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DISABILITY RETIREMENT
SOCIOECONOMIC DIFFERENCES
AND HEALTH OUTCOMES

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ACADEMIC DISSERTATION

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ABSTRACT

Disability retirement has implications for public health and the economy, and thus generates strong interest in terms of its causes and consequences. The major predictors include deteriorating health and work ability as well as socioeconomic factors. A comprehensive understanding of the mechanisms through which a low socioeconomic position is associated with an increased risk of disability retirement would help direct interventions to high-risk groups. Socioeconomic position and other key socio-demographic factors also shape the retirement process, thereby modifying health outcomes after the transition. Mental ill health is playing an increasingly important role in work disability, and has attracted much attention as a cause of early retirement. However, less is known about the subsequent mental-health and other associated health outcomes. This study focuses on the socioeconomic differences in disability retirement and the influences of socio-demographic factors on mental health and mortality in relation to the transition.

The study was based mainly on register data on a representative sample of the Finnish population including longitudinal records from various administrative sources linked together by Statistic Finland, but also included survey data on the Helsinki Health Study employee cohort linked to register data. Disability retirement was used as an outcome measure in the first part of the study. In the second part further outcomes of mental health and mortality were observed in relation to the transition to disability retirement. Cox proportional hazard and linear regression models were used in the analyses.

Those in lower socioeconomic positions had a higher risk of all-cause disability retirement as measured by education and occupational social class in particular, but also by household disposable income. Part of the effect of each of these three socioeconomic factors was nevertheless explained by or mediated through the other two. Social-class differences were particularly large in the case of retirement on the grounds of musculoskeletal diseases. Much of the association between social class and disability retirement was mediated through physical working conditions, although job control also played a part, particularly in retirement on the grounds of mental disorders. The contribution of health behaviours to the association between social class and disability retirement was modest regardless of the underlying diagnostic category. Depressive morbidity measured via purchases of antidepressant medication decreased after disability retirement, following a pre-retirement increase. Such changes in depressive morbidity were more pronounced in the case of retirement on the grounds of mental disorders, particularly depression. Among younger adults there was a bigger increase in antidepressant medication before retirement, and a smaller decrease afterwards. The modifying effects of gender, social class and living

arrangements were more modest. Compared to the general population, those who retired on the grounds of depression and other mental disorders had a high mortality risk, particularly from unnatural and alcohol-related causes. This excess mortality was generally more pronounced among younger adults, those in higher social classes, and those living with a partner and children, particularly in the case of unnatural and alcohol-related causes of death. The absolute level of mortality was not always the highest in these socio-demographic groups, however.

Socioeconomic and socio-demographic factors play an important role in disability retirement in terms of both its causes and consequences. Education, social class and income are not interchangeable as determinants, both showing independent and interdependent pathways. Improvements especially in physical working conditions among those in lower social classes could reduce socioeconomic differences as well as the overall incidence of disability retirement in the population. It seems that, post-retirement, a high socioeconomic position and family ties have only limited protective effects against mental ill health and mortality. Among those under the age of 45, disability retirement is associated with particularly poor health outcomes later on, including prolonged depressive morbidity and a high risk of mortality especially from unnatural causes. Particular attention should therefore be paid to younger adults in terms of mental ill health, work disability and other social problems.

ABSTRAKTI

Työkyvyttömyyseläkkeelle siirtyminen aiheuttaa kansanterveydellisiä ja -taloudellisia haasteita, minkä vuoksi sen syiden ja seurausten ymmärtäminen on tärkeää. Terveyden ja työkyvyn huonontumisen lisäksi sosioekonominen asema on tärkeä työkyvyttömyyseläkkeelle siirtymisen taustatekijä. Jotta interventioita pystyttäisiin kohdistamaan paremmin korkean riskin ryhmiin, olisi hyödyllistä saada tarkempaa tietoa mekanismeista, joiden kautta matala sosioekonominen asema on yhteydessä korkeaan riskiin siirtyä työkyvyttömyyseläkkeelle. Lisäksi sosioekonominen asema ja muut sosiodemografiset tekijät muovaavat eläkeprosessia, minkä vuoksi työkyvyttömyyseläkkeelle siirtymisen yhteys myöhempään terveydentilaan saattaa vaihdella eri väestöryhmissä. Mielenterveyden ongelmilla on yhä tärkeämpi rooli työkyvyttömyydessä, ja nämä ovatkin saaneet paljon huomiota varhaisen eläkkeelle siirtymisen taustalla olevina tekijöinä. Vähemmän kuitenkin tiedetään mielenterveyden kehityksestä ja siihen liittyvistä muista terveysongelmista työkyvyttömyyseläkkeelle siirtymisen jälkeen. Tässä tutkimuksessa tarkasteltiin työkyvyttömyyseläkkeelle siirtymisen sosioekonomisia taustatekijöitä sekä sosiodemografisia eroja mielenterveydessä ja kuolleisuudessa työkyvyttömyyseläkeläisillä.

Tutkimuksessa käytettiin pääasiassa Suomen väestöä edustavaa otosaineistoa, joka perustuu Tilastokeskuksen yhdistämiin eri hallinnollisista lähteistä peräisin oleviin pitkittäisiin rekisteritietoihin. Lisäksi käytettiin Helsinki Health Study -tutkimuksen työntekijäkohorttia koskevaa kyselytutkimusaineistoa, johon on yhdistetty rekisteritietoja. Tutkimuksen ensimmäisessä osassa vastemuuttujana käytettiin työkyvyttömyyseläkkeelle siirtymistä. Tutkimuksen toisessa osassa tarkasteltiin mielenterveyttä ja kuolleisuutta työkyvyttömyyseläkkeelle siirtyneillä. Analyysimenetelmänä käytettiin Coxin ja lineaarisen regression malleja.

Matalissa sosioekonomisissa asemassa olevilla oli korkeampi riski siirtyä työkyvyttömyyseläkkeelle, varsinkin kun asemaa mitattiin koulutuksella ja ammattiperusteisella sosiaaliryhmällä, mutta myös kun tätä mitattiin kotitalouden käytettävissä olevilla tuloilla. Osa kunkin näiden kolmen sosioekonomisen tekijän vaikutuksesta kuitenkin selittyi tai välittyi kahden muun tekijän kautta. Sosiaaliryhmittäiset erot olivat erityisen suuret työkyvyttömyyseläkkeelle siirtymisessä, joka tapahtui tuki- ja liikuntaelinten sairauksien vuoksi. Sosiaaliryhmän ja työkyvyttömyyseläkkeelle siirtymisen yhteys välittyi suurelta osin fyysisten työolosuhteiden kautta. Varsinkin mielenterveysperusteisissa eläkkeissä yhteys välittyi osittain myös työn hallinnan kautta. Terveyskäyttäytyminen vaikutti sosiaaliryhmän ja työkyvyttömyyseläkkeelle siirtymisen yhteyteen vain vähän diagnoosista riippumatta. Työkyvyttömyyseläkkeelle siirtymisen jälkeen masentuneisuus väheni kun tätä mitattiin masennuslääkeostoilla. Siirtymää kuitenkin edelsi

masentuneisuuden voimakas lisääntyminen. Kyseiset muutokset olivat suurempia mielenterveysperusteisten ja varsinkin masennusperusteisten eläkkeiden ympärillä. Masentuneisuuden lisääntyminen ennen työkyvyttömyyseläkkeelle siirtymistä oli voimakkainta nuoremmilla aikuisilla, joilla myös siirtymän jälkeinen lääkityksen väheneminen ei ollut ollut yhtä suurta kuin vanhemmilla ikäryhmillä. Vaihtelu sukupuolen, sosiaaliryhmän ja asumisjärjestelyjen mukaan oli vähäisempää. Valtaväestöön verrattuna masennuksen ja muiden mielenterveyden häiriöiden vuoksi työkyvyttömyyseläkkeelle siirtyneillä oli korkeampi kuolleisuusriski varsinkin ulkoisista ja alkoholiin liittyvistä syistä. Mielenterveysperusteiselle eläkkeelle siirtymiseen liittyvä ylikuolleisuus oli yleisesti suurempaa nuoremmilla aikuisilla, ylemmissä sosiaaliryhmissä olevilla, sekä puolison ja lasten kanssa asuvilla varsinkin ulkoisissa ja alkoholiin liittyvissä kuolinsyissä. Absoluuttinen kuolleisuuden taso ei kuitenkaan ollut aina korkein näissä sosiodemografisissa ryhmissä.

Sosioekonomisilla ja sosiodemografisilla tekijöillä on tärkeä rooli työkyvyttömyyseläkkeelle siirtymisessä sekä sen syiden että seurausten näkökulmasta. Koulutus, sosiaaliryhmä ja tulot eivät ole keskenään vaihdettavissa olevia työkyvyttömyyseläkkeelle siirtymisen sosioekonomisia taustatekijöitä. Niiden vaikutus kulkee sekä itsenäisiä että toisistaan riippuvia polkuja pitkin. Varsinkin fyysisten työolosuhteiden parantaminen matalissa sosiaaliryhmissä olevilla vähentäisi sosioekonomisia eroja sekä yleistä työkyvyttömyyseläkkeiden alkavuutta koko väestön tasolla. Työkyvyttömyyseläkkeelle siirtymisen jälkeen korkea sosioekonominen asema ja perhesiteet suojaavat mielenterveyden ongelmilta ja kuolleisuudelta vain rajoittuneessa määrin. Alle 45-vuotiailla työkyvyttömyyseläkkeelle siirtymisen on yhteydessä erityisen suuriin terveysongelmiin, jotka ilmenevät pitkittyneenä masentuneisuutena sekä korkeana riskinä kuolla varsinkin ulkoisista syistä. Nuorten aikuisten mielenterveyden ongelmiin, työkyvyttömyyteen, sekä muihin sosiaalisiin ongelmiin tulisi tämän vuoksi kiinnittää erityistä huomiota.

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LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

- I Leinonen T, Martikainen P, Lahelma E. Interrelationships between education, occupational social class, and income as determinants of disability retirement. *Scand J Public Health* 2012;40:157–66.

- II Leinonen T, Pietiläinen O, Laaksonen M, Rahkonen O, Lahelma E, Martikainen P. Occupational social class and disability retirement among municipal employees – the contribution of health behaviors and working conditions. *Scand J Work Environ Health* 2011;37:464–72.

- III Leinonen T, Lahelma E, Martikainen P. Trajectories of antidepressant medication before and after retirement: the contribution of socio-demographic factors. *Eur J Epidemiol* 2013;28:417–26.

- IV Leinonen T, Martikainen P, Laaksonen M, Lahelma E. Excess mortality after disability retirement due to mental disorders: variations by socio-demographic factors and causes of death. *Soc Psychiatry Psychiatr Epidemiol* 2014;49:639–49.

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

ABBREVIATIONS

ATC	Anatomical Therapeutic Chemical
BMI	Body mass index
CI	Confidence interval
DDD	Defined Daily Dose
ETK	Finnish Centre for Pensions
GEE	Generalised estimation equations
HHS	Helsinki Health Study
HR	Hazard ratio
ICD	International Classification of Diseases
KELA	The Social Insurance Institution of Finland
MET	Metabolic equivalent index
OECD	Organisation for Economic Co-operation and Development
RII	Relative index of inequality
STM	Ministry of Social Affairs and Health
WHO	World Health Organization

1 INTRODUCTION

Disability retirement is a common route for exiting the labour force in Finland (Rantala 2008) and other OECD countries (OECD 2003, 2010). In 2011, seven per cent of the whole working-aged Finnish population and 23 per cent of those aged 60–64 received a disability pension (ETK & KELA 2012). This issue raises concerns related to public health and the economy. Early retirement results in elevated public pension expenditure and reduced tax revenue, thereby exacerbating the challenges of population aging and associated increases in the dependency ratio (OECD 2006). Disability retirement is also closely associated with circumstances that are likely to have negative effects on individual wellbeing, including severe problems with health and functioning, premature exclusion from working life, and a reduced income (Edén et al. 1998; Hyde et al. 2004), and its relations with health and work are complex. People on disability retirement, by definition, suffer from a severe medically diagnosed disease leading to a reduction in work ability (ETK & KELA 2012). On account of such underlying health conditions and potential comorbidities they also have more physical and mental health problems and a higher demand for health care than the population in general (Wallman et al. 2004; Overland et al. 2006). Not only is disability retirement in itself an indication of ill health, it is a major life transition that may influence further health trajectories and outcomes (Vingård et al. 2004).

The prevention of disability retirement is high on the Finnish political agenda aimed at reducing the incidence of early retirement (Valtioneuvoston kanslia 2011). Such a reduction could make a significant contribution in terms of lengthening working careers given that disability pensions tend to be granted at relatively young ages. Interventions require a comprehensive understanding of the underlying mechanisms leading to deterioration in work ability and subsequent retirement. A low socioeconomic position is a major predictor of disability retirement, not only through health but also via its association with the occupational requirements that should be met in order to continue in one's job (Blekesaune & Solem 2005; Stattin & Järholm 2005; Bruusgaard et al. 2010). However, the contributions of various circumstances such as working conditions, employment opportunities, family characteristics and health behaviours to socioeconomic differences in disability retirement are still unclear. Furthermore, the roles of various socioeconomic sub-domains such as education, occupational social class and income in the process still need to be established.

Socioeconomic position and other socio-demographic factors further influence post-disability-retirement morbidity and mortality (Wallman et al. 2006; Karlsson et al. 2007; Oksanen et al. 2011; Laaksonen et al. 2012). Health outcomes after the transition to retirement have attracted much less

attention than the processes leading up to it, however. Not only are socio-demographic factors associated with the underlying diagnosed cause of disability retirement (Bruusgaard et al. 2010), they are also likely to influence experiences related to the transition, which in turn may have consequences for post-retirement health and wellbeing (Moen 1996; van Solinge & Henkens 2007).

Mental health plays an increasingly important role in work disability, particularly among younger adults (OECD 2003, 2010; Järvisalo et al. 2005; Gould et al. 2007). One third of all diagnoses leading to disability retirement in Finland relate to mental disorders, with depression being the most common single diagnosis (Gould et al. 2007; ETK & KELA 2012). Achieving some reduction in depressive morbidity and associated work disability therefore constitutes a special area in policy making (STM 2011). Pensions on the grounds of mental disorders are more often granted to people in younger age groups than those on somatic grounds, resulting in a larger number of potential working years lost (Kannisto & Risku 2010; Knudsen et al. 2012). In addition to being a common primary diagnosed cause, however, mental ill health also has comorbid effects on disability retirement on somatic grounds (Karpansalo et al. 2005; Mykletun et al. 2006). Mental health remains a relevant public-health issue after retirement, too, and the potential mental-health effects of disability retirement itself have begun to attract attention in the literature in recent years (Øverland et al. 2008; Oksanen et al. 2011; Laaksonen et al. 2012). Moreover, those who retire on the grounds of mental disorders have a higher risk of various comorbidities and mortality than the general population (Wallman et al. 2004, 2006; Gjesdal et al. 2008, 2009).

Disability retirement concerns relatively large population groups, and requires special attention in terms of prevention and rehabilitation on the one hand, and post-retirement health and wellbeing on the other. The aim of this study was to examine disability retirement in terms of both its determinants and outcomes. Investigation of the determinants focused on socioeconomic differences. The emphasis was on the multiple dimensions of socioeconomic position as well as the contribution of working conditions and health behaviours to the association between social class and disability retirement. Investigation of the outcomes focused on mental health and mortality. More specifically, the focus was on trajectories of depressive morbidity over time in relation to the retirement transition as well as on excess mortality after retirement on the grounds of mental disorders. The investigation covered the modifying effects of socio-demographic factors, including age, gender, social class and living arrangements, on the association of disability retirement with mental health and mortality.

2 DISABILITY RETIREMENT IN FINLAND

Disability pensions may be granted in the case of long-term incapacity for work, typically after periods of paid sickness absence lasting for a maximum of 300 working days (Niemelä & Salminen 2006). The decision to grant a disability pension is medically and judicially based, and requires a reduction in work ability due to illness. Work ability is assessed by means of medical diagnosis and occupational factors. Social circumstances are also considered in terms of the ability to manage available work deemed reasonable given the person's education, work history, age and other socio-demographic factors (ETK & KELA 2012; ETK 2013). Occupational requirements determine the extent to which particular health problems hinder the ability to continue in one's job. The Finnish disability pension policy thus follows the commonly accepted approach of assessing work ability not only in terms of the individual's health and other resources, but also with regard to the characteristics of the work environment (Stattin 2005; Ilmarinen et al. 2008).

Both the national and earnings-related pension schemes allow for disability retirement. The national scheme covers all permanent residents, and the pension used to be received by all retirees, on top of which many received earnings-related pensions. However, the national pension became proportional to the earnings-related pension in 1996, meaning that an individual may now receive pensions from both schemes only up to a yearly defined level of pension income, after which the earnings-related scheme takes over. Some people receive a pension only from the national scheme. Most of those granted a disability pension in Finland have nevertheless accrued at least some earnings-related pension in previous employment (Karisalmi et al. 2009). A disability pension may be granted before the person reaches the statutory retirement age, which for both pension schemes used to be 65. Since 2005 however, the lower age limit has been 63 under the new, flexible system covering the earnings-related pension scheme, and there are also some occupation-specific age limits (ETK & KELA 2012).

A disability pension may be full or partial depending on the degree of reduction in work ability, although in most cases it is full. It may also be granted until further notice or as a cash rehabilitation benefit for a specific period of time, in the latter case when the person's work ability is likely to be at least partially restored. This type of pension is common among younger adults in particular. Some older people also used to be entitled to an individual early-retirement pension as a special type of disability pension focusing more on the occupational aspects of disability. Age entitlement to this pension gradually increased from 55 to 60, and since 2003 it has been phased out altogether. Special emphasis is nevertheless still placed on occupational factors in granting a disability pension among people aged 60

or more (ETK et al. 2012; ETK & KELA 2012; ETK 2013). There were also other early-retirement pathways within the Finnish retirement scheme during the period under study, which although not medically based, gave certain alternatives to disability retirement at around the age of 60, including the unemployment pension and the early old-age pension (Rantala 2008; ETK & KELA 2012).

The incidence of disability retirement in Finland decreased notably in the 1990s. This trend was largely attributable to a decrease in disability pensions granted on the grounds of musculoskeletal diseases, which resulted in an increase in the relative contribution of mental disorders in the diagnoses. The real incidence of retirement on the grounds of mental disorders was nevertheless stable throughout the 1990s, and changes in the total incidence of disability retirement have been relatively modest since the late 1990s. There was some increase in all major disease categories until the early 2000s, since when the incidence has decreased again somewhat. The incidence has been similar in musculoskeletal diseases and mental disorders since the late 1990s, each contributing to around one third of all diagnosed causes of disability retirement. Nevertheless, there has been a strong increase in depression as a single diagnosed cause in recent decades in both absolute and relative terms (Gould et al. 2007; STM 2011).

The decrease in the incidence of disability retirement in the 1990s concerned all social classes (Figure 1). However, the trend emerged more slowly among upper non-manual employees, which effectively reduced social-class differences. These differences were smallest in the mid-1990s, after which time they increased again at the same time as the overall incidence increased somewhat. Although the incidence of disability retirement is now much lower in all social classes than it was over two decades ago, the relative class differences are even larger than they were before the recession of the early 1990s: it was more than double among unspecialised manual workers than among upper non-manual employees before the recession, but almost threefold in the 2000s.

