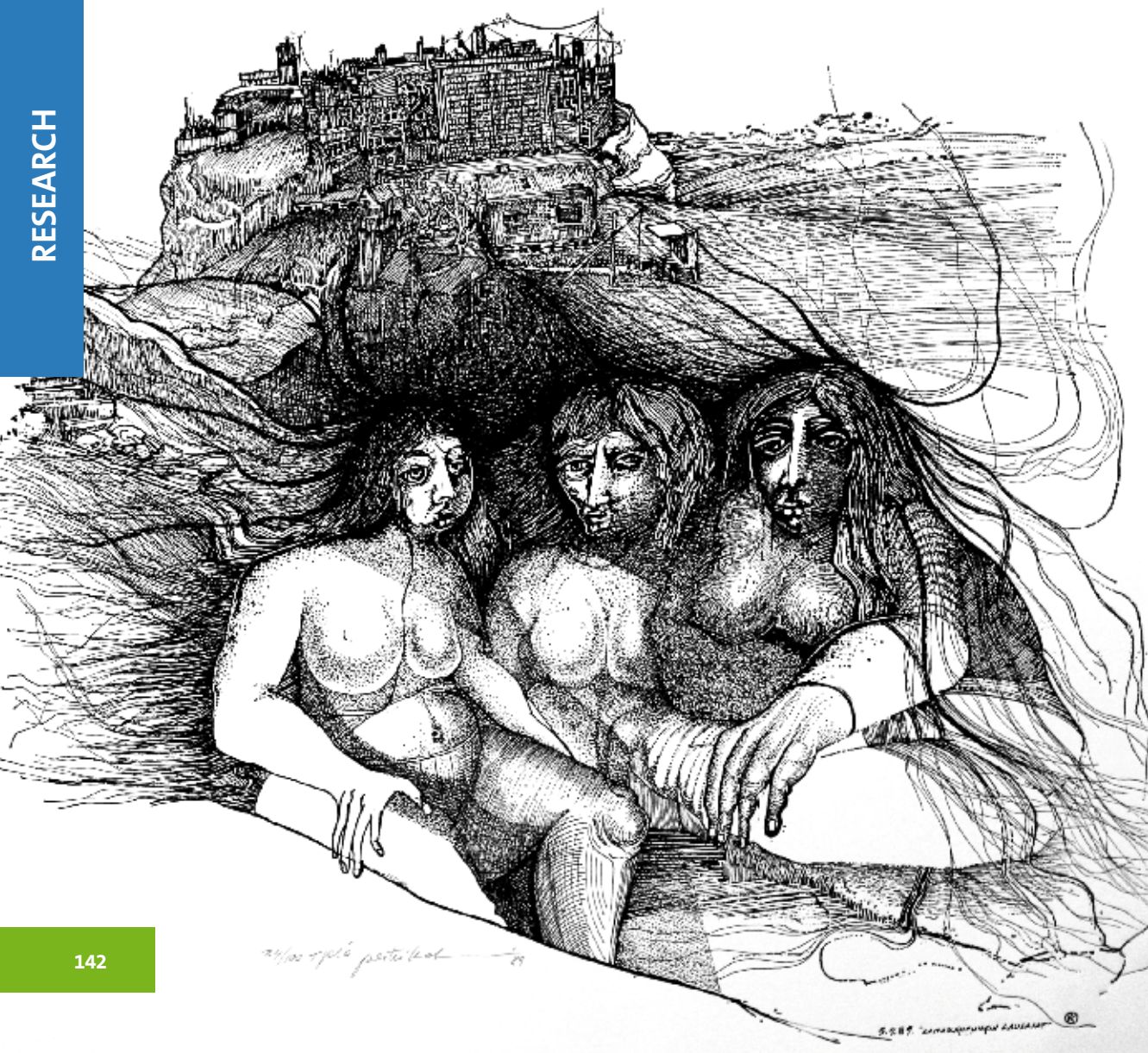


Tiina Hetemaa

Socioeconomic differences in the use and outcomes of hospital treatment for ischaemic heart diseases

RESEARCH



Research 142

Socioeconomic differences in the use and outcomes of hospital treatment for ischaemic heart diseases

Tiina Hetemaa

ACADEMIC DISSERTATION

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ABBREVIATIONS

AP	Angina Pectoris
ARIC	Atherosclerosis Risk In Communities
CABG	Coronary Artery Bypass Grafting
CVDR	National Cardiovascular Disease Register
CHD	Coronary Heart Disease
CI	Confidence Interval
DDD	Defined Daily Dose
FHDR	Finnish Hospital Discharge Register
HILMO	Finnish Health Care Register
HR	Hazard Ratio
ICD	International Classification of Diseases
MI	Myocardial Infarction
MONICA	Multinational monitoring trends and determinants in cardiovascular disease
OECD	Organisation for Economic Co-operation and Development
PCI	Percutaneous Coronary Intervention
PTCA	Percutaneous Transluminal Coronary Angioplasty
RR	Relative Risk
SII	Social Insurance Institution
STAKES	National Research and Development Centre for Welfare and Health
STEMI	ST segment elevation MI
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation

ABSTRACT

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As in other industrialised countries, coronary heart disease (CHD) constitutes a huge burden on Finnish society and, specifically, on the health care system. The importance of CHD to public health is due not only to the high prevalence of, and mortality due to, the disease, but also to the result of costly invasive treatments such as coronary artery bypass grafting (CABG) and percutaneous coronary interventions (PCI). Although CHD mortality has markedly declined in Finland over the past few decades, it is still the main cause of death.

The general aims of the study were to evaluate and describe socioeconomic differences in the use of coronary procedures and the outcomes of CHD patients and to elucidate the factors that have an effect on differences, such as the change in supply for invasive treatments of CHD, the duration of follow-up, co-morbidity, disease severity and regional variations in procedure rates. The study also examines whether similar socioeconomic disparities in invasive treatments and outcomes of CHD exist in patients with chronic angina pectoris (AP), and with potentially more effective access to secondary prevention, such as in patients with acute MI as the first sign of CHD.

Age-adjusted rates were calculated for coronary operations, hospitalisations due to CHD, CHD and all cause mortality, and incidences of MI and its case fatality. In study I the 1996 Finnish population was used as the standard population for calculations. In the other studies each of the total study population (person years) was used as the standard population in corresponding study.

Several statistical methods were applied including Poisson regression, the Kaplan-Meier method with log-rank test, and Cox's proportional hazards regression model. The statistical analyses were performed using SPSS 10.0 and 11.0, SAS 9.1 and MlwiN software.

Sociodemographic parameters, age, gender, residence (the hospital district), socioeconomic status, education and income, were drawn from the population census or other registers in Statistics Finland. Information on invasive cardiac procedures and hospitalisations due to CHD were drawn from the Finnish Hospital Discharge Register (FHDR). To proxy CHD severity, data on the annual use of short and long acting nitrates was drawn from the Prescription Register and information about patient comorbidities was drawn from the register of persons granted special reimbursement for medication costs at the Social Insurance Institution (SII). The statistics on causes of deaths included data on deaths and mortality by cause of death, age, gender, marital status and other demographic variables.

For each original study the necessary register linkages were performed in Statistics Finland and personal identification numbers were encrypted before the data was transferred to the researchers. The study protocols of the original studies were approved by the Finnish Data Protection Ombudsman and the Ethics Research Committee of STAKES.

From 1988 to 1996, in Finland, the supply of invasive cardiac operations increased, revascularisations multiplied 2.5 times overall. Although, socioeconomic differences in the use of cardiac operations diminished, some socioeconomic and gender inequities persisted in their use relative to need in the mid-1990s. In both study periods white-collar male employees underwent more operations than did blue-collar workers with the same level of need, as indicated by CHD mortality. For women the results were similar but the relative differences smaller, and altered for older age groups in 1996.

In Finland, 5,172 patients aged 40–74 years were hospitalised due to their first MI in 1995, corresponding to an age-standardised rate of 354 events per 100,000 men and 152 per 100,000 women. Within two years after their first MI 33% of men and 21% of women had undergone an invasive cardiac procedure. Blue-collar men underwent 24% (95% CI 13–33) fewer procedures than white-collar men during the period. The socioeconomic differences in procedure rates already existed in the 28 days after infarction and were generally constant throughout the two year follow up. The pattern favouring patients with higher socioeconomic backgrounds was found for men and women independently of the socioeconomic indicator used, although, for women the only statistically significant difference was between high and low income groups.

In 1995–1998 in Finland, 49,846 persons, aged 45–79 with no prior registered information of MI or AP, received an entitlement of reimbursement due to CHD (15,986 men and 13,858 women), or were hospitalised due to their first MI (12,367 men and 7,635 women). In a one year follow up, the age-adjusted proportions for invasive cardiac procedures for male MI patients were 24% for female MI patients were 21%, and for AP patients 25% and 16%, correspondingly. Socioeconomic disparities in undergoing invasive coronary procedures among AP patients without MI were similar to those in MI patients. Blue-collar men underwent fewer procedures than white-collar men during the period: the hazard ratio (HR) for blue-collar male AP patients was 0.75 (95% CI: 0.70–0.80) and was 0.75 (0.69–0.82) among male MI patients. For blue-collar women the ratio for AP patients was 0.79 (0.71–0.87) and for MI patients 0.85 (0.74–0.97). Controlling for regional variation (hospital district), co-morbidity and disease severity (nitrate use) did not change the pattern, although it decreased the differences.

CHD mortality during the two-year follow-up was 5% among AP men and 2% among AP women, and for both MI men and women the two-year mortality rate was 8%. The socioeconomic patterning was similar in CHD mortality and in mortality from all causes in both patient groups in both genders: the higher the in-

come group the lower the mortality. A similar pattern was found among male AP patients for MI incidence in a one year follow up, the HRs for MI were 1.27 (1.03–1.56) for the middle income group and 1.58 (1.27–1.96) for the lowest income group compared to the highest income group. Among female AP patients no socioeconomic differences were found in MI incidence. Among AP men the variation in 28-day case fatality due to the first MI showed no clear socioeconomic pattern, whereas a clear socioeconomic pattern was found among MI men: the higher the income group the smaller the case fatality. The difference between patient groups was also statistically significant ($p < 0.05$). Among AP women the highest income group seemed to demonstrate lower case fatality than did the lower income groups and the pattern was similar to that of MI women.

The results of this study indicate that similar patterns emerged in the use of cardiac procedures according to all socioeconomic indicators: patients with higher socioeconomic status underwent more procedures than patients from lower groups. This applied to both patient groups, AP and MI patients, and both genders. Those of higher socioeconomic status also benefitted first from cardiac procedures. More attention should therefore be paid to the equitable distribution of scarce health care resources.

Socioeconomic differences in CHD outcomes also exist among angina patients. These results suggest that targeted measures of secondary prevention are needed among CHD patients with lower socioeconomic status to reduce socioeconomic disparities in fatal and non-fatal coronary events.

To improve equity, it is vital that in all circumstances, even with insufficient supply of facilities, all patients should have access to health care and receive treatments according to their need, not according to the social category to which they belong to or to their gender.

Keywords: coronary heart disease, myocardial infarction, cardiac procedures, socioeconomic factors, social inequity

TIIVISTELMÄ

Tiina Hetemaa, Socioeconomic differences in the use and outcomes of hospital treatment for ischaemic heart diseases [Sosiaaliryhmien väliset erot sepelvaltimotaudin sairaalahoidossa ja hoidon vaikuttavuudessa] Tutkimus 142. 137 sivua. Helsinki 2014. ISBN 978-952-302-328-4 (painettu); ISBN 978-952-302-329-1 (verkko)

Kuten muissakin teollistuneissa maissa sepelvaltimotauti aiheuttaa kustannuksia yhteiskunnalle ja erityisesti terveydenhuoltojärjestelmälle. Sepelvaltimotaudin kansanterveydellinen merkitys ei johdu vain taudin suuresta valitisevuudesta tai kuolleisuudesta, vaan myös kajoavien toimenpiteiden, kuten sepelvaltimoiden ohitusleikkaus ja pallolaajennus, kalleudesta. Sepelvaltimotautikuolleisuus on merkittävästi vähentynyt parin viimeisen vuosikymmenen aikana, mutta se on edelleenkin suomalaisten yleisimpiä kuolemansyitä.

Tutkimuksen tarkoituksena oli selvittää ja kuvata sepelvaltimotoimenpiteiden ja hoitotulosten sosioekonomisia eroja. Lisäksi selvitettiin erilaisten tekijöiden vaikutusta eroihin, kuten kajoavien toimenpiteiden tarjonnan lisääntyminen, seuranta-ajan pituus, liitännäissairaudet, sairauden vaikeusaste ja alueellisen toimenpidemäärän vaihtelu. Lisäksi tutkittiin onko samanlaisia sosioekonomisia eroja kajoavissa toimenpiteissä ja sepelvaltimotaudin hoitotuloksissa kroonista sepelvaltimotautia sairastavilla potilailla, jotka ovat jo sekundaari prevention piirissä, verrattuna potilaisiin, joiden ensimmäinen oire sepelvaltimotaudista oli äkillinen sydänkohtaus.

Ikävakioidut luvut laskettiin sepelvaltimotoimenpiteille, sairaalahoitajakoille sepelvaltimotaudin vuoksi, sepelvaltimo- ja kokonaiskuolleisuudelle, sydäninfarktin ilmaantuvuudelle ja sen kohtauskuolleisuudelle. Ensimmäisessä osatutkimuksessa vuoden 1996 Suomen väestöä käytettiin standardiväestönä, muissa osatutkimuksissa tutkittava väestö (henkilövuosina) toimi standardiväestönä kyseisessä osatutkimuksessa. Tilastollisina menetelmiä käytettiin mm. Poisson regressiota, Kaplan-Meierin menetelmää log-rank testillä ja Coxin mallia. Tilastolliset analyysit tehtiin SPSS10.0 ja 11.0, SAS 9.1 ja MlwiN ohjelmistoilla.

Sosiodemografiset muuttujat: ikä, sukupuoli, asuinpaikka (sairaanhoitopiiri), sosioekonominen asema, koulutus ja tulotiedot hankittiin Tilastokeskuksen väestö- ja muista tilastoista. Tiedot kajoavista sydäntoimenpiteistä ja sairaalahoitajakoista sepelvaltimotaudin vuoksi hankittiin sairaaloiden poistoilmoitusrekisteristä. Sepelvaltimotaudin vaikeusastetta kuvaamaan hankittiin tiedot lyhyt- ja pitkäkestoisen nitrojen käytöstä Kelan reseptitiedostosta. Kuolemansyy, ikä, sukupuoli, siviilisäätö ja muita demografisia tietoja hankittiin kuolemansyytilastosta. Osatutkimuksia varten rekisteritietojen yhdistäminen tehtiin Tilastokeskuksessa ja henkilötunnukset kryptattiin ennen aineiston luovuttamista tutkimusryhmälle. Suomen tietosuojavaltuutettu ja STAKESin tutkimuseettinen toimikunta hyväksyivät tutkimussuunnitelmat.

Vuosina 1988–1996 Suomessa kajoavien toimenpiteiden määrä lisääntyi huomattavasti, revaskularisaatiot lisääntyivät 2.5-kertaisesti. Vaikka sosioekonomiset erot toimenpiteiden käytössä pienenevät, ne eivät hävinneet kokonaan, vaan sosioekonomisia ja sukupuolten välisiä eroja oli edelleen havaittavissa tarpeeseen nähden 1990-luvulla. Molempina tutkimusvuosina toimihenkilömiehille tehtiin enemmän toimenpiteitä kuin työntekijämiehille samalla sairastavuuden tasolla, joka arvioitiin sepelvaltimotautikuolleisuudella. Naisilla tulokset olivat samanlaisia, mutta suhteellinen ero oli pienempi ja vanhemmissa ikäryhmissä vuonna 1996 suhde muuttui.

Suomessa 5 172, 40–74-vuotiaista, potilasta joutui sairaalahoitoon ensimmäisen sydäninfarktin vuoksi 1995, tämä vastaa ikävakioiduna 354 tapausta 100 000 miestä ja 152 tapausta 100 000 naista kohden. Kahden vuoden aikana ensimmäisestä sydäninfarktista 33 % miehistä ja 21 % naisista oli tehty kajoava sydäntoimenpide. Työntekijämiehille tehtiin 24 % (95 % CI 13–33) vähemmän toimenpiteitä kuin toimihenkilömiehille seuranta-aikana. Sosioekonomiset erot toimenpiteissä oli havaittavissa jo 28 päivän kohdalla ja ne pysyivät lähes samanlaisina kahden vuoden seurannan aikana. Samanlainen systemaattinen paremmassa sosiaalisessa asemassa olevaa suosiva sosioekonominen ero oli havaittavissa kaikilla sosioekonomisen aseman osoittimilla sekä miehillä että naisilla, vaikka naisilla ainoa tilastollisesti merkitsevä ero havaittiin vain ylimmän ja alimman tuloluokan kesken.

