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Set for life?

SOCIOECONOMIC CONDITIONS, OCCUPATIONAL COMPLEXITY, AND LATER LIFE HEALTH

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Set for Life? Socioeconomic conditions, occupational complexity, and later life health

THESIS FOR DOCTORAL DEGREE (Ph.D.)

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I like work; it fascinates me. I can sit and look at it for hours.

Jerome K. Jerome

ABSTRACT

Life expectancy has increased in the western parts of the world and more people reach old age. Some groups of people have benefitted more of the increase in life expectancy and have better health than others. Because of biological, psychological, behavioral, and social factors over the life course, adverse health accumulates in later life. Most societies are socially structured and people higher in the social structure tend to have better health. People's position in the social hierarchy is commonly assessed by socioeconomic position (indicated by education, social class [occupation based], and income). Labor market stratification plays a central role in stratifying people in to socioeconomic positions. An important factor in the labor market stratification is the level of complexity of work. All these stratification principles could play a role in shaping the risk of adverse later life health. Identifying factors associated with later life health has become more important because of the growing number of people that reach old age.

The overall aim of this thesis was to investigate the relationships between socioeconomic conditions, the complexity level of peoples' work (measured as occupational complexity), and health in late life by studying 1) the association between complexity of work during midlife and later life health and 2) health inequalities in late life attributable to differences in socioeconomic position. All studies used individually linked data from the Swedish Level of Living Survey (LNU) and the Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD).

Results from study I showed that higher occupational complexity in midlife decreased the odds of psychological distress 20 years later. Socioeconomic position partly accounted for the association between occupational complexity and psychological distress. Still, occupational complexity may play a role in shaping the risk of psychological distress in old age.

Results from study II showed that the magnitude and direction of the effect sizes, for education, social class, and occupational complexity were similar in relation to later life health (psychological distress and physical functioning). Income was more strongly associated with late life health than the other indicators of socioeconomic position. The income-health association was also the only one that remained significant in the mutually adjusted models. Thus, if the primary objective to include socioeconomic position is to statistically adjust for socioeconomic position, income may be the preferable single indicator. However, if the primary objective of a study is to analyze socioeconomic health inequalities, and the underlying mechanisms that drive these inequalities, then the choice of how to measure socioeconomic position should be carefully considered.

Results from study III initially showed that occupational complexity scores aggregated from across the working life and different trajectories of occupational complexity were associated with physical function (as indicated by mobility and ADL limitations) in late life. Adjusting for socioeconomic position diminished the association. This suggest that the association was confounded (or possibly mediated in the case of income) through socioeconomic position.

Results from study IV showed that financial hardship in childhood increased the risk of psychological distress in late life (at mean age of 81 years). This was partly explained by a direct association from financial hardship in childhood to psychological distress in later life. In addition, chains of risks were found between financial hardship in childhood and psychological distress in later life. This means that financial hardship in childhood increased the risk of a) psychological distress in midlife, b) lower levels of education, c) unemployment in midlife, and d) financial hardship in midlife, which, in turn, increased the risk of psychological distress in later life.

In summary, the results from this thesis showed that there are socioeconomic health inequalities in later life. Lower socioeconomic position in midlife and financial hardship in childhood increase the risk of adverse later life health. Moreover, higher occupational complexity in midlife was investigated, and showed, to play a role in shaping the risk of psychological distress in late life. In contrast, the results showed that occupational complexity is not associated with physical functioning. Occupational complexity play a role in determining socioeconomic position, however, it does not capture an aspect of general life chances that comes with higher socioeconomic position and is relevant for health, beyond that of education, social class, and income.

SAMMANFATTNING

Den förväntade livslängden ökar i många länder och fler individer når hög ålder. Vissa grupper av individer tenderar att ha bättre hälsa och högre förväntad livslängd än andra. Samhällen tenderar att vara socialt strukturerade och personer som innehar positioner högre upp i strukturen har i genomsnitt bättre hälsa än de på lägre positioner. Individers position i den sociala strukturen mäts ofta i termer av socioekonomisk position (indikerat av utbildningsnivå, social klass och inkomst). Arbetsmarknaden är en central arena för de processer som skapar den socioekonomiska strukturen och fördelar livschanser i befolkningen. En bidragande faktor till stratifieringen på arbetsmarknaden är komplexitetsgraden på en persons yrke. Dessa processer påverkar, i sin tur, sannolikheten att exponeras för olika hälsorisker. I och med att befolkningen åldras har intresset för faktorer som påverkar hälsan senare i livet ökat. Hälsa senare i livet påverkas av förutsättningar och exponeringar under hela livet och erfarenheter från arbetsmarknaden kan påverka hälsan senare i livet.

Det övergripande syftet med den här avhandlingen var att undersöka sambanden mellan socioekonomisk position, yrkets komplexitetsgrad och hälsan senare i livet. I avhandlingen undersöktes: 1) sambandet mellan yrkets komplexitetsgrad och hälsa senare i livet och 2) socioekonomisk ojämlikhet i hälsa senare i livet. Alla delstudierna i avhandlingen använde data från Levnadsnivåundersökningen (LNU) och Undersökningen om äldres levnadsvillkor (SWEOLD).

Resultaten från studie I visade att det fanns ett samband mellan grad av komplexitet i senare delen av yrkeslivet och psykiska besvär ca 20 år senare. Socioekonomisk position förklarade delvis detta samband men komplexitetsgraden i yrket hade ett samband med psykiska besvär senare i livet som kvarstod när vi tog hänsyn till skillnader i socioekonomisk position.

Resultaten från studie II visade att utbildningsnivå, social klass och yrkets komplexitetsgrad hade ungefär lika starka samband med hälsa senare i livet (psykiska och fysiska besvär). Inkomst hade lite starkare samband med hälsa och var också den enda indikatorn för socioekonomisk position som fortfarande hade ett statistiskt säkerställt samband med hälsa i modeller som inkluderade alla indikatorer på socioekonomisk position.

Resultaten från studie III visade att det inte fanns något samband mellan yrkets komplexitetsgrad och nedsatt rörelseförmåga eller förmåga att klara grundläggande, vardagliga aktiviteter (äta, gå på toaletten, tvätta håret, klä på sig eller gå och lägga sig) när hänsyn togs till skillnader i socioekonomisk position.

Resultaten från studie IV visade att det fanns ett samband mellan ekonomiska svårigheter under uppväxten och risken för psykiska besvär när personerna var i 80-års åldern. Sambandet drevs delvis av direkta samband mellan ekonomiska svårigheter i barndomen och psykiska besvär i hög ålder. Men en del av sambandet gick också via utbildning, arbetsliv, ekonomiska svårigheter och psykiska besvär i medelåldern. Det vill säga, de som upplevde ekonomiska svårigheter i barndomen löpte en förhöjd risk för låg utbildning, arbetslöshet, ekonomiska

svårigheter och psykiska besvär i medelåldern, vilket i sin tur var kopplat till en förhöjd risk för psykiska besvär sent i livet.

Sammanfattningsvis visar resultaten i den här avhandlingen på robusta samband mellan socioekonomisk position i medelåldern och hälsan senare i livet, samt mellan ekonomiska svårigheter i barndomen och psykisk hälsa senare i livet. Dessutom pekar resultaten på att det finns samband mellan komplexitetsgraden på det yrke man har i vuxen ålder och risken för psykiska, men inte fysiska, besvär senare i livet.

LIST OF SCIENTIFIC PAPERS

This thesis is based on the following four papers, referred to in the text by their respective Roman numerals.

I. **Darin-Mattsson A**, Andel R, Fors S, Kåreholt I. Are occupational complexity and socioeconomic position related to psychological distress 20 years later? *Journal of Aging and Health 2015:7:1266-1285.*

II. **Darin-Mattsson A**, Fors S, Kåreholt I. Different indicators of socioeconomic status and their relative importance as determinants of health in old age. *International Journal for Equity in Health 2017:16:1:173.*

III. **Darin-Mattsson A**, Andel R, Fors S, Nilsen C, Fritzell J, Kåreholt I. Occupational complexity and late life physical functioning in Sweden. *Manuscript*

IV. **Darin-Mattson A**, Andel R, Keller Celeste R, Kåreholt I. Linking financial hardship throughout the life-course with psychological distress in old age: sensitive period, accumulation of risks, and chains of risk hypotheses. *Manuscript*

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CONTENTS

LIST OF ABBREVIATIONS

ADL	Activities in Daily Living
AME	Average Marginal Effect
EGP	Erikson–Goldthorpe–Portocarero
LNU	The Swedish Level of Living Survey
OR	Odds Ratio
SEI	Swedish Socioeconomic Classification
SEK	Swedish krona
SEP	Socioeconomic position
SES	Socioeconomic status
SWEOLD	Swedish Panel Study of Living Conditions of the Oldest Old

1 INTRODUCTION

For approximately 250 years, life expectancy has increased in the western part of the world. In the beginning of the 20th century, the increase in life expectancy was mostly driven by lower death rates in younger people. Since the 1950s, most of the increases in life expectancy have been caused by improvements in survival after age 65 (Oeppen & Vaupel, 2002). In Sweden, the number of people 75 years or older has increased by 270% since 1960. The increase is even larger in the group of people 85 years or older. In 2020, more than 1 million people will be 75 years or older (Statistics Sweden, 2017). The increase in life expectancy has been ranked as one of the world's greatest achievements (World Health Organization, 2011). However, this great societal success also leads to more societal expenditures, as people in late life most often require more health care and social services than younger people (Jagger et al., 2011).

Socially disadvantaged groups tend to have poorer health than more advantaged groups, and those with more social advantages have benefitted more from the increases in life expectancy (Pongiglione et al., 2015). One of the most reliable findings in the social sciences is that people with higher socioeconomic positions tend to live longer and healthier lives than those with lower socioeconomic positions (Fritzell, 2014). This association is also evident in countries with relatively equal distribution of resources, little absolute poverty, and an ambitious egalitarian welfare apparatus (e.g., Sweden) (Fritzell and Lundberg, 2007). Health differences between people who occupy different positions in the social structure are in some cases larger in Sweden than in other European countries (Mackenbach et al., 2008). Despite efforts to decrease these inequalities, they persist across space and time (Link and Phelan, 1995; Phelan et al., 2010). What drives these inequalities is difficult to disentangle.

The labor market plays a crucial role in the distribution of life chances and material rewards. Thus, inequalities are largely shaped by labor market processes. One such process is (unequal) selection into occupations that have different levels of complexity in working tasks. People with higher socioeconomic positions tend to have occupations with relatively complex everyday tasks; that is, they experience occupational complexity (Le Grand and Tåhlin, 2013). Because people are living longer, interest in identifying work-related factors associated with health in late life has increased (Nilsen et al., 2014; Parker et al., 2013; Wahrendorf et al., 2013). Occupational complexity seems to play a role in the pathway to later life health. Research has shown that higher occupational complexity is associated with lower risk for dementia and better cognitive function (Andel et al., 2005). A better understanding of how occupational complexity and socioeconomic position work together to influence later life health might inform policies aiming to increase health and to reduce health inequalities in late life.

The overall aim of this doctoral thesis is to investigate the relationship between socioeconomic position and occupational complexity and to assess how the two factors work together to influence health in late life.

2 LATER LIFE HEALTH

In this chapter, I present a short overview of the concept of health as used in this thesis and of the health indicators used in the four studies that constitute the thesis.

Health is a multidimensional concept that has different meanings and interpretations. In 1946, the World Health Organization (WHO) proposed a broad definition of health that included physical, mental, and social dimensions. WHO defined health as "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1980). This definition was groundbreaking and ambitious because of its holistic and utopian view of health; however, it was also widely critiqued (Huber et al., 2011). Most of the critique was aimed at its low operational value; according to this definition, most people would be unhealthy most of the time. However, people of old age is a group with heterogenic health and broad definitions including many aspects of health have also been used to define the concept of "healthy aging" in Sweden (The Public Health Agency of Sweden, 2018). WHO has identified five domains essential for healthy aging that are related to functional ability; meet their basic needs; learn, grow, and make decisions; be mobile; build and maintain relationships; and contribute. These domains are essential for people to fulfill things that they value and to keep autonomy and health (World Health Organization, 2015). In general, older people experience more psychological, physical, and social complications than younger people.

Although the psychological, physiological, and social domains of health are related, indicators of psychological and physical health and social well-being are distinct and each is fundamental to health in late life in its own right (Marengoni et al., 2011; Santoni et al., 2015) As people age, multimorbidity (the simultaneous experience of several diseases) becomes increasingly common. It is nearly impossible for the health care system to guarantee that people in late life fulfill the criteria for good health with this broad definition of health. Instead, the health care system does its best to eliminate the adverse health. Thus, the most traditional indicator of health in older adults is the absence of diseases. This perspective relies on eliminating "evils" instead of creating a utopian health for everyone. This was also the perspective chosen for this thesis, in which health was measured, as psychological health problems indicated by psychological distress, and as impaired physical function indicated by mobility limitations and limitations in activities of daily living (ADL).

