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UNEQUAL DRUG TREATMENT: AGE AND EDUCATIONAL DIFFERENCES AMONG OLDER ADULTS

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Unequal drug treatment: age and educational differences among older adults

THESIS FOR DOCTORAL DEGREE (Ph.D.)

by

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ABSTRACT

The overall aim of this thesis is to investigate whether drug treatment is unequally distributed among older adults on the basis of age and socioeconomic position.

All studies in this thesis are based on nationwide register data from the Swedish Prescribed Drug Register (SPDR) record-linked to other registers in Sweden.

In **Study I**, we investigated differences in drug use between centenarians (≥100 years; n=1,672), nonagenarians (90-99 years; n=76,584) and octogenarians (80-89 years; n=383,878). The results showed that the proportion of people living in institutions increased with age, but the number of drugs was similar across the age groups. Centenarians were more likely to use psychotropics (hypnotics/sedatives, antidepressants and anxiolytics) and pain killers (minor analgesics and opioids). This might indicate that drug treatment has a more palliative character in centenarians than in the other age groups. Centenarians used older types of cardiovascular drugs which could reflect a lack of regular re-evaluation of drug use in centenarians or a disinclination to make changes in well-functioning drug therapy among the extremely old.

The aim of **Study II** was to investigate educational differences (as a measure of socioeconomic position) in osteoporosis drug use before and after osteoporosis-related fractures among persons aged 75-89 years (n=645,429). There is a general underuse of osteoporosis drugs among older adults in Sweden. Our results suggest that older persons with lower levels of education are less likely to receive drug treatment both before and after an osteoporosis-related fracture (only statistically significant in women) than their more highly educated counterparts. The educational differences were more pronounced for newer and more potent osteoporosis drug treatments. Lower socioeconomic position seems to be linked to a lower use of osteoporosis drugs – a drug therapy that is generally underused.

In **Study III**, the aim was to investigate educational differences in antipsychotic drug use among older adults (aged 75-89 years) with and without dementia

(n=641,566). Antipsychotic drugs are commonly used to treat behavioral and psychological symptoms of dementia, but the use of these drugs has been associated with increased morbidity and mortality. Efforts have therefore been made to reduce the prescribing of antipsychotic drugs to older adults with dementia. We found a higher use of antipsychotic drugs among persons with lower levels of education, both among persons with and without dementia. Lower socioeconomic position seems to be positively associated with a higher use of antipsychotic drugs – a drug therapy that is generally overused.

We investigated educational differences in being prescribed psychotropic drugs by specialist physicians among older (aged 75-89 years) psychotropic drug users (n=221,579) in **Study IV**. Higher levels of education were associated with more access to geriatrician and psychiatrist prescribing. However, when place of residence was taken into account, the association between higher education and psychotropic prescription by geriatricians became non-significant, whereas the association between higher education and prescription by psychiatrists persisted. Limited access to specialists could be one mechanism liking lower socioeconomic position to less optimal drug treatment.

This thesis contributes to a better understanding of how socioeconomic position and age are related to drug use. In general, lower socioeconomic position and older age seem to be associated with less optimal drug treatment. However, the mechanisms behind these findings are probably complex and need to be addressed in further research to provide a foundation for social policy.

LIST OF SCIENTIFIC PAPERS

I. **Wastesson JW**, Parker MG, Fastbom J, Thorslund M, Johnell K. Drug use in centenarians compared with nonagenarians and octogenarians in Sweden: a nationwide register-based study. Age Ageing 2012:41:218-224.

II. **Wastesson JW**, Weitoft GR, Parker MG, Johnell K. Educational level and use of osteoporosis drugs in elderly men and women: a Swedish nationwide register-based study. Osteoporos Int 2013:24:433-442.

III. **Wastesson JW**, Weitoft GR, Johnell K. Educational disparities in antipsychotic drug use among older people with and without dementia in Sweden. Acta Psychiatr Scand (In press).

IV. **Wastesson JW**, Fastbom J, Weitoft GR, Fors S, Johnell K. Socioeconomic inequalities in access to specialised psychotropic prescribing among older Swedes: a register based study. Eur J Public Health (In press). Doi: 10.1093/eurpub/cku058

CONTENTS

LIST OF ABBREVIATIONS

ATC	Anatomic Therapeutic Chemical Classification System
BPSD	Behavioral and psychological symptoms of dementia
CI	Confidence interval
DDD	Defined daily dose
GP	General practitioner (in Sweden: specialist in family medicine)
OR	Odds ratio
OTC drug	Over-the-counter drug (i.e., drugs that can be bought without a prescription)
SEK	Swedish crowns
SEP	Socioeconomic position
SER	Swedish Educational Register
SERMs	Selective estrogen receptor modulator
SPR	Swedish Patient Register
SPDR	Swedish Prescribed Drug Register
SSSR	Swedish Social Services Register

1 INTRODUCTION

During the last 250 years, life expectancy has increased in western Europe, and it is expected to increase even further.[1] The ageing population is indeed a success story, as more people are living longer. In Sweden, 2.4% of the population was 80 years or older in 1970, 5.2% by 2013, and the share is expected to grow even further in the future.[2] The number of extremely old persons has also risen rapidly; there has been a 7-fold increase in the number of centenarians since the 1970s.[3] At the same time as life expectancy has risen, the mortality gap between persons with higher and lower levels of education has also increased during the last three decades.[4]

It is unclear whether the increase in life expectancy has been attained through the addition of more healthy or more sick years. Some evidence suggests that disability has been postponed but chronic conditions have increased.[5, 6] Part of the trend toward an increased number of chronic conditions can be attributed to increased medical knowledge, more preventive treatments and earlier dignoses. Many 'silent diseases and conditions' such as osteoporosis, diabetes and hypertension,[5] are now detected and treated earlier, before they lead to functional limitations.

The earlier detection of diseases and the increased number of available treatments have led to increased use of pharmaceutical drugs (Figure 1).[7] In Sweden, people aged 80 years and older use on average five drugs concurrently.[8] Treating older adults with drugs is a challenge because of age-related physiological changes and high levels of co-morbidities.[9] The concurrent use of many drugs among the oldest old has been criticised,[10] and polypharmacy has been linked to an increased risk of inappropriate drug use[11] and adverse drug events,[12] which ultimately can lead to hospitalisation.[13, 14] The challenge is to balance potentially valuable drug therapy against the risk of adverse events.

Health and disease is socially patterned, and generally, more well-off people have better health.[4, 15] Access to health care is one factor that can contribute to the health divide between socioeconomic groups.[16] Studies show that more

advantaged people have greater acess to health care and use it more frequently.[17, 18] On the other hand, research shows that disadvantaged people have a higher risk of potentially inappropriate drug treatment[19] and of being prescribed drugs in a manner that does not follow guidelines in Sweden.[20, 21] Furthermore, disavantaged people have a smaller chance of receiving potentially valuable drug therapy,[22] receiving newer[23] and more expensive drugs[24] and of being prescribed drugs by specialist physicians in old age.[25]

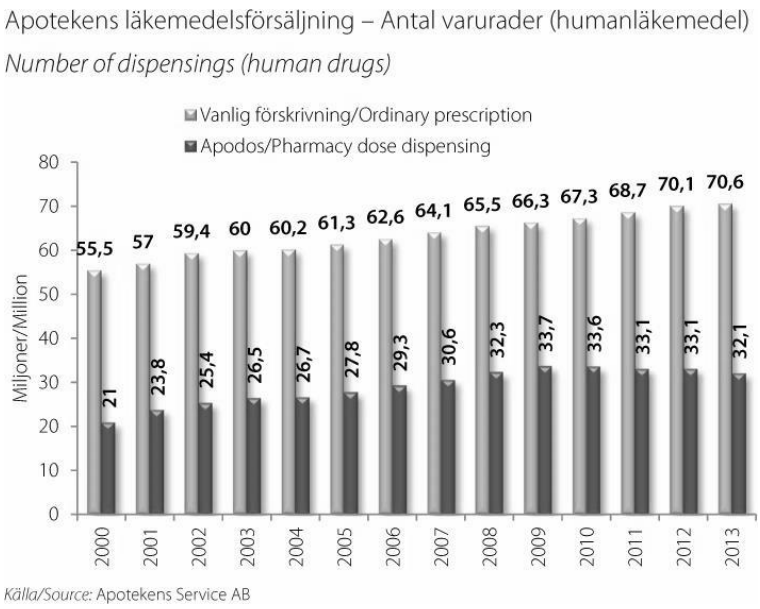

Figure 1. Number of items dispensed in Sweden, 2000-2013. Source: LIF, Fakta 2014.

Given that an increasing number of older adults are living longer with chronic conditions, and that this development is accompanied by increased and prolonged drug use, equal access to health care and drug treatment is of growing importance. Thus, the overarching aim of the present thesis was to investigate whether drug treatment is unequally distributed among older adults on the basis of age and socioeconomic factors.

1.1 DRUG UTILISATION RESEARCH

Drug utilisation research is part of the wider field of pharmacoepidemiology.[26] Recently, drug utilisation research has been defined as *"*an eclectic collection of descriptive and analytical methods for the quantification, the understanding and the evaluation of the processes of prescribing, dispensing and consumption of medicines, and for the testing of interventions to enhance the quality of these processes" (Wettermark et al 2008).[27]

This thesis uses the multidisciplinary framework of drug utilisation research to focus on how social stratification (age and socioeconomic factors) affects inequality in drug use, as depicted in Figure 2.

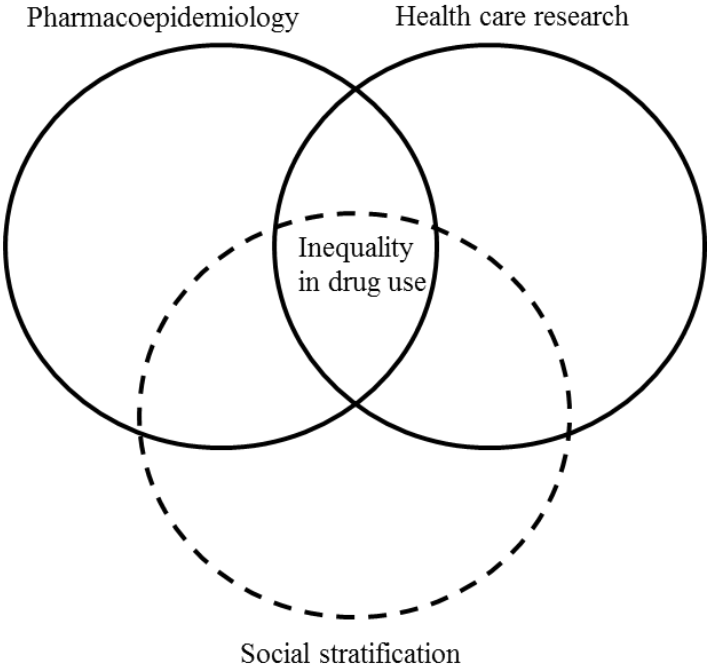

Figure 2. Multidisciplinary perspective on inequality in drug use. Modified from Wettermark et al. 2014.[28]

Drug utilisation research encompasses elements of both pharmacoepidemiology and health care research. A division between descriptive and analytical drug utilisation research is sometimes made.[29] Descriptive drug use research

undertakes to describe patterns and trends. Analytical drug use research further tries to evaluate whether the drug use is rational when different outcomes of drug use are considered (morbidity, mortality etc.). An additional feature of analytical drug use research is the investigation of potential mechanisms behind the patterns of drug use. [29] Elements from both descriptive and analytical drug use research are incorporated in this thesis.