Suomessa vuosina 1995–1998, 49 846 henkilöä, iältään 45–75 -vuotiaita, joilla ei ollut aiempaa merkintää rekistereissä sydäninfarktista tai kroonisesta sepelvaltimotautista, saivat erityiskorvausoikeuden sepelvaltimotautilääkkeisiin (15 986 miestä ja 13 858 naista) tai joutuivat sairaalahoitoon ensimmäisen sydäninfarktin vuoksi (12 367 miestä ja 7 635 naista). Vuoden seuranta-aikana ikävakioidut osuudet sydäntoimenpiteitä saaneista olivat sydäninfarktin kokeneille 24 % miehistä ja 21 % naisista, vastaavasti kroonista sepelvaltimotautia sairastavilla 25 % ja 16 %. Sosioekonomiset erot sydäntoimenpiteissä kroonista sepelvaltimotautia sairastavilla, jotka eivät olleet sairastaneet sydäninfarktia, oli samanlainen kuin infarktin sairastaneilla. Työntekijämiehille tehtiin vähemmän toimenpiteitä kuin toimihenkilömiehille: Hazard ratio (HR) työntekijämiehillä kroonista sepelvaltimotautia sarastavilla oli 0.75 (95 % CI: 0.70–0.80) ja 0.75 (0.69–0.82) sydäninfarktin sairastaneilla miehillä verrattuna toimihenkilömiehiin. Työntekijänaisilla HR kroonista sepelvaltimotautia sarastavilla oli 0.79 (0.71–0.87) ja sydäninfarktin sairastaneilla 0.85 (0.74–0.97) verrattuna toimihenkilönaisiin. Vakiointi alueellisen vaihtelun (sairaanhoidopiirin), liitännäissairauksien tai sairauden vaikeusasteen (nitron kulutus) suhteen ei muuttanut tuloksia muuten kuin pienentämällä eroja.

Sepelvaltimotautikuolleisuus kahden vuoden seuranta-aikana oli kroonisesta sepelvaltimotautia sairastavilla 5 % miehillä ja 2 % naisilla, sydäninfarktin sairastaneilla se oli 8 % sekä miehillä että naisilla. Sosioekonomiset erot olivat samansuuntaiset sekä sepelvaltimotauti- että kokonaiskuolleisuudessa molemmilla potilasryhmillä sekä miehillä että naisilla: mitä korkeampi tuloluokka sitä pie-

nenmpi kuolleisuus. Samansuuntainen tulos saatiin kroonista sepelvaltimotautia sairastavien miesten sydäninfarktin ilmaantuvuuden suhteen vuoden seurannassa: HR infarktin suhteen oli 1.27 (1.03–1.56) keskimmaisessä tuloluokassa ja 1.58 (1.27–1.96) alimmassa tuloluokassa verrattuna ylimpään tuloluokkaan. Naisilla ei sydäninfarktin ilmaantuvuudessa havaittu sosioekonomisia eroja. Kroonista sepelvaltimotautia sairastavien miesten ensimmäisten sydäninfarktien kohtaustappavuudessa ei havaittu selkeitä systemaattisia sosioekonomisia eroja, kun taas sydäninfarktin sairastaneilla miehillä selkeä systemaattinen ero oli havaittavissa: mitä korkeampi tuloluokka sen pienempi kohtauskolleisuus. Potilasryhmien välinen ero tämän suhteen oli tilastollisesti merkitsevä ($p < 0.05$). Kroonista sepelvaltimotautia sairastavilla naisilla ylimmässä tuloluokassa kohtaustappavuus oli vähäisempää kuin alemmissa tuloluokissa ja tämä havaittiin myös sydäninfarktin sairastaneiden ryhmässä.

Väitöskirjan tutkimusten tulokset osoittivat, että systemaattiset sosioekonomiset erot sydäntoimenpiteissä tulivat esiin kaikilla sosioekonomisen aseman osoittimilla: ylemmässä sosiaalisessa asemassa oleville potilaille tehtiin enemmän toimenpiteitä kuin alemmassa sosiaalisessa asemassa oleville. Tämä tuli esiin sekä miehillä että naisilla molemmissa potilasryhmissä eli sekä kroonista sepelvaltimotautia sairastavilla että sydäninfarktin sairastaneilla. Lisäksi korkeammassa sosiaalisessa asemassa olevat pääsivät hyötymään sydäntoimenpiteistä ennen muita. Niukkojen terveydenhuollon resurssien oikeudenmukaisempaan jakoon pitäisi kiinnittää enemmän huomiota. Sosioekonomiset erot sepelvaltimotaudin hoidon tuloksissa oli havaittavissa myös kroonista sepelvaltimotautia sairastavilla potilailla. Tulokset viittaavat siihen, että kohdennetut toimenpiteet sekundaari preventiossa ovat tarpeen alemmassa sosiaalisessa asemassa oleville sepelvaltimotautipotilaille, jotta voidaan vähentää sosioekonomisia eroja fataaleissa ja ei-fataaleissa sepelvaltimotapauksissa.

Oikeudenmukaisuuden lisäämiseksi, on erityisen tärkeää, että vaikka tarjonnassa olisi puutteita, niin kaikki potilaat pääsisivät hoidon piiriin ja saisivat tarvitsemaansa hoitoa sairauden perusteella, eikä sukupuolen tai sen mukaan mihin sosiaaliseen ryhmään he kuuluva.

Avainsanat: sepelvaltimotauti, sydäninfarkti, sydäntoimenpiteet, sosiaaliryhmä, sosiaalinen eriarvoisuus

CONTENTS

Abbreviations	
Abstract	
Tiivistelmä	
Contents	
List of original publications.....	13
1 Introduction.....	15
2 Review of literature.....	19
2.1 Coronary heart disease.....	19
2.1.1 Definition of CHD and prevalence estimates.....	19
2.1.2 Treatment of coronary heart disease.....	21
2.2 Socioeconomic disparities in health.....	24
2.2.1 Definition.....	24
2.2.2 Explanatory models.....	24
2.2.3 Historical research.....	25
2.2.4 Indicators of socioeconomic status.....	26
2.2.5 Socioeconomic inequity in mortality.....	27
2.3 Socioeconomic inequity in CHD and its treatments.....	29
2.3.1 Socioeconomic inequity in CHD.....	29
2.3.2 Effect of risk factors on disparities.....	30
2.3.3 Disparities in cardiac procedures.....	30
2.4 Summary of the literature review.....	33
3 Aims of the study.....	35
4 Materials and methods.....	37
4.1 Administrative registers.....	37
4.1.1 The Finnish Care Register for Health Care.....	37
4.1.2 The National Cardiovascular Disease Register.....	37
4.1.3 The registers at the Social Insurance Institution.....	38
4.1.4 The registers at Statistics Finland.....	39
4.2 Study populations and outcome variables.....	40
4.2.1 Finnish population in 1988 and 1996.....	40
4.2.2 First MI in 1995 in Finland.....	40
4.2.3 Angina pectoris and first MI patients from 1995 to 1998 in Finland.....	41
4.3 Explanatory variables.....	42
4.3.1 Socioeconomic status.....	42
4.3.2 Education.....	43
4.3.3 Family disposable income.....	43

4.4	Confounding factors	43
4.4.1	The hospital district	43
4.4.2	Severity of the CHD	44
4.4.3	Co-morbidities.....	44
4.5	Statistical methods	44
4.6	Legislation and ethics.....	46
5	Results	49
5.1	Impact of an increase in the supply of coronary operations on socio-economic and gender equity in their use in Finland, 1988 vs. 1996.....	49
5.2	Socioeconomic inequities in invasive cardiac procedures after first MI....	52
5.3	Socioeconomic inequities in invasive cardiac procedures among patients with incidental angina pectoris or myocardial infarction.....	54
5.4	Are there socioeconomic differences in myocardial infarction event rates and fatality among patients with angina pectoris?	57
6	Discussion.....	59
6.1	Data, registers and variables	59
6.2	Socioeconomic differences.....	61
6.3	Differences between genders and according to socioeconomic status in men and women	62
6.4	Angiographies and revascularisations	62
6.5	Regional variation	63
6.6	Waiting time	63
6.7	Co-morbidity	64
6.8	Disease severity	64
6.9	Supply of revascularisations.....	65
6.10	Health care system	66
6.11	Patient doctor relationship and patient characteristics.....	68
7	Conclusions	71
8	Suggestions for future research and practical implications.....	73
	Acknowledgements	74
	Appendix tables.....	76
	References	85
	Original publications	99

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following articles referred to in the text by their Roman numerals.

- I Hetemaa T., Keskimäki I., Manderbacka K., Leyland A.H., Koskinen S. How did recent increase in the supply of coronary operations in Finland affect socioeconomic and gender equity in their use? *Journal of Epidemiology and Community Health* 2003; 57: 178–185.
- II Hetemaa T., Keskimäki I., Salomaa V., Mähönen M., Koskinen S. Socio-economic inequities in invasive cardiac procedures after first myocardial infarction in Finland 1995. *Journal of Clinical Epidemiology* 2004; 57: 301–308.
- III Hetemaa T., Manderbacka K., Reunanen A., Koskinen S., Keskimäki I. Socioeconomic inequities in invasive cardiac procedures among patients with incident angina pectoris or myocardial infarction. *Scandinavian Journal of Public Health* 2006; 34: 116–123.
- IV Manderbacka K., Hetemaa T., Keskimäki I., Luukkainen P., Koskinen S., Reunanen A. Are there socioeconomic differences in MI event rates and fatality among patients with angina pectoris? *Journal of Epidemiology and Community Health* 2006; 60: 442–447.

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1 Introduction

For decades the major objectives of Finnish health policy have been providing health care for all, universal coverage of, and equal access to care, and use of services according to need. In various Finnish health policy documents these tenets have been stated repeatedly since the 1960s. The “equity challenge” emerged in 1987 in policy statements such as the ‘Health for all by the Year 2000’ and in its revised version in 1993 (Kuusi 1964; Ministry of Social Affairs and Health 1987; World Health Organisation – Regional Office for Europe and Ministry of Social Affairs and Health 1991; Ministry of Social Affairs and Health 1993). In the 1990s the equity goal was further strengthened by including the objective in the decrees on social rights in the constitution and in legislation involving patient rights (Kokkonen 1994). The goal of public health programmes is reduce differences in health between population groups, according to the ‘National Action Plan to Reduce Socio-Economic Inequalities in Health 2008–2011’ and ‘Health 2015’ (Ministry of Social Affairs and Health 2001; Ministry of Social Affairs and Health 2008). One of the eight main targets set out in ‘Health 2015’ – the public health programme – is to reduce health disparities between population groups in terms of their work ability and functional capacities, self-rated health, morbidity and mortality. The aim of reducing health inequalities is to bring the status of the less healthy closer to that of those who now enjoy better health. The programme’s quantitative targets involve the differences in life expectancy between vocational groups, on the one hand, and between educational groups, on the other. (Ministry of Social Affairs and Health 2001) One objective of the Health Care Act, which came into force in Finland on 1st May 2011, is to reduce health inequalities between different population groups. (Ministry of Social Affairs and Health 2010a) ‘The WHO Health 21 programme’ for the European Region has a similar target: the difference in life expectancy between socioeconomic groups is to be reduced by at least 25 per cent by 2020 (World Health Organisation 1999).

In last century there was a change in the socioeconomic distribution of heart disease: in 1931 and 1951 it was more common in men of upper social classes, but in 1961 it was more common in men of lower classes in Britain. (Marmot et al. 1978a; Fox et al. 1984) Mackenbach has noted that inequalities in mortality from cardiovascular disease account for almost half of the excess mortality in lower socioeconomic groups in most European countries. (Mackenbach 2006). Comparing mortality in the 1980s to 1990s in the Nordic countries, England/Wales and Turin in Italy, Mackenbach et al. concluded that reducing socioeconomic inequalities in mortality in Western Europe critically depends upon speeding up mortality de-

clines from cardiovascular diseases in lower socioeconomic groups (Mackenbach et al. 2003). Tarkiainen et al. have shown that a slower decline in mortality due to coronary heart disease (CHD) among men in the lowest income quintile was a significant factor increasing the gap in life expectancy from 1988–92 to 2003–7 between highest and lowest income groups in Finland (Tarkiainen et al. 2012).

As in other industrialised countries, CHD places a huge burden on Finnish society and, particularly the health care system. The public health importance of CHD is not only due to the high prevalence of and mortality from the disease, but also due to costly invasive treatments such as coronary artery bypass grafting (CABG) and percutaneous transluminal coronary angioplasty (PTCA). Although, CHD mortality in Finland has markedly declined over the past few decades, it is still the main cause of death, involved in 23% of all deaths in men and 20% in women in 2012. (Official Statistics of Finland (OSF) 2013a; Official Statistics of Finland (OSF) 2013b) Mortality from CHD continues to be considerably higher in Finland than in Western Europe, the United Kingdom and other Nordic countries, among men and women, although, Finland no longer has the highest CHD mortality, as rates in most Central and Eastern European countries exceed those of Finland. (Koskinen et al. 2006; Eurostat 2012)

Finland offers unique preconditions for research into inequities and health care. The Finnish data protection legislation allows individual linkages to be made in registry data from different original sources and the links can be made through a unique personal identification number. The validity and coverage of Finnish administrative registers are good, for example, 99% of births were reported to the Finnish Medical Birth Registry, (Teperi 1994) and the coverage of the Causes of Death Register is considered to be almost perfect (Keskimäki et al. 1997; Mähönen et al. 1999). The accuracy of the Finnish Health Care Register is generally good, and approximately 95% of hospital discharges and 90–95% of surgical procedures were recorded in the register (Salmela and Koistinen 1987; Keskimäki and Aro 1991; Sund 2012). There is thus a good opportunity, compared to many other countries, to carry out research focused on socioeconomic differences in hospital use or mortality in Finland.

In 1972 personal identification numbers began to be included in hospital discharge records, which made it possible to link death certificate data with hospital records over the whole country (Romo et al. 1982). The first study of health inequity in Finland to be based on linked records was ‘Occupational Mortality in 1971–75’ by Hannele Sauli, published in 1979 (Sauli 1979). Since then several studies have exploited the administrative registers. For example, Valkonen and Niemi studied the development of mortality from cardiovascular diseases in the counties of Finland in 1961–75 (Valkonen and Niemi 1980), and Notkola et al. analysed the effect of socioeconomic conditions in childhood on mortality and morbidity caused by CHD in adulthood in rural Finland (Notkola et al. 1985). Kauhanen et al. found that men who were socially disadvantaged in childhood had an elevated cardiovas-

cular, CHD and all-cause mortality and risk of acute coronary events (Kauhanen et al. 2006). Socioeconomic differences in mortality have been a focus in several research studies (Pyörälä et al. 1985; Kannisto 1986; Martelin 1987). Several studies have used data, based on record links, in order to analyse regional differences in life expectancy, mortality, and use of surgical interventions (Romo et al. 1982; Notkola et al. 1985; Kannisto 1988; Kannisto 1990; Keskimäki et al. 1994; Koskinen 1994).

One of the main principles in the ethics of medical doctors is equity, that patients needing similar care are treated in accordance with the same principles. People have the same right to proper care and humane treatment regardless of age, domicile, social status, mother tongue, sex, ethnic background, culture, sexual preferences or personal convictions. (National Advisory Board on Health Care Ethics (ETENE) 2001)

This thesis is part of the research project ‘Social Equity in the Use of Hospital Care and the Outcomes of Health Services in the 1990s’ carried out in the National Institute for Health and Welfare, at the time STAKES, the National Research and Development Centre for Welfare and Health. The study was an exceptionally good opportunity to carry out register-based research on CHD patients, operative treatments and outcomes. In Finland CHD is one of the main public health diseases with limited resources for operative treatments.

This thesis is based on four register-based linkage studies on CHD operations and hospitalisations and mortality in Finland in the years 1988 to 1998. Information from eight different registers maintained by four separate institutions is utilised in the studies. A brief description of the data sources is given in Chapter 4. The empirical analyses on which the conclusions are based are presented in the four original articles, which will be referred to by means of Roman numerals (I-IV) (see the list on page 13).

In the next chapter the relevant literature is briefly reviewed to explain CHD and its treatments, invasive coronary procedures and mortality. Previous research is then reviewed for inclusion of socioeconomic factors and disparities in health, especially in CHD patients, as well as differences in the use of invasive procedures.