2.1 PSYCHOLOGICAL HEALTH

Psychological distress is the unpleasant and subjective experience of depressive symptoms and anxiety, which can have both emotional and physiological manifestations. Psychological distress often stems from being unable to cope with negative life events and adverse circumstances and/or being stressed (Mirowsky and Ross, 2003a). In Sweden, psychological distress is most common in younger adulthood and in later life, and least common in midlife. About 40% of women and 30% of men age 80 to 84 report moderate or severe symptoms of anxiety or depression (Molarius et al., 2009). Psychological distress often goes undetected because people do not seek care for these symptoms (Stefansson, 2006).

2.2 PHYSICAL FUNCTION

Physical function affects people's ability to perform activities. The inability to perform activities in any domain of life (e.g., hobbies, shopping, hygiene) because of limitations in physical function is often defined as disability (Verbrugge and Jette, 1994). Mobility limitation; e.g, balance or walking speed, increase the risk for disability (Heiland et al., 2016). Mobility limitations and disability increase community dependency and is associated with quality of life, and health care utilization (Ahacic et al., 2000; Marengoni et al., 2011; Rantakokko et al., 2013).

Severe disability is often measured as limitations in activities in daily living (ADL), whereas mild disability often is measured as limitations in instrumental activities in daily living (IADL). ADL is a measure of basic activities (e.g., eating, using the toilet, or getting dressed) and was constructed as an instrument to indicate how much care a person needs (Katz, 1983). ADL limitations are related to reduced quality of life and increased mortality (Hirsch et al., 2011). It has been estimated that about 10% of the 65-75 years old population have ADL limitations in Sweden (World Health Organization, 2015), and this prevalence increases to 20-25% in those 75 years or older, and up to 40% above age 90 (Angleman et al., 2014).

Mobility limitations are not as severe as disability; however, it is associated with multimorbidity, quality of life, and health care utilization (Marengoni et al., 2011). People under the age of 40 rarely have mobility limitations, but after 60, there is an increase in the incidence rate (Ahacic et al., 2000; Heiland et al., 2016). In Sweden, the prevalence of at least one mobility limitation has been estimated to be about 9% among people 60 years old and to increase substantially with increasing age, about 80% was estimated to have at least one mobility limitation at age 84 (Heiland et al., 2016). In Sweden, the prevalence of mobility limitations in people 77 years or older increased from 1992 to 2011, and women have a higher risk of developing mobility limitations than men (Fors and Thorslund, 2015).

3 SOCIAL STRATIFICATION

The hierarchical ordering of positions in the social structure is often termed social stratification. People in higher positions in the social structure have more advantages, better life chances, and less exposure to risks. Social stratification can be based on any number of characteristics, including but not limited to age, ethnicity, gender, sexual orientation, and socioeconomic position. The socioeconomic stratification principle is present in most societies and exert strong influence on the social structure (Goldthorpe, 2004). This is the dimension of stratification investigated in this thesis. Stratification principles can change over time and place; however, the relationship between positions in the social structure are usually stable over time and place (Goldthorpe and Jackson, 2007). Socioeconomic resources are also the resources most easily transferred between generations (Molander, 2016). The resources associated with the positions in the structure are independent of the person inhabiting the position. People with positions at the lower end of the social hierarchy tend to have worse health than those at the upper end.

3.1 SOCIOECONOMIC POSITION

Socioeconomic position is a concept that describes relative standing in a socioeconomic hierarchy. It follows from the idea that positions in a social structure are associated with a set of resources independent of the person occupying the position (Glymour et al., 2014). That is, a position's relative standing does not change with the abilities of the person who occupies the position at the moment. For example, the wages earned from specific occupations are usually rather stable. A doctor earns more than a nurse independent of who is doctor and who is nurse. Hence, the positions are relative in their standing, independently of the people occupying the positions, and the positions come with certain resources.

Socioeconomic position and socioeconomic status are two concepts often used interchangeably. However, there is a difference between the concepts. Whereas socioeconomic position is a relative measure (one person's standing in relation to other people's standing), socioeconomic status refers to the resources of a person (not in relation to others) (Glymour et al., 2014). People or groups of people can have different amounts of resources without necessarily affecting their relative standing. In the United States, it is more common to discuss from the perspective of socioeconomic status while the European tradition is to discuss from the perspective of socioeconomic position. The use of occupation-based measures as a marker of socioeconomic standing is more common in the European tradition of health studies while in the United States occupation-based measures have sometimes been viewed as a surrogate for education and income (Nam and Boyd, 2004).

The most commonly used indicators of socioeconomic position are education, occupation-based social class, and income. In studies of health, these dimensions of socioeconomic position have often been used as if they were interchangeable. Some sociologists have tried to find one indicator to capture the underlying concept of socioeconomic position. However, that has proven rather difficult, and many argue that one indicator is not enough to capture the multidimensionality of the relationship between socioeconomic position and health (Geyer et

al., 2006; Torssander and Erikson, 2009). Moreover, creating one multidimensional measure that includes many pathways and possible mechanisms to explain the association between socioeconomic position and health does not provide information useful for policy or that furthers the understanding of why socioeconomic position is associated with health (Deaton, 2002; Goldthorpe, 2009). Even though these dimensions tap in to the same underlying processes and have overlapping properties, they are also independently associated with different health outcomes in the working-age population (Geyer et al., 2006; Torssander and Erikson, 2009). The interpretation of the association between socioeconomic position and health depends on which dimension of socioeconomic position is studied, however, many studies do not provide a rationale for the indicator they use (Geyer et al., 2006; Ploubidis et al., 2014). Few studies have investigated the relationship between multiple dimensions of socioeconomic position and health in late life (Avlund et al., 2003; Duncan et al., 2002; Grundy and Holt, 2001).

There are three main reasons to include indicators of socioeconomic position in a study about health differences. The first is to map the differences in the health of people occupying different socioeconomic positions. The second is to investigate how and why socioeconomic position, and the different dimensions of socioeconomic position affect health. This could guide policies aiming to reduce the influence of social conditions on health and increase understanding on specific populations (Glymour et al., 2014). The third is that socioeconomic position is a confounder in many other associations. If one aims to estimate a causal effect, socioeconomic position should often be considered and maybe accounted for.

3.1.1.1 Education

One of the most commonly used indicators of socioeconomic position is education. The use of education as an indicator of socioeconomic positions has its origins in Weberian theory of status domains (Galobardes et al., 2006). Education marks a person's social standing from early adulthood and forms a bridge between the social standing of parents and the social standing of their children (Lynch and Kaplan, 2000; Mirowsky and Ross, 2003b). Education plays an important role in the social stratification process in part because it enables access to better occupations and higher salaries and can facilitate social mobility. Education also increases people's skills, psychological resources, productivity, health behaviors, and self-control (Mirowsky and Ross, 2005). More psychological resources, self-control (e.g., the feeling of being able to define goals and reach them), and better health behaviors have a positive impact on health (Ross and Mirowsky, 2013). Education is typically a stable measure from early adulthood and aims to measure knowledge related assets of people (Galobardes et al., 2006). People with higher levels of education tend to have better health in late life than those with lower levels of education (Fors and Thorslund, 2015).

3.1.1.2 Occupation-based social class

There are several theories as to how occupations structure life chances, and there is a wide range of different class schemas. Most commonly, class schemas divide groups of people by

their positions in the labor market. The primary line of division, in classical sociology, runs between those who own the means of production and those who make a living from selling their labor (e.g., between employers and employees). Secondly, groups of employers and employees are distinguished by type of organization, skill requirements, power relations, and working conditions (Goldthorpe, 2007; Rose and Harrison, 2014). Social class is associated with current income but also with income security (both short and long-term) and with income development (Goldthorpe, 2004; Watson et al., 2009). Thus, there is a direct link between social class and material resources. In addition, people with lower socioeconomic positions tend to be exposed to more adverse physical working conditions (e.g., adverse ergonomics, noise, and chemical exposures), more adverse psychosocial working environments (e.g., low autonomy, monotonous work, and low influence/decision-making), and more job insecurity (Albin et al., 2017). Both low social class and adverse physical and psychosocial working conditions are associated with worse health (Hoven and Siegrist, 2013; Lahelma et al., 2012; Siegrist and Marmot, 2004).

3.1.1.3 Income

Income is a marker of social standing in the social structure. In addition, income is associated with access to a range of resources. However, income is sensitive to reverse causality—people that get sick and cannot work usually lose income and that income can change fast and are not stable over time is sometimes overlooked in the literature (Galobardes et al., 2007). Income is arguably the most straightforward indicator of people's material conditions (Galobardes et al., 2006; Lynch and Kaplan, 2000). Income, or wealth, allows for more consumption, including more health-enhancing consumption; e.g., better food and exercise. In addition, it enables other health-related behaviors such as access to health services and leisure activities. Income is typically not linearly related with health, this means that the health returns diminish higher up in the income distribution (Rehnberg and Fritzell, 2016).

3.1.1.4 Other indicators of socioeconomic positions

In addition to education, social class, and income, there are other common indicators of socioeconomic positions. For example, poverty and wealth. Wealth and poverty are often used to indicate the opposite ends of the socioeconomic distribution. Common measure of relative poverty is having an income below 60% of the median income, and a measure of of the other end of the socioeconomic distribution could be income in top 1% of incomes at a big company (Bihagen et al., 2012; Fritzell et al., 2015). Wealth is typically a more comprehensive measure of material resources than income because it includes more assets a person has, whereas income does not. Another measure often indicating material resources is type of housing (tenant or owner), which has been associated with health in late life (Avlund et al., 2003).

Financial hardship or financial difficulties can be used to indicate positions in the lower end of the socioeconomic distribution. Financial hardships tend to be taxing for people (e.g., in terms of control over one's own life, health behaviors, stress, and material conditions) and is

associated with quality of life (Lynch and Kaplan, 2000; Wiggins et al., 2004; Marmot and Wilkinson, 2007; Siahpush and Carlin, 2006).

3.2 HEALTH INEQUALITIES

The term "health inequalities" refers to differences in health of social groups of people. These differences systematically follow the patterns of social structure such that, on average, people who occupy higher socioeconomic positions live longer and lead healthier lives than people who occupy lower socioeconomic positions. The term is generally used descriptively and does not include a moral dimension; that is, whether or not the inequalities are just (Arcaya et al., 2015). Health inequity is usually used when indicating that health inequalities are unjust (Kawachi et al., 2002), whether or not the health inequalities are unjust lies beyond the empirical studies included in this thesis.

3.3 EXPLANATIONS TO HEALTH INEQUALITIES

Socioeconomic inequalities in health have persisted over time and are present in all societies, even when major causes of morbidity and mortality have changed. The fundamental cause theory suggests that people who occupy higher socioeconomic positions will use their resources (money, knowledge, prestige, networks, and power) to avoid risk factors at any given time and place (Link and Phelan, 1995; Phelan et al., 2010). In contrast, people with low socioeconomic positions are not able to avoid such exposures. Link and Phelan argued that it is important to study socioeconomic position instead of only focusing on individual-based mechanisms because if the social context in which individuals act is overlooked, interventions will not be effective.

The fundamental cause theory is helpful in understanding why health inequalities persist over space and time, and a better understanding of social context may help increase the effectiveness of interventions. However, fundamental cause theory does not help us identify the dimensions of socioeconomic position that are most important to certain health outcomes. Moreover, it does not help us identify dimensions in which it is possible to intervene; instead, the fundamental cause theory suggests more distribution of resources.

However, other possible explanations of the association between socioeconomic position and health have been suggested. These explanations could result in interventions that are more specific. Most commonly, researchers seem to rely on four different explanations: selection or the materialistic, psychosocial, and/or behavioral explanation. These explanations relate to different dimensions of socioeconomic position, dimensions that are related to different sets of policy implications.

3.3.1 Selection

In contrast to social causation, in which low socioeconomic position leads to worse health, health selection (or reversed causality) occurs when adverse health hinders people from achieving higher socioeconomic position. If a child experiences a dramatic, long-lasting injury or has mental illness, the child will have more difficulty managing school (Case et al., 2005).

Without a proper education, it is hard to get a high-income job with beneficial working conditions. Similarly, if a worker gets a disease or mental illness, the person may not be able to work the way they did prior to the disease or mental illness and might lose income. Hence, in the process of health selection, it is not socioeconomic position that affects health, but rather health that affects socioeconomic position.

Despite the great amount of research focusing on health inequalities, it is still not clear whether social causation or health selection best explains the association between socioeconomic position and health. A meta-analysis showed that research using variables closely related to the labor market resulted in equal evidence in favor of social causation and health selection (Kröger et al., 2015). However, measures of education and income provided stronger support for the social causation hypothesis. Another study found no support for social causation and only weak support for health selection (with income) during a five year follow-up (Foverskov and Holm, 2016). Instead, they found that the association between socioeconomic position and health was most likely driven by indirect selection.

Indirect selection is a form of confounding in which a third variable drives the observed relationship. For example, people that are more ambitious might work harder to reach certain positions and might engage in health enhancing activities. In addition, greater cognitive ability, as well as some types of personality are more prized in the labor market and are also associated with better health (Batty et al., 2009; Bihagen et al., 2012; Turiano et al., 2011). Thus, personality and cognitive ability might explain any observed association between the socioeconomic position and health if not considered in the analyses.