1.2 DRUGS AND AGEING

Ageing is often accompanied by many diseases and symptoms. When two or more conditions are present at the same time, the person is said to have multimorbidity[30] or complex health problems.[31] Increasing rates of co-morbidity are often followed by an increase in drug use. Women tend to live longer than men but to have more health problems, the so-called male-female health-survival paradox.[32] Similarly, men tend to have fewer health problems, but more life-threatening conditions.[33] Women also tend to use more drugs than men in old age.[34]

Older adults are rarely included in randomised clinical drug trials, especially if they have more than one disease.[35] There is therefore little evidence of the effects and side-effects of most drugs among older adults, and concurrent treatment with many different drugs may even be considered an experiment.

The literature also indicates that older age often is linked to lower quality of drug treatment. Older age tends to increase the risk of inappropriate drug use,[11] adverse drug effects[36] and having older medications.[8] However, given that new drugs are rarely tested on older adults and that older adults can have a lower tolerability of drugs, cautious prescribing of newer drugs in clinical practice can be warranted.

1.2.1 Pharmacological aspects of drug intake in old age

In the ageing body, physiological changes alter the body's response to drug treatment, and coexisting diseases can further complicate prescribing. The physiological changes in the body, which include reduced organ function, often

mean that the effects of a drug are prolonged and/or increased. The challenge is to balance the risk of unintended adverse effects of drugs without denying older people valuable drug therapy.

1.2.1.1 Pharmacokinetics

Pharmacokinetics can be described as 'what the body does to the drug'. Pharmacokinetic changes in the body can affect the ability to absorb, distribute, metabolise and excrete drugs.[37] With ageing, the proportion of body water is reduced, which leads to an increase in the proportion body fat. This increase gives fat-soluble drugs a larger volume of distribution, which can lead to a prolonged effect and consequently a risk of adverse drug effects.[9]

Renal function is also reduced in old age. This limits the body's ability to excrete drugs. As a result, drugs can accumulate in the body, which can cause adverse events.[38] It is thus important to take renal function into account when administering drugs to older adults.

1.2.1.2 Pharmacodynamics

Pharmacodynamics can be described as 'what the drug does to the body'. In old age, sensitivity to drugs can increase because of changes in organ systems. For example, old persons' tolerance of psychotropic drugs can decrease because the brain becomes more sensitive to drugs that act on the central nervous system. Changes in the gastrointestinal organs also lead to an increased risk of gastrointestinal bleeding.[37]

1.2.2 Drug utilisation in old age

A panel of 12 experts in geriatric care ranked pharmacological management as the number one target area for quality improvement among a set of geriatric conditions. The ranking by Sloss et al. 2000[39] was based on: "1) prevalence, 2) impact on health and quality of life, 3) effectiveness of interventions in reducing mortality and improving quality of life, 4) disparity in the quality of care across providers and geographic areas and 5) feasibility of obtaining the data needed to test compliance with quality indicators".[39] Other conditions ranked as good

targets for quality improvements were: depression (2), dementia (3), heart failure (4), falls and mobility disorders (7) and osteoporosis (13).

1.2.2.1 Number of drugs and age

In general drug use increases with age; only 10% of the Swedish population between the ages of 20 and 29 use 5 or more prescribed drugs in one year, whereas almost 80% of the population between the ages of 80 and 89 years do so.[40] However, after age 80, the use of prescribed drugs seem to level off (Figure 3).[8]

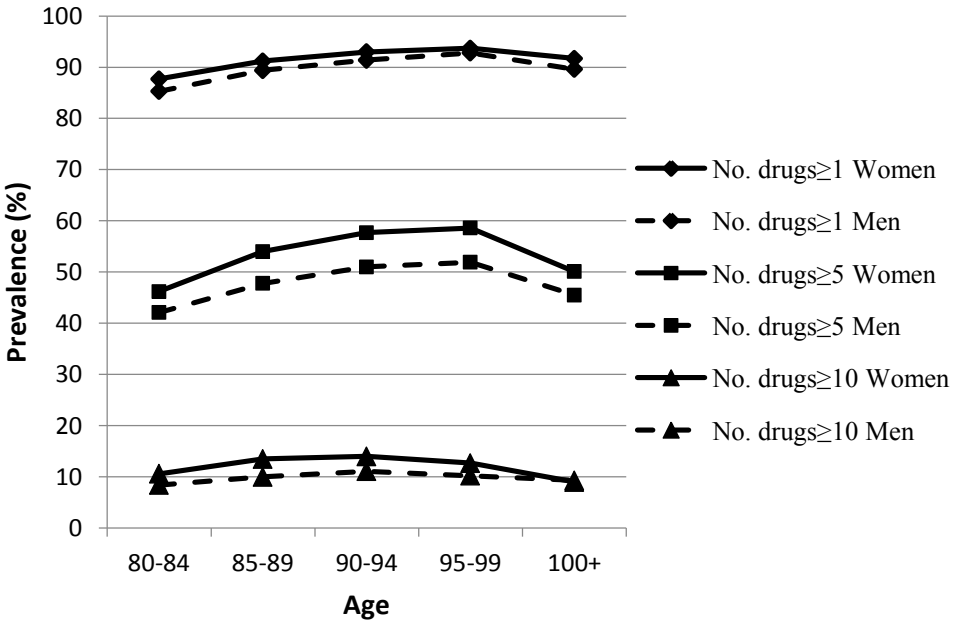

Figure 3. Number of dispensed drugs (unpublished data from Study I).

1.2.2.2 Osteoporosis

Osteoporosis is a disease that makes bone fragile and increases the risk for fractures. The prevalence of osteoporosis increases with age, and the disease is common among older adults. Sweden has among the highest incidences of osteoporosis in the world:[41] nearly half the women and one fifth of the men between the ages of 80 and 84 years are affected.[42] The Swedish Council on

Technology Assessment in Health Care has estimated that osteoporosis causes 70,000 fractures a year in Sweden.[43] Osteoporosis and subsequent fractures lead to great societal costs and reduced quality of life among older adults.[44]

Older age has been associated with a higher risk of being undertreated with osteoporosis drugs.[45] Women are more likely to have osteoporosis and subsequent fractures than men, but mortality after most osteoporotic fractures is higher among men.[46] The findings regarding socioeconomic position (SEP) are mixed. Two related reviews found that low SEP was associated with higher risk of low bone density in women but not in men[47] but found no association between SEP and osteoporotic fractures.[48]

The three main osteoporosis drug treatments are calcium/vitamin D combinations (also available as over-the-counter drugs), bisphosphonates and selective estrogen receptor modulators (SERMs) (only used in women). Osteoporosis drug treatment can be initiated both to prevent an osteoporosis-related fracture and as secondary prevention after an osteoporosis-related fracture. The effectiveness of osteoporosis drugs has actually been documented in randomised controlled trials in older adults.[49, 50] Calcium/vitamin D combinations are the least potent of the drugs, and the more newly marketed drugs (bisphosphonates and SERMs) are used in more severe cases of osteoporosis. SERMs are hormone-adjusting drugs that are only used in women. In recent years, researchers have questioned the use of SERMs for treating osteoporosis because of the increased risk for venous thromboembolism and stroke.[51] A number of researchers have argued that there is a general undertreatment with osteoporosis drugs,[45, 52, 53] especially among men.[54] A few studies have investigated whether the use of osteoporosis drugs differs between socioeconomic groups, with mixed results.[55-58]

1.2.2.3 Mental health

Mental disorders are common among older adults; among persons aged 75 years or older, approximately one in four has a mental disorder[59] or psychological distress.[60] Mental disorders include several diseases and symptoms (e.g.

depression, anxiety and mood disorders). Many mental disorders may be underdiagnosed among older adults because the symptoms are sometimes different in older adults than younger persons (e.g. the symptoms of depression).[61]

In older adults, mental disorders are mainly treated with psychotropic drugs. Psychotropics can be divided into antipsychotics, anxiolytics, hypnotic sedatives and antidepressants. Psychotropics are mainly prescribed to older adults by general practitioners (GPs) who work in outpatient care (in the Swedish health care system, GPs undergo a specialist education in family medicine.).[62] The Swedish system, in which GPs prescribe the majority of psychotropics, has been criticised.[62] Many GPs may not have sufficient knowledge about the specific symptoms of mental disorders in old age, and psychotropic prescribing may be further complicated by the multimorbidity and lower tolerance of drugs among older adults.

1.2.2.4 Behavioural and psychological symptoms of dementia

Behavioural and psychological symptoms of dementia (BPSD) include a range of behaviours and symptoms such as screaming, wandering and hallucinations.[63] The concept of BPSD has been criticised as non-specific, and there is no consensus about what constitutes BPSD.[63]

It has been estimated that almost 90% of people with dementia experience some kind of BPSD during the progression of the disorder.[64] In clinical practice, antipsychotics have often been used to treat many of these symptoms.[65] However, around 2005, a series of studies found that antipsychotics increase the risk of morbidity and mortality among older adults with dementia,[66-69] and since then their use in institutional settings has declined from 17% to 13%.[70]

In the current Swedish guidelines developed by the National Board of Health and Welfare, antipsychotics are not recommended as a first-line treatment for BPSD. Rather, the guidelines call on social and health care professionals to first rule out all causes of BPSD, such as suboptimal pain treatment and problems in the care

environment. Non-pharmacological treatments are thus the first-line treatments.[71]

One study on the association between SEP and antipsychotic drug use among older adults with dementia in Canada found that those with lower income were more likely to be treated with potentially inappropriate antipsychotics.[72] A report from the Swedish National Board of Health and Welfare also indicates that the use of antipsychotics is more common in persons with dementia who have a low level of education and/or were born outside Sweden than in those with dementia who have a high level or education and/or were born in Sweden.[70]

1.3 SOCIAL STRATIFICATION

Most societies have some principle of social stratification. That is, a system of social positions in which some people have more resources and better life chances than others. The principles of stratification can change over time and across regions. This thesis focuses on socioeconomic stratification, measured as educational level.

1.3.1 Social inequalities in health

There is a vast literature on the association between SEP and health, and most health conditions seem to follow a social gradient whereby every step lower in the social hierarchy is linked to worse health.[15] Socioeconomic inequalities in health are one of the most consistent findings in social epidemiology and seem to persist across time and regions.[15, 73-75] Moreover, these inequalities in health seem to persist into old age.[76, 77] However, the mechanisms behind the relationship are not fully understood. For summaries of the mechanisms, see Mackenbach 2012[78] and Bambra 2011[79].

A common typology divides the mechanisms into material, psychosocial and behavioural.[80, 81] Material explanations emphasise differences in material living standards and consumption. Psychosocial explanations emphasise the psychological and physiological responses to stress that can arise from feeling disadvantaged. Behavioural explanations focus on the social patterning of

behaviours and lifestyles and the higher frequency of poor habits among less advantaged persons.