2 Review of literature

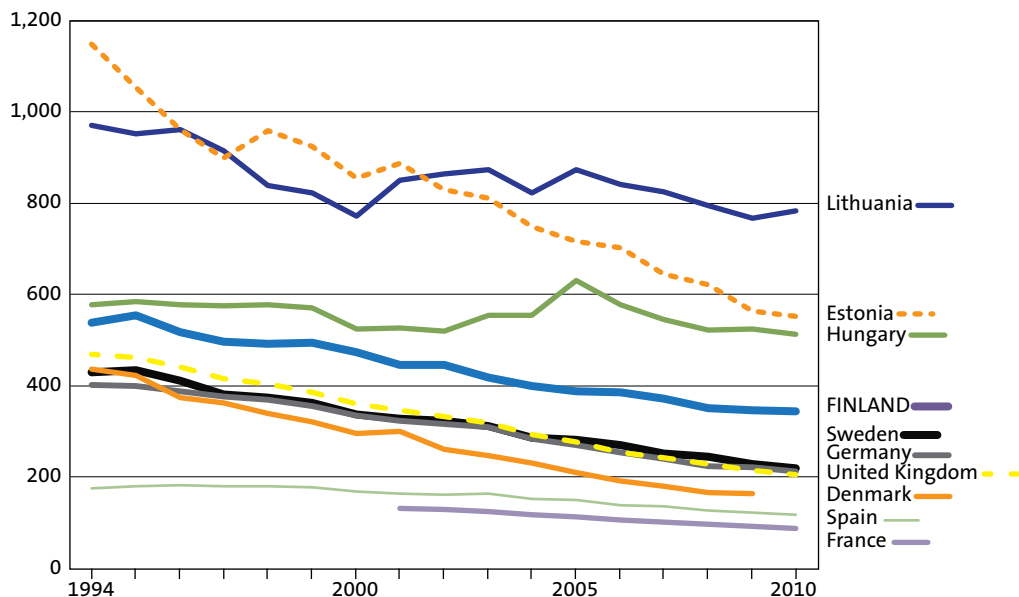
2.1 Coronary heart disease

2.1.1 Definition of CHD and prevalence estimates

In CHD the lumen of the coronary arteries is narrowed (Swan and Prediman 1986). Symptoms of CHD vary according to how narrow the lumen is, how many coronaries are affected and how long it has taken the obstruction to build up. (Lepojärvi and Werkkala 2008; Nikus et al. 2008; Sinisalo and Virtanen 2008; Sheldon cop. 1986) The general manifestations of CHD are sudden death due to CHD, myocardial infarction (MI) and classical chest pain during physical or psychosocial stress, angina pectoris (Reunanen 2008). The main risk factors for cardiovascular diseases are raised blood pressure, smoking, diabetes, and raised serum cholesterol concentration, especially low density lipoprotein cholesterol concentration (Finnish Heart Association 1986; Working groups of the Finnish Society of Internal Medicine and the Finnish Cardiology Society 1988; Vartiainen et al. 1998; Reunanen 2008).

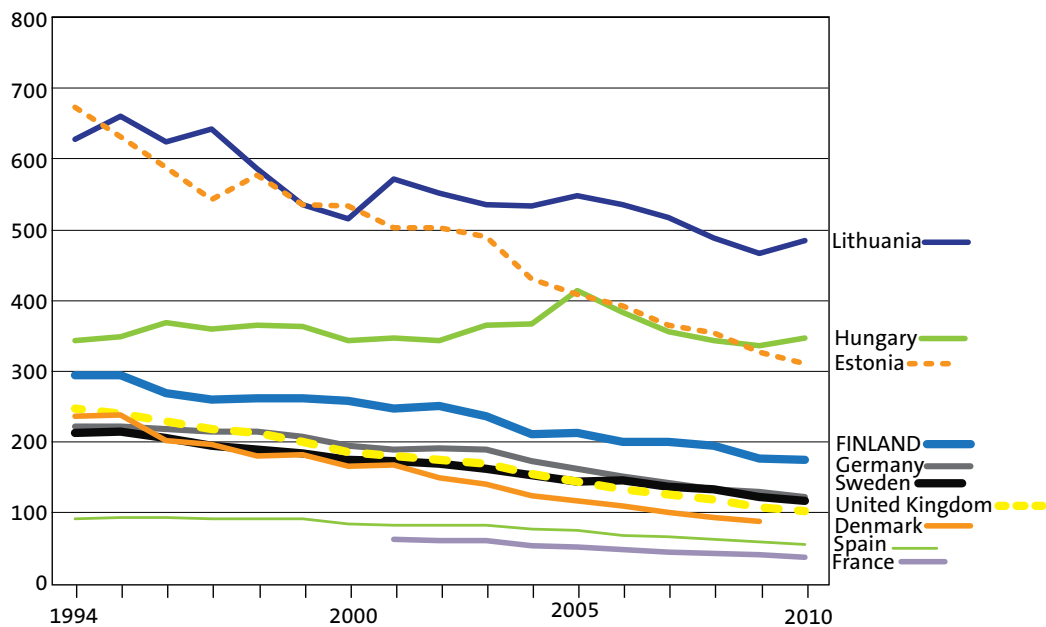
Mortality due to CHD has decreased in recent decades in Finland as it has elsewhere in Europe. From 1999 to 2009 Finland had the highest death rates due to CHD among the Nordic countries, however, among both women and men (Figures 1 and 2). The rates were higher than in the United Kingdom or in other countries of Western Europe. Only in Eastern European countries were the rates even higher than in Finland. (Eurostat 2012) The number of deaths due to CHD has not decreased in Finland, because at the same time the age of the population has grown older (Kesäniemi and Salomaa 2003). Cardiovascular diseases, including CHD, are the leading cause of death in high-income countries at the moment, and are forecast to be the highest worldwide by 2030 (Kreatsoulas and Anand 2010).

At the end of 2012 in Finland, 1.4% of all disability pensions were due to CHD, 3,519 persons, and, approximately 3.4% of the population, 183,648 persons – 108,721 men and 74,927 women – were entitled to a special refund for medicine costs due to CHD. Of these 146,181 were aged 65 or over, 36,447 were aged 45 to 64, and 1,020 were 0 to 44 years of age (Finnish Medicines Agency Fimea and Social Insurance Institution 2013; Social Insurance Institution 2013). The prevalence of CHD increases in the older age groups, and is almost 30% among men and over 20% among women 80 to 84 years old in Finland (Reunanen 2008). According to the Finnish Health Care Register there were 40,476 hospitalisations for CHD, accounted for 348,441 days in hospital in 2009, and the total number of coronary operations was 20,715, which rate has been approximately constant for several years now (National Institute for Health and Welfare 2011). CHD remains a major public health burden in Finland, because the population is getting older.



Source: Eurostat.

FIGURE 1. Age-standardised death rate per 100,000 inhabitants from CHD in 1994–2010, men.



Source: Eurostat.

FIGURE 2. Age-standardised death rate per 100,000 inhabitants from CHD in 1994–2010, women.

CHD is divided into stable and acute diseases. The risk factors for atherosclerosis affect stable angina, whereas in acute coronary syndromes the risk factors for thrombosis are also required. The symptoms of stable angina are experienced as regular or predictable pain during exercise or in psychological stress. This retrosternal heaviness is described as a crushing, squeezing or constricting sensation in the precordial and substernal areas. Typically, this chest discomfort subsides in few minutes, spontaneously with rest or after taking nitro-glycerine. (Kettunen and Airaksinen 2008)

Acute coronary syndromes are divided into three groups, ST segment elevation MI (STEMI), non-ST segment elevation MI and unstable angina. These all need acute care in hospital. In ST segment elevation, MI thrombolytic treatment or primary angioplasty are options for re-opening the occluded artery. (Nikus et al. 2008) Because of the time delay to care and other contraindications to thrombolytic therapy, it is estimated that only 30 to 50 per cent of MI patients in Finland in the 1990s had the opportunity of thrombolytic treatment (Tierala and Toivonen 1997). Conservative treatment of non-ST segment MI and unstable angina involves intensive medical management, followed by risk stratification by non-invasive means (usually by stress testing) to identify patients who may need coronary angiography (Nikus et al. 2008).

2.1.2 Treatment of coronary heart disease

CHD is primarily treated with medication and lifestyle changes: patients are encouraged to stop smoking, increase physical exercise, lose weight, etc. The aim is to reduce risk factors and symptoms and to halt the progress of the disease, and to prevent MI and death. Medical treatment is the most important way of treating CHD. Medicines are used in combinations that are adjusted to the individual patient's needs. The basic medicines to avoid hypertension, tachycardia, ischaemia and thrombosis are beta-blockers, angiotensin-converting-enzyme inhibitors, calcium channel blockers, nitrates, aspirin, and statins, which are used to reduce serum cholesterol concentration. (European Atherosclerosis Society 1987; Tierala et al. 2001; Fox et al. 2006; Graham et al. 2007; Airaksinen 2008)

Thrombolytic drugs, such as tissue plasminogen activators and streptokinase, are involved in the breakdown of blood clots. The medical therapy is called thrombolysis and it is used in ST segment elevation MI, in suitable situations. The aim is to clear the blocked artery and avoid permanent damage to the perfused tissue. The delay from patient contact to health care to the initiation of fibrinolytic treatment should be less than 30 minutes and, 90 minutes for primary angioplasty. (Antman et al. 2004; Syväne et al. 2008)

Coronary angiography is defined as the radiographic visualisation of the coronary vessels after injection of radiopaque contrast media, by which coronary anat-

omy and the degree of luminal obstruction of the coronary arteries can be detected. Coronary angiography is essential in determining whether a patient is referred to surgery for a by-pass operation or to a cardiologist for angioplasty. (Tierala et al. 2001)

There has been rapid growth in coronary angiography since the mid-1960s and, in Finland coronary angiographies have been performed since the early 1970s (Tierala et al. 2001; Mehta and Khan 2002).

The first CABG was performed in 1964 by a Russian surgeon, Dr Vasilii Kolesov, but the world's first successful coronary artery bypass operation was performed in the United States by Dr Robert Hans Goetz in the late 1960's. It quickly became a routine operation for revascularisation in patients with CHD. (Mehta and Khan 2002) In Finland the first CABG operation was carried out in the early 1970s (Huhtamies 1999). In CABG a section of vein or artery is used to reroute the blood supply around the obstructed area.

PTCA was introduced into clinical practice in 1977 by Grüntzig and his team (Grüntzig et al. 1978). Initially it was only considered appropriate for patients with single-vessel disease, but later it was also introduced for patients with multi-vessel disease (Mehta and Khan 2002). In Finland the first PTCA was performed in the 1980s (Tierala et al. 2001). PTCA is a much easier operation for patients than CABG. In PTCA the obstructed coronary is dilated mechanically with a balloon, which is introduced via catheterisation. In PTCA a metallic mesh tube, a stent, can be placed in a coronary to avoid the restenosis. (Gandhi and Dawkins 1999; Grines et al. 1999; Hannan et al. 2000)

CABG and PTCA were mainly used for treating stable CHD patients until the late 1990s, because the treatments were considered too dangerous to apply in acute cases. Since then it has been proved safe to perform a coronary angiography or an angioplasty in acute cases immediately after a person has fallen ill or within the next few days. (Weaver et al. 1997) In fact, instant action may save a patient's life in certain cases, and, in any case, the duration of hospital care can be shortened and the need for new hospital treatments reduced (Tierala et al. 2001). This has been taken into account in current Finnish care guidelines for STEMI and for acute coronary syndrome: unstable angina and myocardial infarction without ST elevation (Acute coronary syndrome: unstable angina and myocardial infarction without ST elevation: Current Care Guidelines Abstract 2009; STEMI: Current Care Guidelines Abstract 2011).

In Finland 272 PTCAs and 2,114 CABGs were performed in 1988. The number of revascularisations increased rapidly and in 1996 there were 2,102 and 4,577 procedures, respectively. Since then the rate of CABGs has decreased being 4,334 in 1998, 4,268 in 1999, and 2,584 in 2007. The rate of PTCAs continued to increase, being 2,524 in 1998 and 3,138 in 1999, with 8,135 angioplasties in 2007. In 2001 more PTCAs were performed than CABGs (Figure 3). The number of coronary angiographies rose from 8,000 in 1993 to 12,000 in 1998 and, to 22,000 in 2007. In-

formation on these specific coronary treatments in Finnish hospitals is gathered by the Finnish Cardiac Society by questionnaires to hospital executives. (Finnish Cardiac Society 2012; National Institute for Health and Welfare 2013)

In 2010 almost 24,000 (447 per 100,000 of population) coronary angiographies and about 9,000 (168 per 100,000) PTCA were performed. The total number of CABGs was 2,110 (39 per 100,000). The numbers of PTCA and CABG procedures did not increase during 2007–2010. (Mustonen et al. 2012)

In the mid-1990s there were fewer operations in Finland than in Europe: when comparing revascularisation rates to CHD mortality in western European countries, CHD mortality in Finland was the second highest, but the revascularisation rate was on average level (Unger 1998; Windecker et al. 1998; World Health Organisation 1998). Nowadays, the rate of revascularisation has been evaluated as comparable to other European countries and there is no need to add invasive operations (Mustonen et al. 2012).

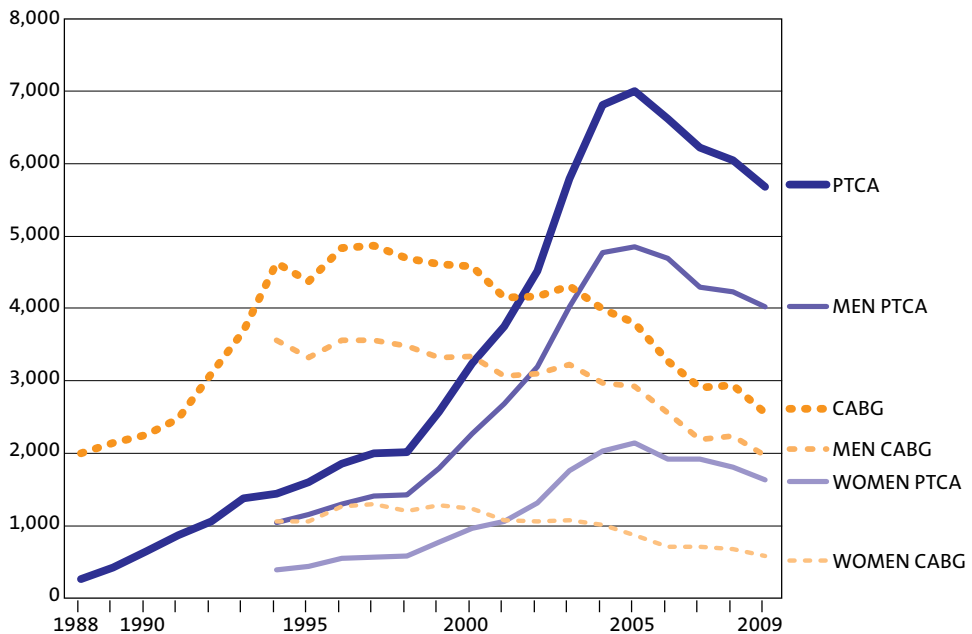


FIGURE 3. Number of coronary angioplasties and by-pass operations in Finland in 1988 to 2009, women and men together and in 1994 to 2009 also separately. (Data from the National Institute for Health and Welfare and the Finnish Heart Association)

2.2 Socioeconomic disparities in health

2.2.1 Definition

In general, social inequalities in health mean systematic disparities in health between population groups, in terms of their state of health, morbidity and mortality, which are judged as unfair, unjust, avoidable, and unnecessary (Whitehead 1992; Krieger 2001a; World Health Organisation 2008). Disparities in morbidity are generally similar to those in mortality, and similarly, individuals from lower socioeconomic positions experience relatively higher rates of morbidity (Pocock et al. 1987; Benzeval et al. 1995; Kunst et al. 1995; Scambler 2012). This is also true in Finland (Lahelma et al. 1997; Valkonen et al. 2007b).

A working group paper, the 'Black Report', aroused broad international interest after being published in England in 1980. It became apparent that there were large differentials in mortality and morbidity that favoured the higher social classes and that were not being redressed by health or social services in England. (Davey Smith et al. 1990a; Townsend et al. 1990) Since then, research on socioeconomic disparities in health has increased in England and elsewhere (Davey Smith et al. 1990a; Kaplan 2006). According to Kaplan there were hundreds of papers on this topic published each month in the early 2000s. He grouped them into three: papers dealing with the association between socioeconomic position and health, studies seeking the reason for the association, and, studies examining interventions to reduce income-related disparities in health outcomes (Kaplan 2006). This study belongs to the second category, studies seeking the reason for the association, especially via the role of access to and quality of medical care. Other explanations for the association, involve material and psychological, as well as, biological and behavioural factors. Some of the studies take a life course approach, and others examine the contribution of neighbourhoods and communities to disparities (Kaplan 2006).

2.2.2 Explanatory models

There were four explanatory models in the 'Black Report' for inequalities in health: artefact, selection, behavioural and materialist. There are also many social epidemiology frameworks explaining population patterns of health and disease, including the psychosocial theory, the social production of disease, the eco-social theory, the social-ecological systems perspective, and the web of causation, but these are not in the scope of the current thesis (Townsend et al. 1990; Krieger 1994; Macintyre 1997; McMichael 1999; Krieger 2001b). The World Health Organisation's Commission on the 'Social Determinants' of Health took a holistic view of the social determinants of health and addressed factors in the social environment that determine access to health services and influence lifestyle choices in the first place. The main recommendations were to improve the conditions of daily life, to tack-

le the inequitable distribution of power, money, and resources, and to measure and understand the problem, and evaluate action. (World Health Organisation 2008) In fact, a comparison of 21 OECD countries in 2000 revealed inequity in the use of physicians favouring patients who are better off; the degree of pro-rich inequity was highest in the United States and Mexico, followed by Finland, Portugal and Sweden. In Finland especially the use of specialist doctors was pro-rich. (van Doorslaer et al. 2006) In 2009, the degree of pro-rich inequity was highest in Chile, Brazil, Mexico and the United States followed by Estonia and Finland; both general practitioners and specialists visits were included (OECD Health Division 2013).