3.3.2 The materialistic, psychosocial, and behavioral explanation

Materialistic explanations emphasize differences in material standards and living conditions as a cause of health inequalities (Lynch and Kaplan, 2000). Psychosocial explanations focus on stress as a response to disadvantages, as stress can have detrimental effects on both psychological and physiological health (Marmot and Wilkinson, 2007). Behavioral explanations focus on different lifestyles and health behavioral patterns to explain differences in the health of socioeconomic groups (Pampel et al., 2010)

It is easy to understand that material conditions such as access to clean water and a place to sleep are important to health. It might be harder to understand that even in high-income countries characterized by general prosperity, material resources explain health differences. However, having more resources expands people's opportunity to improve hazardous environments (e.g., achieve better working conditions, safer neighborhoods, and safer transportation), access better health care, and obtain more nutritious food (Berkman et al., 2014). For example, people with higher socioeconomic positions have more job security and better working conditions (they are at less risk of exposure to adverse ergonomics, noise, and chemicals or of experiencing low autonomy, monotonous work, and low influence/decision-making) (Albin et al., 2017). Even in high-income countries with general prosperity, material

standards differ by socioeconomic group (Lynch et al., 2000), and working conditions partly explain health inequalities (Moore and Hayward, 1990; Parker et al., 2013).

In contrast to materialistic explanations, psychosocial explanations emphasize subjective experiences and emotions that come from comparing one's position in the social structure to that of others or from experiencing disadvantages. The experience of having a lower position than others and of other disadvantages can result in acute and chronic stress. In addition, people who experience low control over their life or low autonomy are under constant stress that affects the neuroendocrine system. The neuroendocrine system (hormone signaling system) affects biological functions, and an overactivation of the system can cause both physiological and psychological illness (Marmot & Wilkinson, 2005; 2001). This may be one reason that work-related stress in midlife is associated with more adverse health outcomes in later life (Nilsen et al., 2014; Wahrendorf et al., 2012). Conversely, having a positive psychosocial work environment such as high complexity at work is associated with a lower risk of dementia and mortality (Fujishiro et al., 2017b; Karp et al., 2009; Moore and Hayward, 1990).

Behavioral explanations emphasize that some people have healthier behaviors than others. Studies show that people who occupy higher socioeconomic positions have more health-enhancing lifestyles than people who occupy lower socioeconomic positions; for instance, people with lower socioeconomic position smoke more and are more physically inactive (Pampel et al., 2010; Shaw et al., 2014).

These three explanations are not mutually exclusive; it is most likely that they interact to create health inequalities. People that occupy socioeconomic positions higher up in the social structure have greater command over resources. Therefore, they have more possibilities to act in what way they desire, which leads to more sense of control that is health enhancing (Fritzell and Lundberg, 2007). For example, people who occupy higher socioeconomic positions have higher income that result in more possibility to decide where to live, choose means of transportation, and what food to buy while people with low income have restricted opportunities to choose and decide by themselves. This could result in less hours of sleep and less nutritious food, which directly affect health. In addition, it might affect health by stress-related processes driven by feelings such as hopelessness, shame, anger, and despair (Fritzell and Lundberg, 2007).

Important aspects of a person's command over resources, such as social class and income, are determined by their labor market activities. Aspects such as childhood socioeconomic position (parents' socioeconomic position), inherited wealth, investment returns, and education are not. Childhood socioeconomic position and education are important to future achievements such as occupational class and income but also tend to go hand in hand with the level of occupational complexity during working years (Le Grand and Tåhlin, 2013; Tåhlin, 2011). Work environment seems to play a role in the association between socioeconomic position and health.

4 OCCUPATIONAL COMPLEXITY

Work tasks differ by occupation; for example, in the degree to which they require people to solve problems and make decisions. Occupations that include tasks with a great deal of decision-making and problem solving are intellectually engaging—at least more so than monotonous or routine work. Making choices and decisions on the basis of one's own knowledge is also more demanding and engaging than following the orders of external authorities. Highly complex jobs are those where employees need to solve problems, be creative, gather and evaluate information, continue learning, work unsupervised, and make decisions even when the outcome is uncertain (Hayward et al., 1998; Mirowsky and Ross, 2007).

4.1 OCCUPATIONAL COMPLEXITY AND SOCIOECONOMIC POSITION

Undeniably, occupational complexity links closely with education, social class, and income. However, occupational complexity may hold the key to the proper assessment of working conditions and their subsequent influence on health. On the other hand, education, social class, and income may simply be proxies for other factors that, in turn, determine subsequent health outcomes. For example, common social class schemas assume that the relationship between the employer and the employee is one of dependency. The employment relations are the basis of the contract between employer and employee, which can be more or less beneficial for the worker (Erikson and Goldthorpe, 1992; Goldthorpe, 2004). If the employer depends on the employee, then the employee can expect the employer to increase her or his wages and offer more stable contracts with more opportunities for positive career development to persuade the employee to stay on the job. On the other hand, if the employee is easy to control and monitor, or easily exchanged for another employee, the employee can expect lower wages and a less advantageous contract. Some researchers have found this theoretical proposal hard to test empirically and only found weak support for the theory when they attempt to test it (Tåhlin, 2007, 2011). They suggest that occupational complexity may provide a better explanation of the connection between social class and income, as it is measurable and captures a number of factors related to jobs and income (skill requirements, ability, and job performance) (Le Grand and Tåhlin, 2013; Tåhlin, 2007, 2011). Drawing on this line of arguments, it is possible that occupational complexity can be used as an efficient indicator of influences on health, which we typically try to capture with the measurement socioeconomic position because occupational complexity captures one important mechanism through which social class may drive general life circumstances and, subsequently, link these to health. In summary, occupational complexity might capture a dimension of social stratification; namely, job performance, not captured by the more commonly used indicators of socioeconomic position. In turn, job performance may increase socioeconomic resources that may drive general life chances and, subsequently, influence health.

4.2 OCCUPATIONAL COMPLEXITY AND HEALTH

A work environment that requires problem solving, decision-making, and continued learning increases people's cognitive abilities, self-esteem, and sense of control over their lives (Miller et al., 1979; Schooler, 1984; Schooler et al., 1999, 2004).

Several qualities of complex work environments might spill over into a wide range of situations in life and increase health-enhancing behaviors. These include sense of control (the belief that one's own actions, rather than external causes, determine outcomes), continued learning, and intellectual flexibility (the ability to cope with the demands of a complex situation). The environmental complexity hypothesis proposes that environments that require problem solving and decision making—in other words, environments like those that characterize complex occupations—are more engaging and result in a better sense of control, better cognitive abilities, and more intellectual flexibility (Kohn and Schooler, 1978). Sense of control and intellectual flexibility may buffer the negative stress response to adverse situations (Jonker et al., 2009; Mirowsky and Ross, 2007; Ross and Mirowsky, 2013). In addition, cognitive abilities and functioning have been associated with many health-related outcomes in old age (Atkinson et al., 2007; Small et al., 2011; Verhaegen et al., 2003).

Higher occupational complexity has been associated with better labor market and health-related outcomes in working age such as disability pension, cardiovascular disorder, happiness, self-confidence, psychological well-being (Adelmann, 1987; Hayward et al., 1998; Schaubroeck et al., 1994).

4.3 OCCUPATIONAL COMPLEXITY AND LATER LIFE HEALTH

Previous research has focused mainly on the association between occupational complexity and cognition and dementia. Results suggest that higher occupational complexity may protect against cognitive decline and dementia. The observed associations persist even after adjustment for childhood socioeconomic conditions, education (Andel et al., 2005, 2006, 2007; Karp et al., 2009), and income (Lane et al., 2017). In two Sweden-based studies taking a close look at education, schooling and risk of dementia, higher occupational complexity mediated the effect of higher (e.g. college) education on lower risk of dementia (Dekhtyar et al., 2015). However, occupational complexity did not compensate for the increased risk of dementia associated with low school grades in childhood. The lowest risk for dementia was found in those with high childhood school grades and high occupational complexity in midlife. Neither educational attainment nor occupational complexity protected those with low grades in their early school years from dementia risk (Dekhtyar et al., 2016).

There are also some indications that higher occupational complexity is associated with a lower risk of mortality (Fujishiro et al., 2017a; Moore and Hayward, 1990).

Occupational complexity might be indirectly associated with psychological distress and physical functioning in late life through its association with cognition and dementia. Psychological distress has a dose-response association with dementia and mortality and is also

associated with cardiovascular and cerebrovascular diseases (Batty et al., 2014; Russ et al., 2012; Wilson et al., 2005). In addition, cognitive functioning is associated with physical function in late life (Atkinson et al., 2007; Tabbarah et al., 2002).

Another possible pathway through which occupational complexity might affect later life health is stress. Exposure to negative stress or chronic stress can damage the body through physiological pathways (Anisman, 2014; Brunner and Marmot, 2005; Marmot and Wilkinson, 2001). Previous findings suggest that work-related stress is associated with psychological and cognitive health and physical function in later life (Andel et al., 2012; Nilsen et al., 2017; Sindi et al., 2016; Theorell et al., 2016). Researchers have found that occupational complexity increase cognitive abilities and psychological resources such as intellectual functioning, self-esteem, and sense of control over one's own life (Kohn and Schooler, 1978, 1983; Miller et al., 1979; Schooler, 1984; Schooler et al., 1999, 2004). These are resources that can be used to handle stress and negative life events (Marmot and Wilkinson, 2007; Mirowsky and Ross, 2003b, 2003a, 2005; Ross and Mirowsky, 2013; Siegrist and Marmot, 2004).

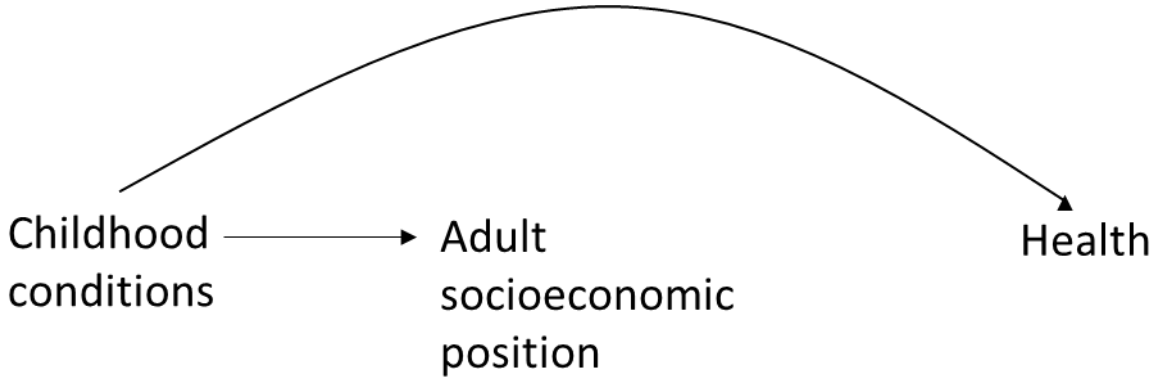
The habit of engagement in work during adult working life might directly lead people to be more engaged in activities after they leave the work force (Atchley, 1989; Diggs, 2008). Therefore, another indirect pathway between occupational complexity and late life health could be through the continuation of an active lifestyle. Because engagement in work and other activities (e.g., social, cultural, and political activities) is associated with better health (Berkman et al., 2000; Glass et al., 1999, 2006; Kåreholt et al., 2011), it may be that people who have an intellectually engaging occupation replace this engagement with engagement in other financially gainful, social, cultural, and/or intellectual activities later in life. Previous findings suggest that engagement in activities in midlife is associated with engagement in activities in later life (Agahi et al., 2006; Atchley, 1989; Diggs, 2008). Having an active and engaged lifestyle may lower the risk of negative health outcomes (Berkman et al., 2000; Glass et al., 1999, 2006; Kåreholt et al., 2011).

5 A LIFE COURSE APPROCH TO HEALTH INEQUALITIES

Health and health inequalities are influenced by biological, psychological, and social factors over the whole life course. Socioeconomic inequalities in health are present at every stage of life: at birth (e.g., infant mortality), during working life (e.g., cardiovascular disease), and in late life (e.g., disability). At any given time, people have used their resources to fend off health risks and threats (Phelan et al., 2010).

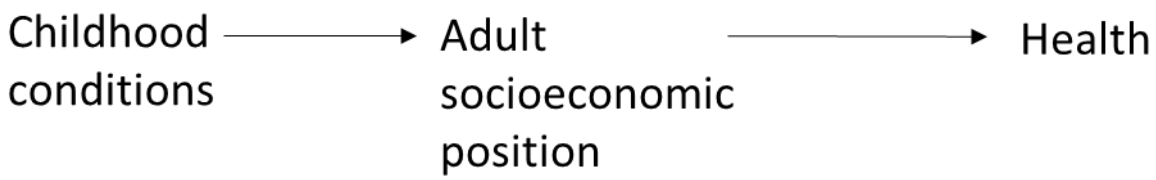
However, there are certain windows of time during the life course when people might be more susceptible to adverse social conditions. These windows of time (critical or sensitive periods) might include childhood (Figure 4.1), when rapid cell growth take place (Ben-Shlomo and Kuh, 2002) or adolescence, when people are more sensitive to peer behaviors (Glymour et al., 2014).