It has also been proposed that the association between SEP and health may be due to health selection processes. This explanation implies that poor health results in a less advantaged social position rather than the other way around; i.e., a person with poor health will not have the same opportunities to have an education, get a job and/or earn a high income. Other researchers have questioned the hypothesis that selection processes may be the main driver of the general socioeconomic differences in health,[82] although health selection will have some impact on income and occupation because it is clearly related to the ability to work.[83]

1.3.1.1 The fundamental cause theory of health inequalities

A more recent theory on the mechanism behind socioeconomic differences in health is the fundamental cause theory of health inequalities. Phelan and Link first formulated the theory in 1995,[73] and it has been developed further since then.[84-88] The theory is foremost an attempt to explain the persistence of health inequalities across time and regions, but the theory also contextualise the ways in which access to and use of health care and medical treatments can contribute to health inequalities.

The persistence of a social gradient in health has been robust over time, irrespective of the radical changes in life expectancy, disease panorama and risk factors over the last century. Furthermore, neither the expansive welfare states nor the technical innovations in health care have been able to eradicate the association. Rather, it seems that the more developed welfare states and health care systems have enlarged the relative differences between social groups.[78]

According to Phelan and Link, controlling disease and morbidity through health care advances is not likely to remove the social differentials in health; rather, advantaged persons are more likely to benefit more from the advances made.[86] Thus, the socioeconomic difference is likely to be larger for diseases that are preventable. Some studies have shown that the socioeconomic differences in

mortality are larger for amendable conditions,[87, 89] but these findings have not been replicated in all studies.[90] Further, it has also been shown that health technological innovations may increase inequalities in health, since highly educated persons are more likely to access and exploit the new technologies.[91] For example, in the United States, cholesterol levels were higher in high than low SEP groups before the introduction of statins, but after statins achieved wide use in high SEP groups, the relationship between SEP and cholesterol reversed.[92]

According to the fundamental cause theory, people with higher SEP use their flexible resources (such as money, knowledge, prestige, power and beneficial social connections) to gain faster access to care, obtain better health information and avoid risks. Thus, irrespectively of what new mechanism linking SEP to health that emerges, more advantaged persons will use their flexible resources to attain a health advantage over persons in lower social strata.

Material resources are used to buy health-enhancing services and items. Social resources are important to obtaining health-related information, informal care and access to providers. Cognitive resources can be used to gain and assess health-related advice, avoid risks and orient oneself in the health care system.[93] People with many resources also tend to socialise with people who are more health-aware (through workplaces, institutions and neighbourhoods), which can have a positive influence on health behaviours.[93]

1.3.1.2 Educational level as an indicator of socioeconomic position

Socioeconomic conditions are often measured through SEP. SEP can be measured with indicators, such as income, social status, occupation and education.[94] The different measures of SEP are often used interchangeably but have different theoretic underpinnings and can also point to different underlying mechanisms.[94-96]

As an indicator of SEP, education has some specific properties. First, it is usually the SEP indicator attained earliest in life, which reduces some of the risk of health selection biases.[94] Poor health in mid-life can lead to the loss of a job or income, whereas education remains constant. Second, since education is

sometimes a prerequisite for entry into the labour market and for a high income, education will also be a partial marker of occupation and income. However, there are selections into education that are not necessarily related to SEP. For instance, in older cohorts, few people – and in particular, few women – had the opportunity to obtain a higher level of education. Education is also an indicator of immaterial resources and is linked to factors such as lifestyle behaviours, habits, social relationships and cognitive abilities.[78, 97, 98] Education also has an impact on individuals' health-related knowledge, health literacy and ability to demand care.[99]

Assessing the SEP of older people is difficult for a number of reasons.[100] Older adults are often retirees, so it is not possible to assign them an occupation (if not asked in retrospect or using administrative data on last/main occupation). Further, for retirees, pensions are the main source of income, and most pension systems tend to equalise the income distribution. Thus, wealth may be a better indicator of older people's financial resources than income.[101] Further, the relative importance of different indicators of SEP might vary over time. For instance, general educational attainment was low at the beginning of the twentieth century, and few had more than a basic education. Future cohorts of older adults will have higher levels of education, and this will lead to compositional changes that might affect the associations between education and a variety of outcomes.[102]

1.4 THE SWEDISH HEALTH CARE SYSTEM AND INEQUALITY

1.4.1 The Swedish health care system

In Sweden, the state is responsible for health policy, whereas the county councils (n=20) and municipalities (n=290) are responsible for funding and provision of services. The county councils are responsible for health care, which is financed through taxation.[103] Care for older adults is, however, mainly performed and financed by the municipalities.[103]

1.4.1.1 Primary care

In Sweden, primary care is foremost provided by GPs. The physicians working as GPs in Sweden are most often specialists in family medicine ('allmänläkare').[62] The patient can choose any public or private provider accredited by the county councils.[103] A visit to the GP is usually the first contact that older adults with physical or psychological problems have with the health care system. For older adults, the district nurse is also a common first health-care contact. District nurses are most often employed by the municipalities but act under the supervision of a physician. District nurses regularly make home visits and have the right to prescribe some drugs.[103]

1.4.1.2 Specialised care

Specialised care, which requires more medical equipment and technology, is mainly provided at hospitals. The most specialised and advanced care is provided at the seven university hospitals, and more regular specialised care is provided at about 70 local hospitals. About two-thirds of the hospitals have 24-hour acute care. The number of acute care settings has decreased continuously over the last decades, and during this time there has been a move from hospital inpatient care to outpatient care. For example, outpatient care at hospitals has grown; that is, treatment or surgery for conditions that do not require an overnight stay.[103]

1.4.1.3 Inequality in health care

The Swedish Health Care Act states that access to health care should be equal and provided in relation to need.[104] Inequality in health care can be both horizontal and vertical. Vertical equality implies that individuals with different levels of need should have access to different amounts of health care; amounts that correspond to their needs. Horizontal equality implies that persons who have the same level of need should have access to the same amount of health care.[105] This thesis focuses on horizontal equality in health care use.

Health care should be equal irrespective of age, gender, place of residence, functional capacity, ethnicity, religion, sexuality, education and other social

factors.[106] This thesis focuses on inequality related to age and SEP (education). To study whether health care use matches need, it is important to measure a person's actual need for health care. The best method for assessing need is the focus of much discussion in the field of health care inequality research.[107] Need is most often assessed by using some measure of health status[108] or by comparing patients with the same disease.

In Sweden, socioeconomic inequality in health care use was small in the 1970s and 1980s[109] but increased during the 1990s.[109, 110] Since then, studies have found the socioeconomic differences in Sweden are of a similar magnitude to those in other high income countries.[17, 18, 101, 111] The general finding in Sweden is that, in relation to need, the use of GP care is equal across social groups, whereas the use of specialised care tends to be higher among persons with high SEP.[112, 113] The same pattern is found in many other high income countries. Most health care inequality studies do not specifically focus on older adults, but the results of most studies on health care inequality among older adults mirror the results of studies on younger age groups.[101, 114, 115]

1.4.2 Prescribing in Sweden

The vast majority of all drugs prescribed in Sweden are prescribed by physicians, although some nurses and dentists also have limited rights to prescribe.[62] The number of drugs used by older adults has increased over time,[116] which is also reflected in an increase in drug expenditure in Sweden. Between the 1990s and early 2000s, drug expenditure increased by approximately 10% annually, but the increase has slowed down since 2005.[117, 118] The increase in drug expenditure was driven by both newer expensive drugs and increased drug use for chronic conditions.[117] In 2004, drug costs represented 12% of the total health care expenditure in Sweden.

Patients' expenditures on prescription drugs are largely reimbursed in Sweden. The Dental and Pharmaceutical Benefits Agency ('Tandvårds- och läkemedelsförmånsverket [TLV]') is a governmental agency responsible for deciding which drugs are subsidised by the state. The TLV decides which drugs

to include in the high-cost threshold on the basis of medical, humanitarian and financial considerations. Drugs included in the high-cost threshold are reimbursed from the state. The patient receives gradual reimbursements, calculated on a yearly basis, and the patient is fully reimbursed (100%) when the yearly expenses exceed 2200 Swedish Crowns (SEK) (Figure 4).[119] The maximum yearly individual expenditure was increased from 1800 SEK to 2200 SEK in 2012.[119]

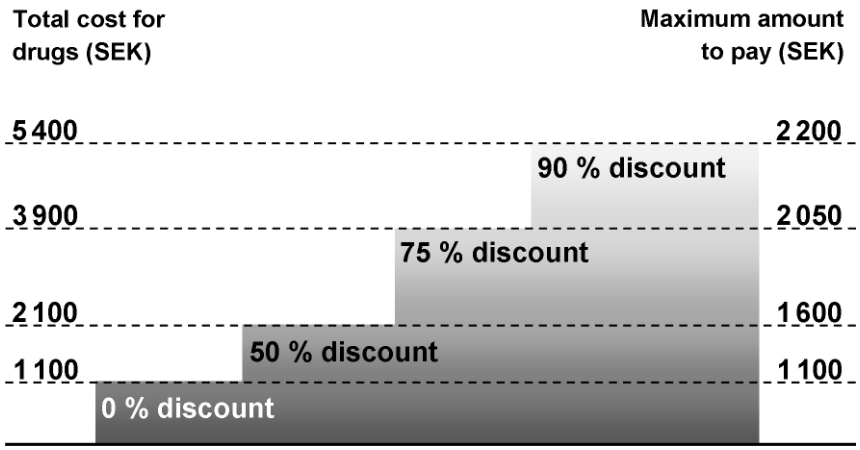

Figure 4. Reimbursement scheme (high-cost threshold) for prescribed drugs on a 12-months basis in Sweden (Costs in Swedish crowns [SEK]). Source: FASS.se.

1.4.3 What explains inequality in use of health care and drugs?

The causes of inequality in health care and drug use are far from understood but are likely to be complex and multifaceted.[107] Models of factors that affect access to health care have been developed. The models have been used to discuss where in the process of health care use inequality might arise. However, these models have rarely taken prescribing of drugs into account.

