopulations with varying sickness absence patterns. Most employees had no or a low rate of sickness absence. Only among a tenth of employees, the long-term sickness absence rates increased rapidly and among roughly a fifth the long-term sickness absence rates increased modestly.

Short- and long-term sickness absence patterns were interconnected, but heterogeneity regarding their relationship was also noticed. There was uncertainty in the development of sickness absence. If there was a high frequency of short-term sickness absence spells, it was equally likely to have no long-term sickness absence or a high rate of long-term sickness absence. Those working in the social sector or in healthcare had a higher risk for sickness absence.

The results suggest ways of reducing sickness absence. Attention should be given to modifiable health behaviours and factors related to specific high-risk occupational sectors. Occupational healthcare check-ups could be targeted more towards certain occupational sectors or occupational groups. The rate of short-term sickness absence spells can also be considered as a tool to detect at-risk employees, while keeping in mind the heterogeneity of the sickness absence patterns.

Finally, the results from this study show that health behaviours, such as low physical activity, contribute to diseases and sickness absence. For example, preventing a sedentary lifestyle should be considered at the societal level, as well as in the workplace. Continued support from the employer towards a physically active lifestyle might facilitate healthier work careers and successively less sickness absence. The same applies to all health behaviours that ultimately develop under the influence of the cultural and societal surroundings in which we work and live.

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