Figure 4.1. A model of childhood conditions as a sensitive period for health in late life.



Another life course model is the chain of risks model (Figure 4.2). Instead of thinking of childhood as a stage in life when social conditions can have a detrimental influence on physiology, this model posits that low socioeconomic position in childhood is unhealthy because it leads to adverse circumstances, more exposures to risk, fewer or worse opportunities, and lower socioeconomic position later on. Hence, low childhood socioeconomic position would increase the risk for worse social outcomes that occur in a chain and only later affect health (Ben-Shlomo and Kuh, 2002). For example, poor health in childhood could decrease a person's chances of achieving their full potential: a person who has had a chronic condition since childhood might not be able to complete their schooling, and without completing their education, it will be hard to get a job and a good income.

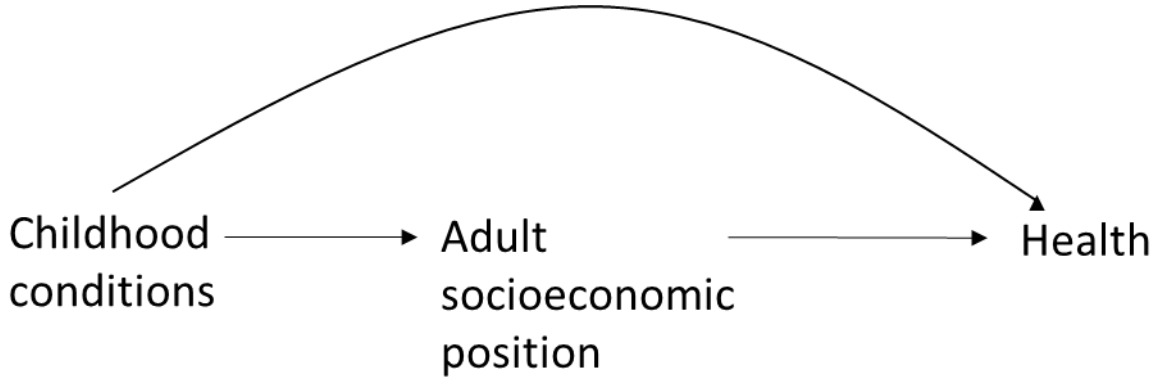
Figure 4.2. A chain of risks model of childhood conditions association to health later on.



Finally, there is the accumulation of risk model (Figure 4.3). The accumulation hypothesis posits that each time (or the severity) a person experiences adverse conditions or an exposure

(e.g. adverse work environment) it will have an independent impact on health later on (Glymour et al., 2014; Kuh et al., 2003). Hence, the more time a person spends in adverse situations, the greater the accumulated exposure and the greater the toll on health.

Figure 4.3. Accumulation of risks model.



It is difficult to disentangle these three models; most likely, the pathways between health inequalities over the life course and later life health outcomes are more complex than any of the separate models. Typically, each theoretical model is investigated in a separate statistical model and then the model fit indices of each is compared. This analytical strategy has often led to support for each hypothesis, as they have approximately the same model fit (Hallqvist et al., 2004; Pudrovska and Anikputa, 2014; Rosvall et al., 2006). However, this finding could be due to collinearity between the models. The different models interact both theoretically and empirically but how they interact remains unknown.

5.1 HEALTH INEQUALITIES AND AGING

People usually have more health problems during old age than earlier in life. Evidence also suggests that the magnitude of health inequalities varies with age. Some studies support the hypothesis that health inequalities converge (Beckett, 2000; House et al., 2005), whereas others find that health inequalities increase in later life (Chandola et al., 2007; Kim and Durden, 2007; Leopold and Leopold, 2018). The inconsistency in the results is most likely dependent on the age of the study population in which health inequalities are investigated.

The most commonly invoked explanation for the convergence of health inequalities with age is the age-as-leveler hypothesis. According to this hypothesis, health inequalities should decrease with age, and the literature refers to at least three different mechanisms that explain why age would level health inequalities. First, as people age, the biological systems of the body deteriorate in all socioeconomic groups such that the impact of social conditions are effectively, progressively crowded out (House et al., 1994; Liang et al., 2002). Second, stratification processes and differences in resource allocation are greater at midlife than later in life, when macro processes even out resources distribution (e.g., through pensions schemes or directed welfare programs). Hence, these processes and differences do not affect health later in life as much as they did earlier in life (Hoffmann, 2011). Lastly, as people age, those with lower socioeconomic position experience worse health and are at a greater risk of dying at a younger

age. Hence, only those in good health reach old age. This has been referred to as selective survival (Markides and Machalek, 1984). As people who occupy lower socioeconomic positions have higher mortality rates, the population composition changes from midlife to late life, a change that could potentially explain the observed convergence in health inequalities (Dupre, 2007; Ferraro and Shippee, 2009).

The term "Matthew effect" was coined by sociologist Robert K. Merton to describes why similar work of well-known researchers were more recognized than the work by unknown researchers (Merton, 1968). The Matthew effect refers to a quote in the bible, today it is used to describe the phenomenon that wealthy and powerful people get more wealthy and powerful. The most common explanation for why health inequalities would grow as people become older is based on this notion and is referred to as the cumulative inequality hypothesis (Dannefer, 2003; Ferraro and Shippee, 2009). This hypothesis posits that people have different trajectories in life. Their socioeconomic resources and health—or lack thereof—accumulate, so heterogeneity in populations increases with time.

On a more technical note, the inconsistency in study results can partly be attributed to the use of different measures of socioeconomic position and health. Some pathways might be more prone to affect health earlier in life, whereas others are more important later in life. In addition, health inequalities can be measured as either relative or absolute. Relative health inequalities are inequalities in relationships between groups. They are often expressed as different measures of ratios (e.g., the risk of disease in people with low socioeconomic positions divided by the risk of disease in people with high socioeconomic positions). Absolute health inequalities are the differences in health between, for example, people with low socioeconomic positions and people with high socioeconomic positions. The choice of relative or absolute measures is important, because it affects the interpretation of health inequalities and possible policy implications (Lynch et al., 2006). Research suggest that relative differences are greater in midlife, whereas absolute differences are greater in late life (Benzeval et al., 2011; Elo and Preston, 1996; Hoffmann, 2011; Huisman et al., 2003).

6 AIMS

The overall aim of this thesis was to increase our understanding of the relationships between socioeconomic position, occupational complexity, and health in late life by studying 1) the association between occupational complexity and late life health and 2) socioeconomic health inequalities in late life. Studies I to III investigated the relationship between occupational complexity and health. Study II examined the relative importance of education, social class, occupational complexity, and income in midlife to health in late life. Study IV investigated the association between financial hardship and psychological distress from a life course perspective.

6.1 RESEARCH QUESTIONS

1. Is occupational complexity associated with psychological distress in late life? (study I)
2. What is the relative importance of education, social class, occupational complexity, and income to psychological distress, mobility limitations, and ADL limitations in late life? (study II)
3. Is occupational complexity associated with mobility limitations and ADL limitations in later life? (study III)
4. How is life course financial hardship associated with life course psychological distress? Is there evidence that childhood is a sensitive period in the relationship between financial hardship and late life psychological distress? Can any association between financial hardship and late life psychological distress be explained by chain of risks or accumulation of risks? (study IV)

7 MATERIALS AND METHODS

This thesis used data from two linked Swedish longitudinal surveys with nationally representative samples—the Swedish Level of Living Survey (LNU) and the Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD). Swedish administrative data, such as information from tax registers, have been linked to the survey data.

7.1 THE SWEDISH LEVEL OF LIVING SURVEY (LNU)

The first Swedish Level of Living Survey (LNU) was a part of a Swedish governmental commission on low-income earners. The main goal was to obtain a better understanding of the Swedish population's living conditions. LNU was first conducted in 1968 encompassing about 6000 people who had previously been included in the Labour Force Survey conducted by Statistics Sweden and the department of Sociology at Uppsala University. The Swedish Institute for Social Research (SOFI) at Stockholm University have been responsible for the LNU since then.

The interviews are conducted face-to-face by professional interviewers and covered a wide range of topics, such as working life (e.g., participation, working conditions, and working hours), socioeconomic conditions, family (e.g., family members, contacts, network, and family members' socioeconomic conditions), childhood conditions (retrospectively), and health.

LNU 1968 included a random sample of about 1 per 1000 Swedes between the ages of 15 and 75. The same people, up to the age of 75, were interviewed in 1974, 1981, 1991, 2000, and 2010 (LNU 2010 was not used in this thesis). To keep the cross-sectional sample nationally representative, younger people and immigrants have been added at each wave (Fritzell and Lundberg, 2007). The lower age limit was changed to 18 years in later surveys. Among the LNU waves used in this thesis, the highest response rate, 91%, was obtained in 1968, and the lowest response rate, 78%, was obtained in 1991. The bulk of the participants have taken part in more than one wave.

7.2 THE SWEDISH PANEL STUDY OF LIVING CONDITIONS OF THE OLDEST OLD (SWEOLD)

The Swedish Panel Study of Living Conditions of the Oldest Old (SWEOLD) is a longitudinal follow-up of people previously in the LNU sample that have "aged out" of LNU (LNU upper age limit=75 years; SWEOLD lower age limit=77 years). SWEOLD has been conducted in 1992, 2002, 2004, 2011, and 2014. The first SWEOLD included a sample of 537 (response rate was 95%). The first SWEOLD survey included only people who had previously participated in at least one of the three first waves of LNU (1968, 1974, or 1981). In the following waves of SWEOLD, the sample included all survivors from the LNU sample, regardless of whether they participated previously or not; hence, they comprise random samples of the Swedish population, aged 77 years and older. SWEOLD 2011 and 2014 also include an oversampling of older people (Lennartsson et al., 2014). The main mode of interviews in SWEOLD 1992, 2002, and 2010 was face-to-face interviews; these were complemented with telephone and

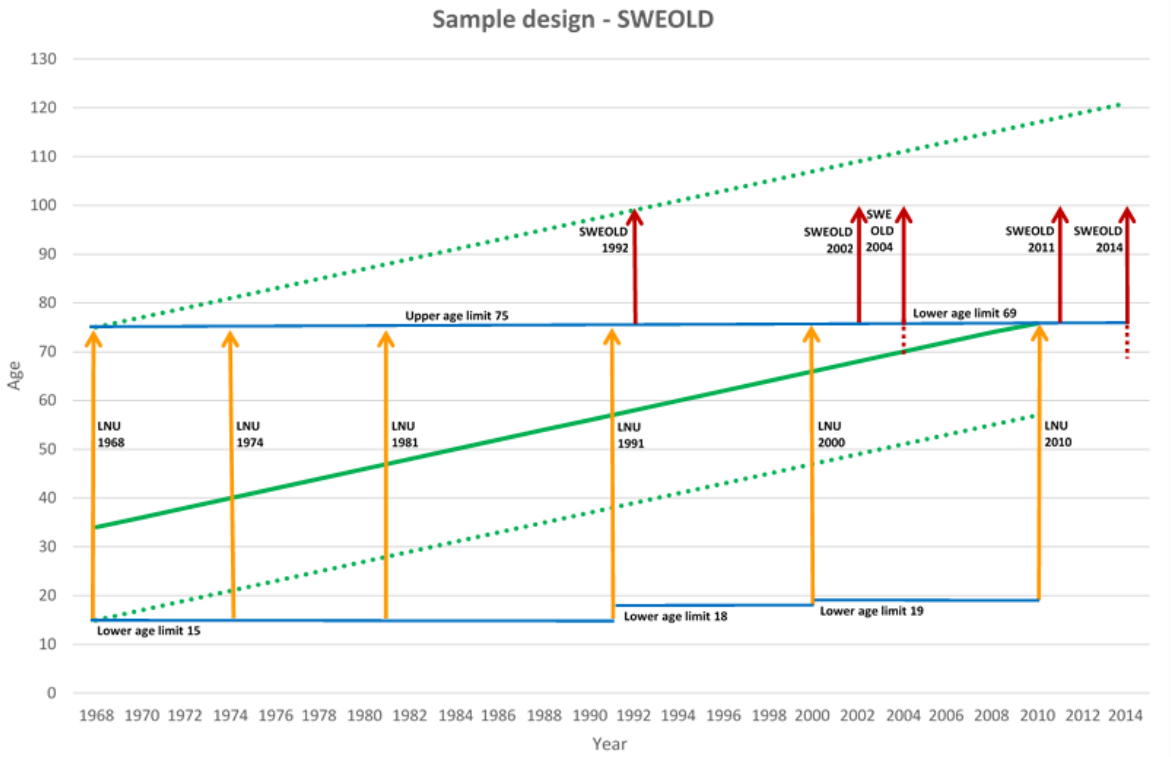
proxy interviews (indirect interview with a person close to the respondent e.g. children or caretaker). In addition, SWEOLD include people living in institutions. The inclusion of people living in institutions and proxy interviews are important to get a representative sample of the older population, institutionalized and proxy interviewed people had worse health, lower education, higher mortality risk, and were more likely to be women (Kelfve et al., 2013). In 2004 and 2014, the main mode of interview was telephone interviews complemented with postal questionnaires. In SWEOLD 2004, the lower age limit was 69 years, and in SWEOLD 2014, it was 70 years. Response rates in SWEOLD ranged from 96% in 1992 to 83% in 2014.