1.4.3.1 The behavioural model of health services use

The most influential model of access to health care is the Behavioural Model of Health Services Use, which has been gradually developed since the 1960s (for overviews, see Andersen 1995[120] and Andersen 2008[121]). The behavioural model

is a conceptual framework that broadly outlines three sets of predictive factors that influence care use: need factors, enabling factors and predisposing factors. Each factor can further be divided into individual or contextual dimensions. The model defines access to health care as actual health care use. The model can be used for predicting use of health care, promoting social justice (equal care) and investigating effectiveness.[122]

Individual-level need factors are thought to affect how people respond to their general health, illness and symptoms. In other words, individual factors influence how people perceive their needs. In turn, perception of needs influences care-seeking behaviors. Contextual need factors involve the physical environment of the individual. As an example, the proximity of health care services in a neighbourhood can influence health-care seeking among individuals living in the neighbourhood.[122]

At the individual level, enabling factors include the financial means to pay for health care services, access to transportation and having time to visit health care services. At the contextual level, enabling factors can include health policies that promote health and utilisation of health care services.[120, 122]

Predisposing factors include individual traits such as education, occupation and social networks that might affect a person's ability to handle health problems and command resources. Contextual predisposing factors are related to the composition of the community. For instance, if people in the individual's community are generally well educated or if most are old, it can affect the degree of services in the area and the health beliefs of those living in the community.[122]

1.4.3.2 The behavioural model of prescribing

Nordin et al.[24] have extended the behavioural model of health services use by proposing a model for the drug utilisation process:

1. Demand for health care (response to illness)
2. Demand meets supply (i.e., the patient meets an available and affordable doctor who can prescribe the drug)

3. Health care production (the doctor writes out the prescription on the basis of medical and possibly other considerations)
4. Dispensing of the drug (the patient collects the drug if the patient can afford/have access to a pharmacy/adheres to the treatment)
5. Consumption of the drug (the patient consumes the drug if s/he adheres to the treatment)

In Nordin et al.'s extended model,[24] the same factors (need, enabling and predisposing) are thought to influence access to pharmaceutical care, but the researchers have add steps not explicitly discussed in the behavioural model of health services use; namely the steps from the prescribing to the consumption of drugs (steps 3–5). A similar model has also been proposed by Weitoft et al. 2008[123] and is depicted below (Figure 5). The figure illustrates a health-care use chain in which socioeconomic factors can have an influence at different points in the process.

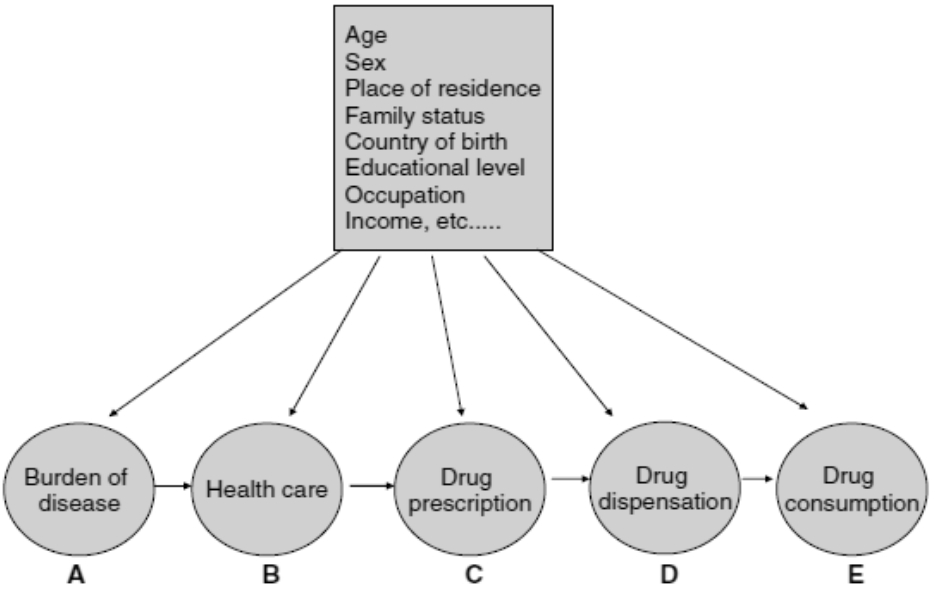

Figure 5. Conceptual framework of sociodemographic influences on drug use. Source: Weitoft et al. 2008.[123]

The models provide guidance as to where inequality can arise in the complex process of health-care seeking and provision of care. The models incorporate multiple levels and factors that can influence the delivery of care at many different points in the process. However, the models are difficult to test as they are all-encompassing and provide little information about the directionality of influences between and among the different levels and factors.

1.4.3.3 Other mechanisms

A range of mechanisms have been suggested to explain inequalities in drug use. Most suggestions come from qualitative work because quantitative studies often provide little information on underlying pathways. A notable example of a qualitative study that highlights the mechanisms linking SES with differences in treatment is Lutfey & Freese 2005.[124] They set out to further develop the fundamental cause theory of health inequalities by using in-depth ethnographic data to study the explicit mechanisms that lead to differences in care. By comparing the routine care at two diabetes clinics (one with predominantly white and middle/upper class patients, the other with predominately black/Hispanic and working class patients), Lutfey and Freese found a large number of potential mechanisms likely to produce and reproduce the endurable relationship between SES and health care use/outcomes. They found mechanisms in many aspects of care that are likely to maintain the unequal use and outcomes of care, even as new treatments are developed and enter the market. The proposed mechanisms were visible in the organisation of clinics, external barriers to seeking care, differences in patient motivation (and the apprehension of motivation by the physicians) and in cognitive ability. Many other mechanisms have also been proposed in the literature. Some of the proposed mechanisms are discussed below; the discussion covers mechanisms at the individual level, those that involve patient-physician interaction, and those at the societal or system level.

1.4.3.4 Individual level

Possible individual-level mechanisms range from patients' preferences to financial means. One set of suggested pathways is mainly cognitive. It includes

factors such as socioeconomic differences in knowledge[125], health literacy[99] and health beliefs.[126] Such explanations propose that individuals with lower SEP have less health-related knowledge, which in turn leads to poorer access and utilisation of health care services. Another set of explanations predominantly highlights patients' preferences and attitudes; these explanations often suggest that individuals with low SEP have attitudes that are less health-enhancing, and that this is linked to an inadequate use of health care.[127, 128]

Other explanations relate to the physical environment. These suggest that differences are due to geographical distances and transportation.[129] Still other research suggests that financial resources are a pathway, both through differences in the ability to pay for health services and differences in competing demands from work.[130-132]

1.4.3.5 Physician-patient interaction

The patient-physician interaction has been studied and discussed for a long time (for an overview, see Heritage et al. 2006[133]). Studies propose a number of mechanisms as to how the physicians' and patients' perceptions and behaviours interrelate and influence differences in treatment.[134] The provider contribution to differences in treatment often draws on social cognition research and highlights the risk that physicians may stereotype specific subgroups. Stereotyping can entail ascribing negative characteristics and behaviours to subgroups, leading to preconceived ideas that can influence the choice of treatment.[135, 136] Other research has emphasised the role of patients' expectations of and demands for care, which can influence physicians' decisions about whether or not to treat.[137, 138] This research suggests that the expectations and demands are most likely related to SEP.

Furthermore, research has shown that physicians are influenced by therapeutic traditions. For instance, physicians who work at the same health care centre have similar prescribing patterns,[139] and physicians working at private clinics sometimes prescribe differently than those who work at public clinics.[139, 140] Private clinics are more common in areas with a high concentration of people

with high SEP, which can translate into socioeconomic differences at a national level.[141]

1.4.3.6 Societal level

More general and upstream factors such as the organisation and financing of the health care system also have consequences for the way socioeconomic differences affect health care and drug treatment. The Swedish health system, which has universal coverage, is probably better at equalising differences in health care use than systems that use private health insurance.[142] However, even in Sweden, reimbursement schemes that affect out-of-pocket expenses are likely to influence different socioeconomic groups in different ways.[130] For instance, when prices increase, persons with lower SEP are more likely to refrain from collecting drugs.

1.4.4 Socioeconomic differences and drug prescribing

Sweden was among the first countries to produce statistics on drug prescribing. First, Sweden gathered wholesale statistics from Apoteket AB, Sweden's government-owned national pharmaceutical retailer, which formerly had a monopoly on prescription drug sales. These statistics could be used to assess prescribing trends and regional/international variations.[143] Second, data were gathered by recording individuals' outpatient drug use in two regional settings: the county of Jämtland[144] and the municipality of Tierp[145] starting in the early 1970s. In 2005, the Swedish Prescribed Drug Register (SPDR) was introduced; this register includes individual-level prescription data for all people in Sweden.[146, 147]

One of the first studies to focus on socioeconomic differences in drug use in Sweden was published 1988 and based on the Tierp study.[131] The authors found small differences: people of lower social class used more psychotropics, and this difference was found both in people of working age and those who were retired.[131]

A number of studies have also examined the association between indicators of SEP and the number of drugs used (e.g., polypharmacy) among older adults or in the general population, in Sweden and elsewhere.[19, 116, 148-153] With a few exceptions,[150] these studies found that people with low levels of education used more drugs. However, as some of the authors have noted, the more extensive use of drugs reported among people with low SEP likely reflects the differences in health between social groups.[152]

Some of the studies that analyse the association between SEP and polypharmacy have also included other measures of drug use, such as quality indicators.[19, 116, 149] Haider et al.[19, 116] found that low SEP was associated with more potentially inappropriate drug-drug interactions and inappropriate use of three or more psychotropics among older adults. The socioeconomic differences in drug-drug interactions are partially expected since drug-drug interactions are highly correlated to the number of drugs used.[154] Odubanjo et al.[149] also found that relatively deprived older adults were more likely to receive potentially harmful drugs and were more likely to receive treatments that were not evidence-based. An overview of studies of socioeconomic differences in drug use that have focused specifically on older adults (aged 65+ years) can be found in Table 1.

A nationwide register-based study, by Ringbäck Weitoft et al.,[123] reported that in the general population of Sweden, the socioeconomic differences in prescribing followed the social gradient in disease prevalence for most drug types. Among the exceptions were antibiotics, hormone replacement therapies, migraine medications and dementia drugs. The authors concluded that more studies are needed in which data on individuals' diseases are available, as this will make it possible to differentiate between socioeconomic differences in need and prescribing.[123]

A number of disease-specific studies have also been published in which socioeconomic differences in drug use have been found for patients with the same conditions. Examples include studies on osteoporosis,[22] epilepsy,[155] and acute myocardial infarction.[20, 156] In all these studies, lower SEP was linked to less optimal drug treatment.

Inequality in the cost of drugs has also been found between socioeconomic groups. In a study of a nationally representative sample of Swedes, researchers found that women with a higher level of education were prescribed more expensive drugs than women with a lower level of education, for general drug use. No education-based differences were found in men, and no income-based differences were found in either women or men.[24] Further, for specific drugs, the socioeconomic-based difference was greater when the drug was prescribed for diseases that are not severe (e.g., sildenafil for erectile dysfunction). A register-based study of people in Stockholm County found that public expenditure on health care in the last year of life was larger for persons with higher income.[157] One explanation for the difference in costs for drugs might be that more affluent persons are prescribed more brand-name drugs, as studies of older Canadians[158] and of statin users in the Swedish region of Skåne[140] have found.

In Sweden, the cost of drugs is not fully covered by public money; patients must also pay a portion of the cost of prescription drugs they collect at pharmacies. When a patient does not collect a prescription, it is called primary non-adherence or non-initiation.[159] In Sweden, more deprived persons are more likely to be primary non-adherent, and the relative difference between socioeconomic groups increases at older ages.[160] However, it is not clear whether this is because of poorer financial resources or lower levels of trust in the health care system among more deprived persons.[160] One study has found that persons with lower education or lower income are more sensitive to increases in the price of drugs: if the patients' user fees would increase, then primary non-adherence would increase more in persons with low SEP.[130] However, in this hypothetical situation, the researchers also found that price sensitivity decreased with age. Thus, older adults were less likely than younger adults to change their primary adherence if patient fees increased.[130] In a nationally representative survey of persons aged 77 years or older in Sweden, as few as 1% of respondents reported having refrained from collecting drugs for financial reasons.[161]

A number of studies have also examined how area effects and individual socioeconomic conditions affect different measures of drug use. These studies

found that people with low SEP are more likely to receive cheaper and older lipid-lowering agents[139, 140], have lower adherence to antihypertensives[162] and to have lower general primary adherence[163] over and above the studied area effects.