The incidence of disability retirement in Finland is very similar among men and women. It increases strongly with age, according to which the diagnoses also vary. Mental disorders make the biggest contribution among younger adults, whereas the most common causes at older ages are musculoskeletal diseases (ETK & KELA 2012).

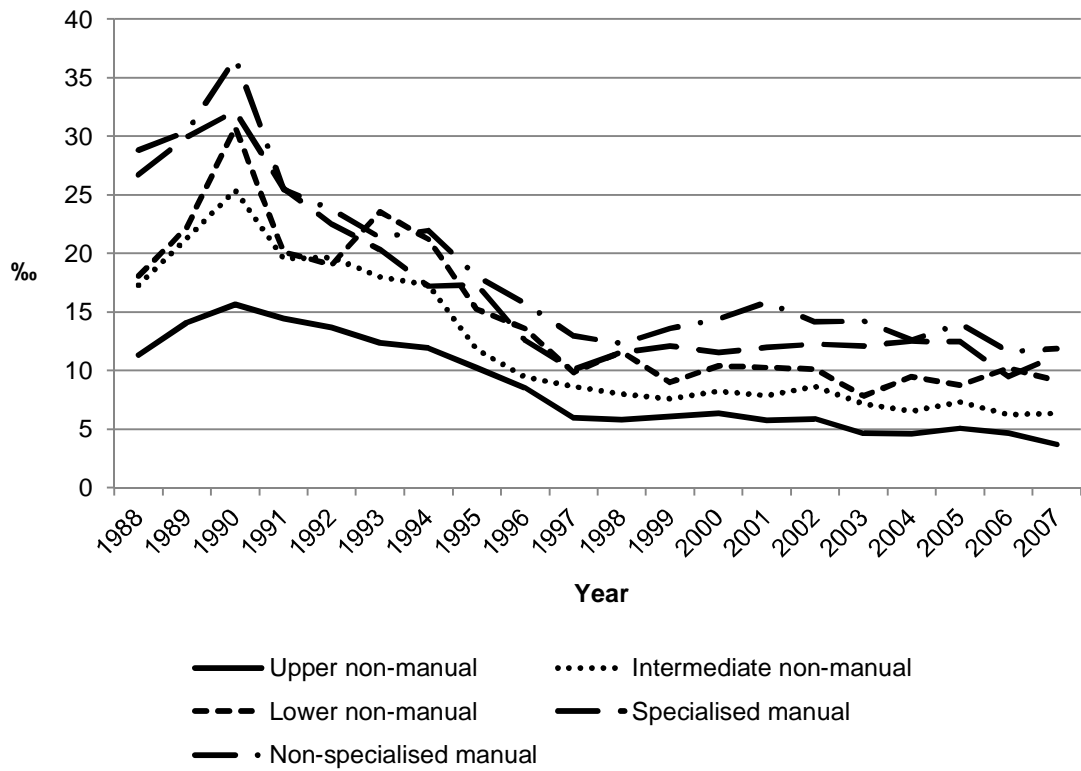


Figure 1 Trends in age- and gender-adjusted incidences of disability retirement in Finland by social class among those aged 30–62 with no previous pensions (Source: Leinonen et al. 2011).

3 CONCEPTUAL AND THEORETICAL BACKGROUND

According to the literature, early retirement is influenced by a number of factors, often categorised as push and pull factors (Kohli & Rein 1991), that may operate on both the individual and the institutional level (Beehr 1986; Kohli & Rein 1991; Kolberg & Hagen 1992; Saurama 2004; Stattin 2005; Järnefelt 2010). In addition to reduced work ability — reflecting interplay between ill health and the work environment — limited employment opportunities may, for example, push individuals towards disability retirement (Bratsberg et al. 2010; Støver et al. 2012). Pull factors may include economic incentives (Bratberg 1999; Hakola 2002; Dahl et al. 2003), as well as any other individual life circumstances and preferences that increase the attractiveness of retirement (Beehr 1986; Stattin 2005; Järnefelt 2010). The concept of push and pull factors is closely related to the notion of involuntary and voluntary retirement. Disability retirement, which is strictly medically based and therefore rather an involuntary outcome than a voluntary decision, is more likely to be influenced by push rather than pull factors (Saurama 2004). Retirement transitions nevertheless only occur within the limits of the prevailing pension system. Moreover, institutional and labour-market settings that determine the availability, attractiveness and use of alternative pathways out of working life influence the demand. Unemployment and disability retirement have similar risk factors, for example, and may compensate for each other to some extent (Hakola 2002; Rantala 2008).

This study focuses on individual-level socioeconomic, socio-demographic and health factors associated with the transition to disability retirement, which is viewed primarily as a health and work-ability problem leading to involuntary early exit from the labour force. Various approaches to the phenomenon are adopted related to determinants on the one hand, and outcomes on the other. In terms of determinants, the focus is on disability retirement as an medically based indicator of poor work ability that carries particular social risk factors. The theoretical background derives largely from the study of socioeconomic health inequalities and their explanations (Lynch & Kaplan 2000; Lahelma & Rahkonen 2011), but also relates to the study of individual-level (push) factors of early retirement (Beehr 1986; Kohli & Rein 1991; Stattin 2005). The focus in terms of outcomes is on disability retirement as a life transition with potential consequences for health and wellbeing. The theoretical background relates to the sociological and life-course perspectives on heterogeneity in the retirement experience as determined by the social and temporal contexts of the transition (George 1993; Moen 1996). Both of the above-mentioned perspectives, in other words determinants and outcomes, share a social epidemiological approach to

health differences (Berkman & Kawachi 2000; Marmot & Wilkinson 2006; Laaksonen & Silventoinen 2011). The former focuses on socioeconomic determinants and views disability retirement as a disadvantageous social and health outcome in itself, whereas the latter concerns social differences in later mental-health and mortality outcomes after the transition. The conceptual and theoretical background of the study is discussed in more detail below.

3.1 SOCIOECONOMIC DETERMINANTS OF DISABILITY RETIREMENT

Theoretical approaches to the socioeconomic determinants of disability retirement derive to some extent from the broader framework of socioeconomic inequalities in health. In general, a high socioeconomic position is assumed to provide material and non-material resources that influence health through behaviours and lifestyles, work and living conditions, as well as access to health care (Lynch & Kaplan 2000; Lahelma & Rahkonen 2011). Socioeconomic position is a complex, multidimensional concept reflecting a wide range of social and economic circumstances that cannot be directly measured without operationalization. Education, occupational social class and income are considered to be the key indicators of adulthood socioeconomic position. Although each of these reflects the overall position that an individual has in the socioeconomic hierarchy, the level of interchangeability among them has been questioned. It has been suggested, for example, that each socioeconomic sub-domain represents a specific dimension of a wider and more abstract theoretical construct called socioeconomic position. Thus, each sub-domain has its own although often interrelated pathways to health. Education is typically acquired in early adulthood and remains relatively stable throughout the life course. It provides knowledge, skills and other non-material resources, and shapes attitudes and values that promote healthy lifestyles and behaviours, including the use of health care and compliance with treatment. It also provides skills and qualifications for succeeding in the labour market in terms of attaining a high occupational social class and a high level of income. Social class relates people to the labour market and to a more general social structure, thereby promoting the social and power resources that contribute to the ability to maintain good health. It is closely associated with physical and psychosocial working conditions and with other characteristics of working life that may influence health and wellbeing, and is further related to material resources gained through paid employment. Income determines one's material living conditions and purchasing power, which in turn affect the potential to promote a healthy lifestyle, avoid disease and obtain treatment (Liberatos et al. 1988; Lynch & Kaplan 2000; Galobardes et al. 2006a; Lahelma & Rahkonen 2011).

Other less frequently addressed sub-domains of socioeconomic position may also contribute to health differences. Housing tenure, wealth, labour-market conditions, childhood socioeconomic position and area-level socioeconomic circumstances, for example, are all likely to have their own specific pathways to health (Lynch & Kaplan 2000; Galobardes et al. 2006a, 2006b). In addition to these causal pathways, health selection may partly explain the association between socioeconomic position and health. Health problems may directly impede socioeconomic attainment or lead to downward occupational mobility. Indirect health selection may also occur through other social or behavioural factors that influence both health status and socioeconomic position (Macintyre 1997; Lahelma et al. 2009).

The association between socioeconomic position and disability retirement is likely to operate largely through different mental and somatic health conditions leading to retirement. Disability retirement is nevertheless not solely attributable to the underlying disease, thus factors other than health are likely to contribute to the socioeconomic differences. People in different social classes have varying physical and psychosocial working conditions that determine their ability to carry out the work tasks that are specific to their occupational position (Blekesaune & Solem 2005; Stattin & Järvalho 2005; Bruusgaard et al. 2010). In other words, people in physically or mentally strenuous occupations may be more likely to experience poor work ability than those in lighter occupations even in the absence of health disparities between the groups. Social class is also closely associated with employment opportunities, which in turn are likely to influence disability retirement (Bratsberg et al. 2010; Støver et al. 2012). Unemployment may therefore contribute to socioeconomic differences in disability retirement not only through its influence on health, but also through the pressure it exerts on labour-force exit due to the unavailability of work. In addition, socioeconomic position may influence the overall decision to retire given that seeking care in order to apply for a disability pension at least could be perceived of as a somewhat voluntary decision. Income, for example, affects the level of compensation for labour-force participation and expected pension benefit, thereby influencing economic incentives to retire (Bratberg 1999; Hakola 2002; Dahl et al. 2003). Socioeconomic position may also affect retirement through attitudes, values and preferences related to work and leisure (Atchley 1976; Beehr 1986).

3.2 THE CONSEQUENCES OF DISABILITY RETIREMENT FOR MENTAL HEALTH AND MORTALITY

In the context of this study, the mental-health-related consequences of disability retirement refer to post-retirement mental-health outcomes, as well as mortality as a further outcome, associated with mental-health-based

retirement. Despite the emphasis on mental health, physical comorbidity also plays a role. Post-disability-retirement mental-health outcomes are of interest not only in the case of mental-health-based retirement but also when the pension is granted on the grounds of somatic causes. Furthermore, given that mental disorders are typically non-fatal in themselves, mortality following disability retirement on those grounds is largely attributable to somatic or external causes.

Perspectives on mental health and mortality in relation to disability retirement vary somewhat in terms of the nature of these two outcomes. Mental health in this context could be viewed as a longitudinal trajectory that is shaped by the retirement transition. Questions of interest therefore tend to relate to changes in mental health around retirement either within the individual over time in relation to the transition (e.g., Dave et al. 2008; Jokela et al. 2010; Westerlund et al. 2010; Oksanen et al. 2011; Laaksonen et al. 2012), or in comparison with the non-retired population (e.g., Kim & Moen 2002; Mein et al. 2003; Dave et al. 2008). Mortality, on the other hand, constitutes a definite outcome of ill health following the retirement transition. In this case the focus of interest is on the excess post-retirement mortality risk compared with the non-retired population. The absence of the element of health change in this perspective makes it more difficult to distinguish the true health effects of retirement from selection into retirement among those with poor health. This issue is particularly relevant in the case of disability retirement, which by definition is preceded by severe ill health (Wallman et al. 2006; Karlsson et al. 2007; Gjesdal et al. 2008). Nevertheless, such an approach is necessary in the case of nonrecurring outcomes such as mortality. Despite the different perspectives on these two health outcomes, similar theoretical approaches generally apply. However, most of the literature on the health consequences of retirement takes a broad view and does not focus on disability retirement in particular. The following discussion covers theoretical approaches to the mental-health-related consequences of retirement in general, as well as those focusing on specific features related to disability retirement.

Overall, existing theoretical approaches to the effects of retirement on mental health are somewhat conflicting. The tendency has been to view retirement as a stressful life transition that increases the likelihood of ill health and even mortality (Atchley 1971, 1976; Minkler 1981; Ekerd 1987; Phillipson 1987, 1993). In accordance with this line of thought, work-related social networks, roles and status are essential domains in the formation of adult identities. Exclusion from working life is thus expected to result in role loss and a reduced level of psychological wellbeing (Moen 1996; Hockey & James 2003). However, although retirement is a major transition over the life course, it is not necessarily stressful. An alternative argument is that the work role is not the only one, and need not even be the most dominant source of identity. Other socially meaningful roles continue or are assumed in retirement. Moreover, one's work identity may continue to play a role after

retirement (Atchley 1971, 1976), and other pre-retirement social circumstances also tend to persist. Consequently, retirement does not necessarily cause a major break in one's health trajectory: on the contrary, most pre-retirement trends in health and wellbeing are likely to continue (Phillipson 1987, 1993; Kasl & Jones 2000; Hyde et al. 2004). Furthermore, in the absence of work-related stress and an increase in leisure time, retirement may even have positive mental-health consequences (Reitzes et al. 1996; Kim & Moen 2002).

It is unlikely that experiences related to the retirement process and to the transition are universal. Those who retire on the grounds of disability, by definition, suffer from large-scale deterioration in health that is likely to influence their circumstances in retirement. Poor health and disability may undermine the adoption of active social roles, inhibit the meaningful exploitation of leisure time and lead to the further accumulation of disadvantage (Atchley 1976; Phillipson 1987; Kim & Moen 2002). Alternatively, however, previous health problems may result in improved psychological wellbeing in retirement due to the excess advantage gained from the removal of potential work-related stress (Kim & Moen 2002).

Life-course theoretical perspectives point out further sources of heterogeneity in the retirement transition that are related to wider temporal and social contexts. This and other major life transitions are assumed to be more stressful when they occur at the 'wrong' time or when the person concerned has no control over the transition (George 1993; Elder 1995; Moen 1996). Even though disability retirement reflects legitimate exit from the work force due to illness, it may still be perceived as an involuntary transition that tends to happen at untypically young ages. The kind of retirement that deviates from the more normal life course of individuals may be more stressful than on-time statutory retirement (Butterworth et al. 2006; van Solinge & Henkens 2007). Other social circumstances in addition to age also influence experiences related to the retirement transition. Occupational histories and therefore also retirement expectations, experiences and resources vary among population groups (Beehr 1986; Phillipson 1993; Moen 1996). Even though women increasingly participate in employment, they tend to experience more interruption in their working careers than men, and are more likely to have other roles, such as caregiving, that coincide with the work role (Phillipson 1993; Moen 1996; van Solinge & Henkens 2007). It is also likely that socioeconomic groups differ in terms of work-related meanings, strains and rewards. Members of higher social classes, for example, tend to have higher work demands and may be more work-oriented than those in the lower classes (Atchley 1971), who in turn may possess fewer social and economic resources needed for pursuing meaningful leisure activities in retirement (Atchley 1971; Phillipson 1987; Moen 1996). Relationships and support in the family are also likely to influence retirement experiences (Kim & Moen 2002; van Solinge & Henkens 2007).

The effects of retirement may change over time in relation to the transition. According to some theorists, retirement is not a single event, but a process consisting of anticipatory pre-retirement phases, the actual transition, and the post-retirement period including sequential phases of crisis and adaptation, for example (Atchley 1976; Minkler 1981; Beehr 1986; Phillipson 1987). Disability retirement is essentially different from the more typical old-age retirement process. It is typically preceded by periods of sickness absence, and therefore most retirees are practically excluded from working life and the associated stress at the time of their retirement. On the one hand, the transition may influence mental health in bringing psychological relief after the long process of being on sick leave, being under rehabilitation assessment, and eventually applying for a pension. On the other hand, attempts to restore health and work ability are likely to be fewer in retirement (Øverland et al. 2008; Oksanen et al. 2011; Laaksonen et al. 2012). The strong ill-health-based selection into disability retirement makes it challenging to distinguish the potential contribution of retirement itself to subsequent changes in health (Vingård et al. 2004; Kelly & Dave 2011). This also applies to investigations into the modifying effects of socio-demographic factors on the association between disability retirement and mental health, given that underlying diseases and co-occurring health problems leading to retirement are likely to vary considerably between population groups.

Accordingly, excess mortality after disability retirement on the grounds of mental disorders may be related in part to the effects of retirement on health and wellbeing. It is also associated with the underlying disorder leading to retirement (Wallman et al. 2006). Mental disorders may lead to a high risk of mortality through diverse mechanisms. 1) Symptoms of illness, substance misuse and other hazardous conduct may increase the risk of mortality from unnatural causes, including suicide, accidents and violence. 2) A pre-existing somatic illness may have influenced the onset of the mental disorder. 3) The risk of developing somatic conditions may be high due to various factors associated with mental disorders, including unhealthy behaviours, limited access to health care, non-adherence to treatment, or low social status. 4) Mental disorders or the use of psychotropic medication may have direct effects on some somatic conditions (Hiroeh et al. 2001, 2008; Mykletun et al. 2007; Lawrence et al. 2010; De Hert et al. 2011; Bohnert et al. 2012; Crump et al. 2013).

4 EMPIRICAL EVIDENCE

4.1 THE ASSOCIATION BETWEEN SOCIOECONOMIC POSITION AND DISABILITY RETIREMENT

This chapter examines previous findings on the association between socioeconomic position and disability retirement, as well as on the factors that may explain or mediate this association. The literature review focuses mainly on studies of the general population or employee cohorts, therefore excluding patient populations such as those originally on sick leave.

SOCIOECONOMIC DIFFERENCES

Previous studies report considerably higher risks of all-cause disability retirement among those with a lower status in terms of education (Krokstad et al. 2002; Dahl et al. 2003; Blekesaune & Solem 2005; Bruusgaard et al. 2010; Østby et al. 2011; Johansson et al. 2012; Nilsen et al. 2012; Samuelsson et al. 2012), social class (Gubéran & Usel 1998; Månsson et al. 1998; Krokstad et al. 2002; Haukenes et al. 2011; Samuelsson et al. 2012; Polvinen et al. 2013a, 2013b) and income (Dahl et al. 2003; Blekesaune & Solem 2005; Claussen & Dalgard 2009). Several studies on disability retirement include more than one indicator of socioeconomic position in order to show the independent effects of each one while controlling for others. The aim in such approaches is to enhance understanding of the extent to which specific socioeconomic dimensions — given the assumption that education, social class and income are each associated with particular material or non-material resources — ultimately contribute to disability retirement. Independent effects have been reported for each of these three indicators (Hagen et al. 2000; Holte et al. 2000; Dahl et al. 2003; Krokstad et al. 2004; Blekesaune & Solem 2005). Explicit conclusions on the potential variation in magnitude of the effects of different socioeconomic sub-domains are nevertheless scarce. Moreover, little is known about the interdependent associations, in other words whether the effects of socioeconomic factors on disability retirement are explained by or mediated through each other. A Norwegian study did find, however, that education largely explained the effect of social class on disability retirement on the grounds of back pain, whereas the effect of education was only modestly mediated through social class (Hagen et al. 2000).