Despite of the various theories, it is widely acknowledge, that material and social deprivation, as well as demographic factors have a direct influence on health, but also an indirect effect through lifestyle (Benzeval et al. 1995; Adler and Ostrove 1999; Wilkinson and Marmot 2003; World Health Organisation 2008). Impacts of the above factors, including psychosocial factors, are usually interwoven, and it is often impossible to single out one cause or one group of causes that is responsible for health inequities (Adler and Ostrove 1999; Lahelma et al. 2007). Contrary to blame-the-victim ‘theory’, Scambler has noted, and other researchers agreed, that people’s behaviours are often anchored not just in their culture but in their social and economic circumstances, so that eating healthily is not cheap and smoking can afford temporary relief in the face of the monotony of everyday lives devoid of tangible hope (Adler and Ostrove 1999; Lahelma et al. 2007; Scambler 2012). Unfortunately, disadvantages tend to cluster and to accumulate during a lifetime. The longer people live in stressful economic and social circumstances, the greater the physiological wear and tear they suffer, and the less likely they are to enjoy a healthy old age. The social class differentials in mortality are preceded by inequalities in health during life: the shorter life span in less privileged groups seems to accompany a longer period of poor health. (Davey Smith et al. 1990a; Marmot et al. 1998; Wilkinson and Marmot 2003; Scambler 2012).

2.2.3 Historical research

For centuries wealth and health have appeared to be closely related, lower socioeconomic positions have been associated with more morbidity and mortality than higher socioeconomic positions. Poor living and working in conditions impair health and shorten lives. (Kaplan and Keil 1993; Krieger et al. 1997; Kaplan 2006; Mackenbach 2006; Scambler 2012)

In the 19th century a series of national population statistics enabled the calculation of mortality rates by occupation or by city district. Friedrich Engels used the statistics and pointed out the effect of poor living conditions in crating excess morbidity and mortality in England, as illustrated in his book ‘The Condition of the Working Class in England’. (Engels December 13, 2005) Also in England, Edwin Chadwick showed that the average life expectancy for people living in an agricultural area was 52 years for a gentleman and 38 years for a working man, and,

in the towns, it was only 38 years for a gentleman and 17 years for a working man. Chadwick blamed dirt rather than poverty, and recommended that the municipal authorities should clean streets and homes, and improve drainage, ventilation and water supplies. This resulted in the Public Health Act 1848. (Golding 2006) Louis-René Villermé in France proved the association between poverty and mortality by analysing inequalities in mortality between twelve ‘arrondissements’ in Paris in 1817–21 (Julia and Valleron 2011). In Germany Rudolf Virchow made a report on a typhus epidemic in Upper Silesia, in which he applied ideas on the social causation of disease. His famous statement was that “medicine is a social science, and politics nothing but medicine at a larger scale”. (Virchow 1985; Brown and Fee 2006)

Since 1851, information on occupational groups, and thus, the ability to measure social differences in health, has been included in some health records, on birth and death certificates and in the decennial census in Britain (Benzeval et al. 1995). In the United States of America socioeconomic data has not typically been a component of published vital statistics; data instead has been stratified solely by age, sex, and race/ethnicity (Krieger et al. 1997).

In the kingdom of Sweden the first population census covering the whole country was conducted in 1749, and included the area of Finland. Parish clergymen reported the number of the population in the parish by sex, age group and social class. The numbers of births, deaths and marriages during the year were calculated. (Myrskylä 2011) Death certificates are included in Statistics Finland from 1936 onwards. Statistics on causes of death contain data on death by cause, age, gender, marital status and other demographic variables. Population censuses have been carried out nationally since 1950. They collect basic data on the structure, employment, families and housing of the population.

2.2.4 Indicators of socioeconomic status

Traditional indicators for socioeconomic status in health research at the individual level in Finland and elsewhere have been occupationally derived social class, education and income (Adler and Ostrove 1999; Lahelma 2001; Ministry of Social Affairs and Health 2008). These socioeconomic indicators are partially independent and partially inter-dependent determinants; they are strongly correlated, but describe somewhat different aspects of social hierarchy. It is often advised that they be used simultaneously if possible. (Kunst and Mackenbach 1994b; Lahelma et al. 2004) Compared to the other two socioeconomic indicators, educational level is very stable over an adult lifespan, for example, educational level among adults who have completed their schooling is not affected by the occurrence of serious illness, which can force individuals to work at jobs below the level of their normal occupations or otherwise cause their income to decline. In addition, education provides formal qualifications to certain jobs and thus effects social class. It grants knowledge which might make it easier to adopt a healthier lifestyle and the ability to seek medical help when necessary. Occupation determines people’s social class, which

indicates prestige and power. Moreover, it usually reflects material conditions related to wages. Income is derived primarily from paid employment and it determines one's ability to consume, for example, to eat healthier food or use private health services. (Krieger et al. 1997; Lahelma et al. 2004; Galobardes et al. 2006a; Galobardes et al. 2006b)

As opposed to Finland, data on race/ethnicity is more easily available in the USA than data on social class, and thus used more often in research. Navarro used to state that race masks class in the US, but this has proved not to be true in mortality after cardiac surgery by Koch et al. (Navarro 2009; Koch et al. 2010; Scambler 2012). Other indicators of socioeconomic status have also been used: wealth as a material dimension of social inequality has been measured by ownership of homes and cars. (Filakti and Fox 1995; Bartley et al. 1999; Lahelma 2001) Gender, family status, ethnic and spatial relations also have an impact on socioeconomic health inequalities. (Lahelma et al. 2007; Scambler 2012)

Krieger recommended measuring socioeconomic position at multiple levels, in individuals, households, and neighbourhoods (Krieger et al. 1997). This was agreed by Davey Smith et al., who found that individually assigned and area-based socioeconomic indicators have an independent effect on CHD risk factors, morbidity, and mortality (Davey Smith et al. 1998).

Area-based material deprivation indexes are widely used in UK, developed by Carstairs and Morris or by Townsend. The latter is based on the proportions of an area's population that are unemployed, do not own a car, do not own their homes, and live in overcrowded households. In the USA most studies in the 1990s used census 'block-group' data, which allocated codes to all areas of the nation according to a neighbourhood's socioeconomic characteristics. (Krieger et al. 1997; Davey Smith et al. 1998)

2.2.5 Socioeconomic inequity in mortality

In England and Wales, data on the relationship between mortality and social class has been published for almost every decade in last century (Blane 1991). An inverse relationship between mortality and SES has been detected in the UK (Marmot et al. 1984; Townsend et al. 1990; Blane 1991; Kunst and Mackenbach 1994a; Phillimore et al. 1994; Mackenbach et al. 1999; Mackenbach et al. 2003; van Raalte et al. 2011; Blomgren et al. 2012), USA (Seltzer and Jablon 1977; Liu et al. 1982; Pappas et al. 1993; Sorlie et al. 1995; Davey Smith et al. 1996; Steenland et al. 2004), France (Kunst and Mackenbach 1994a; Saurel-Cubizolles et al. 2009; van Raalte et al. 2011), Belgium (van Raalte et al. 2011), Italy (Mackenbach et al. 1999; Mackenbach et al. 2003), Nordic countries (Iversen et al. 1987; Kunst and Mackenbach 1994a; Martelin 1994; Notkola et al. 1997; Mackenbach et al. 1999; Martikainen et al. 2001; Mackenbach et al. 2003; Martikainen et al. 2007; Valkonen et al. 2007a; van Raalte et al. 2011; Blomgren et al. 2012) the Czech Republic (Mackenbach et al. 1999; van Raalte et al. 2011), Hungary (Mackenbach et al. 1999), Estonia (Macken-

bach et al. 1999; van Raalte et al. 2011) and Russia (Plavinski et al. 2003). A number of studies encompass mortality data from several countries, most of them compare Western European countries (Valkonen 1993; Kunst and Mackenbach 1994a; Mackenbach et al. 1999; Marmot and Bobak 2000; Mackenbach et al. 2003; Mackenbach 2006; Strand et al. 2007; van Raalte et al. 2011). Higher mortality rates among lower-educated women were found for most causes of death, but not for neoplasms (Mackenbach et al. 1999) and a reversed social gradient has been found in breast cancer (Strand et al. 2007).

VanRaalte et al. considered census-based mortality data, most from the 1990s, from 11 European countries and found that the least-educated groups died between three and 15 years earlier than the highest-educated groups. Variations in age at death are larger between countries among the least-educated groups, while the highest-educated groups have more similar ages at death in all countries (van Raalte et al. 2012).

The mortality rates has decreased in the past few decades, but socioeconomic disparities have increased: for example, in England and Wales in 2001 the male mortality rate of those in routine and manual occupations was 2.0 times that of those in managerial and professional occupations; in 2008 that ratio had risen to 2.3 (Kaplan and Keil 1993; Pappas et al. 1993; Krieger et al. 1997; Ramsay et al. 2008; Langford and Johnson 2010).

In Finland, the health of people has also improved significantly over the past few decades (Koskinen et al. 2006). The life expectancy of all men aged 35 increased from 1998–2000 to 2003–2005 by 1.4 years, and, 1.2 years for women. The main factor in these changes was the rapid decline in CHD mortality. (Valkonen et al. 2007a) In fact, socioeconomic differences in CHD mortality among middle-aged men tended to be higher in Finland than elsewhere in the 1980s (Kunst et al. 1999). Even though CHD mortality has decreased considerably over the past few decades, it was still by far the major cause of life expectancy differences between social groups at the beginning of the 2000s (Valkonen et al. 2007a). In the mid-1990s, cardiovascular disease accounted for more than half the life expectancy gap of six years between Eastern and Western Europe, while external causes of death accounted for a fifth (Marmot and Bobak 2000). Escalating the decline in mortality from cardiovascular diseases in lower socioeconomic groups, and countering mortality increases from several other causes of death in lower socioeconomic groups are thus essential in order to reduce socioeconomic inequalities in mortality in Western Europe (Mackenbach et al. 2003). In Finland from 1988–92 to 2003–7, the gap on life expectancy among 35-year-olds by household income quintiles, between the highest and the lowest income quintiles, widened during the study period by 5.1 years among men and 2.9 years among women, and in 2007 it stood at 12.5 years and 6.8 years, respectively. The increasing mortality from alcohol-related diseases in the lowest income quintile accounted for 33 per cent of the total difference in men, and the discrepancy in CHD mortality accounted for 19 per cent. (Tarkiainen et al. 2012)

2.3 Socioeconomic inequity in CHD and its treatments

2.3.1 Socioeconomic inequity in CHD

In the 1970s, the Whitehall study of English civil servants revealed a clear socioeconomic patterning of CHD morbidity, a social gradient in which the health of civil servants improved and mortality decreased at each higher step of occupational grade (Marmot et al. 1978b; Rose and Marmot 1981; Davey Smith et al. 1990b). Findings of three epidemiologic studies from the USA, reported by Liu et al. in the 1970s and 1980s, also showed an inverse relationship between education and long-term risk of CHD, cardiovascular disease and all-causes mortality (Liu et al. 1982). Koskenvuo et al. reported disparities in male CHD incidence in the 1970s, mortality, and survival rates by marital status and social class from Finland on a national record linkage study. The highest mortality rate was found among unskilled workers, the highest incidence among widowers and those in the lower professional classes, and the lowest survival rate among divorcees, single persons, and unskilled workers. (Koskenvuo et al. 1981) The excess CHD morbidity and mortality among persons with lower socioeconomic status was also considerable in Finland between 1983 and 2002, as seen in acute coronary events (Salomaa et al. 2000; Salomaa et al. 2001; Lammintausta et al. 2012). In two population-based cohorts, the Atherosclerosis Risk in Communities (ARIC) and FINRISK, with follow-up from 1987 to 2001, indices of low socioeconomic status showed similar associations with an increased risk of cardiac events in Finland and in the USA (Kucharska-Newton et al. 2011).

A comparison of CHD mortality of twelve countries in the 1980s, by occupational class, revealed a north-south contrast within Europe. In England and Wales, Ireland, and the Nordic countries, the manual classes had higher mortality rates than the non-manual classes. In France, Switzerland, and the Mediterranean countries, the manual classes had mortality rates as low as, or lower than, those among non-manual classes. Compared with Northern Europe, mortality differences in the USA were smaller among men aged 30–44 years and approximately as large among men aged 45–64 years. (Kunst et al. 1999) Correspondingly, disparities in CHD mortality by educational level in the 1990s were larger in northern than in southern European populations (Averdano et al. 2006).

Unfortunately, the relative difference in CHD mortality between manual and non-manual social classes tended to increase over time, from 1987 to 2005 in Britain. On the other hand, absolute differences in mortality between these social groups decreased as a result of falling overall mortality rates. (Ramsay et al. 2008) Similar results were reported for CHD mortality from 1982 to 2006 in England between deprivation quintiles, and the steepest falls in CHD mortality rates were detected in the most affluent quintiles (Bajekal et al. 2013). In Sweden the increase over time of the relative risk of MI in those holding low socioeconomic positions

continued into the 1990s (Hallqvist et al. 1998). The pattern of declining absolute but rising relative inequalities is a well-known phenomenon in the context of declining overall mortality rates (Langford and Johnson 2010).

The association of low socioeconomic position with high CHD mortality has been detected both in out-of-hospital and in-hospital deaths. (Capewell et al. 2001; Cesana et al. 2001; Salomaa et al. 2001; Alboni et al. 2003)

2.3.2 Effect of risk factors on disparities

The classical risk factors of CHD, such as serum cholesterol concentration, blood pressure, and smoking, vary by socioeconomic position, and, furthermore, there are trends in these risk factor levels (Kuulasmaa et al. 2000). There are several studies examining the effect of the risk factors on socioeconomic differences in CHD. In the Whitehall study disparities in CHD mortality by employment grade and car ownership could not be accounted for by differences in smoking, blood pressure, cholesterol concentration, glucose intolerance, height, or prevalent disease (Marmot et al. 1978b). On the other hand, Jaglal et al. in a study from Canada concluded that persons with low socioeconomic status were twice as likely to develop CHD because of their higher prevalence of smoking and elevated cholesterol (Jaglal and Goel 1994). A Finnish study by Vartiainen et al. concluded that in the 1970s and 1980s less than half the decline in CHD mortality among white-collar men was explained by the classical risk factor changes, although they explained 75% of the decline among blue-collar men and 89% of the decline among male farmers (Vartiainen et al. 1998). In the 1980s and 1990s, Harald et al. estimated that these risk factors explained about a third of the excess CHD mortality in Finland between manual workers and upper-level employees in men, and most of this reduction was due to smoking (Harald et al. 2006). During the period 1987–2002 only 16% of the decline in mortality among male upper non-manual workers and 28% to 34% in the other occupational classes was attributable to changes in risk factor levels in Finland (Harald et al. 2008). Harald et al. concluded that socioeconomic differences in cardiovascular diseases are a more complex phenomenon than simply being differences in traditional risk factor levels. They suggest other explanatory factors, such as improved treatments. They noted that both primary prevention and equal use of healthcare resources are needed to narrow socioeconomic disparities in cardiovascular mortality (Harald et al. 2008).

2.3.3 Disparities in cardiac procedures

2.3.3.1 *Socioeconomic disparities in cardiac procedures*

There are several studies of AP patients showing that socioeconomic inequalities favour patients with higher socioeconomic status in access to cardiac procedures (Ben-Shlomo and Chaturvedi 1995; Manson-Siddle and Robinson 1998; Alter et al. 1999; MacLeod et al. 1999; Ancona et al. 2000; Hetemaa et al. 2003; Mackenbach

et al. 2003; Haglund et al. 2004; Korda et al. 2009). Race differences were detected even among patients who were clinically assessed appropriate for revascularisation (Feder et al. 2002).

Correspondingly, the evidence for MI patients is comprehensive on socioeconomic inequities in invasive cardiac procedures (Salomaa et al. 2001). There are few studies where no significant disparities were detected among MI patients: CABG (Coory et al. 2002), revascularisations on patients who had undergone angiography (Alter et al. 1999) or elderly Medicare beneficiaries (Rao et al. 2004), and acute PCI, within 2 days of admission, were among first AMI patients (Rasmussen et al. 2007). In a prospective study, Whitehall II, of civil servants aged 33 to 55 years with 15 years follow up until 2001, social position showed no association with the use of cardiac procedures or secondary prevention drugs after adjustment for clinical need (Britton et al. 2004). In Canada, among MI patients who were hospitalised to acute care hospitals between 1986 and 2001, no or no consistent association existed across socioeconomic status indicators on access to cardiac medications or invasive cardiac procedures (Pilote et al. 2007).