The main goal of SWEOLD is to investigate the living conditions of the oldest old in Sweden via a longitudinal continuation of the sample from LNU. SWEOLD, like LNU, includes a wide range of topics, but focuses more on the health of the respondents than does LNU. The interviews and health measures are similar to those in LNU but adapted and expanded to fit the older population. SWEOLD was recently described as one of the major cohort studies of aging (Kingston and Jagger, 2017).

7.2.1 Combining LNU and SWEOLD

Taken together, these two surveys span 46 years. By combining the longitudinal sample in LNU and SWEOLD, it is possible to follow the same people from middle age to old age (Figure 7.1). By including retrospective questions (from the first LNU the respondents participated in), it is possible to cover virtually the entire life course.

Figure 7.1. A schematic picture of the LNU and SWEOLD surveys.



How the two data sources were linked have been described in detail in each separate study (I, II, III, and IV). Data on the outcome variables were derived from SWEOLD (study IV use LNU as outcome as well). The same data set was used in studies I and II. To increase the number of observations, cohorts were created through linking LNU and SWEOLD. Independent variables were assessed at baseline in LNU; the same respondents were then followed-up in SWEOLD approximately 20 years later. Respondents from LNU 1968 were followed-up in SWEOLD 1992, respondents from LNU 1981 were followed-up in SWEOLD 2002 and SWEOLD 2004, and respondents from LNU 1991 were followed-up in SWEOLD 2011.

Study III used data from LNU 1991 as baseline information and from SWEOLD 2014 as follow-up information, which resulted in 24 years of follow-up time. LNU 1991 was used because that was the first LNU in which the respondents were asked about their occupational history. Respondents were asked about their previous occupations (that lasted for at least 6 months) from their first to most recent occupation. First occupation, occupation at age 25, 30, 35, 40, 45, 50, and most recent occupation was used to create trajectories of occupational complexity score over the working life.

Three cohorts were created for study IV. The respondents had an average age of 54 years at baseline, 61 years at follow-up 1, 70 years at follow-up 2 (LNU), and 81 years at follow-up 3 (SWEOLD). In addition, information on childhood conditions were gathered retrospectively, first time the participants took part in LNU.

Studies I, II, and IV included multiple cohorts that were approximately aged balanced. All cohorts were analyzed separately, and the direction and estimated size of the associations were compared to decide whether it was reasonable to combine the cohorts and analyze them as pooled data. No systematic differences were found in the associations between the exposure and the outcomes; however, the cohorts varied in distribution of descriptive statistics, prevalence, and estimate sizes. This was accounted for, through statistical adjustments, in the analyses.

7.3 METHODOLOGICAL OVERVIEW OF THE FOUR STUDIES IN THE THESIS

	Study I	Study II	Study III	Study IV
Title	Are Occupational Complexity and Socioeconomic Position Related to Psychological Distress 20 Years Later?	Different indicators of socioeconomic status and their relative importance as determinants of health in old age	Occupational complexity and late life physical functioning in Sweden	Linking financial hardship throughout the life-course with psychological distress in old age: sensitive period, accumulation of risks, and chains of risk hypotheses
Data sources	LNU: 1968, 1974, 1981, 1991 SWEOLD: 1992, 2002, 2004, 2011	LNU: 1968, 1974, 1981, 1991 SWEOLD: 1992, 2002, 2004, 2011	LNU: 1991 SWEOLD: 2014	LNU: 1968, 1974, 1981, 1991, 2000 SWEOLD: 1992, 2002, 2011
Design	Longitudinal design 20-24 year prospective cohort study	Longitudinal design 20-24 year prospective cohort study	Longitudinal design 23 year prospective cohort study including follow back design of occupational history	Longitudinal design 24-30 year prospective cohort study + childhood assessed retrospectively
Study sample	Born 1902-1935 Age 46-64 (mean 58) at baseline. Age 69-91 (mean 80) at follow-up. n=1,809	Born 1904-1935 Age 46-64 (mean 57) at baseline. Age 69-88 (mean 79) at follow-up. n=2,036	Born 1925-1944 Age 47-66 (mean 54) at baseline. Age 70-89 (mean 77) at follow-up. n=889	Born 1907-1935 Age 50-58 (mean 54) at baseline. Age 79-84 (mean 81) at last follow-up. n=2,990
Independent variables	Occupational complexity and SEP index	Education, social class, occupational complexity, and income	Occupational complexity (aggregated score over working life & trajectories)	Financial hardship in childhood
Variables both independent and dependent	---	---	---	Financial hardship at age 54, 61, 70, psychological distress at age 54, 61, 70
Dependent variables	Psychological distress	Limitations in mobility, ADL, and psychological distress	Limitations in mobility and ADL	Financial hardship at age 81, psychological distress at age 81
Statistical analyses	Ordered logistic regression	Ordered logistic regressions presented as average marginal effects (AME)	Growth mixture models and ordered logistic regression	Path analysis with WLSMV estimator

7.4 SOCIOECONOMIC POSITION

The three most commonly used indicators of socioeconomic position (SEP) are education, social class (occupation-based), and income, which were used in all studies. In addition, in study I, a SEP index based on education, social class, income, and financial hardship was used. In study II, a SEP index based on education, social class, occupational complexity, and income was used.

In study I, a SEP index was used to account for as much confounding by socioeconomic position as possible. Study II compared the association between the SEP index (including occupational complexity) and later life health with the association between separate indicators of SEP and later life health.

7.4.1 Education

In study I, years of education were included in a SEP index.

In study II, education was defined as the highest level of education achieved. The categories were low (compulsory school only), medium (compulsory school plus vocational training), and high (upper secondary school or more). Education was also included in a SEP index.

In studies III and IV, education was defined as the highest level of education achieved. The categories were 1) compulsory school plus vocational training, 2) lower secondary school plus vocational training, 3) upper secondary school or upper secondary school plus vocational training, and 4) university degree or above.

7.4.2 Social class

In studies I-III, occupational-based social class was assessed based on self-reported occupation. Occupations were coded and categorized in accordance with the Swedish Socioeconomic Classification (SEI). The SEI categorization results in a distribution of classes similar to that of the more well-known Erikson–Goldthorpe–Portocarero (EGP) class scheme (Bihagen, 2007; Bihagen and Nermo, 2012; Erikson and Goldthorpe, 1992). However, the categories were then grouped in a more uncommon way where entrepreneurs and farmers were grouped together with other groups. This coding was used to get a social class coding were the farmers and entrepreneurs could be included in an ordered categorization of social class. The association between social class coded in this way and health was compared with the association between a social class measure excluding farmers and entrepreneurs and health. There was small difference in the magnitude of the association; however, the confidence intervals were smaller with the coding that was used.

In studies I and III, occupation-based social class was grouped as: 1) unskilled blue-collar workers; 2) skilled blue-collar workers, small farmers, and entrepreneurs without employees; 3) lower white-collar workers, farmers or entrepreneurs with 1-19 employees; and 4) intermediate and upper white-collar workers, large-scale farmers or entrepreneurs with at least

20 employees, and academic professionals. This coding have been used successfully in earlier publications (Kåreholt et al., 2011).

In study II, social class was categorized as low (unskilled and skilled blue-collar workers, small farmers, and entrepreneurs without employees), medium (lower-level white-collar workers, farmers or entrepreneurs with 1-19 employees), and high (intermediate and upper-level white-collar workers, farmers or entrepreneurs with 20 or more employees, and academic professionals). This categorization was done to fit the objective of study II.

7.4.3 Income

Taxed annual individual income from work and capital was assessed with data from Swedish tax registers the year prior to baseline (e.g., if 1981 was the baseline year, income was assessed in 1980), except for LNU 1991, for which income was assessed the same year as the survey year (1991).

In study I, income was transformed with the zero skewness log transformation to get an income variable without skewness and included in the SEP index.

In study II, individual income was first categorized in quintiles and then as low (quintile 1+2), medium (quintile 3+4), or high (quintile 5). Because income is non-linear associated with health (Rehnberg and Fritzell, 2016), different categorizations of income were tested with spline lines and the health outcomes. Quintile 5 was the only quintile that differed in the health outcomes. To increase comparability between the indicators in study II, all indicators were categorized in three. Income divided in three categories was also included in the SEP index.

In study III, annual individual income was categorized in quintiles.

7.4.4 Financial hardship

In study I, financial hardship was included in the SEP index. Financial hardship was assessed in LNU 1968 with the question "If a situation suddenly arise where you need to raise 2000 SEK in a week, would you be able to?" The amount of money was raised to keep up with the inflation and amounted to 15,000 SEK in 2011. Response alternatives were "no" or "yes". If respondents could raise the money they were also asked how, response alternatives were a) own bank account, b) loan from family, c) loan from relatives or friends, d) by bank loan, and c) another way. Not being able to raise the money in a week was considered severe financial hardship; raising the money by bank loan, with help from relatives or friend, or in another way was considered slight financial hardship; and being able to raise the money by oneself or with help from family was considered to indicate the absence of financial hardship. Financial hardship was included in the SEP index in study I.

In study IV, financial hardship was assessed with the same question and categorized as in study I.

7.4.5 Childhood conditions

All childhood measures in this thesis rely on retrospective data. Questions about childhood conditions were assessed in the first LNU survey in which the respondents participated. In study IV, financial hardship in childhood was assessed at baseline for cohort 1 (1968). For cohort 2 with baseline 1974, 98.6% was assessed 1968 and 1.4% at the baseline. For cohort 3 with baseline 1981, 94.2% was assessed in 1968, 2.5% in 1974 and 3.3% at the baseline.

In study I, childhood conditions were measured as fathers' social class (classified as previously described regarding own social class) and education, family conflicts (yes/no), financial hardship (yes/no), and whether a family member had severe or long-lasting sickness during the respondent's upbringing.

In study IV, the measure of financial hardship in childhood was assessed by the question "Did your family have financial difficulties during your upbringing?" Response alternatives were "yes" or "no."

7.5 OCCUPATIONAL COMPLEXITY

I chose to operationalize occupational complexity by using the complexity scores from the U.S. Dictionary of Occupational Titles assigned to 591 occupational categories in the 1970 U.S. Census.

These scores are built on functional job theories and on the idea that high occupational complexity involves working tasks that require creativity, decision-making, continued learning, and gathering and evaluating information (Fine, 1968). The scores were created by job analysists who evaluated workers' tasks and the abilities needed to carry out these tasks. Forty-six characteristics of workers in 12,000 occupations were analyzed and scored. The scores were averaged and assigned to the 591 occupational categories in the U.S. Census of 1970 (Roos and Treiman, 1980).

Of the 46 worker characteristics, complexity of work with data, complexity of work with people, and complexity of work with things are probably the most widely used in research. They represent three distinct dimensions of occupational complexity related to intellectual engagement, social engagement, and manual work. In combination, they provide a holistic overview of occupational complexity. However, research indicates that complexity of work with things was negatively associated with overall occupational complexity and does not predict health differences (Andel et al., 2005; Cain and Treiman, 1981).

In addition, a principal component factor analysis of the 46 worker characteristics has been carried out (National Research Council, 1980). The results showed that the main factor included general educational development, specific vocational preparation, complexity of work with data, intelligence aptitude, verbal aptitude, numerical aptitude, abstract interest in the job, and temperament for repetitive and continuous processes. This factor was averaged on occupations, and assigned to the occupational categories in the U.S. Dictionary of Occupational

Titles. This factor is considered an overall measure of occupational complexity that was first called *substantive complexity* (Roos and Treiman, 1980).

Two independent raters, one based in the United States and one in Sweden, created a grid that matched Swedish occupations from the 1980 census (Nordic Occupational Classification, NYK80) with occupations from the 1970 U.S. Census. Initially, they agreed on 90% of the occupations and reached consensus about the remaining 10% after discussions. Using this grid, the complexity scores assigned to occupational categories in U.S. Census 1970 were matched to occupations from the 1980 Swedish census (Andel et al., 2005). The matching procedure took into account the complexity of work with data, people, and things, as well as substantive complexity and other working conditions reported in the fourth edition of U.S. Dictionary of Occupational Titles (National Research Council, 1980).

Complexity of work with data is scored from 0 to 6; complexity of work with people, from 0 to 8; and complexity of work with things, from 0 to 7. Scores for substantive complexity range from 0 to 10. For all these scales, higher scores indicate more complex occupations.

Study I examined the complexity of work with data and people, as well as substantive complexity. The complexity of work with things was not included in this thesis because of its low reliability and predictive ability (Andel et al., 2005; Cain and Treiman, 1981).