Table 1. Overview of studies investigating socioeconomic differences in drug use among persons aged 65 years or older.

Author, year	**Participants**	**Indicator of SEP**	**Measure of drug use**	**Main findings**
Mamdani et al. 2002[158]	N=128,314, age ≥65, residents of Ontario (Canada) initiating specific therapies 1 January 1998 through 31 December 1999	Neighbourhood income	Generic vs. brand name agents	Increases in neighbourhood median income levels were associated with the selection of newer brand-name drugs
Odubanjo et al. 2004[149]	N= 95,055, age ≥70, in the Eastern region in Ireland and included in the General Medical Services Scheme	Means tested group (deprived) vs. non-means tested group (affluent)	(1) Number of drugs (2) Potentially harmful prescribing (3) Evidence-based prescribing	The non-means tested groups used fewer drugs, used fewer potentially harmful drugs and were more likely to have evidence-based treatments
Haider et al. 2007[116]	N=512 (year 1992) + 561 (year 2002), age ≥77, nationally representative sample of Swedes	Education	(1) Drug user (2) Number of drugs (3) Drug-drug interactions	Highly educated persons were less likely to be drug users, used fewer drugs and were less likely to have a drug-drug interaction. The education-based difference increased from 1992 to 2002 in women

Haider et al. 2008[23]	N=626,258, age 75–89 who filled at least one drug prescription from August through October 2005; data from the SPDR	Education	Newly marketed drugs	Persons with a higher level of education were more likely to use newly marketed drugs then persons with low education
Haider et al. 2008[148]	N=621 (year 2002), age ≥77, nationally representative sample of people in Sweden	Education, occupation and income	Polypharmacy (≥5 drugs)	Low education was the only SEP indicator associated with more polypharmacy. The association disappeared after adjustment for co-morbidity, marital status and living situation
Haider et al. 2009[19]	N=626,258, age 75–89 who filled at least one drug prescription from August through October 2005; data from the SPDR	Education	(1) Polypharmacy (≥5 drugs) (2) Excessive polypharmacy (≥10 drugs) (3) Potential inappropriate drug use	Highly educated persons were less likely to have polypharmacy, excessive polypharmacy and to use three or more psychotropic drugs
Lesén et al. 2010[164]	N=384,712, age ≥75 who filled at least one psychotropic drug prescription during 2006; data from the SPDR	Income	(1) Three or more psychotropics (2) Potentially inappropriate psychotropic drug use	Persons with higher income were less likely to use three or more psychotropics and to have a potentially inappropriate psychotropic drug use

2 AIMS

2.1 GENERAL AIM

To investigate whether drug treatment is unequally distributed among older adults on the basis of age and SEP.

2.2 SPECIFIC AIMS

2.2.1 Study I

To investigate and describe drug use among people aged 80–89, 90–99 and 100+ years with respect to number of drugs used and the most commonly used drug classes.

2.2.2 Study II

To investigate educational differences in osteoporosis drug treatment before osteoporosis-related fracture (primary prevention) and after osteoporosis-related fracture (secondary prevention).

2.2.3 Study III

To investigate educational differences in treatment with antipsychotics in older adults with dementia and in the general population.

2.2.4 Study IV

To investigate educational differences in access to specialised prescribing (geriatricians and psychiatrists) among older adults who use psychotropics.

3 MATERIAL AND METHODS

The Nordic countries (Sweden, Norway, Finland and Denmark) are the only countries in Europe with the ability to link pharmaceutical registers to other nationwide databases using personal identification numbers.[165] Thus, it is possible to collect drug data that are highly representative of the general population in Sweden (about 9.7 million inhabitants) and can be linked to data in other registers and data sources.

3.1 DATA SOURCES

3.1.1 The Swedish Prescribed Drug Register (SPDR)

The SPDR was introduced in its current individual-based form in 2005. The register contains information on all prescribed drugs dispensed at Swedish pharmacies; in other words, all drugs picked up by the people for whom they were prescribed (or the legal guardians of these people). The register, which also includes information on multi-dose drug dispensing ('ApoDos'), is one of the largest pharmacoepidemiological databases in the world.[146] Only prescribed drugs that are actually collected are recorded in the register. Hence, if a drug is prescribed but not collected, it is not registered in the SPDR. In this thesis, the terms 'dispensed', 'prescribed', and 'collected' are used interchangeably to denote prescribed drugs that were also collected from the pharmacy. For each such drug, information on package size, drug name, dosage of the drug, strength of the preparation and more is recorded in the register.

We investigated drug use at two points in time, July to September 2009 (Study I) and July to October 2005 (Study II-IV). Our study windows of 3 and 4 months should include all regularly used drugs because the maximum amount of a drug that may be dispensed is a 3-month supply.

In Study I, we were interested in overall drug treatment and did not focus on a specific type of drug. We therefore analysed the concurrent use of drugs on a specific day (30 September, the last day of the study period) to avoid overestimating current drug treatment. A one-day point prevalence was

constructed using information about the date of dispensing, amount of drugs dispensed and the dosage of each dispensed drug to calculate if the drug was used on the 30 September. When dosage was incomplete or missing (8.7%), we based our calculations on the defined daily dose (DDD). The DDD is the assumed average dose per day of a drug used for its main indication in adults, as recommended by the World Health Organization (WHO).[166] If a person was dispensed the same drug in different doses this was counted as one dispensed drug.

In studies II through IV, we wanted to investigate exposure to certain drug classes. Therefore, drug use was calculated for a 4-month time window rather than for one specific day. This method probably overestimated the overall number of concurrently used drugs.

Drugs administered in hospitals, over-the-counter drugs (OTC-drugs), and drugs supplied from store rooms in nursing homes are not included in the SPDR. This probably led to an underestimation of the number of drugs used.

3.1.1.1 Drug information

Detailed information on patients' drug use is included in the SPDR: drug name and strength, date of dispensing, package size and doses.

3.1.1.2 Patient characteristics

Further, some key characteristics of the patient is also included, such as age, gender and place of residence.

3.1.1.3 Physician characteristics

It is not possible to identify individual physicians in the SPDR. However, for each dispensed drug, some of the prescribing physician's characteristics are included, such as prescriber profession (physician, nurse or dentist), workplace (e.g., hospital or health care centre) and physician specialty (e.g., geriatrician or psychiatrist).

3.1.2 The Swedish Educational Register (SER)

The SER contains information about the highest educational level achieved by most Swedish citizens aged 74 years or younger (the upper age limit was removed in 2008). Educational attainment data were collected from the Swedish censuses ('Folk- och Bostadsräkningarna') and then continuously updated with information from Swedish schools and universities. The registered level of educational attainment for most Swedish older adults is from the Swedish census in 1990. The studies that include level of educational attainment in this thesis use data from the SPDR in 2005; thus, we could use the educational information from 1990 census to study the educational attainment for people up to the age of 89 years (studies II through IV).[167]

The SER combines the highest attained level of schooling and years in school. Highest attained level refers to compulsory, upper secondary or university education. The years of education are the number of years at each attainment level.[167]

3.1.3 The Swedish Patient Register (SPR)

The SNPR was introduced on a local basis in the 1960s and was then gradually expanded to cover all of Sweden. Since 1987, the register has included information on all hospital discharges across the country. All surgical procedures (including day surgery) have been included since 1997, and all outpatient visits to specialists since 2001.[168]

This thesis mainly uses discharge diagnosis information on main diagnosis and secondary diagnoses (studies II through III). The SPR also include other variables, such as health care setting. A validation of the register found that 99% of discharges from both somatic and psychiatric hospital care were recorded.[169]

3.1.4 The Swedish Social Services Register (SSSR)

The SSSR was initiated in 2007 and includes information on social services for people aged 65 years and older administered by the municipalities in Sweden (e.g., home help and institutional care) . The register includes individual-level

information based on decisions by needs assessors ('biståndsbedömare'). We obtained information on institutional care for 30 June 2008 (Study I).[170]

3.2 OUTCOME MEASURES AND EXPLANATORY VARIABLES

3.2.1 Outcome measures

Drug use is the outcome in all the studies included in this thesis. As recommended by WHO, drugs were classified using the Anatomical Therapeutic Chemical (ATC) system.[166] For an overview of the studies included in the thesis, see Table 2.

3.2.1.1 Drug use in centenarians (Study I)

We compared drug use in centenarians to drug use in octogenarians and nonagenarians in Sweden. We compared the number of drugs and the prevalence of the 16 most commonly used drug groups.

3.2.1.2 Osteoporosis drugs (Study II)

We analysed use of any osteoporosis drug and the use of three different types of osteoporosis drugs: calcium/vitamin D combinations (A12AX), bisphosphonates (M05BA and M05BB) and SERMs (G03X; only in women). Use of each type of osteoporosis drug was analysed separately.

3.2.1.3 Antipsychotics in persons with and without dementia (Study III)

We analysed use of any antipsychotic drug (N05A) and the use of two main types of antipsychotics: second-generation antipsychotics (N05AE04, N05AH02, N05AH03, N05AH04, N05AAX08 and N05AX08) and first-generation antipsychotics (all other N05A drugs). Use of the two main types of antipsychotics was analysed separately.

3.2.1.4 Specialist psychotropic prescribing (Study IV)

In psychotropic drug users, we analysed whether psychotropics were prescribed by a 'geriatrician', 'psychiatrist' or 'other specialist' (mainly GPs). We analysed specialist psychotropic prescribing of four types of psychotropics: antipsychotics

(N05A), anxiolytics (N05B), hypnotic/sedatives (N05C) and antidepressants (N06A).

3.2.2 Explanatory variables

3.2.2.1 Educational level

Educational level was classified on the basis of years of education and educational attainment: low educational level (compulsory school; that is, less than 9 years of education), medium educational level (upper secondary schooling, including 'realskola'; that is, 9 to 12 years of education) and high educational level (a university education; that is, more than 12 years of education) (studies II through IV).

3.2.2.2 Age

In Study I, age was classified into 80–89 years (octogenarians), 90–99 years (nonagenarians) and 100+ (centenarians).

In studies II and III, age was classified as 75–79 years, 80–84 years and 85–89 years.

In Study IV, age was included as a continuous variable.

3.2.2.3 Gender

Gender was included as a dummy variable in studies I, III and IV. In Study II (of osteoporosis drug use), all analyses were performed separately for each sex.

3.2.2.4 Co-morbidities

In studies I through IV, we used number of drugs as a proxy measure of overall co-morbidity, as suggested by Schneeweiss et al.[171, 172] However, given that the number of drugs a person uses is a crude assessment of co-morbidity, some residual confounding is inevitable.[172]

3.2.2.5 Dementia status

In Study III, dementia status was measured with diagnosis of dementia in the SNPR or use of dementia drugs (N06D) in the SPDR. In Study IV, only dementia drug use noted in the SPDR was used to assess dementia status.