Inequality of access to coronary revascularisation or to angiography has been diminishing since more resources have been allocated to invasive cardiac procedures since 1990s (Manson-Siddle and Robinson 1999; Hetemaa et al. 2003; Haglund et al. 2004; Rasmussen et al. 2007; Manderbacka et al. 2009; Korda et al. 2011).

The inverse equity hypothesis, of inequality in the diffusion of high technology in health care, was studied in Australia among the first MI patients between 1989 and 2003. The invasive coronary operation rates peaked earlier in higher socioeconomic status patients than in lower socioeconomic status patients, resulting in inequalities which then disappeared over time as rates peaked in the higher socioeconomic status patients but continued to increase in the lower socioeconomic status patients. The CABG rates peaked and fell earlier in high than low socioeconomic status patients, while the PTCA rates were still increasing for both socioeconomic status groups around the millennium for both genders. In fact, by 2001–2003 the trend in CABG started to reverse with rates higher in the lower socioeconomic status patients. (Korda et al. 2011)

In Finland a pro-rich distribution of common surgical procedures has been persistent from the late 1980s (Keskimäki et al. 1996; Luoto et al. 1997) to the early 2000s. Later on a pro-poor distribution of surgical procedures among men in endoprosthetic surgery, coronary artery procedures, and lumbar hernia operations has been detected. Among women, the only pro-rich operations were hysterectomies and lumbar disc operations in 2003 (Manderbacka et al. 2009). Similar results for disparities in endoprosthetic surgery have also been reported from other countries (Milner et al. 2004; Yong et al. 2004; Agabiti et al. 2007; Judge et al. 2010).

2.3.3.2 Geographical variation

Geographical variations and inequity in the use of invasive cardiac procedures have been reported from Britain, Morris et al. studied the male probability of undergoing revascularisation in 24 median sized towns (Morris et al. 2005), MacLeod et al. studied MI patients in Scotland (MacLeod et al. 1999), and in Trent region, Hippisley-Cox and Pringle studied primary care practices (Hippisley-Cox and Pringle 2000), all in the 1990s. The distance of a practice from a revascularisation centre had an effect on procedure rates, significantly lower angiography and revascularisation rates were seen if the distance was 20km or more (Hippisley-Cox and Pringle 2000). Black et al. also found distance significant in revascularisation rates and noted that most of the geographic variation arose from differences in supply factors (Black et al. 1995). Area deprivation has an effect on regional variation, but does not explain it all. In a national study in Scotland, geographic variability reduced in MI incidence rates 59% in 1990–92 and 33% in 2000–02 after adjustment for area deprivation (Davies et al. 2009). In the late 1990s, a large interprovincial and regional variation were observed in the use of, and waiting times for, invasive cardiac procedures among MI patients in Canada, although they have a similar universal health care system to Finland (Pilote et al. 2004).

2.3.3.3 Gender differences

Gender differences in the use of invasive cardiac procedures have been detected in Finland in the late 1980s for CABG operations and in the mid-1990s for revascularisations. Generally, women undergo fewer operations than men (Keskimäki et al. 1997; Hetemaa et al. 2003). Similar outcomes were seen in a Swedish study, in which the researchers were able also to adjust for severity of disease based on angiography, and for age, year of diagnosis, diagnosis, co-morbidity, hospital and county of residence. They concluded that the gender differences found could not be justified by differences in the severity of the disease. (Haglund et al. 2004) A recent cohort study from Norway showed that women with non-ST-elevation MI were less likely to undergo angiography or PCI than men, but no gender differences were observed in ST-elevation MI patients (Halvorsen et al. 2009). Likewise, in Ireland in 2003, no gender differences were seen in acute-phase reperfusion, but fewer women had undergone revascularisation prior to index admission, although they had a positive history of acute coronary syndrome (Doyle et al. 2005).

In Canada, women suffering from MI in the 1990s underwent coronary angiography and CABG at a significantly lower rate than men, with similar trends evident in the use of PTCA (Jaglal et al. 1994).

For CHD patients in the USA similar trends were seen in the late 1980s (Ayanian and Epstein 1991) and also for angioplasties in 1990s (Maynard et al. 1996). No significant gender disparities in invasive cardiac procedures were detected between African Americans and Caucasians CHD patients, however, in a study from Louisiana at the end of the 1990s (Callier et al. 2004).

In the ARIC –study, among patients hospitalised between 1987 and 2001 with a definite or probable MI, women without a history of MI were less likely to undergo angiography (Pearte et al. 2008). A corresponding gender bias showed in the referral of patients for coronary angiography in 2000–2001, but not in the subsequent use of coronary revascularisation (Nguyen et al. 2008). On the other hand, Fang et al. found that less revascularisation after MI among women was associated with less frequent admission to hospitals capable of revascularisation and less frequent revascularisation even when admitted to performing hospitals (Fang and Alderman 2006). These gender disparities also appeared in other studies of MI patients (Harrold et al. 2003; Chang et al. 2007), however, gender differences in the use of these interventional approaches have narrowed over time (Harrold et al. 2003).

In the UK the male to female ratio for revascularisations decreased between 1987–8 and 1992–3 from 4.2:1 to 3.55:1, although in the private sector it was higher: 1992–3: 5.5:1 v 3.6:1 (Black et al. 1994). A retrospective hospital case note study in 1996–97 by Bowling et al. revealed that despite indications for intervention identical to those of men, women were less likely to undergo cardiac catheterisation, which inevitably limits their access to revascularisation procedures (Bowling et al. 2001). Raine et al. found similar results; but they revealed that there was no gender disparity in revascularisations among patients investigated properly (Raine et al. 1999).

Cardiovascular disease is the leading cause of mortality in women, accounting for a third of all deaths worldwide and half of all deaths of women over 50 years of age in developing countries (Pilote et al. 2007). The burden of CHD is shifting from middle-aged men toward middle-aged women and elderly patients (Mannsværk et al. 2011).

2.4 Summary of the literature review

There is a selection of studies in the appendix that concern socioeconomic disparities in cardiac treatments, shown in Table 1. The focus is on invasive cardiac operations, but there are some studies including medical treatments or CHD investigations. In Table 2 there is a selection of studies of socioeconomic disparities in CHD and all cause mortality. In Table 3 there is a selection of studies which include both mortality and treatments of CHD patients by socioeconomic position.

It is challenging to summarise the vast literature on socioeconomic differences, but one can argue that disparities in health are universal and seem to be quite persistent. Political, social, and economic forces still have an impact on the circumstances in which people live and how health care is organised, thus, with the right social policy, health inequalities can be avoided or at least minimised. There have been changes over time in the distribution of heart disease, CHD mortality dif-

ferences and the distribution of hospital treatments. It was known that clear discrepancies existed between the need for, and use of, coronary artery bypass surgery across socioeconomic groups in Finland in the late 1980s, and, that resources for revascularisations increased rapidly in the early 1990s, but the effect of increased supply in treatments was not examined according to socioeconomic differences. There were numerous studies of MI patients through the WHO MONICA (monitoring trends and determinants in cardiovascular disease) and the FINMONICA/FINAMI project, but few from the socioeconomic point of view. There was need for nationwide research which more deeply explores the socioeconomic determinants of invasive treatments and outcomes of CHD and explanatory factors.

3 Aims of the study

The general aims of the study were to evaluate and describe socioeconomic differences in the hospital treatments and outcomes of CHD patients and, furthermore, to elucidate the factors that have an effect on differences. The study also aimed to develop methods for using data from administrative registers to evaluate the outcome and quality of hospital care using CHD as an example.

The specific aims of the study were:

1. To explore how the change in supply, particularly the marked increase in resources for invasive treatments of CHD, influenced socioeconomic and gender differences in the use of coronary revascularisations (I).
2. To examine socioeconomic differences in coronary procedure rates after first events among hospitalised MI patients, and to investigate whether the differences were dependent on the length of the follow-up, co-morbidity or regional variations in procedure rates (II).
3. To explore socioeconomic differences in invasive cardiac procedures among a cohort of incident CHD patients and examine whether corresponding socioeconomic treatment differences exist among incident angina pectoris (AP) patients with no history of previous MI, and furthermore to investigate whether these differences might be explained by co-morbidity, disease severity or regional variations in procedure rates (III).
4. To examine whether similar socioeconomic disparities in the outcome of CHD exist in patients with chronic angina pectoris, and with potentially more effective access to secondary prevention, as in patients with acute MI as the first sign of CHD (IV).

4 Materials and methods

All the original studies in this thesis are register-based linkage studies. In Finland there is exceptionally good opportunity to carry out this kind of a research, since all Finns have unique personal identification numbers, which are used in all Finnish administrative registers and, thus, enable the combination of individual data from different registers. Data on outcome variables, confounding factors and sociodemographic variables were individually linked to the study data from administrative registers by competent register authorities using these personal identification numbers. The latter were encrypted before the data was transferred to the research team.

The current study used the traditional indicators of socioeconomic status, which were individually linked to data on coronary procedures, mortality, co-morbidity, and nitrate use as well as to demographic indicators. Since there was no data on thrombolytic treatments in the Finnish Hospital Discharge Register (HILMO) in the 1990s, these were excluded from the study.

In Studies I, II and III the rate of invasive procedures of CHD are studied: coronary angiography, PTCA and CABG, additionally, CHD hospitalisations in Studies I and II, mortality in Studies I and IV and MI incidence in Study IV.

The studies in this thesis used data from several administrative registers: the Finnish Hospital Discharge Register, the National Cardiovascular Disease Register, the Cause of Death Register, the Population Censuses, SII's drug reimbursement records and the register of patients eligible for special reimbursement of medicine costs. The registers and the data used in the study are first introduced. The study populations are then presented. Thirdly, information about the study variables and definitions are explained. Finally, a brief summary of the statistical methods and ethics used is presented.

4.1 Administrative registers

4.1.1 The Finnish Care Register for Health Care

The National Institute for Health and Welfare collects data annually from the administrative registers of all public and private hospitals in Finland for the Care Register for Health Care (HILMO); until 1993 the register was called the Finnish Hospital Discharge Register (FHDR). During the 1988–1998 study period the data comprised information on all discharges; including each patient's identification

TABLE 1 Registers and annual data used in the sub-studies

	Study			
	I	II	III	IV
Baseline registers and years for study population	FHDR ¹ 1988 and 1996	CVDR ² 1995	FHDR and SII ³ 1995–98	FHDR, SII and CVDR 1995, 1998
Statistics Finland				
Population census or labour force statistics for socioeconomic status	1985, 1995	1990	1993	1993, 1994–95
Cause of Death Register for mortality	1986–91 1991–95	1995–97	1995–99	1995–98
STAKES				
FHDR for coronary operations and hospital treatments	1988, 1996	1995–97	1995–99	1995–99
Social insurance institution				
Register of persons who have entitlement to refund of medicine expenses due to chronic diseases		1995	1995–98	1995–98
Prescription Register for nitrate use			1995–98	1995–98

1 The Finnish Hospital Discharge Register

2 The National Cardiovascular Disease Register

3 Social Insurance Institution

number, admission and discharge dates, diagnoses (principal and two subsidiaries) and (two) procedure codes. The register has been operating since 1967. For Studies I, II, III, and IV information about coronary procedures, such as CABG, PTCA and coronary angiographies, and hospitalisations due to CHD and MI was collected.

4.1.2 The National Cardiovascular Disease Register

The cardiovascular disease database provides detailed data on the occurrence of CHD in Finland. Data is based on the National Death Register, the Care Register for Health Care and the SII's records on individuals receiving reimbursements for cardiovascular medications. The database is maintained at the National Institute for Health and Welfare. (Salomaa 1997; Laatikainen et al. 2004)

For Study II the information on MI patients in 1995 was obtained from the register. In the Cardiovascular Disease Register Project, the Hospital Discharge Register was searched back to 1981 for hospitalisations with International Classification of Diseases (ICD) code 410 (acute MI) or 412 (old MI), and if none were found, the event was defined as the first MI. Patients having their first MI in 1995 formed the study population.

4.1.3 The registers at the Social Insurance Institution

Several registers concerning welfare benefits and health insurance are maintained in the SII (SII) (Finnish Medicines Agency Fimea and SII 2013; SII of Finland Kela 2013). Data on annual use of short acting and long acting nitrates was drawn from the Prescription Register. This data was used as a proxy for CHD severity in Studies III and IV.

The register of persons granted special reimbursement for medication costs offered us information about patient co-morbidity for studies II, III and IV, as well as, the opportunity to comprise one part of the study population for Studies III and IV, AP patients. The cost of medicines is reimbursed for persons suffering from certain severe chronic diseases, and to be eligible to receive reimbursement of medicine costs under the Special Refund categories the patient must obtain a certificate from their doctor to confirm their need for the medication, which is then reviewed and approved by a specialist at the SII.

4.1.4 The registers at Statistics Finland

Statistics on the causes of death, starting from 1936, are available from Statistics Finland, which also maintains an archive of death certificates. Statistics on the causes of deaths contain data about deaths and mortality by cause of death, age, gender, marital status and other demographic variables. (Statistics Finland 2011)

For the studies in this thesis, data about the cause and date of death were crucial. In Study I the CHD mortality was calculated for the years 1986 to 1991, and 1991 to 1995, and used as relative need indicators for cardiac operations in years 1988 and 1996 correspondingly. In Study II the outcome variables included all-cause and CHD mortality with a two-year follow-up time. The date of death was needed in Study III to discover the patients who died during the follow-up period, since this was censored in the analyses. In Study IV we calculated the two-year CHD mortality and one year MI incidence and its 28 day case fatality.

The Finnish Population Census is a complete set of statistics containing basic data describing the structure, employment, families and housing of the population (Statistics Finland 2013a). The data is gathered from numerous (approximately 30) different registers and administrative files. The classification of socioeconomic groups is based on data about occupations, which was obtained from registers.

Census data has been produced annually for the population since 1971, about dwellings and buildings since 1985, about employment since 1987 and about families since 1977. Population censuses cover the entire population of the country. The full set of Population Census data was produced in 1950, 1960, 1970, 1975, 1980, 1985, 1995 and 2000. (Statistics Finland 2012)

A longitudinal data file spanning the period from 1970 to 2010 and containing information on all persons resident in Finland in 1970, 1975, 1980, 1985, 1990, 1995 and 2000 has been produced from the census data on individual persons. The

file also contains data about families and household-dwelling units. (Statistics Finland 2012)

Employment statistics are annual statistics providing data by region on the population's economic activity and employment, including information of occupational status, educational level and income of the population. Data on occupation and socioeconomic group is available for the years 1990, 1993, 1995, 2000 and yearly since 2004. (Statistics Finland 2013b)

Socioeconomic status, education and family's disposable income were used in each study as an indicator of social class, although, in Study IV results were presented only by income categories. For retired persons we used the longitudinal census data to obtain their pre-retirement occupation to assess their socioeconomic status.

4.2 Study populations and outcome variables

4.2.1 Finnish population in 1988 and 1996

In Study I the study population was comprised of all men and women 40 years and older in years 1988 and 1996 in Finland: 2,094,846 inhabitants in 1988 and 2,401,027 in 1996. We established their rates of coronary procedures and hospital use for CHD from the Finnish Hospital Discharge Register, covering all public and private hospitals in Finland. We established information about CHD mortality in the years 1988 to 1991 and 1991 to 1995 from the Causes of Death Register.

In 1988, diagnoses were coded according to the Finnish version of the 9th revision of the ICD and in 1996 by the 10th revision. In both years, surgical operations were coded according to the classification of procedures by the Finnish Hospital League. This classification does not contain catheterisation procedures, but from 1994 onwards coronary angiographies and angioplasties have been recorded with supplementary questionnaires attached to cardiac patients' discharge reports. For 1988, data on catheterisation procedures was not available, however, according to the aggregate data collected by the Finnish Heart Association, the total number of angioplasties in 1988 was a mere 272, corresponding to 11.4% of all coronary revascularisations.

4.2.2 First MI in 1995 in Finland

Information was obtained from the Finnish Cardiovascular Disease Register on MI patients, men and women aged 40–74 years. Altogether 7,482 persons were treated for MI in Finnish hospitals in 1995. Of these, 5,294 had no earlier treatment episodes due to MI. All those who died after admission to the hospital and those discharged alive after more than four days were included in the study. Thus, 3,540 men and 1,632 women hospitalised alive due to their first MI formed the study population in Study II.

Altogether, there were 5,294 patients, of whom those who were discharged alive after less than four days of total hospital stay were excluded from the study, since the diagnosis was supposedly coded incorrectly: 73 men and 49 women.

Outcome variables were the first hospitalisation due to CHD and all invasive cardiac procedures on two year follow up, established from the FHDR.