Studies II and III used only substantive complexity.

7.6 LATER LIFE HEALTH

7.6.1 Psychological distress

The question "Have you had any of the following diseases or disorders during the last 12 month?" is included in both LNU and SWEOLD. This question is followed by a multi-item list of diseases, disorders and symptoms, including questions about anxiety, depressive symptoms/low mood, and general fatigue. The response alternatives are "yes, severe," "yes, slight," and "no."

In study I, the responses to anxiety, depression, and general fatigue were analyzed separately and in a summarized index that ranged from 0 to 6.

In studies II and IV, the question about general fatigue was not included. Anxiety and depressive symptoms were summarized and analyzed as psychological distress. Possible scores ranged from 0 to 4.

7.6.2 Mobility limitations

In study II, mobility limitations were assessed by asking the respondents if they were able to walk 100 meters at a brisk pace without problems (yes=0, no=1), and if they were able to climb stairs (up and down) without problems (yes=0, no=1). The answers were summarized in an index ranging from 0 to 2.

In study III, the ability to rise from a chair (yes=0, no=1), and the ability to stand up (yes=0, no=1) were added to the information on walking and climbing stairs. These answers were then summarized into an index of mobility limitations that ranged from 0 to 4.

7.6.3 Limitations in activities of daily living (ADL)

In study II, limitations in activities of daily living (ADL) were assessed as the self-reported ability to eat, use the toilet, wash one's hair, dress and undress, and get into and out of bed. Response alternatives were yes, by myself=0; yes, with help=1; and no=2. Responses were summarized in an index that ranged from 0 (managed all five tasks by themselves) to 10 (did not manage any of the tasks).

In study III, the same questions were used, but the responses were dichotomized: "yes, by myself"=0 and "yes, with help" and "no"=1. Responses were then summarized in an index that ranged from 0 (managed all five tasks by themselves) to 5 (did not manage any of the tasks by themselves).

7.7 STATISTICAL ANALYSES

Most of the analyses in this thesis were conducted with Stata statistical software (versions 12 and 15). The main analyses in study IV were conducted with MPlus (version 7.11).

In study I, ordered logistic regression was used. The odds ratio from an ordered logistic regression is the change in odds of a one-step higher value in the outcome when the independent variable (exposure) changes by one unit and all other variables in the model are held constant. The analyses of the association between occupational complexity and psychological distress in late life were additionally adjusted for socioeconomic position (SEP index). The association between SEP index and the outcomes were also investigated, and adjusted for occupational complexity.

In study II, average marginal effect (AME) multiplied by 100 (in order to present them as percentage points) were used. AME is the average difference in the probability of one step higher value of the outcome when all other variables are controlled for. When estimating AMEs from an ordered logistic regression, the estimates can be interpreted as the average probability of a one-step increase in the outcome when the independent variable changes by one unit. AMEs were used to increase the comparability of models that included different variables and to increase the interpretability of the estimates (Mood, 2010). In addition, estimates of explained variance were used to compare the contribution of the main independent variables to the model fit. McKelvey & Zavoina´s pseudo-R2 was used as it has been shown to be good when using different models but the same data set (DeMaris, 2002).

In study III, ordered logistic regression was used to analyze the association between occupational complexity and physical functioning. In addition, random effect growth curve models were used to estimate trajectories of occupational complexity. These models allow for within-person change and between-persons differences in intercept and slope (Curran et al.,

2010). These person-specific estimated intercepts and slopes were then saved in variables that are often called linear unbiased predictions or BLUP (Robinson, 1991). The person-specific estimates were then grouped into different trajectories, and effect coding was used in the analysis of the trajectories and physical function in later life (Pedhazur, 1982).

In study IV, path analysis (an extension of multiple regressions that calculates all associations simultaneously) was conducted with MPlus. A hypothetical model that included multiple pathways of three life course models (sensitive period, chain of risks, and accumulation of risks) was tested with the weighted least squares mean and variance adjusted (WLSMV) estimator. After running this model, the non-significant paths were removed one by one, starting with the path with the highest p-value, until all paths were significant at $p<0.10$. To evaluate the fit of the last model, we relied on the goodness of fit indices provided by MPlus (RMSEA, CFI, TLI, and WRMR).

8 MAIN RESULTS

8.1 STUDY I

Are occupational complexity and socioeconomic position related to psychological distress 20 years later?

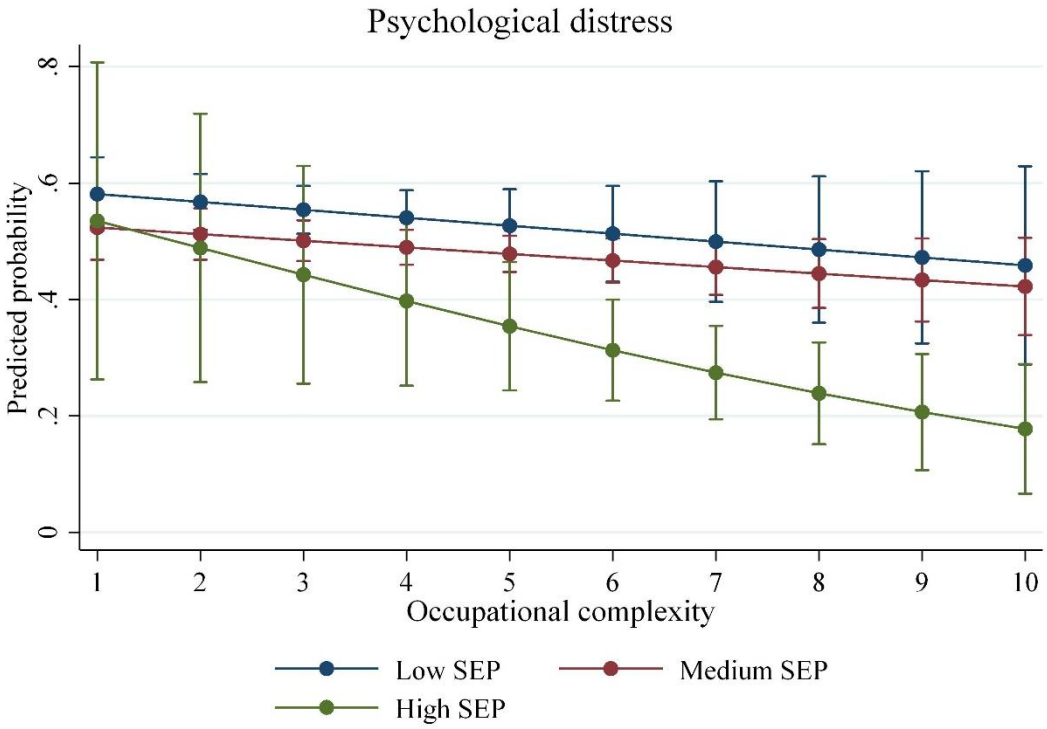
In study I, the main objective was to investigate whether level of occupational complexity in late working life was associated with psychological distress 20 years later. Moreover, the study investigated whether any observed associations could be explained by socioeconomic position in midlife (measured by a SEP index in this study). In addition, the association between socioeconomic position and psychological distress was analyzed.

A higher level of complexity of work with data was associated with less psychological distress more than 20 years later (OR 0.87, CI: 0.78-0.96), as was a higher level of complexity of work with people (OR 0.90, CI: 0.81-0.99) and a higher level of substantive complexity (OR 0.81, CI: 0.73-0.90). Moreover, people with a low socioeconomic position and with a medium socioeconomic position had higher odds of psychological distress (low SEP=OR 2.82, CI: 1.73-4.62; medium SEP=OR 2.46, CI: 1.60-3.85) than those with a high socioeconomic position. Adjusting for occupational complexity attenuated the association.

Substantive complexity was the most robust occupational complexity measure and was associated with psychological distress after adjustment for socioeconomic position (although the estimate size and statistical significance were attenuated).

To study the interaction between socioeconomic position, occupational complexity and health, predicted probabilities were calculated and presented in figure 8.1. Psychological distress was dichotomized for this purpose (0=no psychological distress, 1-6=psychological distress).

Figure 8.1. Shows how the interaction between occupational complexity (substantive complexity) and socioeconomic position relates to psychological distress.



8.2 STUDY II

Different indicators of socioeconomic status and their relative importance as determinants of health in old age

Study II investigated the relative importance of a number of indicators of socioeconomic position, including education, social class, occupational complexity (substantive complexity), and income in midlife and health later in life. In study II, occupational complexity was included as a possible indicator of socioeconomic position. All the aforementioned variables were summarized in a SEP index that was included in the analyses.

In the first model, each indicator of socioeconomic position was analyzed separately (adjusted for age and sex), and then the other indicators were entered one at the time in separate models. The final model (study II, Table 2; model 2) was adjusted for all indicators simultaneously.

The probability of reporting one more mobility limitation (range 0 to 2) differed by all indicators: high vs. low level of education, 12 percentage points; high vs. low social class, 9 percentage points; high vs. low level of occupational complexity, 10 percentage points; high vs. low income, 13 percentage points; and high vs. low score on the SEP index, 10 percentage points. The differences in the probability of reporting one more ADL limitations (range 0-10) were 2 percentage points (high vs. low level of education, difference not significant), 2 percentage points (high vs. low social class), 2 percentage points (high vs. low occupational complexity, difference not significant), 2 percentage points (high vs. low income), and 10

percentage points (high vs. low score on the SEP index). The difference in the probability of reporting more psychological distress (range 0 to 4) was 9 percentage points (high vs. low level of education), 6 percentage points (high vs. low social class), 10 percentage points (high vs. low occupational complexity), 10 percentage points (high vs. low income), and 20 percentage points (high vs. low score on the SEP index). Education, social class, and occupational complexity were similarly associated to all outcomes, whereas the difference between income groups was somewhat larger with regard to health in late life. Overall, the indicators of socioeconomic position contributed similarly to model fit but income contributed the most (measured as the change in McKelvey & Zavoina´s pseudo-R2) (between 9% and 13% to mobility limitations, 3% and 7% to ADL limitations, and 15% and 27% to psychological distress). The SEP index led to somewhat larger estimated differences in health than did the other measures of socioeconomic position.

When all measures of socioeconomic position were included simultaneously; that is, when all indicators of socioeconomic position were adjusted for each other, only income was statistically significantly associated with health. Income also contributed the most to model fit of the indicators. There were no statistically significant interactions between sex and any of the indicators of socioeconomic position (including occupational complexity).

Additionally, the results show that those without a gainful occupation at baseline had a greater risk for adverse health than those with a gainful occupation at baseline.

8.3 STUDY III

Occupational complexity and late life physical function in Sweden

The main objective of study III was to investigate whether different patterns of occupational complexity over the course of working life were associated with physical function in later life. The study investigated how the complexity of people's first and most recent occupation, the aggregated complexity score of all occupations held, and trajectories of occupational complexity related to physical function in later life. Any observed associations were first adjusted for midlife health and then for socioeconomic position.

Higher complexity in people's most recent but not first occupation was associated with mobility limitations (OR 0.90, CI: 0.83-0.96) and ADL limitations (OR 0.89, CI: 0.79-1.00). Adjusting for midlife health had little influence on the associations (OR 0.92, CI: 0.86-0.99, and OR 0.91, CI: 0.81-1.03). However, the associations diminished and lost all statistical significance after adjustment for education, social class, and income. The same pattern was observed in aggregated occupational complexity score across the working life. A higher aggregated occupational complexity score was associated with less mobility limitations (OR 0.85, CI: 0.78-0.93) and ADL limitations (OR 0.80, CI: 0.69-0.92). Midlife health exerted some influence on these associations (OR 0.91, CI: 0.83-1.00, and OR 0.84, CI: 0.72-0.98 respectively) but did not entirely explain them. However, the associations disappeared after adjustment for education, social class, and income.

Six different trajectories of occupational complexity were identified. The trajectories started either as low or high (these groups were equally large) and then diminished, changed little or not at all, or increased over time. There were no associations between the different trajectories and ADL limitations. The worst trajectory (starting low and diminishing) and the next worst (starting low and changing little or not at all) were associated with more mobility limitations (worst trajectory=OR 2.00, CI: 1.18-3.38; next worst trajectory=OR 1.30, CI: 1.00-1.69) than the total mean of mobility limitations in the sample. Having the best trajectory (starting high and increasing) was associated with less mobility limitations than the total mean of mobility limitations in the sample (OR 0.66, CI: 0.49-0.88). After adjustment for midlife health, only the worst trajectory was significantly associated with more mobility limitations (OR 1.79, CI: 1.04-3.04). Adjustment for education, social class, and income made all previously significant associations not statistically significant.