3.2.2.6 Type of housing

People were classified as community-dwelling (living at home) or living in an institution (e.g. in a nursing home or sheltered accommodation). Information on type of housing was obtained from the SSSR.[173]

3.2.2.7 Geographical areas

In Study IV, geographical place of residence was classified as a metropolitan or a non-metropolitan area. The classification was made on the basis of county of residence: Stockholm, Gothenburg and the Malmö region were coded as metropolitan.

In Study III, we calculated corrected standard errors to account for unobserved homogeneity at the municipality level (n=290).

In Study III, we included the Swedish counties (n=21) as dummy variables to adjust for geographical differences.

Table 2. Overview of the data sources and variables used in this thesis.

	Data source*	Outcome	Main independent variable	Other covariates	Stratification variables	Exclusion
Study I	SPDR SSSR	Number of drugs 16 most commonly used drugs	Age (80–89, 90–99, 100+)	Gender Living situation Number of other drugs (co-morbidity)	None	Missing data
Study II	SPDR SER SPR	Use of osteoporosis drugs Different types of osteoporosis drugs	Education (<9 years, 9–12 years, >12 years)	Age (75–79, 80–84, 85–89 years) Fracture diagnosis Number of other drugs	Gender Fracture	Missing data
Study III	SPDR SPR	Use of antipsychotic drugs Different types of antipsychotic drugs	Education (<9 years, 9–12 years, >12 years)	Gender Age (75–79, 80–84, 85–89 years) Dementia diagnosis Dementia drug use Number of other drugs County	Dementia status	Missing data
Study IV	SPDR	Specialist-prescribed psychotropic drugs	Education (<9 years, 9–12 years, >12 years)	Gender Age (in years) Metropolitan area Dementia drug use Number of other drugs	None	Missing data. Diagnosis of intellectual disability, schizophrenia, or bipolar disorder

*SPDR, Swedish Prescribed Drug Register; SSSR, Swedish Social Service Register; SER, Swedish Educational Register; SPR, Swedish Patient Register

3.3 STATISTICAL ANALYSES

The analyses were performed with SPSS, version 17 (SPSS Inc., Chicago, IL, USA) and STATA 11.

3.3.1 Study I

We used logistic regression analysis, unadjusted and adjusted, to investigate the association between age and use of the 16 most commonly used drugs among centenarians compared to nonagenarians and octogenarians (reference category). In the unadjusted model, only the age groups were included as independent variables. In the adjusted model, gender, type of housing and number of other drugs (a proxy for overall co-morbidity) were also included as independent variables.

3.3.2 Study II

All analyses were performed separately for women and men. The analysis was performed in two steps. First, unadjusted (only level of education) and adjusted (including age group, fracture diagnosis and number of other drugs) logistic regressions analysis was performed in the total study sample to investigate the association between education and use of osteoporosis drugs. Second, we repeated the analysis for the subsample of persons with osteoporosis-related fractures.

3.3.3 Study III

The analysis was performed in two steps. First, unadjusted (only level of education) and adjusted (including age group, sex, dementia diagnosis, dementia drug use, county and number of other drugs) logistic regression analysis was performed in the total study sample to investigate the association between education and use of antipsychotic drugs. Second, we repeated the analysis for the subsample of persons with a dementia diagnosis and/or who had a prescription for one or more dementia drug.

3.3.4 Study IV

Multinomial regression analysis with three outcomes (geriatrician, psychiatrist, or other specialist [the latter was the reference category and consisted mainly of GPs]) was performed to investigate the association between patients' level of education and specialised prescribing of psychotropics. The analyses were performed for each of the four types of psychotropics (antipsychotics, anxiolytics, hypnotic/sedatives and antidepressants) separately. Model I was the unadjusted model; only education was included as an independent variable. Model II was adjusted for age, sex, dementia, and number of other drugs. Model III was further adjusted for metropolitan/non-metropolitan place of residence.

4 ETHICAL CONSIDERATIONS

All studies used anonymised register-based data. The Swedish National Board of Health and Welfare linked the data in the various registered and removed the personal identification numbers. The studies were approved by the ethical review board in Stockholm (dnr 2006/948-31; 2009/477-31/3).

5 MAIN RESULTS

5.1 STUDY I

Little is known about drug use in extreme old age. Thus, the objective of Study I was to investigate drug use among centenarians and compare it to drug use among nonagenarians and octogenarians. On average, centenarians used a similar number of drugs (5.1) to nonagenarians (5.7) and octogenarians (5.3). The proportion of persons living in an institution increased with age, from 11% of octogenarians to 59% of centenarians. Individuals who lived in institutions used more drugs than home-dwelling persons, and this difference was more pronounced in the younger age groups. Among centenarians, the most commonly used drug classes were cardiovascular drugs, psychotropics and pain killers.

Using logistic regression, we further investigated the association between age groups and use of different types of drugs. Centenarians were more likely to use psychotropics (hypnotic sedatives, antidepressants and anxiolytics) and pain killers (minor analgesics and opioids) than octogenarians in the unadjusted analysis. The results were confirmed in the logistic regression analysis (with adjustment for sex, living situation and number of other drugs) for all drug types except antidepressants.

Centenarians were more likely to use diuretics (high-ceiling diuretics and potassium-sparing diuretics) than octogenarians in both the unadjusted and adjusted models. However, centenarians were less likely to use other types of cardiovascular drugs (antithrombotic agents, beta blockers and ACE inhibitors) than octogenarians in the unadjusted and adjusted analysis.

Gender differences in centenarians' drug use were in general small, except for use of antidepressants, which was more commonly used among women.

5.2 STUDY II

Results of smaller and more selected studies suggest that there are differences in osteoporosis drug use by socioeconomic position. Thus, our aim was to study SEP differences in osteoporosis drug use in a large data set with nationwide coverage.

In the total study population, 11.5% of the women and 5.0% of the men had sustained an osteoporotic fracture. Of the women, 15.2% used calcium/vitamin D combinations, 7.3% used bisphosphonates and 0.4% used SERMs. Of the men, 3.3% used calcium/vitamin D combinations and 1.1% used bisphosphonates. Of the persons with a previous fracture, only 32% of women and 10% of men used an osteoporosis drug (Figure 6).

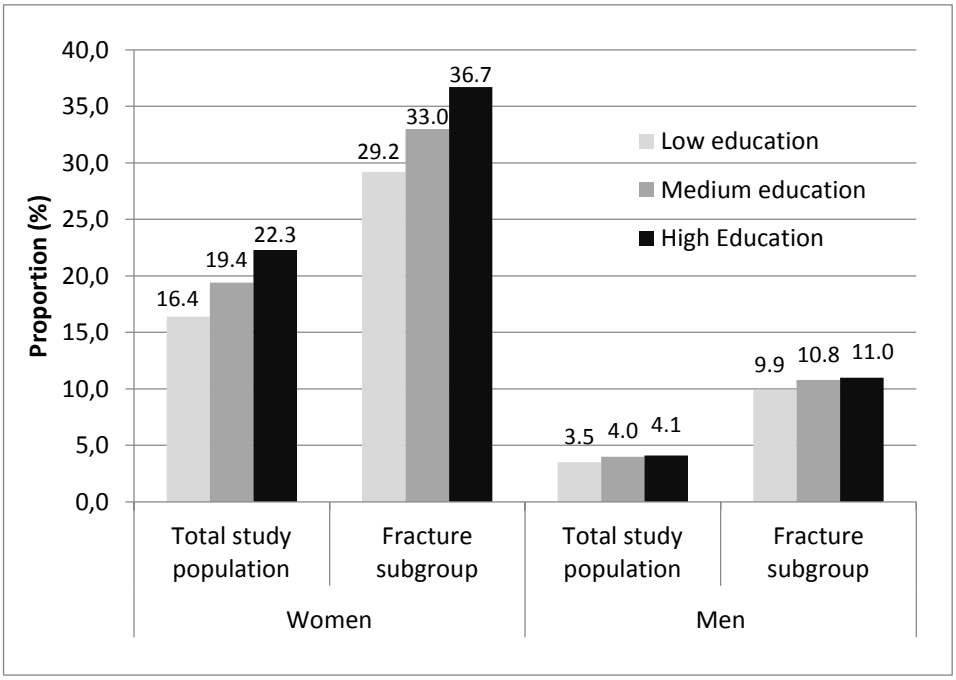

Figure 6. The proportion of women and men who used any osteoporosis drug in the total study sample and in the fracture subgroup by educational level, Sweden 2005.

We found that the proportion of people who used osteoporosis drugs increased with increasing educational level in both women and men. In the subgroup of persons who had sustained a fracture, the use of osteoporosis drug treatment was higher. However, also among those who had sustained a fracture, people with a high level of education used more osteoporosis drugs.

Further analysis with logistic regression confirmed that a high level of education was associated with osteoporosis drug use in the total sample in both women and men after adjustment for age, osteoporotic fractures and number of other drugs. The odds ratio (OR) was higher for bisphosphonates and SERMs than for calcium/vitamin D combinations. In the subgroup analysis of persons with an earlier fracture, a high level of education was still statistically significantly related to osteoporosis drug use in women. Such a tendency was also found in men (OR higher than 1), although the differences were not statistically significant.

In the total sample, older age was positively associated with the use of calcium/vitamin D combinations but negatively associated with use of the more potent drugs (bisphosphonates and SERMs). Furthermore, in the fracture subsample, older age was negatively associated with all osteoporosis drug use among women and with use of bisphosphonates among men.

5.3 STUDY III

Antipsychotic drugs are commonly used to treat BPSD in persons with dementia. Our aim was to study differences in antipsychotic drug use among persons with or without dementia by educational level. In the total study population, about 5% used a dementia drug and/or had a dementia diagnosis. Of the persons with dementia, 21% were treated with antipsychotics, whereas 4% of the total study population were treated with such drugs. First and second generation antipsychotics were used to a similar extent among the total study population, whereas second-generation antipsychotics were more common in persons with dementia.

The proportion of persons who used antipsychotics was higher among those with a low level of education, both in the total study population and in the dementia subsample. This was true of both first and second generation antipsychotics.

In the total study population, lower educational level was also associated with higher use of antipsychotic drugs in the logistic regression analysis (after adjustment for age, dementia drug use, dementia diagnosis and number of other drugs). A diagnosis of dementia in the patient register yielded a higher adjusted OR (OR low vs. high 7.4; 95% confidence interval [CI] 7.1–7.7) of using antipsychotic drugs than did use of a dementia drug (adjusted OR low vs. high 2.4; 95% CI 2.3–2.6).

Higher OR of use of antipsychotic drugs was also found among those with a low level of education in the subsample of persons with dementia after adjustment for age, sex and number of drugs. In all the analyses, the differences by educational level were found for any use of antipsychotics, for use of first-generation antipsychotics and for use of second generation antipsychotics.

Use of antipsychotics increased with age both in the total study population and in the dementia subsample.