Comparisons of the two largest diagnosed causes of disability retirement indicate that socioeconomic differences are typically larger with regard to musculoskeletal diseases than to mental disorders (Gubéran & Usel 1998; Månsson et al. 1998; Blekesaune & Solem 2005; Bruusgaard et al. 2010; Polvinen et al. 2013a, 2013b). Previous findings concerning retirement on the

grounds of mental disorders have nevertheless been inconsistent: some studies report a higher risk among those with a lower status in terms of education, social class and income (Gubéran & Usel 1998; Månsson et al. 1998; Blekesaune & Solem 2005; Bruusgaard et al. 2010; Polvinen et al. 2013b), whereas others have found no clear socioeconomic effects (Blekesaune & Solem 2005; Samuelsson et al. 2012; Polvinen et al. 2013a). There may be various explanations for these discrepancies. Many of the studies reporting linear inverse associations with socioeconomic position were cross-sectional in design (Bruusgaard et al. 2010), or the follow-ups were mainly in the 1970s and 1980s (Gubéran & Usel 1998; Månsson et al. 1998), since which time the relative contribution of mental disorders as a cause of disability retirement (Järvisalo et al. 2005; Gould et al. 2007; OECD 2010) and both the absolute and relative contribution of depression as a single diagnosed cause (Gould et al. 2007; STM 2011) has increased. A recent study found a higher risk of mental-health-based retirement among those with a lower social class except in the case of depression diagnosis in the older age group (Polvinen et al. 2013b). Another study found an association between low income and mental-health-based retirement, whereas education had no effect. However, the study was restricted to older employees aged 60 and above (Blekesaune & Solem 2005). Other recent studies covering broader age ranges report no clear associations with either education (Samuelsson et al. 2012) or social class (Samuelsson et al. 2012; Polvinen et al. 2013a). One of these found that higher education was actually associated with a higher risk of disability retirement on the grounds of mental disorders, but only when the diagnoses were restricted to mood, neurotic, stress-related, and somatoform disorders. Further, there was no association with social class when genetic factors and early-life experiences were accounted for using a twin-cohort study design (Samuelsson et al. 2012).

FACTORS CONTRIBUTING TO SOCIOECONOMIC DIFFERENCES

Age and gender

Other socio-demographic factors may explain some of the socioeconomic differences in disability retirement. The risk of all-cause disability retirement increases strongly with age (Bruusgaard et al. 2010; Samuelsson et al. 2012), and it has been reported that older age partly explains the higher risk among the less highly educated (Krokstad et al. 2002; Nilsen et al. 2012). Age also has modifying effects, showing larger socioeconomic differences among younger age groups (Krokstad et al. 2002; Bruusgaard et al. 2010; Nilsen et al. 2012; Polvinen et al. 2013a, 2013b). The risk of disability retirement for women is typically somewhat higher than among men (Claussen & Dalgard 2009; Haukenes et al. 2012; Samuelsson et al. 2012), and gender may also modify the effects of socioeconomic position. Studies on all-cause disability

retirement have shown stronger social-class effects among men (Krokstad et al. 2002; Samuelsson et al. 2012), and a stronger effect of income among women (Dahl et al. 2003). Findings on whether educational differences in disability retirement are larger among men or women are nevertheless inconsistent. Some studies conducted in Sweden (Samuelsson et al. 2012) and Norway (Krokstad et al. 2002; Nilsen et al. 2012) report stronger effects of education among men, although age-stratified analyses in the Norwegian studies suggest that this result was restricted to those aged 50 and above (Krokstad et al. 2002; Nilsen et al. 2012). In contrast, another Norwegian study on older employees showed a stronger effect of education on disability retirement among women (Dahl et al. 2003).

Employment and family characteristics

An association has been found between unemployment and a higher risk of disability retirement (Bratsberg et al. 2010; Lamberg et al. 2010; Støver et al. 2012), whereas the effects of marital status and having children are inconsistent across studies and by gender (Dahl et al. 2003; Haukenes et al. 2012; Samuelsson et al. 2012; Gustafsson et al. 2014). Furthermore, little is known about the possible contribution of family characteristics and employment opportunities to socioeconomic differences in disability retirement.

Health behaviours and working conditions

Unhealthy behaviours including smoking (Husemoen et al. 2004; Claessen et al. 2010; Koskenvuo et al. 2011; Haukenes et al. 2013), risky alcohol consumption (Månsson et al. 1999; Upmark et al. 1999; Salonsalmi et al. 2012; Skogen et al. 2012), as well as high relative body weight and physical inactivity (Neovius et al. 2008; Robroek et al. 2013), are associated with an increased risk of disability retirement, and health behaviours further explain or mediate some of the socioeconomic differences (Krokstad et al. 2002; Hagen et al. 2006; Nilsen et al. 2012; Polvinen et al. 2013a). The contribution of particular health behaviours to socioeconomic differences in disability retirement has not been widely investigated, however, although a recent Finnish study found that physical inactivity, smoking, the risky use of alcohol and obesity each had a slightly attenuating effect, but only among men (Polvinen et al. 2013a). The potential variation in the contribution of various health behaviours to socioeconomic differences in disability retirement on different diagnostic grounds nevertheless remains unclear.

Various physical and psychosocial working conditions are associated with subsequent disability retirement (Krause et al. 1997; Karpansalo et al. 2002; Christensen et al. 2008a; Lahelma et al. 2012a; Støver et al. 2013). Moreover, it has been found that socioeconomic differences are partly mediated through

more strenuous working conditions among those in lower socioeconomic positions (Krokstad et al. 2002; Hagen et al. 2006; Haukenes et al. 2011; Johansson et al. 2012; Nilsen et al. 2012; Polvinen et al. 2013a). Such mediating factors typically include a low level of job control as well as physical demands and exposures (Haukenes et al. 2011; Johansson et al. 2012; Polvinen et al. 2013a). The number of years in the current occupation may also slightly mediate the association (Haukenes et al. 2011). The roles of job demands and social support at work are less clear, however (Haukenes et al. 2011; Polvinen et al. 2013a). According to a Finnish study, the contribution of these factors may vary by gender in that they somewhat mediated the social-class differences among men and slightly widened them among women (Polvinen et al. 2013a). Little is known about the potential variation in the contribution of working conditions to socioeconomic differences in disability retirement on different diagnostic grounds. Previous findings nevertheless suggest that physically heavy work in particular and exposure to chemical and physical hazards largely mediate the association between social class and disability retirement on the grounds of musculoskeletal diseases. Job control had no effect on this association, whereas accounting for job demands and social support at work widened the differences (Polvinen et al. 2013a).

Early-life factors and ill-health

There are other factors beyond the scope of this study that may also contribute to socioeconomic differences in disability retirement. A twin cohort study indicated that genetic factors and early-life experiences contributed substantially to educational differences (Samuelsson et al. 2012), and according to the results of other studies, conditions, behaviours and personal characteristics in childhood and adolescence explain some of the educational and social-class differences (Upmark et al. 2001; Johansson et al. 2012). IQ in particular may contribute even more to educational differences than working conditions in adulthood (Johansson et al. 2012). Personality and psychosocial factors in adulthood may also have an effect (Krokstad et al. 2002; Valset et al. 2007; Nilsen et al. 2012).

Ill health clearly plays an important role in disability retirement, which in itself reflects poor health and is typically preceded by medically certified periods of sickness absence. Sickness absence for various diagnosed reasons (Kivimäki et al. 2007; Alexanderson et al. 2012; Hultin et al. 2012), more overall mental (Karpansalo et al. 2005; Mykletun et al. 2006; Ahola et al. 2011) and physical (Krause et al. 1997; Gustafsson et al. 2014) morbidity, poor self-assessed health (Månsson & Råstam 2001; Karpansalo et al. 2004; Pietiläinen et al. 2011), pain (Øverland et al. 2012; Saastamoinen et al. 2012; Ropponen et al. 2013) and poor cardiorespiratory fitness (Karpansalo et al. 2003) are associated with a higher risk of disability retirement. Moreover, measures of somatic and mental morbidity are associated with subsequent

disability retirement due not only to these particular health problems but also to other comorbid diseases (Manninen et al. 1997; Hagen et al. 2002; Karpansalo et al. 2005; Jansson & Alexanderson 2013). Given that disability retirement in itself is an indication of poor health and work ability, accounting for previous health status when examining socioeconomic differences and their explanations may lead to over-adjustment: poor health at baseline may operate not only as a confounder but also as a mediating factor in the process (Krause et al. 1997; Lahelma et al. 2012a). However, previous studies conducted in Norway and Sweden have found at most only minor contributions of poor health to educational and social-class differences in disability retirement (Krokstad et al. 2002; Østby et al. 2011; Johansson et al. 2012; Nilsen et al. 2012). This result may be partly attributable to the fact that the granting of a disability pension takes into account not only diagnosed medical conditions but also case-specific occupational requirements. A particular condition may lead to work disability in physically demanding manual occupations but not in lighter non-manual employment, for example. However, a recent study of the employed general population in Finland reports a stronger contribution of ill health to social-class differences in disability retirement than previous studies (Polvinen et al. 2013a).

4.2 THE ASSOCIATION OF DISABILITY RETIREMENT WITH MENTAL HEALTH AND MORTALITY

This section reviews previous research on mental health and mortality in relation to the disability-retirement transition, with a focus on the modifying effects of socio-demographic factors. Those granted a disability pension, by definition suffer from severe problems of health and functioning, and therefore essentially differ from statutory old-age retirees. The literature review therefore primarily covers studies concentrating on ill-health-based retirement.

MENTAL HEALTH BEFORE AND AFTER DISABILITY RETIREMENT

Developments in mental health before and after disability retirement have begun to attract attention in recent years. Two studies on Finnish public-sector employees showed that depressive morbidity measured in accordance with register-based information on purchases of antidepressant medication tended to increase in the years before disability retirement, and to decrease afterwards. The pre-retirement increase was more pronounced when the retirement was on the grounds of mental disorders as opposed to somatic causes, and a post-retirement decrease was observed only in the former (Oksanen et al. 2011; Laaksonen et al. 2012). Trajectories of hypnotics and sedatives as well as other psychotropic drugs differed somewhat from those concerning antidepressant medication: there was less of an increase before

retirement, and even a continuing increase in hypnotics and sedatives post-retirement but no change in other psychotropic drugs (Laaksonen et al. 2012). The studies also report variation in medication trajectories by social class. According to one of them, the post-retirement decrease in antidepressant medication was strongest among the upper non-manual class, but only when the retirement was due to mental disorders (Oksanen et al. 2011). Analyses conducted in connection with the other study covering any psychotropic medication and any diagnosed cause of disability retirement revealed that the pre-retirement increase was largest in the non-manual class, and that the decrease after retirement was restricted to this class (Laaksonen et al. 2012). The shape of these trajectories did not clearly vary by gender (Oksanen et al. 2011; Laaksonen et al. 2012). There is a lack of evidence concerning the potential modifying effects of other socio-demographic factors such as age and family characteristics.

Self-reported measures have also been used to assess mental health before and after disability retirement. A study linking survey information to register data on disability retirement in the years preceding and following the survey found an increase in symptoms of depression and anxiety as retirement approached, after which they decreased (Øverland et al. 2008). Another study reported no changes in mental wellbeing after ill-health retirement (Jokela et al. 2010). Neither study differentiated between mental and somatic causes of retirement.

MORTALITY AFTER DISABILITY RETIREMENT ON THE GROUNDS OF MENTAL DISORDERS

Although mental disorders do not typically lead to death, there is considerably higher mortality among those who have retired on those grounds than among the general population (Wallman et al. 2006; Gjesdal et al. 2008, 2009). Previous findings suggest that early retirement due to ill-health is unlikely in itself to lead to worsening trajectories of mental health (Øverland et al. 2008; Jokela et al. 2010; Oksanen et al. 2011; Laaksonen et al. 2012), self-rated health (Westerlund et al. 2009), physical functioning (Jokela et al. 2010) and many other health conditions (Øverland et al. 2008). The above-mentioned excess mortality is therefore more likely to be related to the presence of the underlying mental disorder that led to retirement.

Many previous studies report that those with depression and other mental disorders have a higher risk of mortality from most natural and unnatural causes than the population in general (Hiroeh et al. 2001, 2008; Laursen et al. 2007; Mykletun et al. 2007; Nordentoft et al. 2013). The magnitude of the excess mortality related to mental ill health nevertheless varies by the cause of death, being highest in the case of unnatural causes, and suicide in particular (Høyer et al. 2000; Laursen et al. 2007; Tidemalm et al. 2008; Melchior et al. 2010; Mittendorfer-Rutz et al. 2012; Nordentoft et al. 2013). Circulatory diseases nevertheless also make a notable contribution given the

large absolute number of deaths (Tidemalm et al. 2008; Lawrence et al. 2010; De Hert et al. 2011), whereas excess mortality from cancer, another prevalent cause of death in the population, is relatively modest (Høyer et al. 2000; Laursen et al. 2007; Mykletun et al. 2007; Hiroeh et al. 2008; Mittendorfer-Rutz et al. 2012) and is likely to be largely attributable to smoking (Melchior et al. 2010; Whitley et al. 2012).

Little is known about the potential modifying effects of socio-demographic factors on excess mortality after disability retirement on the grounds of mental disorders, although variations have been investigated in studies focusing on all-cause disability retirement (Wallman et al. 2006; Karlsson et al. 2007) and sickness absence (Vahtera et al. 2004; Lund et al. 2009), as well as mental illness more generally (Laursen et al. 2007; Chang et al. 2010; Crump et al. 2013; Moustgaard et al. 2013). All in all, the findings indicate that excess mortality is larger in groups in which total mortality is low, in other words younger age groups and higher social classes.

4.3 A SUMMARY OF PREVIOUS FINDINGS AND IDENTIFIED GAPS IN THE RESEARCH

There is evidence of a strong association between a low socioeconomic position and disability retirement measured by various socioeconomic indicators, but there is as yet insufficient knowledge concerning the interrelationships among the different sub-domains of socioeconomic position. Working conditions and, perhaps to a smaller extent, health behaviours partly explain or mediate the association, but the contribution of particular health behaviours and working conditions in the case of disability retirement on various diagnostic grounds has not been widely investigated.

Previous findings on mental-health changes in relation to disability retirement appear to vary somewhat depending on the health measure used and the diagnosed cause of retirement. However, most studies indicate that disability retirement at least does not lead to worsening mental-health trajectories. Moreover, findings regarding depressive morbidity consistently show improvements after the transition to retirement, particularly on the grounds of mental disorders. Despite such within-individual improvement however, those who retire on the grounds of depression and other mental disorders are still largely disadvantaged as a population group, with higher mortality than the general population. There have been no previous studies on mental health and mortality in relation to disability retirement due to single diagnosed causes, such as depression. Furthermore, those experiencing disability retirement comprise a heterogeneous group in terms of both diagnosed causes and social characteristics. The modifying effects of socio-demographic factors on the associations between disability retirement and both mental health and mortality are still poorly understood.

5 STUDY DESIGN AND OBJECTIVES

5.1 GENERAL AIMS AND FRAMEWORK OF THE STUDY

This study had two general aims. The first was to contribute to building up a comprehensive understanding of the socioeconomic determinants of disability retirement. Figure 2 below presents the analytical framework used in examining the association between socioeconomic position and disability retirement. It is assumed in Sub-study I that socioeconomic position in adulthood comprises three main sub-domains each with a particular sequence and relative pathways as determinants of disability retirement. Education, for example, precedes occupational social class, which in turn precedes income. The effects of these three socioeconomic factors are partly interrelated, in other words explained by the preceding or mediated through the succeeding factors (Lahelma et al. 2004). Family characteristics and unemployment may also be explanatory or mediating factors through being either a cause or a consequence of socioeconomic attainment. The

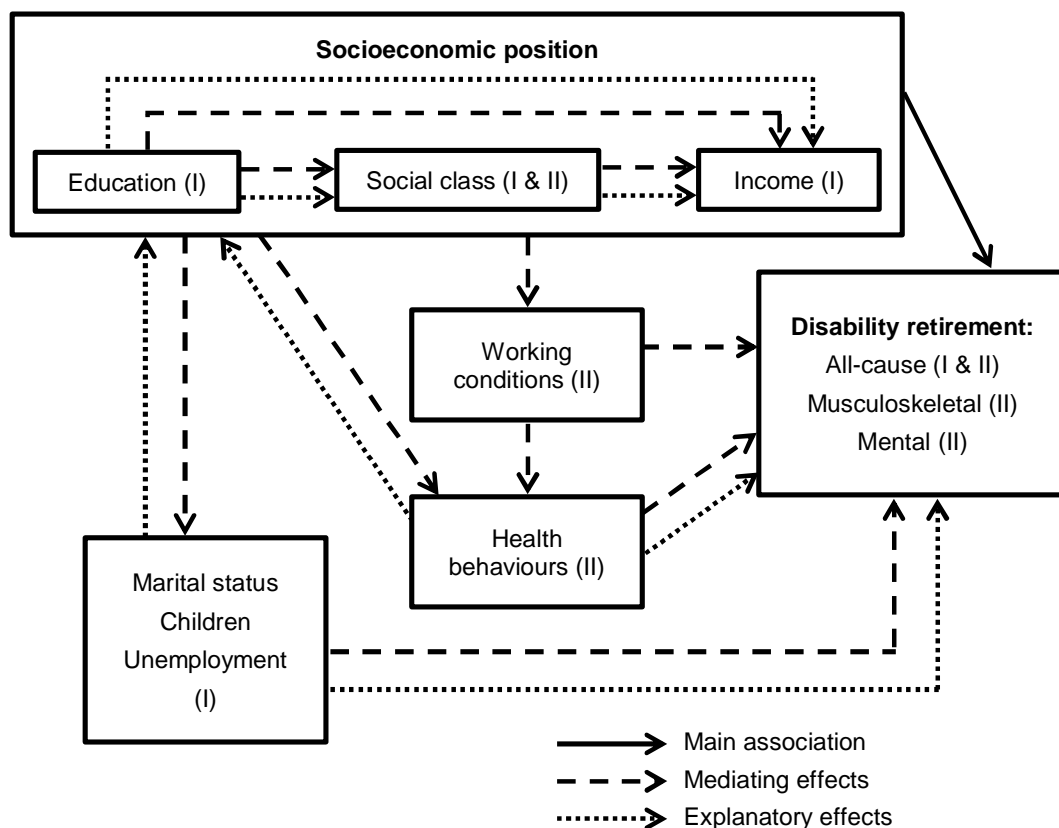


Figure 2 An analytical framework illustrating the association between socioeconomic position and disability retirement (Sub-studies I & II: study numbers in parentheses).

assumption in Sub-study II is that the effects of socioeconomic position on disability retirement may be further mediated through health behaviours and working conditions (either directly or through health behaviours). Nevertheless, health behaviours tend to be adopted in early life before the full establishment of adulthood socioeconomic position and working life, and may therefore also operate as explanatory factors in the association between socioeconomic position and disability retirement.

The second general aim of the study was to enhance understanding of the modifying effects of socio-demographic factors on the association of disability retirement with both mental health and mortality. Figure 3 shows the analytical framework within which these associations were examined. Sub-study III examines mental health as a trajectory spanning pre- and post-retirement periods: mental health may influence the transition to disability retirement, and vice versa. Disability retirement is also likely to be associated with subsequent mortality, which is the focus in Sub-study IV. It is assumed in Sub-studies III and IV that socio-demographic factors, including age, gender, living arrangements and socioeconomic position, modify the associations between disability retirement and both mental health and mortality.