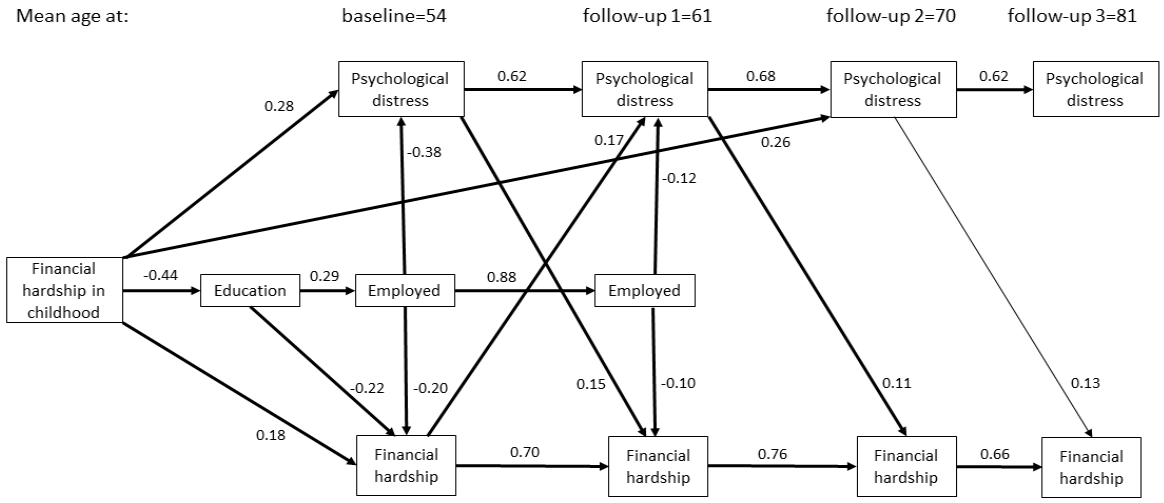
8.4 STUDY IV

Linking financial hardship throughout the life course with psychological distress in old age: sensitive period, accumulation of risks, and chains of risk hypotheses

The main objective of study IV was to investigate the relationship between financial hardship and psychological distress using three life course hypotheses—sensitive period, chain of risks, and accumulation of risk. Models of all three life course hypotheses were included in a single pathway model to investigate and compare their statistical explanatory value. In addition, a test of social causation versus health selection was conducted using repeated measures over the life course. Moreover, a test of the influence of attrition on the final model was undertaken.

The final model (Figure 8.4) had acceptable model fit (Schermelleh-Engel et al., 2003): RMSEA=0.024, CFI=0.973, TLI=0.957, and WRMR=1.061. In this model, exposure to financial hardship in childhood was directly associated with psychological distress at age 70 (β=0.26, $p<0.01$), which supported the hypothesis that childhood is a sensitive period. Financial hardship in childhood was also indirectly associated with psychological distress at age 70 (β=0.23, $p<0.01$) and age 81 (β=0.27, $p>0.01$). In addition, financial hardship in childhood was associated with more psychological distress at baseline (age 54), and, in turn, at ages 61, 70, and 81. A similar chain of risks was found from financial hardship at childhood and financial hardship later in life. Education and employment mediated the childhood-to-old-age chain of risk. Higher education was associated with being employed, being employed was associated with less financial hardship and psychological distress. Financial hardship at age 54, 61, or 70 were not directly associated with psychological distress at age 81; thus, the full model provided no support for the accumulation of risks hypothesis.

Figure 8.4. The final pathway model of the association between financial hardship and psychological distress in late life (thicker lines significant at p<0.05 and thinner line at p<0.10).



Additionally, the associations between financial hardship and psychological distress were bi-directional over the life course. However, taken as a whole, the model suggests that health selection was stronger than social causation.

Although there was approximately 50% attrition between baseline and the last follow-up (mainly due to death), analyses showed that attrition exerted little or no influence on the observed associations.

8.5 SOCIOECONOMIC POSITION AND OCCUPATIONAL COMPLEXITY

Table 8.5.1 presents the correlations between the different measures of socioeconomic position and occupational complexity (data from study I and II). The strongest correlation was between social class and occupational complexity. Both education and income were more strongly correlated with social class than with the other variables measured: overall, social class was the measure of socioeconomic position with the highest correlations to the other measures.

Table 8.5.1. Spearman's correlations between socioeconomic position and occupational complexity (substantive complexity).

	Education	**Social class**	**Occupational complexity**	**Income**
Education	1			
Social class	0.52	1		
Occupational complexity	0.42	0.59	1	
Income	0.37	0.41	0.32	1

All correlations were significant at p<0.001

Occupational complexity scores tended to increase as socioeconomic position increased. Those with a low socioeconomic position (as measured by the SEP index in study I) had a mean occupational complexity score (substantive complexity, range 0-10) of 3.04; those with a medium socioeconomic position, of 4.43; and those with a high socioeconomic position, of

6.84. In addition, women tended to have occupations with lower complexity scores than men (3.68 versus 4.70) (study I).

The five most common occupations among women (same data set as in study II) were secretaries, cleaners, salespersons, nursing assistants, and farmers. In table 8.5.2, the median education, distribution of social class, occupational complexity score, and income distribution for these occupations are presented. The five most common occupations among men were farmers, workshop mechanics, commercial traveler/purchasers, motorists, and business administrators.

Table 8.5.2. The five most common occupations by sex and median education, social class distribution, occupational complexity score, and income distribution[1]

	Years of education (median)	**Social class[2] %**				**Occupational complexity**	**Distribution of income quintiles %**				
Women (n)		1	2	3	4		Q1	Q2	Q3	Q4	Q5
Secretary (108)	9	2	2	82	13	3.2	17	21	36	19	8
Cleaner (84)	6	87	6	6	0	0.7	18	60	18	3	1
Salesperson (78)	7	73	12	11	4	3.4	24	43	22	9	3
Nursing assistant (65)	7	82	17	1	0	3.5	7	28	44	20	1
Farmer (65)	6	0	62	37	1	5.2	71	24	4	1	0
Men											
Farmer (78)	6	0	49	51	0	5.2	43	32	12	10	2
Workshop mechanic (36)	7	35	65	0	0	5.0	5	3	28	53	13
Commercial traveler/purchaser (28)	8	0	0	55	45	6.3	0	3	6	23	68
Motorist (27)	7	63	17	17	3	2.3	17	7	33	30	13
Business administration (25)	12	0	0	8	92	6.3	6	6	3	14	72

[1] Information assessed in the data set from study II. [2] 1) unskilled blue-collar workers; 2) skilled blue-collar workers, small farmers and entrepreneurs without employees; 3) lower white-collar workers, farmers or entrepreneurs with 1-19 employees; and 4) intermediate and upper white-collar workers, large-scale farmers or entrepreneurs with at least 20 employees, and academic professionals.

Although men had higher occupational complexity scores than women, there was no statistically significant interaction between sex and occupational complexity in relation to health in any of the four studies included in this thesis. All analyses that were stratified by sex showed similar patterns between women and men.

9 DISCUSSION

The aim of this thesis was to increase our understanding of the relationships between socioeconomic position, occupational complexity, and health in late life by studying 1) the association between occupational complexity and late life health and 2) health inequalities in late life driven by socioeconomic factors.

9.1 MAIN FINDINGS

9.1.1 Occupational complexity and later life health

The results of this thesis show that people who held occupations with higher complexity level tend to have less psychological distress in later life than people who held occupations with lower levels of complexity. Some of the results suggest that the association between higher occupational complexity and less psychological distress in late life is independent of socioeconomic position (study I). On the other hand, the results in study II and III showed that socioeconomic position explain all association initially found between occupational complexity and physical function in later life.

9.1.1.1 Occupational complexity and psychological distress in later life

Higher score in all dimensions of occupational complexity used in this thesis were associated with less psychological distress; substantive complexity was the measure of occupational complexity most strongly associated to psychological distress after adjustments for socioeconomic position. Study II investigated the relative strength of the association between the predictors education, social class, occupational complexity, and income and the outcomes psychological distress, mobility limitations, and ADL limitations. To make it possible to compare the relative importance of these predictors, occupational complexity was operationalized differently in study II than study I; this resulted in less captured variation of occupational complexity in study II (fewer categories). In addition, education, social class, income, and the SEP index were also operationalized differently in study II than study I because of differences in the objectives of the two studies. Study II did not find a significant association between occupational complexity and psychological distress independent of socioeconomic position. This difference in the findings regarding the independent association between occupational complexity and psychological distress in later life were due to the ways occupational complexity and socioeconomic position were operationalized in the two studies.

A possible pathway to the observed association between higher occupational complexity and less psychological distress could be that higher occupational complexity builds up a reserve of psychological resources such as self-efficacy, self-esteem, self-worth, intellectual flexibility, and sense of control over one's own life (Kohn and Schooler, 1983; Miller et al., 1979; Schooler et al., 2004). This psychological reserve could then be used to cope with precarious situations or to help people make better choices (Jonker et al., 2009) and therefore protect people from adverse mental health in late life. This reserve of psychological resources might

also influence physiological pathways and buffer the declining health that occurs when people age (Berkman et al., 2000; Jonker et al., 2009; Wahrendorf et al., 2013).

Another possible pathway is that of path dependency. People are creatures of habit, and having an intellectually engaging occupation might facilitate a universally active lifestyle that becomes a habit that lasts into old age. The habit of engagement in work during working life might directly lead people to be more engaged in activities after they leave the work force (Atchley, 1989; Diggs, 2008). Engagement in leisure activities in late life is dependent on how active people where earlier in life (Agahi et al., 2006). Leisure activities and social, cultural, and financial engagement (i.e. active lifestyle) are associated with better well-being and less cognitive decline in late life (Andel et al., 2014; Berkman et al., 2000; Glass et al., 2006).

In addition, labor-market selection processes could have driven the observed association. For example, people with higher levels of education usually get jobs with more complex working tasks (Mirowsky and Ross, 2003b), and some personality types and intelligence are associated with labor market outcomes, which could help explain why some people end up in highly complex occupations and others do not (Bihagen et al., 2012, 2017; Heckman et al., 2006). Moreover, women tend to be selected out of more complex work even when they the same educational level as men who obtain such work (Grönlund and Boye, 2017).

9.1.1.2 Occupational complexity and physical function in later life

In study II, occupational complexity was considered a possible indicator of socioeconomic position. Results showed that occupational complexity did not contribute to the understanding of socioeconomic health differences in physical function. In contrast, study III was a deeper investigation of the association between exposure of different levels of occupational complexity and physical function in later life. Previous research have shown the importance of considering the entire career development in health inequalities (e.g. mortality) (Moore and Hayward, 1990). Measures of occupational complexity that considered the entire working life was created to analyze whether occupational complexity was associated with physical function in late life.

Some people have a positive career development and experience characterized by increasing occupational complexity, whereas others experience trajectories of decreasing occupational complexity. Study III analyzed the associations between different trajectories of occupational complexity and physical function in late life. However, using these trajectories did not contribute to any new knowledge regarding occupational complexity and physical function than using the aggregated measure of occupational complexity across the working life, or using the score from the most recent occupation.

Higher score in the aggregated occupational complexity measure was associated with fewer limitations in physical function in late life. The association was attenuated in analyses that adjusted for physical function in midlife. This finding could suggest that selection processes (e.g., the "healthy worker effect") has already sorted people into certain occupations with different complexity levels prior to the study or that midlife health exerts little influence on the

association between occupational complexity and physical functioning. More importantly, adjusting for socioeconomic position in midlife makes the association vanish. Similar results were found in study II, and the results of study III suggests that considering occupational complexity across working life does not change the effect of socioeconomic position on the association between occupational complexity and physical function.

In summary, previous research has shown that there is an association between occupational complexity and cognitive decline and dementia that remains even after adjustment for many different factors (including education and income). The results of study I in this thesis indicate an association between occupational complexity and psychological distress in late life even after adjustment of socioeconomic position. In contrast, study II does not support those results. The results of studies II and III suggest that the association between occupational complexity and physical functioning can be explained by socioeconomic position. Thus, there was no support for the hypothesis that occupational complexity capture important aspects of socioeconomic position relevant for life chances, and, subsequently, influence health.

9.1.2 Socioeconomic position and later life health

The results from this thesis show that higher midlife socioeconomic position is associated with less psychological distress and better physical functioning in late life. Study I, II, and III measured current socioeconomic position in midlife as the main socioeconomic variables, and health in late life. Study IV applied a longer time span, covering almost the entire life course when investigating the association between financial hardship and psychological distress.

The results showed that education, social class, and occupational complexity were similarly associated with psychological distress and physical function in late life. Whereas income was more strongly associated with health differences in all health outcomes than the other indicators. The measure of income used in this study showed no significant difference in health between quintiles 1-4, but a decreased risk of adverse health among the top quintile income earners. In contrast, it is widely recognized that poverty is associated with adverse health (Chetty et al., 2016; Fritzell et al., 2015). The results showed no gradient in the association between income and health in the lower part of the income distribution while the people in the top income quintile had fewer health problems later in life. Our sample might be a rather selected group where all people have high material standards or that the Swedish welfare system with relatively generous welfare benefits and high quality care for people in later life have compensated adverse influences of poverty on health (Fritzell et al., 2007). This, in combination with selective mortality, could result in little differences in health between income groups quintile 1-4.