4.2.3 Angina pectoris and first MI patients from 1995 to 1998 in Finland

In Study III personal identification numbers for AP patients, aged 45–79 years, were obtained from the SII register of those awarded entitlement to a refund of medical expenses due to CHD in 1995–1998. The criteria for this entitlement was (1) chronic angina pectoris symptoms responding to nitrates, and with unequivocal ECG changes (if QS waves are not detected in resting ECG, typical ischaemic changes are required in exercise test), (2) diagnosed MI, (3) performed coronary angioplasty (PTCA) or coronary artery bypass grafting (CABG), or (4) CHD diagnosed in angiography. As noted earlier, eligibility for reimbursement of medicine costs requires the patient to obtain a doctor's certificate confirming their need for the medication, and this certificate is then reviewed and approved by a specialist at the SII. This procedure means that false positive cases are probably rare. The AP patients study population comprised 15,986 male and 12,367 female with angina pectoris.

Data on MIs (code 410, Finnish version of the 9th revision of the ICD in 1995; codes I21 and I22 in the 10th revision in 1996–1998) were obtained from the FHDR. (World Health Organisation 2002; Nienstedt and Petaeu 2011) The patients studied were classified as MI patients if they had not been entitled to a refund of medicine expenses before hospitalisation for MI. The FHDR was searched back to 1990 for hospitalisations with MI or CABG, and to 1994 for PTCA. Both MI and AP patients who were hospitalised due to MI or underwent either CABG or PTCA before the onset of the follow-up were excluded from the study. The study population of first MI patients encompassed 13,585 men and 7,635 women.

The first MI and AP patients altogether, comprised 49,846 patients, for whom we established invasive cardiac procedures in a one year follow up from FHDR in Study III.

In Study IV, AP patients were established in the same manner as for Study III, with the adjustment that they were aged 40–79 years and had received the right to special reimbursement for medication due to CHD between 1 January 1995 and 1 October 1998.

Those with prior hospital treatment attributable to MI or coronary revascularisation, as well as those who already had the right to reimbursement on 31 December 1994, were excluded from this group. To ensure identification of a pure angina cohort, those who had an MI within 90 days of receiving the special right to reimbursement were re-defined as MI patients. Thus, the AP patient cohort had a

rather stable form of CHD without prior evidence of MI and with the potential for secondary prevention.

Accordingly, the personal identification numbers of MI patients aged 40–79 years suffering their first MI (ICD9 code 410 and ICD10 codes I21–I22) were drawn from the hospital discharge records for 1 January 1995 to 1 October 1998.

Personal identification numbers of persons with CHD as cause of death (ICD9 codes 410–414, and 798; ICD10 codes I20–I25, I46.1, I46.9, R96, and R98) during 1 January 1995 to 1 October 1998 were also derived from the cause of death register maintained by Statistics Finland. Patients with hospitalisation attributable to MI in 1990–1994, those having a right to special reimbursement for medication because of CHD before the event, and deceased persons with prior information of MI or revascularisation were excluded from the group. As notes above, AP patients were moved to the MI group if they were hospitalised within 90 days of receiving the reimbursement right. Thus, the MI patients had CHD with acute onset and without previous AP symptoms enabling access to secondary prevention.

The study population constituted of 15,113 male and 13,238 female angina pectoris patients and 21,827 men and 11,172 women, who suffered their first MI. Altogether, there were 61,350 patients, for whom we established two year CHD and all cause mortality from the causes of death register. For AP patients we established one year MI incidence and its case fatality, and the case fatality for MI patients.

4.3 Explanatory variables

Sociodemographic parameters, such as age, gender, residence (the hospital district), socioeconomic status, education and income, were drawn from the population census or other registers in Statistics Finland. Information on invasive cardiac procedures and hospitalisations due to CHD were drawn from the FHDR. As proxy for CHD severity, the data on annual use of short and long acting nitrates was drawn from the Prescription Register and information about patient comorbidities was drawn from the register of persons granted special reimbursement for medication costs in the SII. For each of the four studies, the necessary register linkages were performed in Statistics Finland and the personal identification numbers were encrypted before the data was transferred to the researchers.

4.3.1 Socioeconomic status

The social class of employed persons was obtained from the most recent census. Married women were classified using their own occupation or, if not employed, according to their husband's occupation. The social class of retired persons was derived from their most recent pre-retirement occupation in the censuses of 1990, 1985, 1980, 1975, or 1970. Social class was defined according to the person's occupation as follows:

- (1) Upper white-collar employees: upper level administrative, managerial or professional employees
- (2) Lower white-collar employees: lower level administrative or clerical employees
- (3) Blue-collar workers: skilled or unskilled manual workers
- (4) Farmers: farmer employers or farmers on own account
- (5) Others: employers, self-employed workers, students or occupation unknown

For analysis we used also a combination of Groups 1 and 2, white-collar employees.

4.3.2 Education

The level of education was classified either a low and intermediate or higher education category, or in three categories, as follows:

- (1) High: university degree or a qualification requiring 13 years or more of education.
- (2) Intermediate: secondary school matriculation requiring 10–12 years of education.
- (3) Low: basic education of less than 10 years.

4.3.3 Family disposable income

Disposable income was derived from the registers on taxes and welfare benefits or from the employment statistics at Statistics Finland. It was adjusted for family size using the Organization for Economic Co-operation and Development (OECD) equivalence scale, where the first adult of a family is weighted as 1.0, other adults as 0.7, and children less than 18 years old as 0.5. (OECD 1982) For statistical analysis the study population was grouped into fifths (Study I) or thirds (Studies II, III and IV) according to family disposable income. In Study II the thirds were drawn for men and women together. In Studies III and IV the thirds were drawn for men and women separately from the disposable income in the year before the onset of follow-up.

4.4 Confounding factors

4.4.1 The hospital district

For specialised medical care purposes, Finland is divided into hospital districts. The area of a hospital district comprises municipalities that belong to the joint municipal board for the hospital district in question. Some specialised medical care services are organised on the basis of special responsibility areas of university hospitals. Altogether there are 20 hospital districts and 5 areas of university hospitals in Finland. (Ministry of Social Affairs and Health 2010b)

4.4.2 Severity of the CHD

The annual use of short acting and long acting nitrates was used as a proxy for CHD severity in Studies III and IV. Consumption of nitrates was expressed using a defined daily dose (DDD), the assumed average maintenance dose per day for a drug used for its main indication in adults. (World Health Organisation 2003) The study population was divided into four groups according to their nitrate use - that is, 0, 1–99, 100–349, and 350 or more DDD for statistical analyses.

4.4.3 Co-morbidities

For Studies II, III and IV data on entitlements to the reimbursement of medicine costs attributable to chronic diseases were gathered from the SII. The study patients were entitled to reimbursements for 43 different chronic disease categories in total. For the analyses we classified these disease categories into five (Study IV) or seven (Studies II and III) groups and used them as proxies for comorbidities.

In Study IV the groups were heart failure, arrhythmia, hypertension, diabetes mellitus, and other diseases.

In Studies II and III the groups were heart failure, arrhythmia, hypertension, diabetes mellitus, asthma or chronic obstructive pulmonary disease, severe mental disorders, and other diseases, which includes 36 chronic diseases such as thyroid insufficiency, multiple sclerosis, Parkinson's disease, epilepsy, malignant tumours, sarcoidosis, rheumatoid arthritis, ulcerative colitis, Crohn's disease and gouty arthritis.

4.5 Statistical methods

In original Studies I and II indirect age-adjustment, and in Studies III and IV direct age-adjustment was used to calculate the rates for cardiac operations, hospitalisations due to CHD, all cause and CHD mortality and the incidence of MI and its case fatality. In Study I the Finnish population in the year 1996 was used as the standard population for calculations. In the rest of the studies each of the total study populations (person years) was used as the standard population in corresponding study.

In Study I a multilevel Poisson regression was used to assess the influence of the regional supply of revascularisations on gender and socioeconomic gradients in operation rates. The correlation between the overall procedure rate was estimated in each hospital district, and the regional rate ratios for socioeconomic and gender groups. The outcome was the number of procedures observed in groups defined by age, gender, and socioeconomic status within each hospital district.

TABLE 2. Information on study populations, socioeconomic status indicators, end point variables and need indicators or co-morbidity and severity of the disease used in Studies I– IV.

Study	Study population	N	Age range (years)	Explanatory variables (number of groups)	Outcome variables	Confounding variables or need indicators (number of groups)
I	Finnish population in 1988 in 1996	2,094,846 2,401,027	40 years and older ¹	Social class (5) Education (3) Family disposable income (5) ²	CABG in 1988 CABG or PTCA in 1996 Coronary angiography in 1996	Need indicators Annual CHD mortality in 1988–91 Hospital use due to CHD in 1988 Annual CHD mortality in 1991–95 Hospital use due to CHD in 1996
II	Incident MI patients in 1995	5,172 (3,540 men and 1,632 women)	40–74	Social class (4) Education (2) Family disposable income (3) ³	CABG, PTCA or coronary angiography in two-year follow-up Hospitalisation due to CHD	Co-morbidity Entitlement to refund of medicine expenses due to chronic diseases (7)
III	Incident AP patients in 1995–98 MI patients in 1995–98	49,846 (15,986 men and 13 858 women) (12,367 men and 7,635 women)	45–79	Social class (4) Education (3) Family disposable income (3) ⁴	CABG, PTCA or coronary angiography in one-year follow-up	Co-morbidity Entitlement to refund of medicine expenses due to chronic diseases (7) Severity of the disease The annual use of short and long acting nitrates (3)
IV	Incident MI patients or incident CHD death in 1.1. 1995–1.10.1998 Incident AP patients in 1.1.1995–1.10.1998	61,350 (21,827 men and 11,172 women) (15,113 men and 13,238 women)	40–79	Social class (4) Education (3) Family disposable income (3)	one- and two-year CHD mortality one-year MI one-year MI 28-day case fatality	Co-morbidity Entitlement to refund of medicine expenses due to chronic diseases (5) Severity of the disease The annual use of short and long acting nitrates (4)

1 In some analysis 40–69 years old

3 Study population used as standard population

3 Study population used as standard population, men and women together

4 Study population used as standard population, men and women separately

In Study II the Kaplan-Meier method with log-rank test was used to compare invasive cardiac operations after the first MI between socioeconomic groups. Log-rank tests the probability that there is a trend in operations, and survival scores, across the groups.

Cox's proportional hazards regression model was used in Studies II and III to compute the hazard ratios and 95% confidence limits of invasive coronary treatments in the lower socioeconomic groups compared with the highest. Patients who died during the follow-up were censored in the analyses. The models were fitted in four phases in Study II: controlling only for age, controlling for age and co-morbidities, controlling for age and hospital district, and controlling for age, co-morbidities and hospital district. In Study III the models were fitted in three phases: controlling for age only, controlling separately for age and co-morbidities, age and disease severity, and age and hospital district, and controlling simultaneously for age, co-morbidities, disease severity and hospital district.

The statistical analyses were performed using SPSS 10.0 and 11.0, SAS 9.1 and MlwiN software.

4.6 Legislation and ethics

The Finnish Constitution states that the right to privacy is a basic right (Ministry of Justice 1999c). According to the Personal Data Act everyone has a right to know and have control over the information that is collected about them, and for what purpose and how it is used (Ministry of Justice 1999a).

Confidential, individual-level data was needed from several administrative registers, for the studies in this thesis, and so applications for data were made to respective register authorities and permissions granted. From the register holders in question Statistics Finland and the National Institute for Health and Welfare are under the jurisdiction of the Statistics Act, and the latter also under the Act on National Person Register for Health Care (Ministry of Social Affairs and Health 1989; Ministry of Finance 2004). The SII is under jurisdiction of the Act on the Openness of Government Activities (Ministry of Justice 1999b). According to these Acts and the Personal Data Act, the register holders can grant permission for the use of personal data for scientific research which is based on an appropriate research plan (Ministry of Justice 1999a). The Statistics Act also states that permission to use data can be given if data enabling direct identification of the statistical unit has been removed, and individuals cannot be identified. (Ministry of Finance 2004)

The study protocols of the four studies were approved by the Finnish Data Protection Ombudsman. The chairman of the research Ethics Committee of STAKES Hannu Uusitalo, noted that ethical review of Study I was not needed in STAKES, when the study protocol was orally presented to him. The policy later

changed and the study protocols of the rest of the original studies were approved by an Ethics Committee in STAKES in 2000, diary number 4936/54/2000.

Permission for the original studies to use the data were gathered from the register authorities in question and an agreement about the co-operation between STAKES, diary number 5337/59/2000, SII and the National Public Health Institute, diary number 392/412/2000, was signed on 24th of October 2000. Research permissions from Statistics Finland were TK-53-400-98, TK-53-401-98, TK-53-402-98, TK-1585-00 and TK-53-684-01.

5 Results

5.1 Impact of an increase in the supply of coronary operations on socioeconomic and gender equity in their use in Finland, 1988 vs. 1996

Patients aged 40–69 underwent 1,779 bypass operations altogether, in Finland in 1988, corresponding to 185 for men and 35 for women per 100,000. In 1996, the numbers were much higher: 3,510 coronary bypass operations, 1,709 angioplasties and 7,764 angiographies. The numbers corresponded to 440 coronary revascularisations, and 597 angiographies per 100,000 men and 121 and 232 per 100,000 women. Making allowances for the lack of data on angioplasties in 1988, the male rate of coronary revascularisations increased by about 140% and the female rate by 250% over the study period. Along with the increasing overall rates of coronary procedures, socioeconomic differences in operation rates diminished.

Age-adjusted rates of coronary operations, hospital utilisation, and mortality from CHD for men and women aged 40 to 69 years are presented in Figure 4. Age-adjusted rates of coronary operations and hospital utilisation from CHD are also presented by social class, education, and family disposable income for men,

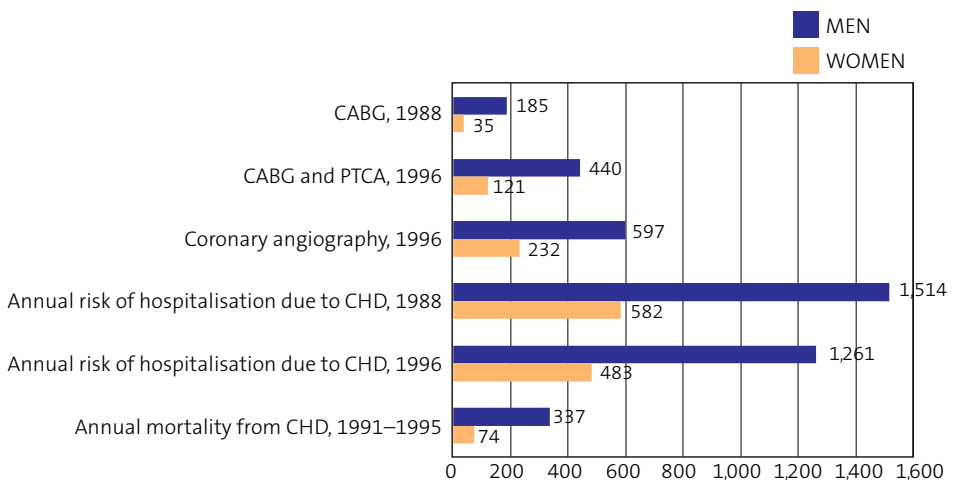


FIGURE 4. Age-adjusted rates per 100,000, Finnish population in 1996 used as standard population, for CABG, PTCA, coronary angiography, hospital utilisation due to CHD and mortality from CHD in 1988 and 1996 in Finland, men and women aged 40–69.

in Figure 5. While male age-adjusted rates for coronary bypass operations in 1988 showed a pronounced gradient favouring the better off, independent of socioeconomic indicator used, no systematic socioeconomic trends existed in rates for coronary revascularisations or angiographies in 1996. According to all three socioeconomic indicators, however, male mortality from CHD in 1991–1995 systematically increased towards the lower socioeconomic groups. In both study years hospitalisations attributable to CHD displayed higher rates in men who were worse off in terms of social class and education. In the lowest income group, however, risk of hospitalisation attributable to CHD was lower than in middle groups in both years. (Table 1, Study I) The pattern was similar for men aged 70 years and older in hospitalisations attributable to CHD in 1996. In operation rates among elderly men a gradient favouring the better off was observed (Table 2, Study I).

In 1988 socioeconomic differences for women in bypass operations were less distinct; no clear gradient was found according to any socioeconomic indicator used (Table 1, Study I). In 1996, gradients in the rates of coronary revascularisations and angiographies favoured the lowest groups according to social class and education, while according to income the highest rates occurred among women with intermediate family incomes. Female mortality in 1991–1995 and the 1988 and 1996 annual risks of hospitalisation attributable to CHD showed similar overall gradients for the socioeconomic indicators used: the lower the socioeconomic status the higher the mortality and hospitalisation rate. This was also true for women aged 70 years and older in 1996. For this age group the pattern for the operation rates showed no clear gradient (Table 2, Study I).