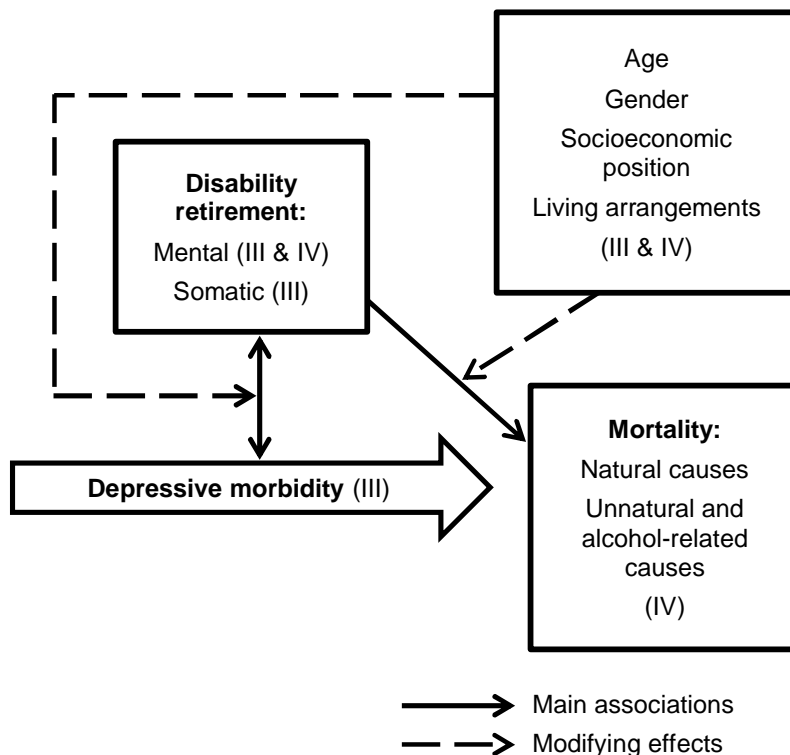


Figure 3 An analytical framework illustrating the associations between disability retirement and both mental health and mortality (Sub-studies III & IV; study numbers in parentheses).

5.2 RESEARCH QUESTIONS

More specifically, the purpose of this study was to examine:

1. The independent and interdependent associations of education, occupational social class and income with disability retirement (Sub-study I)
2. The contribution of health behaviours and working conditions to the association between social class and disability retirement, and the extent to which these contributions vary by the diagnosed cause of retirement (Sub-study II)
3. The trajectories of depressive morbidity before and after disability retirement, and the extent to which they vary by socio-demographic factors and the diagnosed cause of retirement (Sub-study III)
4. Excess mortality after disability retirement on the grounds of mental disorders compared with the general population, and the extent to which it varies by socio-demographic factors, causes of death and the type of disorder leading to retirement (Sub-study IV).

6 DATA AND METHODS

6.1 STUDY POPULATION AND FOLLOW-UP

Table 1 summarises the main characteristics of Sub-studies I–IV. Sub-studies I, III and IV are based on employment and other administrative register data linked by Statistics Finland by means of unique personal identification numbers. The longitudinal base data comprise a nationally representative 11-per-cent sample of the Finnish population between the end of 1987 and 2007. In addition, those who died were oversampled to cover 80 per cent of all deaths that occurred in Finland during the study period. Because of the different sampling probabilities in the two strata, analytical weights were used in all of the analyses concerning Sub-studies I, III and IV. Sub-study II is based on survey data from the Helsinki Health Study (HHS) (Lahelma et al. 2013) covering a cohort of employees of the City of Helsinki. With approximately 40,000 employees (70% women) the City of Helsinki is the largest employer in Finland. Its employment branches comprise general local administration, health care, social welfare, education and culture, public transport, and technical and construction services. The HHS data include baseline survey data from 2000–2002 linked to register data.

Each sub-study includes information on disability retirement. It is the outcome variable in Sub-studies I and II, and a time-varying variable in Sub-study IV. The focus of interest in Sub-study III is time in relation to disability retirement. Complete retirement data was available for each sub-study. All types of disability pension are included regardless of the duration and degree of work incapacity (see Chapter 2). The retirement data used in Sub-study I are based on information from the employment register of Statistics Finland on the receipt of pensions at the end of each year. The retirement date was set at the midyear of the first year in receipt of a disability pension. For Sub-studies II–IV, date-specific retirement data including primary diagnosed causes of disability retirement were obtained from the Finnish Centre for Pensions (earnings-related pensions) and the Social Insurance Institution of Finland (national pensions). The diagnoses were based on the International Classification of Diseases (ICD-10) (WHO 2013). Sub-study II examines musculoskeletal diseases (ICD-10 M00–M99) and mental and behavioural disorders (F00–F99), in other words the two largest disease groups, separately. Given the mental-health-related focus in Sub-studies III and IV, mental and behavioural disorders were further divided into depression (F32, F33) and other mental disorders (F00–F99 excluding F32 and F33). Sub-study III also covers a wider diagnostic group comprising all somatic causes (all diagnoses excluding F00–F99).

Table 1 The main characteristics of Sub-studies I–IV.

Study characteristics	Sub-studies			
	I	II	III	IV
Data sources	Statistics Finland	Helsinki Health Study, Finnish Centre for Pensions	Statistics Finland, Finnish Centre for Pensions, the Social Insurance Institution of Finland	Statistics Finland, Finnish Centre for Pensions, the Social Insurance Institution of Finland
Type of data	Register	Survey, register	Register	Register
Target population	General workforce	Municipal employees	Disability and old-age retirees	General population
N	262,984	6,516	62,814	392,985
Age range	30–63	40–60	30–64 ^a	25–64
Follow-up	1996–2004	2000–2010	1997–2007	1997–2007
Outcome	Disability retirement	Disability retirement	Changes in antidepressant medication	Mortality
Main independent variables	Education, social class, income	Social class	Time in relation to retirement	Disability retirement due to mental disorders
Covariates of main interest	Marital status, children, employment status	Working conditions, health behaviours		
Stratifications	Gender	Gender, diagnostic cause of retirement	Diagnostic cause of retirement	Gender, disability retirement due to depression and other mental disorders, causes of death
Interactions with main independent variable			Age, gender, social class, living arrangements	Age, social class, living arrangements
Methods	Cox regression analysis: hazard ratio (HR) and relative index of inequality (RII)	Cox regression analysis: hazard ratio (HR)	Linear regression using generalised estimation equations (GEE)	Cox regression analysis: hazard ratio (HR)

^aThe age range for old-age retirees was 57–68.

The register-based baseline study population of Sub-study I comprises the 30–63-year-old work force at the end of 1995 in receipt of no kind of pension (N=262,984). Individuals could still receive a disability pension at the age of 64, but this would not be captured because the retirement data were only updated at the end of each year. The study population was followed up for disability retirement from baseline until the end of 2004, and a person was censored at retirement on grounds other than disability (10.9%), the age of 64 (2.2%), death (1.7%), emigration (0.7%) or the end of 2004 (75.5%).

The baseline HHS survey data used in Sub-study II were collected during 2000, 2001 and 2002 among employees reaching the age of 40, 45, 50, 55 or 60 in each year. Of the employees responding to the survey 80 per cent were women, which corresponds to the general gender distribution in the Finnish municipal sector. The response rate was 67 per cent, of which 74 per cent further gave written consent to link the survey data to register-based retirement data. The study population consisted of 6,516 respondents giving consent to such linkage and excluding those in receipt of a pension at baseline (1%) or with incomplete information on social class (0.14%). These respondents were followed up for disability retirement from baseline until the end of 2010. A study subject was censored at the age of 63 (18%), retirement on grounds other than disability (14%), death (1%) or the end of 2010 (57%).

The register-based population of Sub-study III comprises people who retired on the grounds of disability between 1997 and 2007 aged 30–64 (N=42,937), or were granted an old-age pension aged 57–68 (N=19,877), provided they were in receipt of no previous pension. Those in receipt of an old-age pension were included in order to facilitate comparison between disability retirement and the more common statutory retirement. The selected age range of 57–68 for statutory retirement includes the most typical retirement ages (96.5%). Depressive morbidity measured in accordance with purchases of antidepressant medication 7.5 years before and 7.5 years after retirement was observed in 60 three-month periods in relation to the date of retirement. Antidepressants are primarily used to treat depression in Finland (Sihvo et al. 2008). They are prescribed by a physician and reflect medically diagnosed conditions that require treatment. The data on antidepressant medication were based on complete information on purchases of prescribed medication among the study population obtained from the records of the reimbursement register of the Social Insurance Institution of Finland. Purchases of antidepressants between 1997 and 2007 were identified from the Anatomical Therapeutic Chemical (ATC) classification (WHO Collaborating Centre for Drug Statistics 2013) code N06A. Information on Defined Daily Doses (DDD) were used to calculate the total amount of antidepressant medication purchased per three-month period over a total of 30 periods before and 30 periods after retirement. Because the time units refer to three-month periods, 90 DDDs could be interpreted as a full daily dose. Within the 60 three-month periods, a single study subject was followed

for a maximum of 44 periods, corresponding to the 11 years between 1997 and 2007. The follow-up began after the beginning of 1997 or immigration to the country from the first full three-month period of the maximum of 30 periods before retirement. The follow-up ended before death, emigration, or the end of 2007 to the last full three-month period of the maximum of 30 periods after retirement. In order to account for an increasing secular trend in the use of antidepressant medication, the calendar year at the midpoint of each three-month period was used in the analyses as a categorical control variable.

The register-based baseline population of Sub-study IV consists of those aged 25–64 at the end of 1996 with no previous history of retirement due to mental disorders (N=392,985). Those in receipt of a disability pension granted on somatic grounds as well as those retired on the grounds of unemployment or old age were included: even though these groups were no longer likely to be at risk of disability retirement due to mental disorders, they were still at risk of mortality, in other words the primary outcome in Sub-study IV. The study population was followed up for mortality from baseline until the end of 2007, disability retirement on the grounds of mental disorders being used as a time-varying variable. The underlying causes of death were based on the ICD-10 classification: natural causes include circulatory diseases (ICD-10 I00–I425, I427–I99), cancer (C00–D48) and other natural causes (A00–R99, excluding I00–I99, C00–D48, F10, G312, G4051, G621, G721, K292, K70, K860, O354); unnatural and alcohol-related causes include alcohol-related diseases and accidental poisoning by alcohol (F10, G312, G4051, G621, G721, I426, K292, K70, K860, O354, X45), suicide (X60–X84, Y870) and other unnatural causes (V01–X44, X46–X59, X85–Y86, Y871–Y89). A study subject was censored at emigration. With regard to the analyses of both particular causes of death and particular mental disorders as diagnosed causes of disability retirement, the subjects were also censored at all other causes of death and all other mental disorders, respectively, than those already examined.

Those under the age of 30 at baseline (Sub-study I) or retirement (Sub-study III) are not included in this study on the assumption that socioeconomic position is not firmly established in earlier adulthood. However, given the prevalence of disability retirement on the grounds of mental disorders among young adults, Sub-study IV includes those aged 25 and over at baseline.

6.2 INDEPENDENT VARIABLES

SOCIOECONOMIC FACTORS

Occupational social class is the main socioeconomic indicator used in this study. In Sub-studies I, III and IV it is based on a Statistics Finland classification (1989) comprising 1) upper non-manual employees, 2) intermediate non-manual employees, 3) lower non-manual employees, 4) specialised manual workers, 5) non-specialised manual workers, 6) entrepreneurs and 7) others or unknown. Categories 2 and 3 as well as 4 and 5 were combined in Sub-studies III and IV. The data on social class were available at five-year intervals between 1970 and 2005. In the case of Sub-study I these data were from the baseline year of 1995, whereas the most recent measurement before the year of retirement was used in Sub-study III. Both of these sub-studies made use of previously recorded information on social class with regard to those who were economically inactive in these particular years. Social class was used as a time-varying covariate in Sub-study IV according to the most recent available information throughout the follow-up period.

Social class at baseline in Sub-study II was categorised according to the City of Helsinki classification using information on occupation from the personnel register for the respondents who gave written consent for such data linkage (78%). For the rest, the information was obtained from the survey questionnaire. The classes include 1) managers and professionals, 2) semi-professionals, 3) routine non-manual employees and 4) manual workers (Lahelma et al. 2005).

Sub-study I also includes information on education and income. The highest achieved educational level is categorised as 1) higher tertiary, 2) lower tertiary, 3) secondary and 4) primary. Household disposable income per consumption unit comprises the individual income of all household members including wages, capital income and income transfers, taking taxes into account. For data-protection reasons the highest three per cent of incomes were combined and given a constant of 1.25 times the minimum income in this group. Account was taken of household size in terms of dividing the total household disposable income by the number of consumption units. The first adult in the household was given a value of 1.0, all other adults the value 0.7, and all children aged 0–17 the value 0.5 (OECD 1982). Income quintiles were subsequently used.

AGE, FAMILY CHARACTERISTICS AND EMPLOYMENT

Age was measured at baseline in Sub-studies I and II and at the end of the year preceding retirement in Sub-study III. It was used as time-varying covariate in Sub-study IV, in other words approximating age at death for the deceased.

Sub-study I includes information on marital status and dependent children, as well as being either employed or unemployed at baseline. In the case of marital status the categories were 1) married, 2) never married, 3) divorced and 4) widowed, and with regard to dependents they were 1) no children, 2) all child(ren) over the age of six and 3) at least one child under the age of seven.

Sub-studies III and IV include a variable on living arrangements incorporating information on union status and household composition, measured at the end of each calendar year and used as a time-varying covariate. The categories were as follows: 1) living with a partner and children, 2) living only with a partner, 3) living alone, 4) being a single parent and 5) other or unknown. However, the categories that were ultimately included in the analyses varied somewhat in the two sub-studies: categories 1 and 2 were combined in Sub-study III because the results were similar, whereas single parents could not be examined separately in Sub-study IV due to the small size of the group.

HEALTH BEHAVIOURS

The survey data were used in Sub-study II to investigate health behaviours. Smoking included 1) never smokers, 2) former smokers, 3) current moderate smokers and 4) current heavy smokers (>20 cigarettes per day). Alcohol consumption was used as a continuous variable indicating weekly portions, defined as 12 grams of pure alcohol and including various beverages combined. Physical activity during leisure time or commuting was measured in terms of the average weekly hours of physical activity in the previous year in four intensity grades ranging from walking to brisk running, or other forms of physical activity with equivalent intensities. Total physical activity was calculated as follows: first the time spent on each grade of physical activity was multiplied by the approximate metabolic equivalent index (MET) values estimated for each one, and then a sum variable was formed from these values. Body mass index (BMI) (kg/m²) was used as a continuous variable.

WORKING CONDITIONS

Sub-study II also includes information on working conditions. Work contracts were obtained from the personnel register of the City of Helsinki, yielding information on whether work was on a permanent or a temporary basis. Self-reported information from the baseline survey was used for all other working conditions. Shift work, defined as doing varying shifts at different times of the day or night but not, for example, regular night work, and overtime defined as working more than 40 hours per week were used as dichotomous variables.

Hazardous exposures, physical workload and computer work were derived from factor analyses including 18 items of potentially harmful working conditions. The respondents were asked whether they were exposed to and bothered by each of the conditions: the response alternatives were “does not exist”, “exists but is not bothersome”, “exists and is somewhat bothersome” and “exists and is very bothersome”. The items of each factor were used as sum variables. Hazardous exposures included nine items: 1) noise, 2) vibrations, 3) dry air, 4) dust and dirt, 5) dampness and wetness, 6) mould, 7) irritating substances such as solvents and gases, and 8) suboptimal lightning or 9) temperature (Cronbach's alpha 0.79). Physical work load included six items: 1) uncomfortable working positions, 2) rotating movements of the back, 3) repetitive movements, 4) standing, 5) walking, and 6) heavy physical work including lifting and carrying (Cronbach's alpha 0.82). Computer work included three items: 1) sitting, 2) using the computer and 3) using the mouse (Cronbach's alpha 0.80).

Job control and demands were measured according to the Framingham version of Karasek's (1985) job-content questionnaire. Sum variables of nine items were calculated for each one (Cronbach's alpha 0.82 and 0.78). The respondents were asked whether they agreed with certain statements about their job, the response alternatives ranging from “fully agree” to “fully disagree”. Job control was based on questions concerning the amount of control over one's work, variety, and opportunities to use skills, and job demands on the pace of work and conflicting demands.

Being a victim of workplace bullying was defined as isolation, disregard of one's work, threatening behaviour, talking behind one's back and other forms of bullying. The response alternatives were: 1) not at all, 2) sometimes, 3) frequently and 4) don't know.

6.3 STATISTICAL METHODS

Cox proportional hazard regression analysis (e.g., Singer & Willett 2003) was used to estimate hazard ratios (HR) and their 95-per-cent confidence intervals (CI) for disability retirement (Sub-studies I and II) and mortality (Sub-study IV). Sub-study I focused on the independent and interdependent associations of education, social class and income with all-cause disability retirement, with successive adjustment for different combinations of these indicators. Further adjustments were made for unemployment and family characteristics following the inclusion of all three socioeconomic factors in the model. The relative index of inequality values (RII) and their 95-per-cent CIs were also calculated for socioeconomic differences in disability retirement: the original values of each socioeconomic indicator were replaced by the midpoint of the cumulative proportion of the socioeconomic group and then used as continuous variables, all the values ranging between 0 and 1. The RII regression coefficient could consequently be interpreted as the

difference between the hypothetically worst-off and best-off people in the population in terms of each socioeconomic indicator. Given that the RII takes account not only of the relative differences in disability retirement between socioeconomic groups, but also of the differences in the socioeconomic distributions, it facilitates comparison between the sizes of the effects of the different indicators (Shaw et al. 2007). The RII imposes linear associations between the socioeconomic indicators and disability retirement, thus entrepreneurs and those of an unspecified social class, in other words groups that could not be hierarchically ranked, were excluded from the calculations. Gender-stratified results of the RII calculations are also presented in order to assess the differences between men and women.

Sub-study II focused on the association between social class and all-cause disability retirement and that related to musculoskeletal diseases and mental disorders. In order to assess the contribution of health behaviours and working conditions to the HRs of the social classes these factors were introduced into the age-adjusted model first individually and then simultaneously. Multiple imputation was conducted for missing values of the explanatory factors via the `aregImpute` function in the `Hmisc` package (Alzola & Harrell 2006) for R software: ten imputed datasets were created and the data were assumed missing at random. Women and men were examined separately in the analyses of all-cause disability retirement, and pooled in the cause-specific analyses on account of the small number of events, especially among men.

Disability retirement on the grounds of mental disorders was used as a time-varying variable in Sub-study IV for calculating the HRs for all-cause and cause-specific mortality. The subjects were still classified as being in receipt of a disability pension despite later transfer to old-age retirement typically at 65. The rest of the study population, regardless of other retirement statuses, comprised the reference group. Exclusion from this group of those granted a disability pension on somatic grounds would have resulted in larger mortality differences between those retired on the grounds of mental disorders and the reference population. Restricting the reference group to a healthier part of the population could, however, have led to misleading results on the magnitude of this excess mortality. The analyses were stratified by gender and by whether disability retirement was attributable to depression or other mental disorders. The models were adjusted for age, social class and living arrangements, and interactions between each of these socio-demographic factors and retirement on the grounds of mental disorders were further investigated. In order to examine the relative differences, HRs were calculated using those with no history of mental-health-based retirement within their own socio-demographic group as the reference group. Absolute differences were also examined in a two-step procedure: 1) the youngest age group, the upper non-manual class, and those living with a partner and children among those with no history of disability retirement due to mental disorders were used as reference groups

in the regression models for all other combinations of socio-demographic and retirement categories; 2) the mortality rates were extracted by rescaling these relative differences according to the crude death rates (mortality rate=HR*crude death rate of the reference group).