Although some previous research indicates that the different indicators have overlapping properties, other findings point out that the different indicators have distinct properties and underlying mechanisms related to health, at least in the working age population (Geyer et al., 2006; Torssander and Erikson, 2009). The results from this thesis suggests that income is the only indicators with an independent association to later life health. Moreover, the results

indicated that occupational complexity does not measure any socioeconomic stratification process relevant to health inequalities in late life that is beyond what is already measured by education, social class, and income.

Socioeconomic position and the different dimensions of socioeconomic position might influence health differently at different stages of life. In addition, health in late life is dependent on experiences and exposures throughout the life course. Study IV investigated the relationship between financial hardship and psychological distress over the life course. The final model showed that when the models indicating sensitive period, chain of risks, and accumulation of risks were analyzed simultaneously, there was little support for the accumulation of risk hypothesis. Instead, financial hardship in childhood seemed to act as the trigger in a chain of subsequent risk factors. It increased the risk of lower education and unemployment, financial hardship, and psychological distress in midlife, which then increased the risk of psychological distress in late life. In addition, there was a direct association between financial hardship in childhood and psychological distress in late life (average age 70 years). In summary, childhood socioeconomic conditions seem to play a key role as the starting point of life course trajectories of socioeconomic advantage and disadvantages that, in turn, may shape the risk of psychological distress in old age.

These findings aligns with previous results showing that childhood conditions are important to subsequent socioeconomic achievements and psychological health (Evans, 2016; Ferguson et al., 2007; Wickham et al., 2017). However, the importance of socioeconomic position in childhood for later health seem to vary by country (Hyde et al., 2006). The results also confirmed that education (Berndt and Fors, 2016; Quesnel-Vallée and Taylor, 2012) and employment mediate the association between childhood conditions and later life health. Earlier studies have found that periods of financial hardship have an accumulated effect on psychological health, but study IV did not find such an effect (Kahn and Pearlin, 2006; Lynch et al., 1997; Shippee et al., 2012). A possible reason for this inconsistency in findings is that in study IV, models indicating the accumulation of risks hypothesis and the sensitive period and chain of risks hypotheses were tested simultaneously, whereas most commonly, the three life course hypotheses are tested in separate models (Hallqvist et al., 2004; Pudrovska and Anikputa, 2014; Rosvall et al., 2006).

The three life course hypotheses are not exclusive but complementary, and it is difficult to disentangle them both theoretically and empirically. However, in study IV, I have identified that models indicating sensitive period and chain of risks had the stronger statistical support than accumulation of risks, when tested simultaneously (in competition). This has not been done before. This might lead to a better understanding of how socioeconomic conditions affect health. Moreover, this improved understanding might provide guidance for policymakers to help decrease the influence of socioeconomic conditions on health.

Although financial hardship at childhood was directly associated with psychological distress in later life and with future socioeconomic achievements and health, the model as a whole provided somewhat stronger support for the hypothesis that people with psychological distress

have increased risk for financial hardship (health selection) than that financial hardship leads to more psychological distress later on (social causation). However, the relationship between psychological distress and financial hardship seem to be bi-directional.

9.1.3 Later life health among people without employment

People without gainful employment are at higher risk for adverse health than those who are employed (Marmot, 2005). People without a gainful occupation is commonly excluded in studies of occupation-based classifications of socioeconomic position. This might lead to an underestimation of socioeconomic health inequalities (Galobardes et al., 2007). The focus of this thesis was on understanding how differences in occupational complexity and socioeconomic position are associated with later life health. Therefore, this thesis did not aim to investigate how unemployment is associated with later life health. However, to obtain better knowledge about health variations in the population, people without a gainful employment was analyzed in study II and IV. The results show that not being gainfully employed in midlife was associated with an increased risk of adverse later life health. Study II found that people without gainful employment in midlife had 7.5 percentage points higher probability of one more mobility limitation, 8.6 percentage points higher probability of ADL limitations, and 7.3 percentage points higher probability of psychological distress than those who had a paid occupation at midlife. Occupation was assessed in late working life, and there might be many reasons why people were without gainful employment (e.g., they may have had mobility limitations or psychological ill-health). Study III showed that more than 90% of the sample was working at age 25, 30, 35, 40, 45, and 50, which indicates a low unemployment rate over working life. Aggregated occupational complexity and trajectories were calculated for everyone, even if they did not have an occupation at every age. The final pathway model from study IV suggested that being employed was associated with less financial hardship and psychological distress in midlife than being without gainful employment. In addition, being employed moderated the association between financial hardship at childhood and psychological distress in late life.

9.1.4 Sex differences

Women and men have different career development, such that men in general get access to occupations that are more complex and pay more (Grönlund and Boye, 2017). The results of this thesis show that women, in general, had occupations that were less complex and occupied lower socioeconomic positions than men. In addition, women generally experienced more psychological distress, mobility limitations, and ADL limitations than men. Even so, in the analyses stratified by sex, there were no systematic differences in the associations between occupational complexity and health in late life. In addition, no statistically significant interaction between sex and occupational complexity were found.

9.2 LIMITATIONS AND SHORTCOMINGS

Most research has some limitations; therefore, one study does not provide enough evidence to make secure conclusions about the relationships between predictors and outcomes. Every study

should be interpreted with caution. Each of the four studies in this thesis has some specific limitations; however, some limitations apply to all of the studies. This section discusses some of these limitations.

9.2.1 Selection

Selection bias refers to when the sample is systematically biased. A common cause of selection bias in population-based survey data is non-response. People who decline to participate in surveys generally differ from those who chose to participate (e.g. by socioeconomic position), and this difference may results in biased data. However, both data sources used in this project have relatively high response rates. Both LNU and SWEOLD are based on random samples of the Swedish population. The response rates of the LNU waves used here ranged between 78% and 91% and the response rates of the SWEOLD waves ranged between 84% and 95%. However, this does not, in itself, guarantee a lack of bias.

Common sources of selection bias in surveys of older populations include the exclusion of the oldest old, people living in institutions, and those who are not able to answer survey questions themselves. The exclusion of these groups provides an incorrect description of the old age population; including people living in institutions and those interviewed by proxy better describes the population (Kelfve et al., 2013) and affects estimates of health inequalities in later life (Kelfve, 2017).

All studies included in this thesis were longitudinal. As in all longitudinal studies, there was attrition. People who occupy lower socioeconomic positions have higher mortality rates than those who occupy more advantageous positions (Chetty et al., 2016; Fors et al., 2011). Thus, the estimates of inequality might have been attenuated. However, the focus of this thesis was on the health of those who survived to old age. Study IV used sensitivity tests to estimate the potential effect of attrition on the final model and found that any influence on the observed associations was likely to have been small.

In addition, the phenomenon of "healthy worker effect" might have biased the results of the studies. People from certain occupational cohorts stay healthier and have a reduced mortality rate compared to the general population (Shah, 2009). In contrast, people with adverse health are likely to select out of employment, if their work environment caused their ill health and they were excluded from the study, this would lead to underestimation of the association. Thus, all studies analyzing occupation as an exposure are likely to be systematically biased by the healthy worker effect (Shah, 2009).

9.2.2 Confounding

Another type of selection important to interpreting the findings might be selection into occupations and labor market success. Many factors might influence people's career trajectories, and the associations found here could be due to unmeasured factors that occurred before our variables were assessed. These could be individual factors (biological,

psychological, or social) and social structures e.g., women are not as likely as men to be promoted into jobs with highly complex working task (Grönlund and Boye, 2017).

There are at least two confounding factors that were not accounted for in this thesis: personality and intelligence. Both of these traits (personality, which is non-cognitive, and intelligence, which is cognitive) are associated with labor market success (Farkas, 2003; Heckman et al., 2006) and with health outcomes (Batty et al., 2009; Gottfredson and Deary, 2004; Turiano et al., 2011). Thus, non-cognitive and cognitive traits likely affect not only which socioeconomic position people end up in and the complexity of their occupation, but also their health. This could lead to spurious associations between the independent and dependent variables. Thus, the associations found could be completely, mainly, or partly driven by personality types or intelligence.

Statistical models are commonly adjusted for confounding factors; however, even after such adjustment, there might be confounding bias in the association studied. Few measures capture all the variation they aim to capture; thus, residual confounding remains in the associations studied (Rothman et al., 2008).

9.2.3 Misclassification

Measurement errors can be random or systematic. In epidemiology, "non-differential misclassification" refers to random and "differential misclassification" to systematic measurement errors (Rothman et al., 2008). Random measurement errors occur when the different groups (e.g. exposed and unexposed) have the same probability of being misclassified. Systematic measurement errors occur when the probability of being misclassified is different between groups. This can occur in both the exposure and the outcome.

9.2.3.1 Information bias in the dependent variables

The outcome measures used in this thesis were assessed by self-report and there might be systematic bias in the reporting. Whether or not people reported symptoms of anxiety or depression in the past 12 months might depend on their expectations on their health, which could differ by personality type (e.g., neurotic personality) or socioeconomic group.

Both mobility and ADL limitations are measures that are more "objective" because the response depends on whether or not a person can perform a task.

I chose to analyze all outcomes as ordinal and did not classify health outcomes as good or bad. Therefore, the outcomes were always measured as an increase in the ordered scale of the outcome. This might have reduced the risk of misclassification, as summarizing the responses in fewer categories might have increased the risk for misclassification.

9.2.3.2 Information bias in the independent variables

The measurement of occupational complexity is likely to include measurement errors. A score based on a matrix that measured occupational complexity was assigned to Swedish

occupations. Some occupations have greater variability in individual-level complexity of working tasks, and the level of complexity of the same occupation might differ by workplace. This might lead to random and/or systematic measurement errors that were overlooked in the thesis. However, the matrix of occupational complexity used in this thesis measured variation between occupations more objectively than job complexity measured at the individual level would have done. I could have measured job complexity with the responses to three questions previously used in LNU: "Is any schooling or vocational training above elementary schooling needed in your job?" "About how many years of education above elementary schooling are needed?" and "Apart from the competence required to get a job like yours, how long does it take to do the job reasonably well?" (Tåhlin, 2011). These measures are more subjective than self-reported occupation and might contain systematic errors because responses could be driven by factors such as personality, intelligence, and like or dislike of the boss.

Income and social class were assessed at the individual level. Household social class, classified in accordance with the highest social class of the household, might be a more efficient measure than individual social class (Erikson, 1984), and the same can be said about income. However, family-based measures rely on the assumption of (equal) transfers of the resource within the family. When both individual- and family-based measures were available, both were tested. In this thesis, individual-based measures had the greatest predictive value.

Study IV relied on retrospective assessment of financial hardship at childhood, and the reporting might therefore suffer from recall bias. Financial hardship at childhood was assessed the first time the respondents participated in a LNU survey. Financial hardship in childhood was assessed at baseline for cohort 1 (1968). For cohort 2 with baseline 1974, 98.6% was assessed in 1968 and 1.4% at the baseline. For cohort 3 with baseline 1981, 94.2% was assessed in 1968, 2.5% in 1974 and 3.3% at the baseline. It is possible that people who have psychological distress and/or those experiencing financial hardship in midlife could report more negatively about their childhood conditions than others. However, the main outcome of psychological distress was measured at age 81 and financial hardship in childhood was assessed (retrospectively) about 30 years earlier.

10 CONCLUDING REMARKS

This thesis show that there are socioeconomic health inequalities in later life. It also show that socioeconomic position in early life is associated with later life health. The results underscore the importance of childhood conditions for future socioeconomic position and health. The findings suggest that both childhood conditions and midlife socioeconomic position are associated with later life health. Childhood conditions were directly associated with psychological distress in later life, however, education and employment partly mediated the negative association from financial hardship in childhood on psychological distress in later life. In addition, childhood conditions were associated with health in midlife. Thus, the results are in line with the growing body of evidence that suggests that social policies designed to improve socioeconomic conditions and health in early life may decrease health inequalities in later life.

The studies in this thesis also showed that from midlife to old age, psychological distress preceded financial hardship to a greater extent than financial hardship preceded psychological distress. This finding suggests that people with psychological distress may be especially vulnerable to financial difficulties. Thus, policies designed to efficiently detect and treat psychological distress in the population may have beneficial long-term economic effects and prevent poverty.

This thesis tested the hypothesis that occupational complexity could have long-term effects on health in late life. Overall, the results suggest that occupational complexity may play a role in shaping the risk for psychological distress in old age, but that associations between occupational complexity and physical health are fully attributable to socioeconomic position. Hence, it may prove fruitful to focus future research on psychological outcomes in general and on the causal nature of the association between occupational complexity and psychological distress in particular.

11 ETHICAL APPROVALS

All studies that comprise this thesis received ethical approval. Ethical permits were issued by the Uppsala University Hospital Ethical Committee (Dnr 247/91 and Dnr 4010-91), the Ethical Research Committee of Karolinska Institutet (Dnr 03-413), and the Regional Ethical Review Board in Stockholm (Dnr 04-314/5, EPN Dnr 2010/403-31/4, and EPN Dnr 2014/1003-31/5). All respondents or, if a respondent was too physically or cognitively impaired to sign the form at the time of the interview, a relative (normally a spouse or an adult child) gave informed consent.

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