5.4 STUDY IV

The majority of prescriptions for psychotropics for older adults in Sweden are written by GPs. We investigated whether there were educational differences in the access to specialist prescribing (by geriatricians or psychiatrists) among older psychotropic drug users. In the study population of psychotropic drug users, the majority (87%) used only one psychotropic, 9% used two types, 4% used three types and 1% used all four types of psychotropics. The vast majority of psychotropic drug users had been prescribed their psychotropics by a physician from the category ‘other specialists’; 95% of these other specialists were specialists in family medicine (GPs). Only 9% received at least one prescription for a psychotropic from a geriatrician; 4%, from a psychiatrist; and less than 1%, from both a geriatrician and a psychiatrist. Furthermore, GPs prescribed the

majority of all types of psychotropic drugs; however, they prescribed a larger proportion of hypnotic/sedatives (83%) than antipsychotics (70%).

For all psychotropic drug types, the proportion of psychotropics prescribed by GPs was higher for persons with a low level of education. The unadjusted multinomial regression models confirmed that high education was associated with more access to geriatrician and psychiatrist prescribing. However, when we adjusted for place of residence (Model III), the association between higher education and geriatrician prescribing became non-significant, whereas the association between higher education and psychiatrist prescribing persisted.

Furthermore, increasing age was positively associated with obtaining a prescription from a geriatrician and negatively associated with obtaining a prescription from a psychiatrist.

6 DISCUSSION

6.1 MAIN FINDINGS

The results of this thesis give support to the hypothesis that drug use among older adults varies by SEP. Thus, educational inequalities in drug use seem to persist to older ages and exist for some of the most prevalent diseases and conditions among older adults.

Furthermore, there also seem to be age differences in drug treatment. In general, older age was associated with less optimal drug use.

6.2 EDUCATIONAL DIFFERENCES IN DRUG USE

It is well-known that health and disease is socially patterned; this finding has been consistently found across time and geography.[15, 73-75] The mechanisms linking poor social circumstances to poor health are many; poorer access to health care among less privileged persons in society is among the suggested mechanisms.[174] To receive drug treatment is often the end point in the health care chain.[24, 123] Additionally, inequality in drug treatment has been used as an example of how more advantaged people can utilise their flexible resources to gain better health in an ever-changing landscape of risk factors, resources and diseases.[92] In this thesis, SEP is only measured as level of education. Use of complementary indicators of SEP would have allowed a more refined analysis. However, education is often a prerequisite for higher occupational positions and higher income and is therefore highly related to other socioeconomic indicators.[94] Socioeconomic differences in drug treatment are not only unjust in themselves but can also point to inequalities in other areas of the health care system. Furthermore, suboptimal drug treatment can also lead to increased costs for the health care system because adverse drug reactions are a common cause of hospitalisation among older adults.[36]

6.2.1.1 Study II

Previous studies have indicated that use of osteoporosis drugs may be unequal.[55, 56] The added value of our paper is the large unselected population and information on fracture status. By adding fracture status, we can confirm inequalities in both preventive treatment for osteoporosis and secondary prevention after a fracture (only statistically significant in women).

Studies often find that socioeconomic disparities are larger for preventive treatments and screening; such findings could be explained by a higher level of health awareness among people with high SEP.[175] After a fracture, most people in these age groups should be prescribed an osteoporosis drug.[176] However, we find low treatment rates after fractures in general, particularly among men. The finding of educational differences among women even after a fracture is worth highlighting, since it suggests that differences in drug treatment by SEP also exist after being admitted to the hospital. Being admitted to the hospital should reduce the influence of patient behaviours and preferences for osteoporosis treatment. Furthermore, educational differences were larger for more newly marketed osteoporosis drugs, which gives support to earlier findings that show differences in the diffusion of new medical treatment and technology by patients' educational level.[23, 91]

6.2.1.2 Study III

Antipsychotics are commonly used to treat BPSD.[65, 72] During the past decade, efforts have been made to reduce the use of antipsychotic drugs among older adults with cognitive deficits.[71] A study of a Canadian province, showed that older adults with dementia and low income were more likely to be treated with potentially inappropriate antipsychotic drugs than those with dementia and high income.[72] We can confirm the finding from a Canadian province in a large-scale study conducted in another setting and with an alternative measure of SEP. In our study, we found higher use of antipsychotic drugs in persons with dementia than in cognitively intact older adults, which supports that antipsychotics are still widely used to treat BPSD. Moreover, persons with dementia and a low level of education were more likely to be prescribed an antipsychotic than were persons

with dementia and a high level of education. Research on whether the occurrence of BPSD varies by SEP is inconsistent.[177-179] Thus, one possibility is that our finding reflects a higher burden of BPSD among persons with a lower level of education. Another possibility is that the prescription of antipsychotics is unequal. If our results reflect inequality in prescribing, it would suggest that the mechanism that links education to being prescribed antipsychotics to a relatively small extent goes through individual level characteristics. The ability to use cognitive resources to demand care is reduced in persons with dementia; thus, other factors such as having highly educated relatives (children) may be of importance.

6.2.1.3 Study IV

In Sweden, GPs prescribe the majority of psychotropics to older adults.[62] In our study, we found that persons with a higher level of education were more likely to have access to specialised prescribing (by geriatricians and psychiatrists) than persons with a lower level of education. Studies have also found inequality in access to specialists for general health care use in older adults.[101, 114] It is not clear from this study whether specialist prescribing leads to better prescribing and fewer adverse drug reactions for older adults with a high level of education. However, access to specialist prescribing (by specialist in the relevant field) could be an important pathway between patients' levels of education and quality of prescribing. Further, the educational differences in access to specialised prescribing were partially explained by geographical variations. Living in a metropolitan area was highly associated with access, especially access to prescriptions from a geriatrician. This suggests that differences in drug use by educational level in many cases may be confounded by place of residence.

6.3 AGE DIFFERENCES IN DRUG USE

6.3.1.1 Study I

In Study I, we found that the number of concurrently used drugs did not increase with age in the oldest segment of the population; i.e., centenarians did not use more drugs than nonagenarians. Thus, the common notion that drug use

increases with age does not seem to hold true in extreme old age. However, there were marked differences in the drug types most commonly used in centenarians and those most commonly used in nonagenarians and octogenarians. Anxiolytics, hypnotics/sedatives and painkillers were more often dispensed to centenarians than octogenarians. This might indicate that drug treatments are more palliative in character in centenarians than in younger age groups.

Furthermore, cardiovascular drug therapy did not seem to follow guidelines to the same extent in centenarians as in nonagenarians and octogenarians. Centenarians used older types of cardiovascular drugs. This could reflect continued but not regularly re-evaluated use of specific drugs in centenarians, a disinclination to make changes in well-functioning drug therapy provided to the oldest old, or a tendency to focus on symptomatic rather than preventive cardiovascular drug treatment in centenarians.

6.3.1.2 Study II

In the total sample, older age was positively associated with receiving more calcium/vitamin D combinations. However, age was negatively associated with use of the more potent drugs; that is, bisphosphonates and SERMs. Further, when we focused only on people with a previous fracture, we found that increasing age was negatively associated with all osteoporosis drug use among women and with use of bisphosphonates among men. Because age is the strongest risk factor for osteoporosis, these results are surprising and seem to suggest that undertreatment of osteoporosis is common in older people.[45] Undertreatment of osteoporosis can lead to unnecessary fractures and subsequently mortality.[52, 180] For bisphosphonates, an alternative explanation of the low treatment rate among the oldest old could be the difficulties in administering the drugs and uncertainty about the length of time patients should be treated with these drugs.[181]

6.3.1.3 Study III

Use of antipsychotics increased with age, but the association was not statistically significant for use of first-generation antipsychotics in the dementia subsample.

Antipsychotic drugs have been linked to severe side effects in older persons with dementia.[66-69] Given the severe side effects, it is indeed important to try to reduce the use of antipsychotics, especially in older people, in whom high co-morbidity and lowered tolerance are to be expected.

6.3.1.4 Study IV

Age was positively associated with being prescribed psychotropics from a geriatrician but negatively associated with being prescribed by a psychiatrist. Thus, geriatricians seem to treat the patient group they are specialised in. The low rate of prescription of psychotropics by psychiatrists to older adults could reflect that mental health problems among older adults are a neglected problem and that older adults with such problems are mainly treated in primary care.[182]

6.3.1.5 Gender differences in Study I–IV

Research has shown that there are gender differences in drug use in Sweden[183], also among older adults.[34] In the present thesis, most gender differences in centenarians' drug use were found to be small (Study I). However, gender differences in osteoporosis drug use were relatively large; men were more often undertreated with osteoporosis drugs (Study II). Previous studies have also found low treatment rates for osteoporosis in men, and one explanation for these findings might be that osteoporosis is often perceived as a female disease.[54]

There were no differences in antipsychotic drug use in women with dementia and men with dementia (Study III). This is somewhat surprising because men tend to display higher rates of aggressive behaviour when they experience BPSD.[184] The gender differences in specialist prescribing of psychotropic drugs were small; women and men had similar chances of receiving a prescription of a psychotropic drug from either a geriatrician or a psychiatrist.

6.4 LIMITATIONS

A general limitation of this thesis is that only register data were analysed. A data source with more comprehensive information would have made it possible to explore potential confounders and underlying mechanisms in greater detail. On

the other hand, register data have the advantage of covering very large and unselected populations with high statistical precision.

6.4.1 Selection bias

In epidemiological studies, selection bias can arise if the selection of individuals into a study is systematically biased. The most common form of selection bias is that the non-response group differs systematically from the response group.[185] In studies of older adults, non-response groups tend to have more health problems and lower cognitive abilities than response groups.[186] Additionally, the oldest segment of the population tends to be underrepresented in pharmacy-based interview studies of drug use, since such people are more likely to have someone else collect their drugs at the pharmacy.[187] Because it is not possible to opt out of national registers in Sweden, there is no selective non-response group in the studies described in this thesis. However, persons that were not identified through the SPDR (did not use a drug) will probably be different from the persons that were identified (used a drug).

In all the studies, we used the SPDR to identify persons to whom a drug was prescribed and dispensed during the study window; these people made up the study population. In old age, the vast majority of people are regularly dispensed at least one drug, and compared to Statistics Sweden's registration of the total population, we capture about 90% of the octogenarians, 94% of the nonagenarians and 94% of the centenarians (from Study I). Thus, coverage of older adults in the Swedish population was good in these studies. People not included in the study population were probably healthier than those who were included, because they did not use a drug.

Drugs provided by hospitals and nursing home supply rooms are not included in the SPDR. In most counties in Sweden, drugs provided by nursing home supply rooms account for less than 1% of the total drug use in people 80 years or older. However, in Stockholm County, as many as 10% of prescribed drugs were distributed from nursing home supply rooms in 2006.[188] Furthermore, since drugs used at hospitals are not included in the SPDR, some people with severe

diseases will not be included in the register. These persons will most likely have poorer health than those included in the SPDR.

In studies II and III, we investigated associations in disease-specific subgroups. The subgroups included those identified in the SPR as having a diagnosis of dementia and/or using an anti-dementia drug in the SPDR, or having experienced osteoporosis-related fractures according to SPR. Because the sensitivity of the registers can be low, especially for dementia,[189] the number of people with dementia may have been underestimated, which would result in the inclusion of too few cases in the subgroup analysis. A better estimation of the prevalence of dementia would have been possible if we had data from primary care and not only inpatient diagnoses.[190] However, specificity is high,[189] so people in the subgroup analyses probably really had dementia as indicated by SPR data. It is unclear how this selection bias, the low sensitivity of dementia from SPR and SPDR, would affect the results.