The first step in the analyses conducted in Sub-study III was to plot the graphical trajectories of the unadjusted mean DDD of antidepressant medication in 60 three-month periods over time in relation to all-cause and cause-specific disability retirement as well as old-age retirement. The 60 periods were then divided into four longer time frames over which changes in the mean DDD per three-month period and their 95-per-cent CIs were calculated. The analyses were based on linear regression using generalised estimation equations (GEE). GEEs account for the interdependence between repeated within-subject measurements by assigning them a correlation structure (Twisk 2003). An autoregressive correlation structure was chosen on the assumption that correlation is stronger between observations that are closer to each other in time. The models were adjusted for socio-demographic factors and calendar year. The next step was to identify interactions between changes in DDD and socio-demographic factors, including gender, age, social class and living arrangements. The respective adjustments for socio-demographic factors in the interaction analyses were based on mean age at retirement and the mean values of the weighted coefficients (using the overall distributions of these variables) for gender, social class and living arrangements.

7 RESULTS

7.1 SOCIOECONOMIC DIFFERENCES IN DISABILITY RETIREMENT

INTERRELATIONSHIPS AMONG THE SOCIOECONOMIC INDICATORS (SUB-STUDY I)

Around nine per cent of the total population in Sub-study I made the transition to disability retirement during the follow-up (Table 2). This was

Table 2 The study population (% and unweighted N) and those who made the transition to disability retirement during the follow-up (% and unweighted n) by socioeconomic factors, men and women.

	MEN		WOMEN					
	%	N	Disability retirement		%	N	Disability retirement	
			%	n	%	N	%	n
Education								
Tertiary, higher	8.4	10,530	3.5	580	7.0	7,743	3.3	402
Tertiary, lower	19.5	25,731	5.6	2,196	25.1	28,207	5.1	2,045
Secondary	39.8	56,171	8.6	6,787	37.9	43,801	8.4	4,786
Primary	32.3	52,971	14.2	9,654	30.1	37,830	13.4	6,219
Occupational class								
Upper non-manual	18.5	23,974	5.0	1,829	15.5	17,543	4.8	1,182
Intermediate non-manual	14.4	19,848	7.1	2,030	23.4	27,247	7.4	2,759
Lower non-manual	4.2	5,686	7.2	605	25.3	29,092	7.5	2,942
Manual, specialised	29.4	44,325	11.3	6,706	10.3	12,493	11.1	1,764
Manual, non-specialised	15.9	25,866	13.2	4,521	14.5	18,094	14.2	3,097
Entrepreneur	17.0	24,609	9.9	3,366	10.3	12,270	10.5	1,625
Other/unknown	0.7	1,095	10.2	160	0.7	842	7.2	83
Household income								
1. quintile (highest)	20.1	27,737	8.8	3,408	19.2	22,393	8.5	2,503
2. quintile	19.1	26,662	9.5	3,515	20.1	23,437	9.5	2,816
3. quintile	18.8	25,935	8.5	3,067	20.6	23,874	8.9	2,768
4. quintile	19.0	27,095	8.5	3,319	20.4	23,693	7.7	2,447
5. quintile (lowest)	20.8	34,151	11.5	5,352	18.4	22,464	9.3	2,782
Does not belong to the household population/missing	2.3	3,823	9.4	556	1.4	1,720	4.9	136
Total	100.0	145,403	9.4	19,217	100.0	117,581	8.7	13,452

more common among those with a low education and occupational social class, whereas differences by household disposable income were smaller and less consistent. Socioeconomic differences and their interrelationships as determinants of disability retirement were relatively similar in both genders. Table 3 shows the pooled results of the regression analyses for men and women: the observed small gender differences are discussed later. The associations of each socioeconomic indicator with disability retirement followed clear gradients in the age- and gender-adjusted Model 1. The risk among those with primary education and non-specialised manual workers was about three-fold compared to those with higher tertiary education and upper non-manual employees. The effect was smaller for income: the risk among the lowest quintile was about 70 per cent higher than among the highest quintile.

The RIIs turned out to be similar in magnitude to the HRs between the lowest and the highest socioeconomic groups. Table 3 shows the percentage changes between the models. Adjustment for social class attenuated the educational differences to a great extent (55%) (Model 2), and adjustment for income to a lesser extent (13%) (Model 3). The effect of education attenuated by 58 per cent following simultaneous adjustment for social class and income (Model 5). Income thus had a negligible effect on educational differences that were independent of the effect of social class (Model 5 compared to Model 2). Adjustment for education attenuated the social-class differences (37%) (Model 2), and the attenuation was weaker following adjustment for income (12%) (Model 4). Education and income together attenuated social-class differences by 43 per cent (Model 5). Adjustment for education and social class attenuated the income differences individually by 47 (Model 3) and 58 (Model 4) per cent, respectively, and together by 66 per cent (Model 5). Further adjustments for marital status, children and employment status had relatively modest effects on these socioeconomic differences (Models 6–8).

In the fully adjusted Model 8, those with a primary education still had a two-fold risk of disability retirement, and non-specialised manual workers around a 70-per-cent higher risk compared to those with a higher tertiary education and upper non-manual employees, respectively. The RII showed opposite but complementary results, however, in that social class had a larger effect than education. Compared with the HR between the highest and the lowest socioeconomic groups, the RII measures overall inequality across the groups in taking into account the sizes of the categories. Given the small proportion of the study population with a higher tertiary education (8%), the RII gives less weight to differences between this group and the less highly educated. Instead, the social classes are more evenly distributed among the higher and lower classes, resulting in higher overall levels of inequality across the classes. Following all the adjustments, the effect of income was still the smallest measured in terms of HRs and the RII: the lowest quintile had a 24-per-cent higher risk of disability retirement than the highest. Interpretations of the relative importance of income compared to the other two

socioeconomic indicators were similar when individual taxable income was used instead of household disposable income (results not shown).

Table 3 All-cause disability retirement (hazard ratios and relative indices of inequality (RII)) by socioeconomic factors, successively adjusting for potential explanatory and mediating factors.

	Model							
	1	2	3	4	5	6	7	8
Education								
Tertiary, higher	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Tertiary, lower	1.63	1.47	1.58		1.45	1.45	1.41	1.41
Secondary	2.77	1.98	2.60		1.94	1.92	1.82	1.82
Primary	3.32	2.29	3.08		2.24	2.21	2.07	2.07
RII	2.91	1.86	2.66		1.81	1.78	1.68	1.67
% change in RII ^a		-55	-13		-58	-59	-64	-65
Social class								
Upper non-manual	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Intermediate non-manual	1.51	1.14		1.47	1.13	1.12	1.10	1.10
Lower non-manual	1.70	1.26		1.65	1.26	1.26	1.24	1.23
Manual, specialised	2.46	1.65		2.34	1.63	1.60	1.55	1.53
Manual, non-specialised	2.88	1.90		2.70	1.85	1.81	1.74	1.72
Entrepreneur	1.91	1.35		1.73	1.27	1.29	1.26	1.31
RII	3.48	2.57		3.17	2.42	2.35	2.24	2.22
% change in RII ^a		-37		-12	-43	-45	-50	-51
Household income								
1. quintile (highest)	1.00		1.00	1.00	1.00	1.00	1.00	1.00
2. quintile	1.25		1.07	1.06	1.02	1.02	1.07	1.06
3. quintile	1.29		1.05	1.04	0.99	0.99	1.07	1.05
4. quintile	1.35		1.07	1.06	1.00	1.00	1.12	1.07
5. quintile (lowest)	1.72		1.32	1.33	1.25	1.20	1.35	1.24
RII	1.81		1.43	1.34	1.28	1.23	1.47	1.30
% change in RII ^a			-47	-58	-66	-72	-43	-64

$$^a(RII_{Modelx}-RII_{Model1})/(RII_{Model1}-1)*100$$

Bold: $p < 0.05$

Model 1: Individual socioeconomic factors adjusted for age and gender

Model 2: Age, gender, education and social class

Model 3: Age, gender, education and household income

Model 4: Age, gender, social class and household income

Model 5: Age, gender, education, social class and household income

Model 6: Model 5 + marital status

Model 7: Model 6 + children

Model 8: Model 7 + employment status

The general socioeconomic patterning was similar among men and women, although the age-adjusted RII for each indicator was larger among the men (Figure 4a). Among the men, too, somewhat more of the educational and social-class differences and somewhat less of the income difference was attenuated after mutual adjustment for socioeconomic indicators (results not shown). There were no longer any gender differences in disability retirement by education and social class in the fully adjusted model, whereas the effect of income was still larger among the men (Figure 4b).

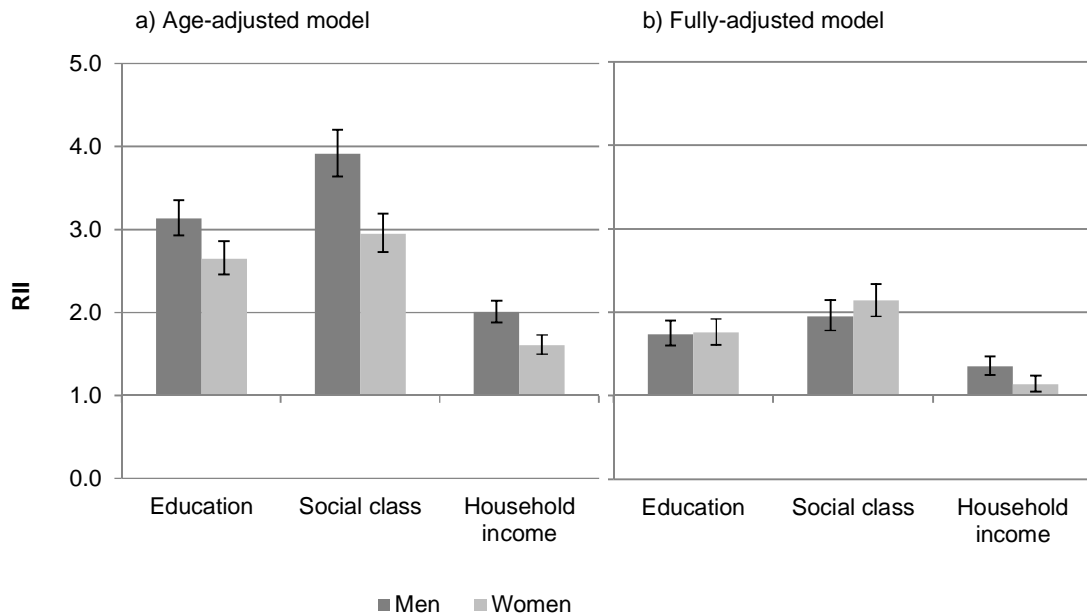


Figure 4 Relative indices of inequality (RII) for all-cause disability retirement by socioeconomic factors among men and women following adjustment for a) age and b) age, all three socioeconomic factors, marital status, children and employment status.

THE CONTRIBUTION OF HEALTH BEHAVIOURS AND WORKING CONDITIONS (SUB-STUDY II)

As reported in Sub-study II, 10 per cent of the women and eight per cent of the men in the HHS cohort made the transition to disability retirement during the follow-up (Table 4). This transition was more common among those in the lower social classes, most notably in retirement on the grounds of musculoskeletal diseases, which together with mental disorders contributed to around two thirds of all diagnosed causes. These two diagnoses were equally prevalent among the men, whereas musculoskeletal diseases were more prevalent among the women.

Table 4 The study population (% and N) and those who made the transition to disability retirement during the follow-up, attributable to any cause, musculoskeletal diseases and mental disorders (% and n) by social class, women and men.

	Distribution		Disability retirement						
			All causes		Musculo-skeletal diseases		Mental disorders		
	%	N	%	n	%	n	%	n	
WOMEN									
Managers and professionals	28.6	1462	4.7	68	1.0	13	2.0	29	
Semi-professionals	19.3	986	8.5	84	3.1	31	2.7	27	
Routine non-manual employees	41.2	2105	11.6	245	5.4	113	2.9	62	
Manual workers	11.0	561	20.5	115	13.2	74	1.8	10	
Total	100.0	5114	10.0	512	4.5	232	2.5	128	
MEN									
Managers and professionals	44.6	625	4.8	30	0.5	3	1.6	10	
Semi-professionals	20.0	281	8.2	23	2.5	7	2.8	8	
Routine non-manual employees	9.4	132	13.6	18	4.5	6	6.8	9	
Manual workers	26.0	364	12.9	47	6.0	22	3.3	12	
Total	100.0	1402	8.4	118	2.7	38	2.8	39	

The age-adjusted risk of all-cause disability retirement among manual workers was over four-fold among women (Figure 5) and over three-fold among men (Figure 6) compared to managers and professionals. Adjustment for health behaviours had only minor effects on the social-class difference: smoking in women and BMI in both genders slightly attenuated the difference. Adjustment for physical workload largely attenuated the difference in both genders. Adjusting for hazardous exposures had an even stronger attenuating effect among the men, and a relatively modest effect among the women. Job control somewhat attenuated the difference in both genders, and shift work slightly among the men. Going against the direction of all the other effects, the social-class difference widened somewhat following adjustment for computer work in both genders, and job demands in the men. These conditions were more common among those in higher social classes (results not shown). Partly due to these contrary effects, adjustment for all health behaviours and working conditions led to a reduction in the social-class difference that was similar in magnitude to the reduction following adjustment only for factors of the physical work environment, in other words explaining over half of the original association. Following adjustment for all variables the risk of disability retirement among manual workers was still two-and-a-half times the risk in women and twice that in men compared to managers and professionals.

Results

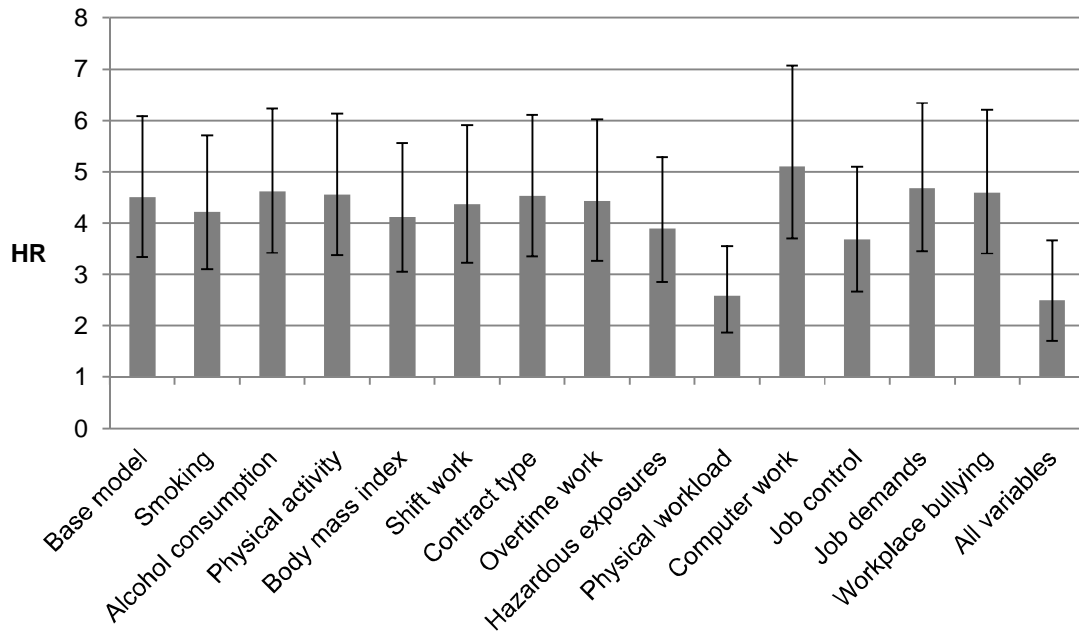


Figure 5 Hazard ratios (HR) and 95-per-cent confidence intervals for all-cause disability retirement among manual workers compared to managers and professionals (HR=1.00) after individually including health behaviours and working conditions in the age-adjusted base model, women.

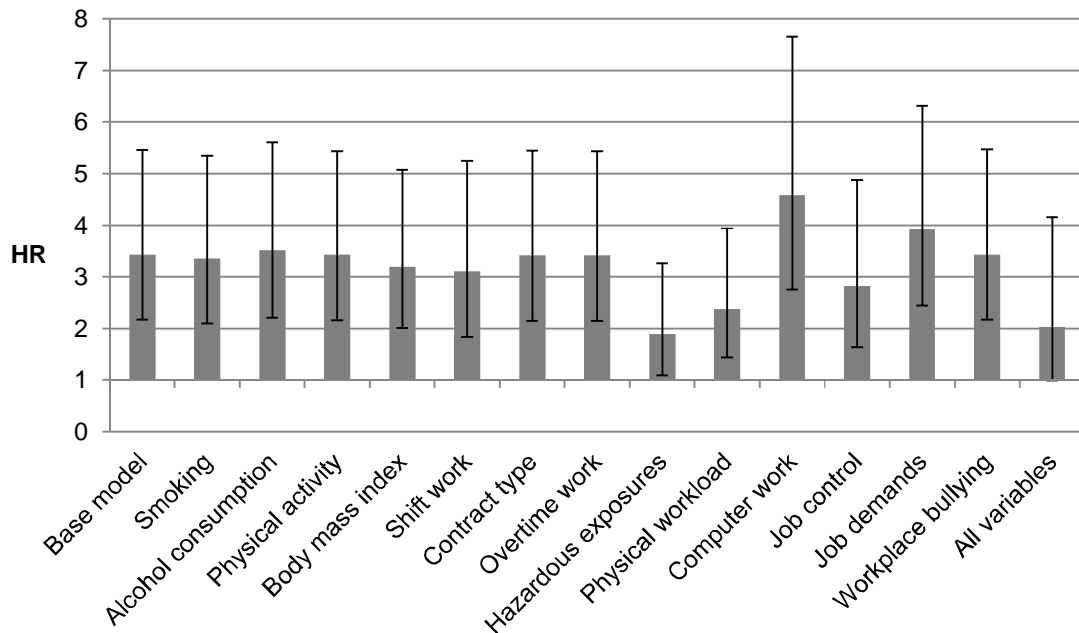


Figure 6 Hazard ratios (HR) and 95-per-cent confidence intervals for all-cause disability retirement among manual workers compared to managers and professionals (HR=1.00) after individually including health behaviours and working conditions in the age-adjusted base model, men.

Social-class differences in disability retirement on the grounds of musculoskeletal diseases were considerably larger than those in all-cause disability retirement (Figure 7). After pooling women and men in these analyses, the age- and gender-adjusted risk was almost 15-fold among manual workers, six-fold among routine non-manual employees, and four-fold among semi-professionals compared to managers and professionals. Adjustment for physical workload, hazardous exposures and job control again made the biggest contributions. Physical workload had the largest effect, attenuating the differences across all social classes but particularly in the lower ones. Hazardous exposures somewhat attenuated the HR for manual workers, and job control the HRs for manual workers and routine non-manual employees. The social-class differences in disability retirement on the grounds of musculoskeletal diseases remained large even after all the adjustments.