Age specific curves for revascularisation rates in 1988 and 1996 for white-collar and blue-collar men and women against mortality from CHD for 40 to 69 year olds, are presented in Figure 2, Study I. In both study years white-collar male employees underwent more operations than blue-collar workers with the same level of need, indicated by CHD mortality. For women the results were similar but the relative differences smaller, and the curves crossed for the older age groups in 1996. For both genders, however, the distances between the curves of procedure rates and mortality in socioeconomic groups diminished from 1988 to 1996.

Corresponding patterns emerged for men and women when we plotted similar curves for education and disposable income groups and when angiographies were examined instead of revascularisations in 1996.

Patients aged 60–69 underwent comparatively more operations in 1996 than in 1988; the curves declined for older age groups in 1988 but rose in 1996 (Figure 2, Study I). We noted that while few operations in 1988 were performed on patients older than 70 years, in 1996 operation rates markedly dropped only for those aged 80 or more.

Kakwani's inequity indices were also calculated for the socioeconomic distribution of coronary revascularisations using deaths and hospitalisations attributable to CHD as proxies for need (Table 3, Study I). Among those aged 40 to 69 all

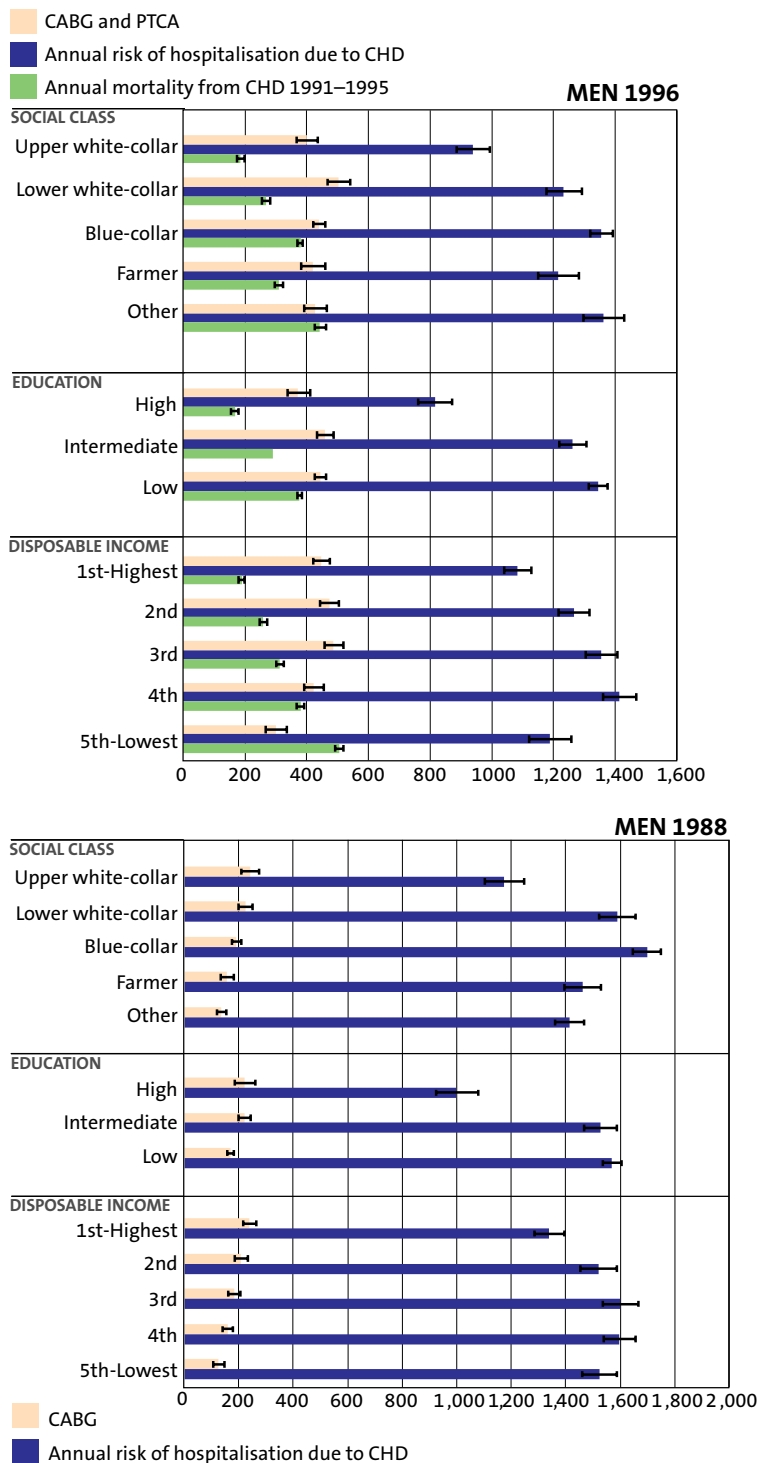


FIGURE 5. Age-adjusted rates per 100,000, Finnish population in 1996 used as standard population, and their 95% confidence limits for CABG, PTCA, hospital utilisation due to CHD and mortality from CHD by socioeconomic status in 1988 and 1996 in Finland, men aged 40–69.

the indices, except that for women's education, were smaller in 1996 than in 1988, suggesting a more equitable distribution of revascularisations in 1996. The changes in the indices were larger when hospitalisation attributable to CHD was used as a proxy for need. All the index values were positive in 1996, however, indicating that the distribution of operations favoured higher socioeconomic groups.

For age groups over 70 years, Kakwani's inequity indices were mostly concordant with the results for those aged 40–69. However, the indices were somewhat higher when annual risk of hospitalisation, and lower when mortality attributable to CHD, was used as proxy for need. The indices for angiographies for those aged 40 and more closely resembled those for revascularisations in 1996 (Hetemaa et al unpublished information).

To study the influence of the supply of coronary revascularisations on socioeconomic and gender differences in their utilisation, the associations between the overall coronary operation rates in the 21 hospital districts and the regional revascularisation rate ratios for women and men and for low and high socioeconomic groups were calculated. As an example, Figure 3 Study I plots the ratios of revascularisation rates among women compared with those for men, and the corresponding rate ratios for blue-collar and white-collar groups among men against overall hospital district rates in 1988 and 1996. Among all four plotted groups there seemed to be a positive association between the overall district rate and the rate ratio, an increase in the overall rate corresponding to an increase in the rate ratio. The measure of the strength of this association was the correlation coefficient, and estimates of the correlation between the overall rate and the rate ratio—both on the log scale—together with 95% confidence intervals (Table 4, Study I). In 1988, there was a clear association between the hospital district rates of coronary revascularisations and the rate ratios for genders and socioeconomic groups among men. For women, the correlation coefficients in 1988 were only significantly different from zero for the correlation between regional operation rates and rate ratios for educational categories. By 1996, the association between the regional supply of coronary operations and trends in operation rates had weakened and only the rate ratios for gender differences and men's social class differences revealed a statistically significant correlation with overall hospital district rates.

5.2 Socioeconomic inequities in invasive cardiac procedures after first MI

The hospital records revealed 5,172 patients aged 40–74 years who were hospitalised due to their first coronary attack in 1995, corresponding to an age-standardised rate of 354 events per 100,000 for men and 152 per 100,000 for women. At the time of their first MI, the mean age for men was 61.4 years and for women 66.3 years. The incidence of hospitalisation due to CHD, for either operative or con-

servative care, was 49% for men (635 to 545 per 1,000 person-years) and 42% for women (509 to 413 per 1,000 person-years) within two years after the first MI. No systematic socioeconomic gradients were observed across educational and income groups in the incidence of hospitalisation in both genders. According to social class, the gradients for men and women were reversed: male white-collar employees were more often hospitalised than blue-collar workers, and female blue-collar workers and farmers were more often hospitalised than white-collar employees (all $P < .05$). (Figure 1, Study II.)

Within two years after the first MI 33% of men and 21% of women had undergone an invasive cardiac procedure, (e.g., coronary angiography, coronary angioplasty, or coronary bypass operation). Cumulative curves for invasive cardiac procedures after the first MI, by social class, are presented in Figure 2, Study II. White-collar employees underwent more procedures than blue-collar workers in both genders and the difference already existed at the beginning of the follow-up. The difference between white- and blue-collar men was statistically significant ($P < .001$ by the log-rank test); among women the relative difference was slightly smaller and not statistically significant ($P > 0.1$).

Cox regression models for the relative risks of having an invasive cardiac procedure within 2 years after the first MI among men and women were produced (Table 2, Study II). Separate models are presented for social class, education and family disposable income. In procedure rates a pattern favouring patients with higher socioeconomic background was found for men and women independently of the socioeconomic indicator used. Analyses were also made for four different time periods (0–28, 29–182, 183–730, and 0–730 days after the onset of the event) controlling for age; the socioeconomic differences were already evident in the acute phase, within 28 days after the attack, and the differences remained relatively similar throughout the study period, these results are not presented here. Among men, the differences were statistically significant when comparing white-collar employees to blue-collar workers or farmers and patients with high income compared with those with low income (all $P < .001$). Blue-collar men underwent 24% (95% CI 13–33) fewer procedures than white-collar men during the 2-year follow-up (Table 2, Study II). Invasive cardiac procedures were less frequent among women and, although the socioeconomic patterns of procedure rates resembled those for men, the only statistically significant difference was between patients with high and low income ($P < .001$).

At the time of the infarction 26% of men and 27% of women were entitled to reimbursement for drugs due to CHD. If drug reimbursements for cardiovascular disorders in general, CHD, arrhythmia, cardiac insufficiency, hypertension, and familial hypercholesterolemia, were combined, the proportion was 54% for men and 65% for women (Table 1, Study II). Models were built for the effect of comorbidities and regional variation on these socioeconomic disparities. The age-adjusted rate of cardiac procedures was slightly reduced if the patient was entitled to reim-

bursement of medicine costs due to cardiac insufficiency, diabetes mellitus, chronic asthma and chronic obstructive pulmonary diseases, or other chronic diseases, but these results were not statistically significant. There was variation in procedure rates between hospital districts, and the differences were significant both for men and women.

Adjustments for entitlement to reimbursed medication due to CHD or any chronic disease, and for hospital district, did not reduce socioeconomic differences in the relative rates of invasive cardiac procedures. This was also true when all these variables were entered into the model simultaneously. The pattern was similar for all socioeconomic indicators: patients with higher socioeconomic status underwent more procedures than patients with lower socioeconomic status. According to social class and education, the socioeconomic gradient was somewhat weaker among women than men, whereas the inequities between income groups were particularly pronounced in women (Table 2, Study II).

5.3 Socioeconomic inequities in invasive cardiac procedures among patients with incidental angina pectoris or myocardial infarction

From 1995–1998 in Finland, 49,846 persons, aged 45–79 with no prior register information about MI or AP, received an entitlement of reimbursement due to CHD (15,986 men and 13,858 women), or were hospitalised due to their first MI (12,367 men and 7,635 women). The numbers correspond to age-adjusted rates of 481 APs per 100,000 of the mean population in Finland in 1995–1998 for men and 328 per 100,000 for women, and for MIs 385 and 172, respectively. From 1995 to 1998 AP rates decreased 22% in both genders and MI rates decreased 15% for men and 11% for women.

The mean age for AP patients was 63.3 years for men and 67.2 years for women, and for MI patients 65.2 and 70.8 years, respectively. The social class and educational distributions were fairly similar among male MI and AP patients, whereas men with MI more often belonged in the low income group, and men with AP more often in the high income group. Among women, AP patients belonged to higher SES groups more often than MI patients, independently of socioeconomic indicator. The reimbursement for medicine costs entitlement data showed that various comorbid conditions were generally more prevalent among MI patients (Table I, Study III).

Among AP patients, 29% of men and 15% of women underwent an invasive cardiac procedure, coronary angiography, coronary angioplasty, or coronary bypass operation, during the one-year follow-up. The proportions for MI patients were 25% and 15%. Kaplan-Meier curves for invasive cardiac procedures in a one year follow-up for AP and MI patients, separately among men and women, by fam-

ily disposable income, are presented in Figure 1, Study III. Using the total study population as the standard, these figures correspond to age-adjusted proportions of 24% for invasive cardiac procedures for male MI patients and 21% for female, and for AP patients 25% and 16%, correspondingly.

According to analyses controlled for age, women had fewer procedures than men during the one-year follow-up (Hazard ratio (HR) for women: 0.65, 95% CI: 0.62–0.68) and MI patients had more than AP patients (HR for men: 1.22, 1.16–1.27; HR for women 1.75, 1.62–1.88). Blue-collar workers underwent about 18% fewer cardiac procedures than white-collar employees (HR for men: 0.75, 0.71–0.79; HR for women 0.83, 0.76–0.89). These above-mentioned results are only presented here, not in the original article.

The disparities in the use of cardiac procedures were similar by all socioeconomic indicators: patients with higher socioeconomic status underwent more procedures than patients from lower groups. This applied to both patient groups and each gender. The results of Cox's proportional hazards models (hazard ratios plus 95% confidence limits and p-values) for invasive cardiac procedures within a year for male and female AP and MI patients by social class, education, and income are presented in Table II, Study III. Controlling for age, reimbursement entitlement for any chronic disease, nitrate consumption and hospital district, did not change the disparities for either patient group among men or women (Table II, Study III). Although comorbidities, disease severity and area of residence affected cardiac procedures individually, they did not influence the socioeconomic disparities.

Table I Study III presents the influence of co-morbidity and disease severity on the cardiac procedure rates. The rate of cardiac procedures was reduced among men with MI if they were entitled to reimbursed medicine costs due to heart failure, asthma or chronic obstructive pulmonary disease, diabetes mellitus, severe mental disorders or other chronic diseases. Among women only the latter three diseases had a statistically significant effect. Entitlement due to hypertension increased cardiac procedure rates 12% for men and 18% for women. For AP patients, each chronic disease entitling medication reimbursement reduced the cardiac procedure rate, with the exception of hypertension among women. The procedure rates varied between hospital districts for both patient groups and both genders. Increased consumption of nitrates raised the cardiac procedure rate in both patient groups and both genders, the rates were approximately twice as high among patients whose nitrate consumption was 350 DDD, or more compared with those whose nitrate consumption was 0–99 DDD (Table 3.)

The pattern remained similar for all socioeconomic indicators: patients with higher socioeconomic status underwent more procedures than patients with lower status. Disparities were already emerging after the 28-day follow-up among men and women of both patient groups, and they persisted throughout the study period. Additional analyses of the two patient groups showed no statistically significant interaction between any of the indicators of socioeconomic status and patient

group (MI or AP). Finally, the interaction between nitrate use and socioeconomic status was tested in order to find out whether patients in higher socioeconomic groups would undergo invasive cardiac procedures with fewer symptoms than patients in lower groups. No statistically significant interactions were found.

TABLE 3. Age-standardised hazard ratio of having invasive cardiac procedure within one year after entitlement to reimbursed medicine costs for CHD (AP) or first MI, by co-morbidities and nitrate consumption; men and women aged 45–79 years in Finland, 1995–1998.¹

	Angina pectoris patients HR (95% CI)	MI patients HR (95% CI)
MEN		
Entitlement to reimbursed medicine costs for co-morbid disease ² :		
None	1.00	1.00
Heart failure	0.67 (0.59–0.76)	0.78 (0.67–0.89)
Arrhythmia	0.65 (0.55–0.76)	1.12 (0.90–1.38)
Hypertension	0.93 (0.87–0.99)	1.12 (1.04–1.21)
Diabetes mellitus	0.82 (0.74–0.91)	0.86 (0.76–0.97)
Asthma or chronic obstructive pulmonary disease	0.73 (0.63–0.84)	0.79 (0.67–0.93)
Severe mental disorders	0.39 (0.28–0.53)	0.40 (0.30–0.54)
Other diseases ³	0.78 (0.71–0.87)	0.85 (0.75–0.95)
WOMEN		
Entitlement to reimbursed medicine costs for co-morbid disease ² :		
None	1.00	1.00
Heart failure	0.61 (0.51–0.73)	0.88 (0.74–1.06)
Arrhythmia	0.54 (0.41–0.71)	1.12 (0.78–1.60)
Hypertension	0.99 (0.90–1.09)	1.18 (1.05–1.33)
Diabetes mellitus	0.85 (0.72–0.99)	0.74 (0.62–0.88)
Asthma or chronic obstructive pulmonary disease	0.83 (0.70–0.99)	0.90 (0.72–1.13)
Severe mental disorders	0.62 (0.45–0.86)	0.43 (0.28–0.64)
Other diseases ³	0.83 (0.74–0.93)	0.80 (0.69–0.93)
MEN		
Consumption of nitrates:		
0–99 ddd ⁴	1.00	1.00
100–349 ddd	1.43 (1.34–1.52)	1.37 (1.27–1.47)
350 or more ddd	1.83 (1.66–2.02)	2.35 (2.08–2.66)
WOMEN		
Consumption of nitrates:		
0–99 ddd ⁴	1.00	1.00
100–349 ddd	1.63 (1.48–1.78)	1.33 (1.18–1.51)
350 or more ddd	2.22 (1.94–2.55)	2.09 (1.73–2.51)

1 Not presented in the original article.

2 Entitlement to special reimbursement of medicine costs at the start of the follow-up.

3 Includes 36 chronic diseases such as thyroid insufficiency, multiple sclerosis, Parkinson's disease, epilepsy, malignant tumours, sarcoidosis, rheumatoid arthritis, ulcerative colitis, Crohn's disease and gouty arthritis.