However, the high coverage of the Swedish older-adult population in the nationwide registers, provided data in which potential selection biases should be smaller than that in most other observational studies.

6.4.2 Misclassification of outcome

Misclassification arises when the information collected about a person in a study is erroneous. Misclassification can be either differential or non-differential. Differential classification occurs when misclassification is in some way dependent on some other important variable.[185] Non-differential misclassification is likely to affect any epidemiological study and will most likely lead to an attenuation of associations. The outcome of the studies in this thesis was drug use. Information about drug use was collected and registered at Swedish pharmacies when the drugs were actually dispensed. As dispensed drugs were the outcome measure, the risk of misclassification was thus very low.

Adherence to medications is a problem in many studies of drug use. Non-adherence can occur at initiation of treatment (primary-non-adherence), in the implementation of treatment and as discontinuation of treatment.[159] Initiation of

treatment includes the actual dispensing of a drug prescribed by a physician. Using the SPDR, it is only possible to study drugs that have been dispensed, not drugs that have been prescribed. Implementation refers to the process whereby the patients' use of a drug actually corresponds to the suggested dosing regimen. Discontinuation refers to the situation in which a patient discontinues therapy prematurely. Implementation-related non-adherence and premature discontinuation of therapy are difficult or impossible to study with data from the SPDR. However, implementation and discontinuation are of minor relevance to the present thesis.

Studies show that adherence rates are low for many drugs. Among osteoporosis drug users, 20% to 30% discontinue their treatment after 6 to 12 months.[191] In this thesis, it is primarily non-initiation (primary non-adherence) that could have introduced bias. Social differences in the use of a variety of drugs are the main outcome in this thesis, and it is possible that the associations between social groups and drug use might be explained by differences in patients' drug-collecting rates rather than physicians' prescribing rates. Previous studies have shown that primary non-adherence among older adults in Sweden differs by socioeconomic position.[160] However, research on the relationship between adherence rates and SEP has generally been inconclusive.[192, 193] Additionally, regardless of their socioeconomic group, older patients are less likely than younger patients to discontinue a drug therapy because of increases in price.[130] Non-initiation/primary non-adherence can be one mechanism underlying the association between sociodemographic factors and the use of drugs.

6.4.3 Misclassification of exposure

In the studies in this thesis, the main exposures were age and education. Age was classified using the individuals' personal identification numbers and was probably not affected by misclassification.

Data on education was obtained from the SER. At the time we obtained the data for these studies, SER only included information on persons under the age of 75 years. Thus, we had to collect data retrospectively from the register to obtain

data on education for persons older than 75 years. If people increased their level of education after the age of 75, we underestimated their level of education. Further, SER does not have complete data on education completed outside of Sweden.[167] However, for persons in the cohorts in this study, this was likely a minor issue.

Similarly to the selection bias that can arise in disease-specific subgroup analyses (the dementia and fracture subgroup analyses described in *6.4.1 Selection bias*), adjustments for the diseases in the total study population can introduce a bias, but this bias will then be a misclassification of exposure rather than a selection bias.

6.4.4 Confounding

A confounding factor is a factor associated with both the dependent and independent variable that can lead to spurious associations between the dependent and independent variable when not included in the analyses.[185]

Most notable in pharmacoepidemiological studies is confounding by indication. This occurs when the association between drug use and the outcomes are confounded by the underlying disease the drug is intended to treat.[194, 195] Confounding by indication is foremost a problem in studies of the intended or unintended effects of drugs. However, it also bears some relevance in studies of SEP or age and their relation to drug use. If the disease panorama is different in different social groups, the indication of a certain drug can also differ between the groups. Thus, the results regarding inequality in drug use could be dependent on the underlying disease pattern rather than differences in prescribing.

In this thesis, 'number of drugs' was used to adjust for overall co-morbidity. Researchers have shown that using this indicator as a proxy measure of co-morbidities is comparable to using other proxy measures of co-morbidities.[172] However, residual confounding is inevitable because the number of drugs prescribed to and collected by a person does not completely reflect health status.[171] Further, in the instances when we have used diagnoses from the SPR

(studies II and IV) we do not know the severity of the diseases, and disease severity could be an important confounder.

Education was the only indicator of SEP used in the present thesis. SEP can be measured with other indicators as well, such as income and social class.[94] These three indicators partially overlap; however, the empirical and theoretical underpinnings of the three indicators are not the same.[95, 196] Including other indicators of SEP would have allowed for a more refined analysis of other dimensions of SEP. However, one advantage of using education as an indicator of SEP in old age is that it is not affected by retirement (which impacts both income and occupation).

Personal characteristics, such as cognitive ability and personality, could also be an important link between socioeconomic conditions and drug use. Researchers have suggested that as intergenerational social mobility has increased, intelligence and favourable personality traits have become increasingly important to acquiring higher socioeconomic positions.[78] Cognitive ability and personality is likely to influence drug use at many points in the process of drug use, from health-information seeking to the patient-physician interaction.

Gender differences are not a main focus of this thesis but have been considered in all studies in the thesis. Gender differences in drug use are an important topic of study in their own right. In the context of this thesis, it is also important to note that gender differences exist in health, mortality and educational attainment of the cohorts studied. In older cohorts, women tend to have lower educational attainment than men, which is why it is important to consider gender in analyses of socioeconomic inequalities. Further, the gender paradox of health and mortality (i.e., women live longer but have more health problems)[32] means that women are often in majority in study samples of older adults but also tend to use more drugs than men of the same age.

On the one hand, register-based research often provides the opportunity to study very large and unselected populations with high statistical precision. On the other hand, the information is often restricted to a few variables. Potential

confounders relevant to this work on which information was not available in the registers included self-rated health, function, cognitive status, lifestyle factors and caregiver support. A more comprehensive set of variables would both have reduced the risk for spurious results and enabled a more refined analysis of the underlying mechanisms that lead to inequality in prescribing.

6.5 CONCLUSIONS

This thesis contributes to the knowledge about how the sociodemographic factors like SEP and age are related to drug use. The importance of equal access to drugs, regardless of sociodemographic factors, should be highlighted in social policy.

We demonstrated that low SEP is associated with increased risk, in old age, of inappropriate prescribing of antipsychotic drugs to persons with dementia, a lower risk of being prescribed potentially beneficial osteoporosis drugs after a fracture, and a lower risk of being prescribed psychotropic drugs by a physician specialised in geriatrics or psychiatry.

In general, low SEP seems to be associated with less optimal drug treatment. The association seems fairly consistent across different outcomes. However, the mechanisms linking lower SEP to suboptimal drug treatment are probably complex and need to be addressed in further studies. In this thesis, unequal drug use was also found among persons with low cognitive abilities (dementia), which supports that other mechanisms should be sought in addition to those that relate to individuals' abilities to seek and demand health care. Further, we found unequal treatment with osteoporosis drugs both before and after the occurrence of a fracture, which suggests that the health care system does not ameliorate the socioeconomic differences in preventive use of osteoporosis drugs. Finally, differences in the prescription of psychotropics by specialised physicians to people from different socioeconomic groups may indicate that higher socioeconomic groups have better access to specialists, which could be a mechanism that links lower SEP to less optimal drug use.

We found that differences in the geographical area of residence were associated with drug use. Access to specialised prescribing by geriatricians was more closely related to living in a metropolitan area than to the educational level of the patient. Geographical variations are likely to be an important mediator between SEP and drug use but can also have an independent effect on drug use.

Older age was also related to less optimal drug treatment. However, the associations were not as consistent as for SEP. Furthermore, we found that the general perception that the number of drugs increases with age was false at extremely high ages; the number of drugs prescribed seemed rather to level off around 95 years of age.

The present findings have several policy implications. It is clear that there are differences in drug use that are not related to disease, and efforts should be made to prevent such inequality. However, because the mechanisms that link sociodemographic factors to drug use are far from understood, it is unclear how to best implement policies to reduce sociodemographic differences in drug use. Furthermore, as more people get to live longer, many will also spend long periods in the end of their lives in poor health using many medications. Both research and policy should address drug use in older age, in order to reduce drug-related problems and to increase the quality and knowledge of drug therapy among older adults.

6.6 FUTURE DIRECTIONS

The present results indicate that sociodemographic differences in drug use in older people are rather consistent – an empirical regularity. The next step should therefore be to better explore the mechanisms underlying the association between sociodemographic factors and drug use in older people. First, more detailed data are needed; that is, data that make it is possible to explore how age and SEP interrelate with other possible confounders. Moreover, it is also important to investigate the extent to which primary adherence affects the associations; i.e., the extent to which sociodemographic differences in drug use reflect differences in prescribing as opposed to differences in dispensing.

Second, prescribing is ultimately a consequence of health care use. There is a large literature on equity in health care use, but relatively little has been written about equity in drug treatment. Thus, studies of inequality in drug use should rely more on the extensive literature on equity in health care, and drug use should more regularly be included in studies of health care use.

Last, the SPDR was initiated in 2005, and it is now possible to follow individual drug use over an extensive period of time. Longitudinal studies of drug use will provide a golden opportunity to better understand the complexity of this issue. Such studies will make it possible to study drug use as people age so that we can better understand the complex process of initiation and discontinuation of drug treatments. Linking the SPDR to other registers will provide insight into how drug use changes as a consequence of health, living situation and other sociodemographic factors.

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APPENDIX

List of dissertations from the Aging Research Center and the Stockholm Gerontology Research Center, 1991-2014

1991
Herlitz Agneta. Remembering in Alzheimer´s disease. Utilization of cognitive support. (Umeå University)

1992
Borell Lena. The activity life of persons with a dementia disease.

1993
Fratiglioni Laura. Epidemiology of Alzheimer´s disease. Issues of etiology and validity.
Almkvist Ove. Alzheimer´s disease and related dementia disorders: Neuropsychological identification, differentiation, and progression.
Basun Hans. Biological markers in Alzheimer´s disease. Diagnostic implications.

1994
Grafström Margareta. The experience of burden in care of elderly persons with dementia (Karolinska Institutet and Umeå University).
Holmén Karin. Loneliness among elderly – Implications for those with cognitive impairment.
Josephsson Staffan. Everyday activities as meeting-places in dementia.
Stigsdotter-Neely Anna. Memory training in late adulthood: Issues of maintenance, transfer and individual differences.
Forsell Yvonne. Depression and dementia in the elderly.

1995
Mattiasson Anne-Cathrine. Autonomy in nursing home settings.
Grut Michaela. Clinical aspects of cognitive functioning in aging and dementia: Data from a population-based study of very old adults.

1996
Wahlin Åke. Episodic memory functioning in very old age: Individual differences and utilization of cognitive support.
Wills Philippa. Drug use in the elderly: Who? What? & Why? (Licentiate thesis)
Lipinski Terzis Beata. Memory and knowledge in mild Alzheimer´s disease.

1997

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