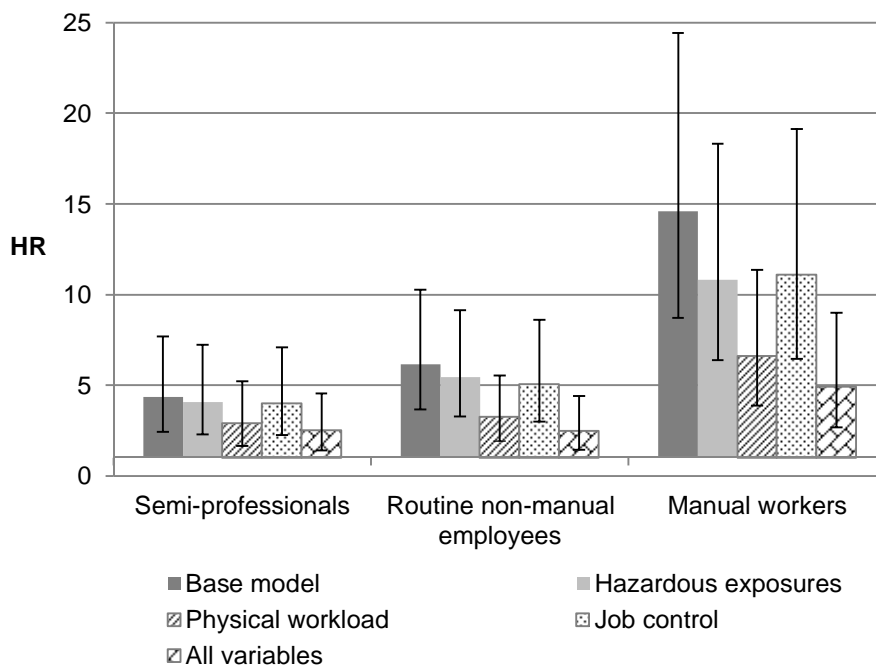


Figure 7 Hazard ratios (HR) and 95-per-cent confidence intervals for disability retirement on the grounds of musculoskeletal diseases by social class: age- and gender-adjusted base model, individual adjustment for working conditions that made the largest contribution, and adjustment for all health behaviours and working conditions used in the analyses (HR=1.00 among managers and professionals).

In the case of disability retirement on the grounds of mental disorders the social-class differences were substantially smaller and followed a non-linear pattern (Figure 8). The age-adjusted risks were highest in the intermediate classes, being almost two-fold among routine non-manual employees and almost 70 per cent higher among semi-professionals compared to managers and professionals. Manual workers were also at an elevated risk, although

not to a statistically significant degree. Adjustment for physical workload and job control attenuated the differences most and among all social classes, whereas hazardous exposures attenuated the difference for manual workers. Computer work and job demands widened the differences, with considerable increases in risk among manual workers and routine non-manual employees. These effects, going in opposite directions, cancelled each other out, and as a result adjustment for all health behaviours and working conditions had only a minor attenuating effect on the social-class differences in in this context.

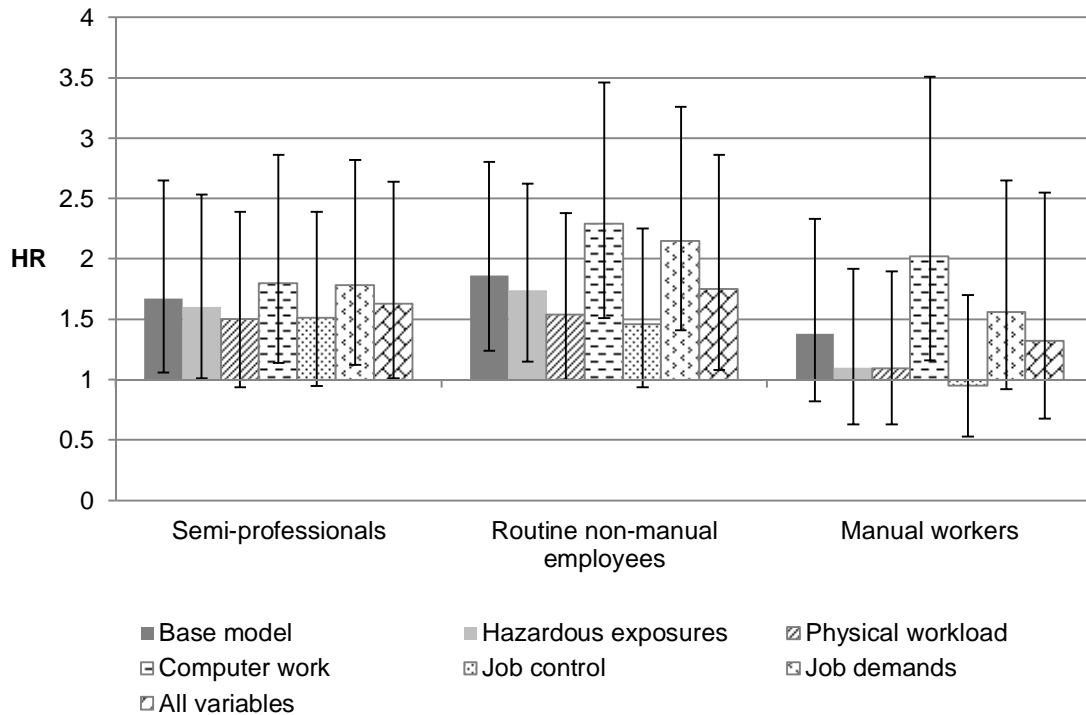


Figure 8 Hazard ratios (HR) and 95-per-cent confidence intervals for disability retirement on the grounds of mental disorders by social class: age- and gender-adjusted base model, individual adjustment for working conditions that made the largest contribution, and adjustment for all health behaviours and working conditions used in the analyses (HR=1.00 among managers and professionals).

7.2 MENTAL HEALTH TRAJECTORIES AND MORTALITY IN RELATION TO DISABILITY RETIREMENT BY SOCIO-DEMOGRAPHIC FACTORS

ANTIDEPRESSANT MEDICATION BEFORE AND AFTER DISABILITY RETIREMENT (SUB-STUDY III)

Of all diagnosed causes of disability retirement investigated in Sub-study III, 30 per cent were mental disorders, over half of which were related to depression. Within the remaining 70 per cent of somatic causes

musculoskeletal diseases constituted the largest group (results not shown). Retirement type and diagnosed cause strongly influenced the trajectories of antidepressant medication (Figure 9). Among disability retirees the overall direction and timing of changes in the mean level of medication per three-month period were nevertheless largely similar regardless of the diagnosed cause. Four time frames were identified: I) moderate increase 7.5–1.5 years before retirement, II) substantial increase 1.5–0 years before retirement, III) substantial decrease approximately 0–3 years after retirement and IV) moderate decrease 3–7.5 years after retirement. The patterns were more pronounced among those retiring on the grounds of depression, particularly around the time of retirement. In the case of somatic causes, antidepressant medication was at a considerably lower level, pre-retirement increase was less pronounced and there were no clear changes after retirement. Medication was at an even lower level among those retiring at the statutory age, with a small increase over time but no changes in this trend around the time of retirement.

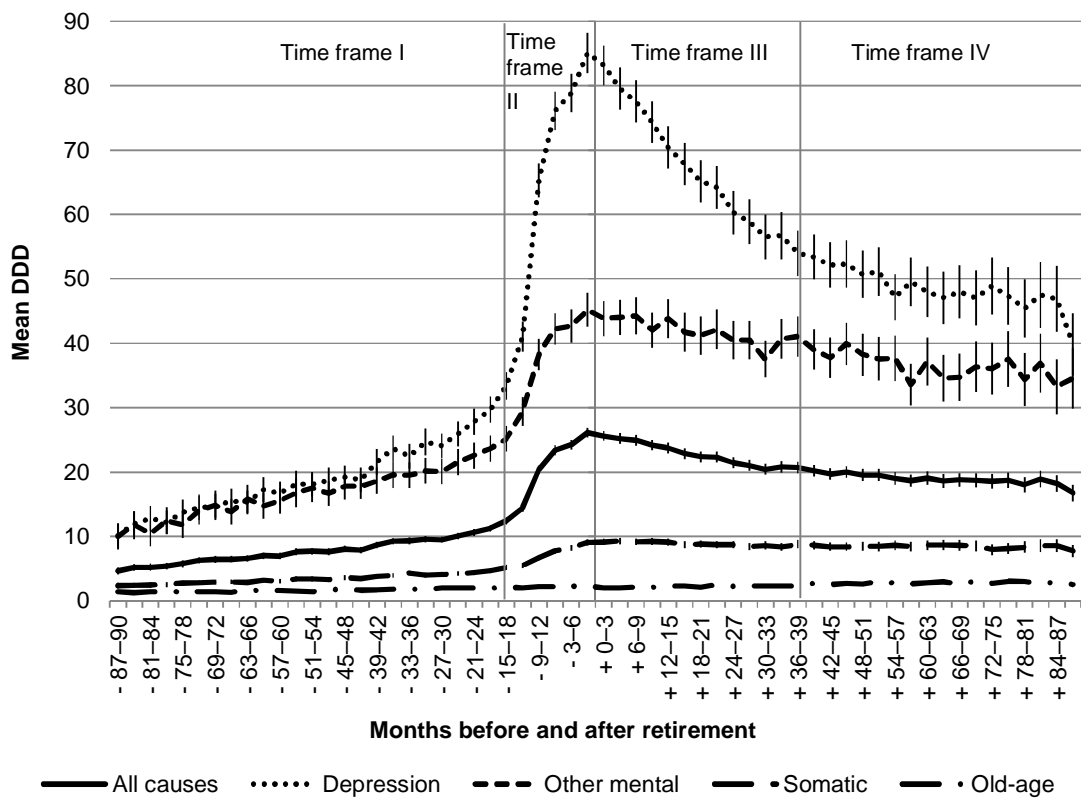


Figure 9 Antidepressant medication (mean defined daily dose (DDD)/3-month period and its 95% confidence intervals) over four time frames in relation to disability retirement due to any cause (unweighted N=42,937), depression (16% of all diagnosed causes), other mental disorders (14%) and somatic causes (70%) as well as statutory old-age retirement (unweighted N=19,877).

Socio-demographic factors largely modified the trajectories in antidepressant medication before and after all-cause disability retirement, the variations depending to a great extent on the various diagnosed causes of retirement among the different groups (results not shown). Analyses of the modifying effects of these factors were therefore carried out separately for those retiring due to depression (Table 5) and somatic causes (Table 6). According to the regression analyses, the observed increases in antidepressant medication before and decreases after disability retirement were all statistically significant in these study populations overall. Moreover, even though no change was observed following retirement on somatic grounds in Figure 9, adjustment for the calendar year in the regression models accounted for an increasing secular trend. This resulted in stronger post-retirement decreases, thereby also disclosing decreases after retirement on somatic grounds (Table 6). This secular trend also fully explained the small increase in antidepressant medication observed in Figure 9 among

Table 5 Change in antidepressant medication (defined daily dose (DDD)/3-month period) over time in relation to disability retirement on the grounds of depression and the modifying effects of the socio-demographic factors.

	Time in relation to disability retirement			
	7.5–1.5 years before	1.5–0 years before	0–3 years after	3–7.5 years after
Total	0.55	9.50	-3.01	-0.95
(95% CI)	(0.43, 0.66)	(9.06, 9.94)	(-3.30, -2.72)	(-1.19, -0.70)
Gender	p=0.966	p=0.010	p=0.002	p=0.598
Men	0.56	10.23	-3.57	-0.91
Women	0.57	9.00	-2.60	-1.04
Age at retirement	p=0.000	p=0.000	p=0.000	p=0.000
30–44	0.99	11.88	-2.10	-0.84
45–54	0.54	10.13	-2.85	-1.42
55–64	0.28	6.94	-3.88	-0.39
Social class	p=0.004	p=0.637	p=0.000	p=0.933
Upper non-manual	0.99	9.62	-3.86	-0.97
Lower non-manual	0.48	9.75	-3.70	-1.08
Manual	0.39	9.26	-2.15	-0.99
Entrepreneurs	0.56	8.45	-2.72	-1.29
Living arrangements	p=0.065	p=0.093	p=0.758	p=0.001
With partner	0.47	9.85	-2.96	-1.34
Alone	0.76	8.84	-3.13	-0.55
Single parent	0.35	10.11	-3.35	-0.42

Adjusted for the calendar year and mutually adjusted for each socio-demographic factor

The p-values are calculated for the interaction between a socio-demographic factor and change in antidepressant medication (bold: p<0.05)

those retiring at the statutory age. Consequently, the regression analyses indicate no changes either before or after statutory retirement, a result that was also consistent across all socio-demographic groups (results not shown).

Age at disability retirement modified the trajectories the most. Increases in antidepressant medication before retirement on the grounds of both depression and somatic causes were much stronger in younger age groups (Tables 5 and 6), among which the decreases were also smaller after depression-based retirement (Table 5). There was even a continuing increase in medication among those under the age of 45 whose retirement was attributable to somatic causes (Table 6). Antidepressant medication was already at a relatively low level among those over the age of 54 three years after retirement (results not shown), which explains the much slower decreases in subsequent years (Tables 5 and 6).

Table 6 Change in antidepressant medication (defined daily dose (DDD)/3-month period) over time in relation to disability retirement on somatic grounds and the modifying effects of the socio-demographic factors.

	Time in relation to disability retirement			
	7.5–1.5 years before	1.5–0 years before	0–3 years after	3–7.5 years after
Total	0.04	0.73	-0.09	-0.08
(95% CI)	(0.01, 0.06)	(0.66, 0.79)	(-0.14, -0.04)	(-0.13, -0.03)
Gender	p=0.167	p=0.406	p=0.061	p=0.682
Men	0.03	0.75	-0.13	-0.08
Women	0.06	0.68	-0.03	-0.10
Age at retirement	p=0.001	p=0.000	p=0.000	p=0.120
30–44	0.13	1.08	0.32	0.04
45–54	0.06	0.89	-0.10	-0.15
55–64	0.01	0.51	-0.18	-0.07
Social class	p=0.009	p=0.000	p=0.829	p=0.640
Upper non-manual	0.17	0.96	-0.02	-0.09
Lower non-manual	0.03	0.97	-0.10	-0.14
Manual	0.02	0.59	-0.07	-0.08
Entrepreneurs	0.08	0.67	-0.14	-0.01
Living arrangements	p=0.919	p=0.075	p=0.259	p=0.434
With partner	0.04	0.68	-0.07	-0.09
Alone	0.03	0.84	-0.18	-0.11
Single parent	0.03	0.99	-0.15	0.12

Adjusted for the calendar year and mutually adjusted for each socio-demographic factor

The p-values are calculated for the interaction between a socio-demographic factor and change in antidepressant medication (bold: $p < 0.05$)

The modifying effects of other socio-demographic factors were more modest. Changes in antidepressant medication in the time frames surrounding depression-based disability retirement were slightly stronger among the men (Table 5). There were no gender differences in retirement on somatic grounds (Table 6).

Decrease in antidepressant medication immediately after depression-based disability retirement was somewhat stronger in the higher social classes, among which the increase was also stronger 7.5–1.5 years before retirement (Table 5). The increase in medication before retirement on somatic grounds was also strongest among the higher social classes (Table 6). The trajectories for entrepreneurs were close to average levels (Tables 5 and 6).

The only modifying effect of living arrangements was that the decrease in antidepressant medication 3–7.5 years after depression-based disability retirement was strongest among people living with a partner (Table 5).

EXCESS MORTALITY AFTER DISABILITY RETIREMENT ON THE GROUNDS OF MENTAL DISORDERS (SUB-STUDY IV)

Almost three per cent of the study population retired on the grounds of mental disorders during the follow-up reported in Sub-study IV (Table 7). Depression was the more specific diagnosed cause in almost half of the male cases, and almost two thirds of the female cases. The age-adjusted mortality rate was around three-fold among both males and females who retired due to mental disorders compared to the rest of the study population, this excess mortality being more pronounced in the case of mental disorders other than depression. Alcohol-related causes, suicide and other unnatural causes accounted for a large proportion of the deaths among the retirees, whereas circulatory diseases and cancer were more prevalent among those with no mental-health-based retirement history. Suicide and alcohol-related causes of death were relatively common in relation to retirement on the grounds of depression and other mental disorders, respectively.

Excess mortality following disability retirement on the grounds of mental disorders was larger in the case of unnatural and alcohol-related deaths and generally also in the case of mental disorders other than depression (Figures 10 and 11). Excess mortality related to suicide was nevertheless particularly large after depression-based retirement, and especially among women. There was no excess risk of cancer mortality except among men retired on the grounds of mental disorders other than depression. The magnitude of the excess mortality nevertheless varied within the category of other mental disorders, being particularly high among those retired on the grounds of alcohol-related disorders (ICD-10 F10) (results not shown).

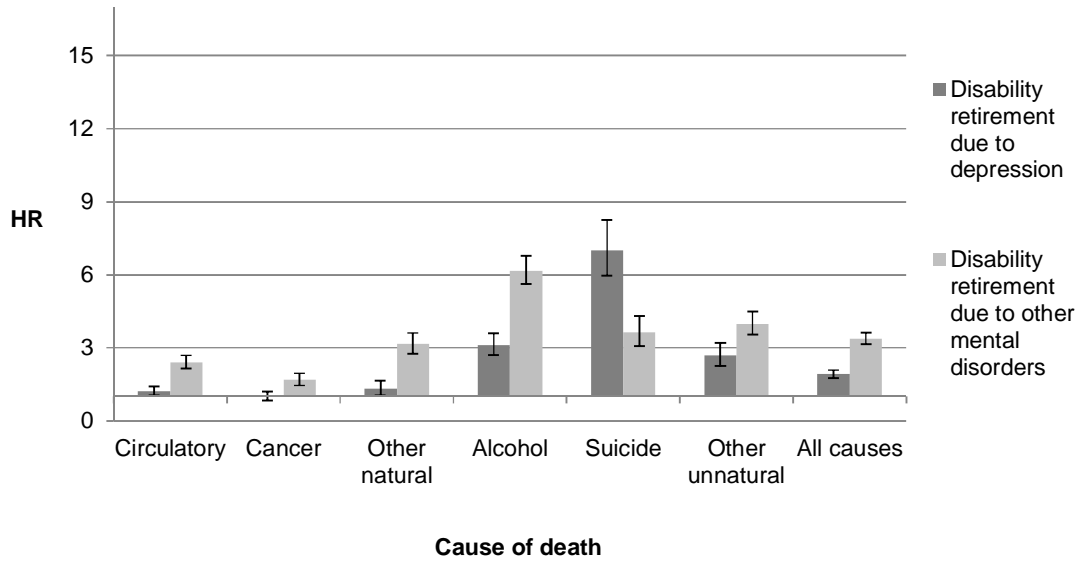
Table 8 shows the modifying effects of age, social class and living arrangements on excess mortality from natural causes following retirement on the grounds of depression and other mental disorders among men and

women. Both absolute and relative differences are considered through mortality rates and HRs, respectively. The HRs indicate excess mortality within their own socio-demographic group among those who retired on the grounds of mental disorders compared to those with no such retirement history, and the p-values show the statistical significance of the interactions between each socio-demographic factor and mental-health-based retirement. The mortality rate increased strongly with increasing age regardless of the retirement status, and was particularly high among the oldest group retired for reasons other than depression. However, excess mortality following retirement on the grounds of mental disorders was higher in the younger age groups. In terms of social class, the mortality rate followed a rather typical

Table 7 Study population (% & unweighted N), mortality (age-adjusted rates per 1000 person years using the whole study population as the standard population and the unweighted number of deaths), and causes of death (%) by gender and mental-health-based disability-retirement status.

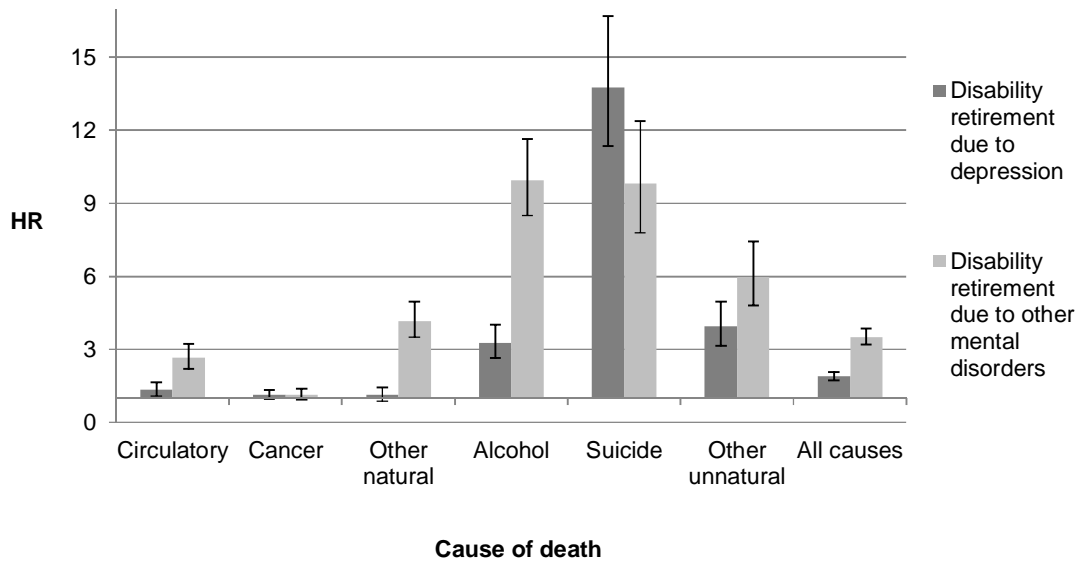
	Disability retirement due to mental disorders			No
	Yes			
MEN	All mental	Depression	Other mental	
%	2.6	1.2	1.4	97.4
N	6,712	2,608	4,104	208,909
Mortality rate	22.2	16.5	29.4	6.6
Number of deaths	3,328	1,014	2,314	73,461
Cause of death (%)				
Circulatory	21	21	22	34
Cancer	11	13	10	25
Other natural	11	8	13	13
Alcohol	31	25	34	12
Suicide	10	18	7	6
Other unnatural	15	15	15	10
Total	100	100	100	100
WOMEN				
%	2.9	1.8	1.1	97.1
N	5,589	3,202	2,387	171,775
Mortality rate	8.6	7.2	11.1	2.8
Number of deaths	1,489	675	814	33,085
Cause of death (%)				
Circulatory	15	14	15	23
Cancer	20	27	14	45
Other natural	16	10	21	17
Alcohol	22	15	28	6
Suicide	16	21	11	3
Other unnatural	12	12	12	6
Total	100	100	100	100

Results



Adjusted for age, social class, and living arrangements

Figure 10 Excess mortality (hazard ratios (HR) and their 95-per-cent confidence intervals) following disability retirement on the grounds of depression and other mental disorders compared to those with no such retirement history (HR=1.00), by cause of death, men.



Adjusted for age, social class, and living arrangements

Figure 11 Excess mortality (hazard ratios (HR) and their 95-per-cent confidence intervals) following disability retirement on the grounds of depression and other mental disorders compared to those with no such retirement history (HR=1.00), by cause of death, women.

pattern, being higher in the lower classes. However, in the case of women retired on the grounds of depression the rate varied little by social class. In these women excess mortality was higher among those in the higher social classes, whereas it was similar across the classes in the rest of the retired groups. The mortality rates of both men and women living alone were higher regardless of retirement status. There was no variation in excess mortality by living arrangements among the women. Among the men, excess mortality following retirement on the grounds of depression and other mental disorders was largest among those living with a partner and children and smallest among those living only with a partner, although among the latter retired group the interaction effect was not statistically significant.

In the case of unnatural and alcohol-related causes of death, age differences in the mortality rate varied somewhat by retirement status (Table 9). It was typically lowest among those under 45, and this absolute difference from the older age groups was particularly pronounced among men retired on the grounds of mental disorders other than depression. This was largely attributable to the high proportion of alcohol-related disorders as diagnosed causes of disability retirement among older groups (results not shown). The mortality rate among the 45-54-year-olds was typically higher than or similar to the rate among the over-54s, with the exception of women retired on the grounds of depression among whom the rate decreased with increasing age. There was also variation in excess mortality by age group. Following depression-based retirement it decreased with increasing age among both men and women. In the case of those retired on the grounds of other mental disorders excess mortality was similar in all age groups among the women, but somewhat smaller among the men in the youngest compared to the older groups. Social-class differences in the mortality rate varied according to the retirement status. Typical gradients were found among those with no mental-health-based retirement history, as well as among women retired on the grounds of disorders other than depression: in other words the rate was lowest among the upper non-manual class and highest among the manual class. In the other retired groups, in other words men retired on the grounds of both depression and other mental disorders as well as women retired due to depression, the mortality rates were relatively similar across the classes. In these groups, excess mortality was higher in the higher social classes. The mortality rate was highest among those living alone in all retirement-status categories, and in absolute terms it was particularly high among men retired on the grounds of mental disorders who were living alone. Excess mortality following disability retirement on these grounds was smallest among those living alone and largest among those living with a partner and children, regardless of gender and the type of mental disorder.

Table 8 Mortality rates per 1000 person years and hazard ratios (HR) for mortality from natural causes among men and women, by mental-health-based disability-retirement status, and the modifying effects of age, social class and living arrangements.

	MEN			WOMEN			
	Disability retirement due to mental disorders			Disability retirement due to mental disorders			
	No	Yes, depression	Yes, other mental	No	Yes, depression	Yes, other mental	
Age							
-44	Rate	0.7	1.8	2.5	0.5	1.1	1.5
	HR	1.00	2.51	3.38	1.00	2.24	3.00
45-54	Rate	3.2	4.5	8.7	1.7	2.3	4.5
	HR	1.00	1.41	2.69	1.00	1.33	2.59
55-	Rate	11.8	12.1	24.6	5.1	5.4	9.7
	HR	1.00	1.03	2.08	1.00	1.07	1.92
P-value for interaction			p=0.000	p=0.000		p=0.002	p=0.009
Social class							
Upper non-manual	Rate	2.6	2.7	6.6	1.5	2.4	3.7
	HR	1.00	1.06	2.57	1.00	1.66	2.52
Lower non-manual	Rate	3.5	4.8	7.8	1.8	2.3	4.1
	HR	1.00	1.36	2.20	1.00	1.30	2.26
Manual	Rate	4.6	5.4	10.9	2.4	2.6	5.1
	HR	1.00	1.17	2.36	1.00	1.10	2.12
Entrepreneur	Rate	3.7	3.6	9.1	2.2	1.7	3.6
	HR	1.00	0.98	2.46	1.00	0.77	1.65
P-value for interaction			p=0.508	p=0.790		p=0.030	p=0.650
Living arrangements							
Partner and children	Rate	1.7	2.5	4.8	0.9	1.0	1.6
	HR	1.00	1.48	2.87	1.00	1.14	1.79
Partner only	Rate	2.1	1.9	4.2	1.1	1.2	2.2
	HR	1.00	0.91	1.96	1.00	1.09	2.03
Alone	Rate	4.1	5.2	10.0	1.5	2.0	3.2
	HR	1.00	1.27	2.46	1.00	1.35	2.15
P-value for interaction			p=0.014	p=0.121		p=0.163	p=0.430
Adjusted for age, social class and living arrangements							

The p-values are for the interaction between a socio-demographic factor and retirement calculated separately for disability retirement on the grounds of depression and other mental disorders (bold: $p < 0.05$)

Table 9 Mortality rates per 1000 person years and hazard ratios (HR) for mortality from unnatural and alcohol-related causes among men and women by mental-health-based disability-retirement status, and the modifying effects of age, social class and living arrangements.

	MEN			WOMEN			
		Disability retirement due to mental disorders			Disability retirement due to mental disorders		
		No	Yes, depression	Yes, other mental	No	Yes, depression	Yes, other mental
Age							
-44	Rate	1.2	6.8	5.2	0.3	3.0	2.2
	HR	1.00	5.55	4.21	1.00	10.78	7.84
45-54	Rate	2.2	8.8	11.8	0.4	2.3	4.1
	HR	1.00	3.95	5.27	1.00	5.35	9.55
55-	Rate	2.4	6.5	12.6	0.3	1.3	2.8
	HR	1.00	2.74	5.29	1.00	3.86	8.20
P-value for interaction			p=0.000	p=0.027		p=0.002	p=0.319
Social class							
Upper non-manual	Rate	0.8	5.3	7.6	0.3	2.5	2.7
	HR	1.00	6.37	9.14	1.00	9.91	11.00
Lower non-manual	Rate	1.2	4.7	7.3	0.4	2.1	3.0
	HR	1.00	3.86	5.96	1.00	5.76	8.41
Manual	Rate	1.8	6.0	9.0	0.6	2.2	4.9
	HR	1.00	3.25	4.88	1.00	3.79	8.33
Entrepreneur	Rate	1.3	4.2	6.3	0.4	3.1	3.9
	HR	1.00	3.30	4.93	1.00	7.43	9.31
P-value for interaction			p=0.000	p=0.000		p=0.000	p=0.790
Living arrangements							
Partner and children	Rate	0.7	4.5	6.3	0.2	1.8	2.3
	HR	1.00	6.81	9.56	1.00	10.74	13.54
Partner only	Rate	1.1	4.0	8.2	0.5	2.4	5.7
	HR	1.00	3.69	7.61	1.00	5.22	12.48
Alone	Rate	3.8	12.4	17.2	0.9	3.8	5.7
	HR	1.00	3.29	4.56	1.00	4.50	6.69
P-value for interaction			p=0.000	p=0.000		p=0.000	p=0.000

Adjusted for age, social class and living arrangements

The p-values are for the interaction between a socio-demographic factor and retirement calculated separately for disability retirement on the grounds of depression and other mental disorders (bold: p<0.05)

8 DISCUSSION

8.1 MAIN FINDINGS AND INTERPRETATION OF THE RESULTS

SOCIOECONOMIC POSITION AND PATHWAYS TO DISABILITY RETIREMENT

The aim of this study was to contribute to current knowledge about the pathways through which a low socioeconomic position leads to a higher risk of disability retirement, thereby enhancing understanding of health inequalities and the causes of early retirement. A comprehensive understanding of the socioeconomic processes involved will make it easier to direct interventions towards high-risk groups.

The findings reconfirm the role of socioeconomic factors as major determinants of disability retirement. Furthermore, there are enormous social-class differences in retirement on the grounds of musculoskeletal diseases, whereas in the case of mental disorders the differences are smaller and follow a less consistent pattern. The conclusions of the present study with regard to social-class differences by diagnosed cause of disability retirement are based on a cohort of a single municipal employer, which does not represent the working population in general. Previous studies have nevertheless also found larger socioeconomic differences in disability retirement attributable to musculoskeletal diseases than to mental disorders, although the findings concerning mental disorders are inconsistent (Gubéran & Usel 1998; Månsson et al. 1998; Blekesaune & Solem 2005; Bruusgaard et al. 2010; Samuelsson et al. 2012; Polvinen et al. 2013a, 2013b). Socioeconomic differences in mental-health-based disability retirement therefore need to be further established through the use of large population-based prospective data sets with sufficient statistical power. It has been found that a low socioeconomic position is associated with mental disorders more generally (Fryers et al. 2003; Lorant et al. 2003; Muntaner et al. 2004). Nevertheless, the association may be more consistent with regard to socioeconomic circumstances other than occupational social class, including low education, poor material conditions and unemployment (Fryers et al. 2003).

The findings of the present study also indicate that education, occupational social class and income, in other words key sub-domains of adulthood socioeconomic position, have both independent and interdependent effects on disability retirement: although each sub-domain turned out to have its own particular pathway, parts of the effects were explained by or mediated through the other two factors. The socioeconomic differences were similar among men and women, who in Finland have

relatively equal educational and employment opportunities despite the clearly segregated labour markets. Unemployment and family characteristics made only a minor contribution to socioeconomic differences in disability retirement.

A closer investigation of the interrelationships between socioeconomic factors as determinants of disability retirement showed that over half of the effect of education was mediated through social class, but this was not mediated much further through household disposable income. In other words the main pathway for the effect of a low educational level is that the people concerned end up in a lower social class, which in turn increases the likelihood of disability retirement. Some of the effect of social class was explained by education, which means that a part of the higher risk among those with a low social class is rather attributable to pre-existing circumstances related to a low level of education than to its own causal effects. The effect of social class was only modestly mediated through income. Education and income together contributed to almost half of the effect of social class. Education and social class together explained almost two thirds of the effect of income. The independent effects of education and social class were larger than that of income. Correspondingly, it was found in a study of retirement on the grounds of osteoarthritis among older employees that the independent effects of individual income were generally weaker than those of education and social class (Holte et al. 2000). Evidence concerning the independent effects of each of these three socioeconomic sub-domains is thus far lacking in the case of all-cause disability retirement, however. With regard to the pathways between the socioeconomic indicators, a previous study on retirement on the grounds of back pain found that education largely explained the effect of social class, but in contrast to the present study on all-cause disability retirement, the effect of education was not strongly mediated through social class (Hagen et al. 2000). A study on all-cause sickness absence nevertheless reports similar findings as the present study: education and social class had stronger independent effects than individual income. Furthermore, the effect of education was largely mediated through social class, and education largely explained the effect of social class. Income had little further influence on these associations, whereas the other two factors explained most of its effect (Piha et al. 2010).

The present study contributes to the general understanding of multiple socioeconomic measures in health research. The relative importance of socioeconomic indicators varies in accordance with the health measure used, and they should not be used interchangeably (Macintyre et al. 2003; Lahelma et al. 2004; Geyer et al. 2006). Many studies on mortality include more than one indicator of socioeconomic position, but they offer no generally applicable conclusions on the relative contributions of education, social class and income (Næss et al. 2005; Elo et al. 2006; Geyer et al. 2006; Martikainen et al. 2007, 2009). However, findings from Finland show similar socioeconomic patterns in mortality as the present study on disability

retirement: education and social class both have independent effects (Martikainen et al. 2007), whereas the effect of income is modest after accounting for other socioeconomic factors and economic activity, particularly when household disposable income is used as the income measure (Martikainen et al. 2009). The contribution of different socioeconomic indicators varies in other domains of health. Previous findings indicate that education, social class and income each contribute to myocardial-infarction outcomes, whereas education has the strongest effect on diabetes (Geyer et al. 2006). Various socioeconomic sub-domains are associated with physical functioning (Laaksonen et al. 2009) and self-rated health (Laaksonen et al. 2005a), economic difficulties having a considerable role in these outcomes and contributing more than income. Economic difficulties also contribute to socioeconomic differences in mental ill health, for which the patterning by more conventional socioeconomic measures is less consistent (Laaksonen et al. 2007; Mauramo et al. 2012). Disability retirement, in turn, is likely to have its particular socioeconomic pathways. The relative importance of social class, for example, may be highlighted through the close connection of work disability with occupational requirements, which determine the ability to continue working in a particular type of job while taking existing health problems into account. It should be noted that musculoskeletal diseases contribute substantially to the results of the present study on all-cause disability retirement, being among the most common diagnosed causes and also reflecting the largest socioeconomic differences. The influence of multiple socioeconomic measures on retirement on the grounds of mental disorders, for example, might yield different results.

Further examination of the effect of social class on disability retirement showed a weaker contribution of health behaviours than working conditions to the association, which is in line with previous findings (Polvinen et al. 2013a). Furthermore, a large proportion of the social-class difference in retirement on the grounds of both musculoskeletal diseases and mental disorders was mediated through the physical work environment. Job control mediated the association particularly in mental-health-based retirement. Those in lower social classes are therefore likely to have a higher risk of disability retirement largely on account of their more strenuous physical working conditions and less control over their work. This study yields novel findings concerning the factors that contribute to socioeconomic differences in retirement on the grounds of mental disorders, which has not thus far been investigated separately. Similar findings on all-cause disability retirement and retirement on the grounds musculoskeletal diseases have nevertheless been reported. According to two recent studies, physical strains and exposures as well as a low level of job control are the most influential factors mediating social class differences in all-cause disability retirement (Haukenes et al. 2011; Polvinen et al. 2013a). In one of these studies, however (Haukenes et al. 2011), the magnitude of the mediating effect of

physical demands was more modest than in the present study, and in the other one (Polvinen et al. 2013a) job control had a mediating effect in the case of all-cause disability retirement but not in the case of retirement on the grounds of musculoskeletal diseases.

The present study indicated that disadvantages related to high job demands and computer work were more common among those in higher social classes, and this widened social-class differences particularly with regard to disability retirement on the grounds of mental disorders. In other words, the class differences would be even wider if those in the lower classes faced, in addition to other observed strenuous working conditions, the same level of job demands and the same amount of computer work as those in higher classes. It should be noted, however, that the results of the present study are based on an occupational cohort of female-dominated municipal employees and may therefore not be generalizable to employees more generally. Previous studies report conflicting findings concerning the contribution of job demands, which according to a nationally representative study conducted in Finland, attenuate social-class differences in disability retirement among men and widen them among women (Polvinen et al. 2013a). A study on the population of a Norwegian county, in turn, found that job demands widened social-class differences when they were accounted for separately, but made no contribution when other work-related factors and baseline health were simultaneously taken into account (Haukenes et al. 2011).

It may be that the results of the present study are, for the most part, valid for work disability more generally given the similar conclusions reported in studies on all-cause sickness absence: working conditions contribute more to social-class differences than health behaviours (Christensen et al. 2008b; Laaksonen et al. 2010), and physical contribute more than psychosocial working conditions (Christensen et al. 2008b; Hansen & Ingebritsen 2008; Laaksonen et al. 2010; Löve et al. 2013). A recent review covering a wider range of health outcomes reports mediating effects of both psychosocial and physical working conditions, particularly in studies using occupational classifications of socioeconomic position or objective health measures (Hoven & Siegrist 2013). It has also been suggested that working conditions contribute more than health behaviours to social-class differences in self-rated health (Borg & Kristensen 2000) and depressive morbidity (Stansfeld et al. 2003). Nevertheless, in the case of physical functioning it has been found that both health behaviours and working conditions among men, but only health behaviours among women, contribute to social-class differences (Stansfeld et al. 2003). Furthermore, the contribution of health behaviours to socioeconomic differences in mortality is typically relatively large, although the magnitudes of the effects vary between studies (Lantz et al. 1998; van Oort et al. 2005; Laaksonen et al. 2008b; Skalická et al. 2009; Stringhini et al. 2011; Gallo et al. 2012). Health behaviours may make larger contributions in cultural contexts in which there is clear social patterning in that respect

(Stringhini et al. 2011). Finnish studies, for example, have reported relatively large contributions of smoking, vegetable consumption and physical activity to educational differences in mortality (Laaksonen et al. 2008b). Smoking alone accounts for a large proportion of these differences among men, and a smaller but increasing proportion among women (Martikainen et al. 2013). All in all, the factors identified in the present study as contributing to socioeconomic differences in disability retirement vary from those found in other domains of health and mortality. The granting of a pension is closely associated with one's work environment, which may explain the larger contribution of working conditions than of health behaviours to the association.

This study further enhances understanding of the causes of ill-health-based early retirement. According to the findings, socioeconomic differences in disability retirement are strongly driven by push factors for exiting the work force. For one thing, strenuous working conditions, operating as push factors, mediated substantially the social-class differences. Second, income, which could also operate as a pull factor reflecting economic incentives for retirement, had much less influence than education and social class.

Some of the social-class differences remained unexplained even after accounting for working conditions and health behaviours. Moreover, the large effect of education that remained after accounting for other socioeconomic factors was not further investigated in this study. The literature suggests that the pathways between education and ill health are likely to relate to a lack of knowledge, skills as well as other cognitive abilities and non-material resources required for adopting a healthy lifestyle and avoiding disease (Ross & Wu 1995). However, studies have indicated that lifestyle factors have a relatively modest contribution to socioeconomic differences in disability retirement even if education were used as the socioeconomic measure (Krokstad et al. 2002; Hagen et al. 2006; Nilsen et al. 2012). The unexplained socioeconomic differences may be partly attributable to various factors associated with socioeconomic position, health and subsequent disability retirement. Such factors may include material resources (Laaksonen et al. 2005b; Aldabe et al. 2011) as well as psychosocial and personality factors (Appelberg et al. 1996; Manninen et al. 1997; Suominen et al. 2005; Valset et al. 2007; Aldabe et al. 2011; Ropponen et al. 2012). Furthermore, circumstances over the whole life course, including genetic liabilities and experiences in childhood or adolescence, may have a part to play (Upmark et al. 2001; Gravseth et al. 2007; Harkonmäki et al. 2007, 2008; Narusyte et al. 2011; Johansson et al. 2012; Samuelsson et al. 2012), as may cumulative exposure to health behaviours (Ropponen et al. 2011) and working conditions (Monden 2005).

DISABILITY RETIREMENT AND MENTAL-HEALTH-RELATED OUTCOMES

Another aim of the study was to enhance understanding of mental-health-related outcomes in disability retirement, and how they vary by key socio-demographic factors. The findings add to current knowledge of disability retirement as a life transition with its particular and yet diverse associations with mental health and mortality. The people affected comprise a heterogeneous group in terms of experiences of the retirement transition. More in-depth knowledge of the interacting associations of disability retirement and social circumstances with subsequent mental-health-related outcomes would facilitate the identification of groups at a higher risk of suffering from major health and social problems in association with work disability.

The results of the study indicate that a large pre-disability-retirement increase in depressive morbidity as measured by purchases of antidepressant medication may be followed by a long-lasting period of declining morbidity. Such changes turned out to be stronger in the case of retirement on the grounds of mental disorders as opposed to somatic causes. These population-based findings are generally in line with the results of previous studies based on Finnish public-sector employees (Oksanen et al. 2011; Laaksonen et al. 2012). Given the lack of observed changes in depressive morbidity around statutory retirement, changes before and after disability retirement are not likely to relate to the retirement transition in general, but may rather be attributable to the associated loss of health and work ability.

Disability retirement on the grounds of mental disorders is, by definition, preceded by large-scale deterioration in mental health that relates to an increase in the use of antidepressant medication before the transition. An increase in depressive morbidity before retirement on somatic grounds may reflect the comorbid effects of mental and physical ill health (Karpansalo et al. 2005; Mykletun et al. 2006). Furthermore, those who are about to take disability retirement are typically on sick leave during the run-up period: it is a period of intensive care and treatment related to the process of rehabilitation, assessing future work ability, and ultimately applying for a disability pension. The decrease in antidepressant medication after retirement may reflect an improvement in depressive morbidity, which in turn may be partly attributable to the removal of work-related strain. Even though a person is typically on sick leave at the time of disability retirement, he or she is still a member of the work force. The transition to a more permanent state of retirement may help in terms of becoming distanced from work-related stressors. Disability retirement may also bring relief and security after the long and potentially stressful process leading up to it. However, a drop in the use of antidepressant medication should not be interpreted outright as declining depressive morbidity, because it is not necessarily an indication of a decreased need for treatment. A post-retirement decrease in usage may also reflect a reduction in efforts to restore

work ability and functioning, as well as the loss of occupational healthcare (Kelly & Dave 2011; Oksanen et al. 2011).

Even though disability retirement is likely to be followed by improvements in mental health within the individual, the people affected nevertheless remain a largely disadvantaged group compared to the general population. The present study reports substantial excess mortality after retirement on the grounds of mental disorders, particularly for unnatural and alcohol-related causes of death. Moreover, excess mortality was larger among those whose retirement was based on mental disorders other than depression, except in the case of suicides when the excess was particularly large following depression-based retirement. Previous studies have also indicated high mortality among those who retire on the grounds of mental disorders (Wallman et al. 2006; Gjesdal et al. 2008, 2009). However, there is thus far a lack of evidence concerning excess mortality after retirement on the grounds of depression in particular, as well as by various causes of death.

This study further brings novel insights into the socio-demographic variation in mental-health-related outcomes of disability retirement. Gender had only a limited influence on the patterns. According to the trajectories of depressive morbidity, men retiring on the grounds of depression may benefit slightly more from the transition to retirement than women. The patterns of excess mortality after retirement on the grounds of mental disorders were also relatively similar among both men and women despite the higher overall level of mortality among the men. Men and women in Finland tend to have relatively similar employment histories, which may contribute to their similar experiences in the disability-retirement process.

Age had substantial modifying effects on both of the investigated outcomes. Those retiring at younger ages experienced larger pre-disability-retirement increases in depressive morbidity than older age groups, and more limited improvement after the transition. Antidepressant medication among the under-45s decreased only modestly after depression-based retirement, and even increased after retirement on somatic grounds. Younger adults retired on the grounds of depression also showed larger excess mortality from both natural and unnatural causes than their older counterparts compared with the general populations of the respective age groups. Moreover, comparisons of the different age groups in absolute terms revealed higher levels of mortality from unnatural causes among young women retired on the grounds of depression than in their older counterparts, and a similar level among young men. On the other hand, the absolute level of mortality from both natural and unnatural causes among men retired due to mental disorders other than depression was considerably higher in the older age groups. This was largely attributable to the high proportion of alcohol-related disorders as diagnosed causes of disability retirement among those over 44 years of age.

Various mechanisms may explain the worse mental-health-related outcomes associated with disability retirement in young adulthood. Those

with the most detrimental health problems are likely to be selected into retirement at younger ages. In addition, the granting of a disability pension to older employees may highlight the occupational aspects of work disability (ETK 2013). These older retirees may therefore have less severe underlying health problems than their younger counterparts. Age may also influence outcomes related to mental disorders through differences in the nature of the underlying disorder, or through the survival of healthier individuals to older ages (Chang et al. 2010). A previous study found higher levels of excess mortality following hospital admission due to mental disorders among younger age groups (Laursen et al. 2007). It has also been suggested that early exit from the labour market may be more stressful for young adults than for those closer to the statutory retirement age. Retirement in early adulthood deviates from the normal life course and could therefore constitute a stressful life transition (Butterworth et al. 2006; van Solinge & Henkens 2007).

The present study also found indications of a somewhat bigger improvement in depressive morbidity following depression-based disability retirement among those in higher social classes. This is in line with previous findings (Oksanen et al. 2011). Non-manual employees are likely to be exposed to higher work demands, which in turn may contribute to the more beneficial effects of retirement on wellbeing due to relief from work-related stress (Wheaton 1990). However, there was no evidence in the present study of social-class differences in the trajectories of depressive morbidity following retirement on somatic grounds. The pre-retirement increase was, nevertheless bigger among those in higher social classes, which may be partly attributable to the different somatic symptoms leading to disability retirement among different classes. The findings also indicate that depression-based retirement may lead to somewhat longer-lasting improvements in depressive morbidity among those living with a partner: spousal support may positively influence experiences related to the retirement transition (Kim & Moen 2002; van Solinge & Henkens 2007).

Despite the finding in the present study that those in higher social classes and those living with family members did not show worse mental-health trajectories after disability retirement than those in lower social classes and those living alone, both groups showed larger excess mortality attributable to unnatural and alcohol-related causes following retirement on the grounds of mental disorders, in comparison with the general population of the respective socio-demographic group. In absolute terms, however, mortality was particularly high among men having retired due to mental disorders who were living alone, whereas the general level was similar across the social classes. Thus far there is scant information about the modifying effects of social class and living arrangements on post-disability-retirement excess mortality. After all-cause sickness absence, however, higher levels of excess mortality have been found in the higher social classes (Vahtera et al. 2004; Lund et al. 2009), but this modifying effect has not been examined separately

with regard to particular diagnosed causes of work disability or different causes of death. The results of the present study indicate that among those who have already developed severe mental illness leading to disability retirement, a high social class and family ties are less protective against mortality from unnatural and alcohol-related causes than among the general population. It is also suggested in other studies that typical associations between socioeconomic factors and mortality are not always found among mentally ill populations: the effects may be weaker or less consistent. This indicates, for example, higher levels of mental-ill-health-related excess mortality from alcohol-related accidental and violent deaths (Moustgaard et al. 2013), as well as homicidal deaths (Crump et al. 2013), among those in higher socioeconomic positions. On the other hand, a previous study found no variation by living arrangements in excess mortality from different causes among those with depression (Moustgaard et al. 2013). Depression-based disability retirement requires both severe medically diagnosed depressive morbidity and long-term loss of work ability. The people affected are therefore subjected to particular selective mechanisms in the process towards retirement and may therefore have different characteristics than depressed populations in general.

8.2 METHODOLOGICAL CONSIDERATIONS

STRENGTHS

This study has several strengths. The populations were, for the most part, derived from a register-based representative sample of the Finnish population including large longitudinal data sets. Records on various socio-demographic factors, retirement, medication and mortality could be linked from various administrative sources by means of unique personal identification numbers. Sub-study II also linked register data to information from survey questions on a large set of working conditions and health behaviours that is not available in the registers. The statistical power of the analyses was especially high in the fully register-based Sub-studies I, III and IV. The use of register-based data also guarded against reporting bias, missing information and loss to follow-up.

Sub-study I showed that different approaches to the measurement of inequality, in other words the use of either HRs or the RII, produce complementary views on the importance of education and social class as determinants of disability retirement. With regard to HRs, the difference between the highest and the lowest groups was larger for education than for social class. Higher tertiary education nevertheless concerns only a relatively small group of individuals due to the skewed distribution of education in the population, whereas upper non-manual employees constitute a relatively large group given the more even distribution of the classes. Measured by the

RII, which takes the distributions of the socioeconomic indicators into account and thereby better captures overall inequality in the population (Shaw et al. 2007), social-class differences were larger than educational differences. Inequality indices have been used previously to facilitate comparison between various socioeconomic indicators as determinants of health and mortality (e.g., Lahelma et al. 2004; Næss et al. 2005; Martikainen et al. 2007). The use of both HRs and the RII in the present study led to a more comprehensive understanding of socioeconomic differences in disability retirement.

Sub-study III examined changes in antidepressant medication during a follow-up period of several years before and after retirement. Corresponding study designs using repeated measures to plot health trajectories around retirement have become more common only in recent years, making use of extensive panel survey data (Westerlund et al. 2009, 2010; Jokela et al. 2010) or register-based longitudinal medical records (Wallman et al. 2004; Oksanen et al. 2011; Laaksonen et al. 2012). This study design has the benefit of comprehensively capturing developments in pre- and post-retirement morbidity. The present study also uses objective data on antidepressant medication prescribed by a physician, and therefore reflects medically diagnosed conditions requiring treatment. The large data set enabled the separate analysis of disability retirement on the grounds of depression and somatic causes even when stratified by socio-demographic factors. Similarly in Sub-study IV, the large data set, the 80-per-cent oversample of deaths and the long follow-up period made it possible first to follow up a cohort for disability retirement on the grounds of mental disorders, and then to examine excess mortality among these retirees due to depression and other mental disorders in different socio-demographic groups.

WEAKNESSES

The survey data in Sub-study II had certain limitations. Non-response (33%) and the exclusion of those who did not give consent to register-data linkage (26%) may have biased the findings. Non-response analysis of the HHS data has shown that survey participation (and, to a smaller extent, giving consent to data linkage) was somewhat less common among younger employees, those in lower socioeconomic positions and those with medically confirmed sickness absence. However, the associations between the other study variables and survey participation were generally not modified by health status as measured by sickness absence (Laaksonen et al. 2008a). There was also a lack of statistical power in Sub-study II, particularly among men as well as in the analyses stratified by the diagnosed cause of disability retirement. Furthermore, working conditions and health behaviours were self-reported and thus may be subject to reporting bias. For example, if those with health problems overestimate the strenuousness of their work environment, the contribution of working conditions to disability retirement

may be overestimated. Moreover, Sub-study II was based on middle-aged employees of a single municipal employer and therefore cannot be generalized to the workforce at large (Lahelma et al. 2013).

Given the methodology used in Sub-study I, it was not possible fully to account for the temporal patterning of various socioeconomic indicators in the regression analyses. More sophisticated assessment of their direct and indirect effects on disability retirement in future analyses would require alternative methods such as the use of structural equation models (e.g., Singh-Manoux et al. 2002). Furthermore, the socioeconomic factors were measured only at baseline in order to minimise the potential influences that the disability retirement process may have on socioeconomic position. This may, however, underestimate the effects of income since it is the socioeconomic measure most likely to change during the follow-up. Assessment of the association between socioeconomic position and subsequent disability retirement in Sub-studies I and II may also be subject to health selection. Health problems that eventually lead to disability retirement may have hindered the attainment of a high socioeconomic position or led to downward occupational mobility. This may overestimate the causal effect of socioeconomic position on disability retirement, or the mediating effect of working conditions on this association, given that working conditions are more disadvantageous in lower socioeconomic groups. Most studies that simultaneously assess social-causation and health-selection paths indicate that the latter is unlikely to have a large effect on socioeconomic differences in mental, physical and self-rated health (Chandola et al. 2003; Warren 2009). However, there is evidence of a large contribution of health selection early in life to socioeconomic differences in psychosomatic symptoms, particularly among men (Huurre et al. 2005). Although there may be health selection in young adulthood, its effect on socioeconomic differences in disability retirement is likely to be relatively small among older study populations, particularly the middle-aged employee cohort examined in Sub-study II. Furthermore, employees with poor health may transfer from more strenuous occupations or work tasks to lighter ones, which may underestimate the mediating effect of working conditions on the association between social class and disability retirement.

Assessment of the association between disability retirement and depressive morbidity in Sub-study III has certain limitations. It is difficult to make conclusions of the health effects of retirement in the absence of a proper control group: trajectories of a hypothetical reference population that would not have been granted a pension remain unknown. The observed decrease in morbidity may be related to recovery after a depressive episode that led to disability retirement. The normal course of depression often consists of periods of recovery and recurrence (Richards 2011). However, given that the shape of the trajectories was similar in retirement on the grounds of both mental disorders and somatic causes and that the peak in antidepressant medication occurred immediately around the transition, the

decrease in morbidity is likely to have at least some link to the retirement transition. The use of antidepressant medication as a measure of depressive morbidity also has its weaknesses. Although antidepressants are primarily used in Finland to treat depression, they are also used to treat conditions such as anxiety, chronic pain and sleep problems. Their non-psychiatric use is nevertheless less common among those in disability retirement than in other groups (Sihvo et al. 2008). Furthermore, sensitivity analyses were carried out excluding medication of less than one-third of the full daily dose, i.e. under 30 DDDs per three-month period. The effect on the results was negligible (results not shown), suggesting that antidepressant medication used in small doses for somatic conditions is unlikely to have a large influence on their interpretation. Another weakness, however, is that purchases of antidepressants capture only medically treated diagnosed conditions. A large proportion of people with depression do not receive treatment. A Finnish study nevertheless found that employment status was not associated with the use of antidepressants among those with a major depressive disorder (Hämäläinen et al. 2009).

It was not possible in Sub-study IV to assess whether the excess mortality after disability retirement on the grounds of mental disorders was attributable to the retirement transition or to the underlying disorder. This is a common shortcoming of observational studies on the association between disability retirement and mortality (Wallman et al. 2006; Karlsson et al. 2007; Gjesdal et al. 2008). Furthermore, the category 'mental disorders other than depression' comprises a wide range of psychiatric conditions that vary in their nature, severity and association with mortality. Results concerning this heterogeneous group should therefore be interpreted with caution. Excess mortality was particularly large following retirement on the grounds of alcohol-related disorders, which therefore made a major contribution to the results for this category.

9 CONCLUSIONS

Socioeconomic and socio-demographic factors play an important role in disability retirement in terms of both its causes and consequences. This study indicates that a low level of education increases the risk of disability retirement mainly through its connections with ending up in a lower occupational position. In addition, the effects of a lower level of education operate through other pathways that could not be further elaborated in the present study. The higher risk among those in lower social classes is largely attributable to unfavourable working conditions, whereas the contribution of health behaviours and income to the association is modest. Income has, all in all, only a limited influence. Efforts to reduce social-class differences in disability retirement should focus particularly on the physical working conditions and the extent of job control among those in the lower classes. Although the extent of manual work cannot be decreased in all occupations, interventions could still be made to lighten the workload and to reduce hazardous exposures. Much attention has been paid in recent years to the association between the psychosocial work environment and different health outcomes (Siegrist & Marmot 2004; Stansfeld & Candy 2006; Bambra et al. 2009; Backé et al. 2012; Lang et al. 2012; Niedhammer et al. 2013). However, physical work continues to have major implications with regard to ill health and socioeconomic health inequalities (Aittomäki 2008; Rahkonen et al. 2011). Improvement in the physical work environment in particular would significantly help in tackling socioeconomic differences in disability retirement. Other strategies have also been suggested, including the general promotion of healthy lifestyles, the prevention and treatment of chronic diseases in the working-aged population, and occupational rehabilitation among employees with disabling conditions. Focusing such interventions on high-risk groups would reduce not only socioeconomic disparities in health and work ability but also the overall level of disability retirement, thereby contributing to longer working careers (Lahelma et al. 2012b).

Compared with its prevention, much less attention has been paid to coping with the individual-level consequences of disability retirement. The present study yields no evidence of worsening trajectories of depressive morbidity after the transition, however. Poor health outcomes, including excess mortality following retirement on the grounds of mental disorders, are therefore likely to relate to underlying ill health and other associated already existing social problems. The results of this study show that mental-health-related outcomes after disability retirement vary by population groups. The typical protective influences of a high socioeconomic position and family ties on post-retirement mental ill-health and mortality do not fully apply in this case, the retirees being a highly selected part of the population in terms of ill health and other social disadvantages. Disability retirement in young

adulthood, approximately up to the mid-40s, is particularly strongly associated with prolonged mental-health problems and a high risk of mortality, especially from unnatural causes. Younger adults need specific interventions targeting mental ill health and its complex relations with non-employment, risky behaviours and other social problems (Mitchell et al. 2002; Bjarnason & Sigurdardottir 2003). Major individual- and social-level challenges arise from the exclusion of a relatively large proportion of young people from education and employment (Myrskylä 2011; OECD 2013). The prevention and treatment of mental disorders are also key areas of intervention. Mental ill health tends to be under-treated even among those who eventually retire on the grounds of diagnosed depression or other mental disorders (Honkonen et al. 2007; Øverland et al. 2007).

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