4 Consumption of nitrates in defined daily doses in the calendar year the follow-up started.

5.4 Are there socioeconomic differences in myocardial infarction event rates and fatality among patients with angina pectoris?

Altogether, 15,113 men and 13,238 women aged 40–79 received the right to special reimbursement for medication due to CHD in the period 01.01.1995 to 01.10.1998, and had no earlier records of CHD (AP patients). There were 21,827 male and 11,172 female patients with MI as first sign of CHD. On average, AP patients were slightly younger than MI patients, and more often belonged to higher income groups. The prevalence of each of the co-morbid conditions studied was lower among AP patients, and they used nitrates slightly more often than MI patients during the year they entered the follow-up (Table 1, Study IV).

CHD mortality during the two-year follow-up was 5% among AP men and 2% among AP women, the two-year mortality rate was 8% for both MI men and women (Table 2, Study IV). Compared to MI patients, CHD accounted for a smaller part of all cause mortality among AP patients during the two-year follow-up period. A clear socioeconomic pattern was found among both AP men and women for the follow-up period, and controlling for co-morbidity and disease severity (nitrate use) did not change the pattern although it decreased the differences (Table 3, Study IV). The socioeconomic patterning of CHD mortality was also similar to that of the MI patient group for both men and women. The socioeconomic pattern was similar also in all cause mortality in both patient groups, for both genders.

The incidence of MI during the first year of follow-up was 4% among AP men and 2% among AP women. Among men, MI incidence showed a socioeconomic pattern: the higher the income group the smaller the MI incidence (Table 4, Study IV). In Cox's regression analysis a clear socioeconomic pattern was observed among men: compared to the highest income group the hazard ratios for MI were 1.27 (1.03–1.56) for the middle income group and 1.58 (1.27–1.96) for the lowest income group. Controlling for co-morbidity and disease severity did not change the results. No socioeconomic differences were found in MI incidence among women with AP.

In AP patients, case fatality was defined according to 28-day mortality after their first MI (during the one-year follow-up), which on average occurred 5.5 months after the follow-up began. In the group of MI patients, case fatality was assessed on the basis of a 28-day follow-up after their first MI, that is, the MI on which their case definition was based. Among AP men, the 28-day case fatality of MI was 57%, and among women 45%. Case fatality of first MI was clearly higher among AP patients compared to those whose disease started as MI (Table 4, Study IV). Among AP men the variation in 28-day case fatality showed no clear socioeconomic patterning, whereas a clear socioeconomic pattern was found among MI men. The difference between patient groups was also statistically significant ($p < 0.05$). Among AP women the highest income group seemed to show lower case fatality than the lower income groups and the patterning was similar to that of MI women. Controlling for co-morbidity did not change the results (Table 5, Study IV).

6 Discussion

In this chapter the results and study design are considered from several points of view. In addition, the findings are mirrored in the present day, since the research was carried out in 1990s and early 2000s, with data from 1980s and 1990s, and, significant changes have occurred in health care and treatment practices since then.

6.1 Data, registers and variables

The unique personal identification number assigned to all persons residing in Finland was used for data linkage in all our original studies, which includes individually linked data on coronary procedures, mortality, co-morbidity, and nitrate use, as well as socioeconomic factors. This protocol enables us to avoid ecological bias.

Three indicators of socioeconomic status were able to be used in each study, although in Study IV the results were reported only for income groups. The social class of employed persons was obtained from the most recent census, and of retired persons from their most recent pre-retirement occupation. Married women were classified using their own occupation or, if not employed, according to their husband's occupation. Disposable income was adjusted for family size using the OECD equivalence scale to obtain more realistic values of this indicator. All these indicators were individually linked from register sources and can therefore be considered reliable.

These indicators also have causal relationships with one another: for example education contributes to occupational class position and through this to income (Lahelma et al. 2004). People with higher education have skills and knowledge to adopt a healthier lifestyle and seek medical advice and services effortlessly when needed. They usually end up in an occupation with a higher socioeconomic position and better income than people from lower educational groups. Compared to these other two indicators, educational level is very stable over an adult lifespan: for example, educational level among adults who have completed their schooling is not affected by the occurrence of serious illness, which can force individuals to work at jobs below the level of their normal occupations or otherwise cause their income to decline (Krieger et al. 1997).

All these classical socioeconomic indicators produced parallel results. Although, the pattern was similar between the indicators, the gradient of the socioeconomic differences varied. The greatest difference was seen repeatedly between income groups.

Regardless of the focus of the research in question, I recommend using all three socioeconomic indicators if it is feasible, since they cover slightly different aspects of positions in the social hierarchy.

The validity and coverage of Finnish administrative registers are good, for example, the coverage of the Causes of Death Register is considered to be almost perfect (Keskimäki et al. 1997; Mähönen et al. 1999). The accuracy of the Finnish Health Care Register is generally good, and approximately 95% of hospital discharges and 90–95% of surgical procedures were recorded in the register (Salmela and Koistinen 1987; Aro et al. 1990; Keskimäki and Aro 1991; Sund 2012). Additionally, there are several studies where the FHDR data on CHD diagnoses have been validated. Mähönen et al. reported that register data gives, on average, a correct picture of changes in the occurrence of acute MI and CHD in Finland and it can be used in health service research (Mähönen et al. 1997; Mähönen et al. 2000; Pajunen et al. 2005) In another study it was shown that the comparability between hospital discharge diagnosis and MONICA/ FINMONICA classifications was good. (Palomäki et al. 1994) Rapola et al. concluded that diagnoses of acute MI and death from CHD in the registers were highly predictive of a true major coronary event, as defined by strict criteria (Rapola et al. 1997). The latest study by Pajunen et al. concluded that diagnoses of fatal and non-fatal CHD events in the FHDR and the Causes of Death register were reasonably valid indicators for hard CHD events when compared with the FINMONICA/FINAMI register data. (Pajunen et al. 2005)

Administrative registers in Finland provide good opportunities for register-based health service research, although one has to bear in mind that these registers were not originally designed for research and the formulation of research questions is limited by the data available. Information from eight different administrative registers maintained by four separate institutions was used in the current studies, which were part of the research project ‘Social Equity in the Use of Hospital Care and the Outcomes of Health Services in the 1990s’ carried out in the National Institute for Health and Welfare. Much practical knowledge accumulated about the processes of applying for, and collecting data, defining variables, compilation of actual research data sets, data mining and cleaning the data. In a discussion paper on register-based health service research in Finland, Kajantie et al. have described similar processes in detail using their own research project as an example (Kajantie et al. 2006).

6.2 Socioeconomic differences

According to our research, patients with higher socioeconomic status underwent cardiac procedures related to need more often, and their mortality was lower than that of patients with lower socioeconomic status. The pattern was similar for all socioeconomic indicators used, and among all CHD patient groups, such as AP and first MI patients. These results accord with earlier findings in Finland (Keskimäki et al. 1995; Keskimäki et al. 1996; Luoto et al. 1997; Keskimäki 2003) and elsewhere. (Ben-Shlomo and Chaturvedi 1995; Manson-Siddle and Robinson 1998; Alter et al. 1999; Carlisle et al. 1999; MacLeod et al. 1999; Ancona et al. 2000; Philbin et al. 2000; Mackenbach et al. 2003; Ministry of Social Affairs and Health 2008)

In Study I two proxies were used for the relative need of procedures, mortality from, and risk of hospitalisation due to, CHD. In Study II the study groups were as homogenous as possible with regard to the severity of CHD and thereby the need for invasive coronary procedures. Salomaa et al. reported from the FINMONICA study that they found no evidence of larger infarcts in low income groups among patients with their first MI (Salomaa et al. 2000; Salomaa et al. 2001). It is therefore unlikely that systematic socioeconomic differences in the severity of the infarction would explain the differences found in Study II.

In Studies III and IV we had two exclusive patient groups with a divergent onset of disease: patients with hospitalisations due to their first MI and those with non-acute onset of AP. Socioeconomic differences in the utilisation of cardiac procedures were similar in both AP and MI groups and by all socioeconomic indicators: social class, education and income. These results from Study III were similar to those reported earlier among MI patients in Finland (Salomaa et al. 2001) and elsewhere (Manson-Siddle and Robinson 1998; Alter et al. 1999; Ancona et al. 2000). Socioeconomic differences in mortality favoured those with higher socioeconomic status in both patient groups: the lower the socioeconomic position, the higher the mortality. These results were in line with earlier results among MI patients in Finland (Salomaa et al. 2000; Salomaa et al. 2001) and elsewhere. (Greenwood et al. 1995; Alter et al. 1999; Ancona et al. 2000; Capewell et al. 2000; Peltonen et al. 2000) Similar socioeconomic differences were also found in MI incidence during the one-year follow-up among AP patients. For the most part socioeconomic disparities in CHD outcomes were similar in all CHD patients whether their first recorded sign of CHD was MI or angina.

Although socioeconomic differences in the use of cardiac procedures were similar in both patient groups, AP and MI patients, and there is also evidence of socioeconomic discrepancies in other procedures (Manderbacka et al. 2009), one cannot generalise these results to apply to other medical treatments or rehabilitation due to lack of research on equity in receiving these treatments.

6.3 Differences between genders and according to socioeconomic status in men and women

The general finding of gender differences was that women underwent fewer cardiac operations than men, and woman's mortality was lower than that of men (Studies I and IV). Socioeconomic differences seemed to be steeper in men compared to women for operation rates, mortality (exception being 2-year mortality for AP women) and MI incidence rate.

In Study I a clear gender difference was found in revascularisation and angiography rates with women undergoing fewer operations compared to men in Finland. Similar results for angiographies and revascularisations have been reported, for instance in the United Kingdom (Petticrew et al. 1993), Canada (Jaglal et al. 1994), and the United States (Ayanian and Epstein 1991; Steingart et al. 1991; Bergelson and Tommaso 1995; MacLeod et al. 1999; Raine et al. 1999). Findings are not completely consistent, since some studies report no gender differences in coronary procedures (Hannan et al. 1999; MacLeod et al. 1999). Additionally, several studies reported no gender disparity in undergoing revascularisations (Leape et al. 1999; Raine et al. 1999) or bypass operations among patients who had undergone angiography (Steingart et al. 1991; Bergelson and Tommaso 1995; Hannan et al. 1999).

Due to gender differences in the symptoms, natural history, and prognosis of CHD, (Wenger et al. 1993) and difficulties in diagnosing CHD in women (Kwok et al. 1999; Lewis et al. 2005), disparities between men and women in the use of coronary operations are difficult to assess, but in our study a tendency of smaller gender differences in rates in hospital districts with a high overall supply of coronary procedures suggests that gender inequities favouring male patients persisted in access to coronary operations in the mid-1990s.

6.4 Angiographies and revascularisations

In Study I angiographies were analysed separately from revascularisations, in Studies II and III those were analysed together as invasive cardiac procedures. Results for Study I suggest that the socioeconomic differences in the use of coronary revascularisations may have been largely determined by uneven access to angiographies in 1996. The distributions of coronary revascularisations and angiographies were parallel according to all indicators of socioeconomic status and in both genders. The socioeconomic patterns of Kakwani's inequity indices for revascularisations and angiographies were also similar. These results correspond to findings in other countries of no or only small differences between genders, income or ethnic groups in revascularisation rates among patients who have undergone angiography. (Ay-

anian and Epstein 1991; Steingart et al. 1991; Alter et al. 1999; Hannan et al. 1999; Leape et al. 1999; Raine et al. 1999) Consequently, an evaluation of equity in access to invasive cardiac treatments is likely to be biased if based solely on hospital data and ignoring the population at risk and its morbidity. Alter et al. drew a similar conclusion from examining access to invasive cardiac procedures after acute MI, and reported that access to angiography was the rate-limiting step in access to revascularisation. (Alter et al. 1999)

6.5 Regional variation

As the socioeconomic distribution of the population varies according to geographic region, another potential explanation for the socioeconomic differences is variation in procedure rates between hospital districts. The effect of these regional variations on socioeconomic differences in procedure rates were studied in a model controlling for age and hospital district. Adjustment for hospital district did not reduce socioeconomic differences in invasive cardiac procedures in our Studies II and III. In Study I a multilevel Poisson regression model was used to analyse the effect of operation rates in hospital districts to socioeconomic and gender differences: in 1988, there was a clear association between the hospital district rates of coronary revascularisations and the rate ratios for genders and socioeconomic groups among men. For women, the correlation coefficients in 1988 were only significantly different from zero for the correlation between regional operation rates and rate ratios for educational categories. By 1996, the association between the regional supply of coronary operations and trends in operation rates had weakened and only the rate ratios for gender differences and men's social class differences displayed a statistically significant correlation with overall hospital district rates.

In 2010 in the Eastern and Northern parts of Finland, the rates of coronary revascularisations were higher than in other parts of the country, which was according to Mustonen et al. due to differences in the population's age distribution and morbidity (Mustonen et al. 2012).

6.6 Waiting time

Alter et al. have suggested that socioeconomic differences could be due to higher status groups undergoing invasive procedures more promptly than lower groups; they reported from Canada that MI patients from higher-income neighbourhoods had shorter waiting times for angiography than patients in lower-income neighbourhoods (Alter et al. 1999). A study on the treatment of CHD in Northern Ireland suggests shorter waiting times for economically active patients and those from more affluent areas (Gaffney and Kee 1995). However, in our studies socioeconomic

ic disparities already existed in the post-MI acute phase and these persisted during the two-year follow-up period, results for the AP patients corroborate this: the differences in coronary procedure rates already existed in the first month after reimbursement entitlement was received. Relative socioeconomic differences were similar among AP and MI patients throughout the follow-up time. In our study the disparities were constant in all four time periods, 0 to 28, 29 to 182, 183 to 730, and 0 to 730 days.

Since this study, treatment practices have changed substantially, revascularisations are performed more often during the first hospital admission, and in fact, it is the large increase in the rate of coronary angioplasties that has made the difference. (Vehko et al. 2011)

6.7 Co-morbidity

It is plausible to assume that comorbidities influence treatment decisions for CHD patients, such as the use of cardiac procedures. Entitlement to reimbursement of medicine costs due to chronic diseases was used as a proxy for co-morbidity in Studies II, III and IV. In these studies the number of co-morbidities varied from none to 10. Generally, women have more co-morbidities, which is logical because they were approximately 5 years older than the men in the study.

MI patients with hypertension had slightly more procedures than MI patients without hypertension, otherwise patients entitled to reimbursement due to coronary insufficiency, diabetes mellitus, chronic asthma and similar chronic obstructive pulmonary diseases, mental disorders or other chronic diseases, underwent slightly fewer cardiac procedures than patients without these co-morbidities.

Overall, however, co-morbidities did not explain socioeconomic differences in invasive cardiac procedures among either MI or AP patients.

In Study IV, diabetes and, among men, hypertension, had an effect on MI incidence. Moreover, diabetes, as well as heart failure and hypertension, and in some cases arrhythmia, also had an individual effect on mortality in various patient groups. Nevertheless, co-morbidities failed to explain socioeconomic differences in CHD outcomes. Similar findings have been reported earlier concerning diabetes and cerebrovascular disease (Capewell et al. 2000).

6.8 Disease severity

Illness severity could not be taken into account in our analysis in Studies I and II because of the lack of relevant data. Salomaa et al. reported from the FINMONICA study that they found no evidence of larger infarcts in low-income groups among patients with their first MI (Salomaa et al. 2001). It is therefore unlikely that sys-

tematic socioeconomic differences in the severity of the infarction would explain the differences found in Study II.

In Studies III and IV the effect of disease severity were analysed using data on nitrate consumption as a proxy. Although nitrate consumption had a strong independent effect on invasive cardiac procedures, MI incidence and CHD mortality, the adjustment for nitrate use did not explain the socioeconomic differences.

6.9 Supply of revascularisations

According to our studies the increased supply of coronary procedures has resulted in a more equitable distribution of operations; in general, older patients, women and those with low socioeconomic status benefited more than other groups.

Our results correspond to the findings of Salomaa et al. reported from Finland, that disparities between income tertiles decreased somewhat in patients under 65 years of age when the number of revascularisations within one year after first MI increased from 1988–92 to 1995 (Salomaa et al. 2001). Our results are also in line with those reported from Canada, where MI patients living in higher-income neighbourhoods were found to be significantly more likely to undergo catheterisation than patients living in lower-income neighbourhoods (Alter et al. 1999). Manson-Siddle and Robinson reported from England that services were socioeconomically equitable in a district with the highest revascularisation rate (Manson-Siddle and Robinson 1998). In another study these researchers reported that additional resources for tertiary cardiology may have reduced socioeconomic inequities in angiography utilisation, although improved equity in revascularisations was not apparent (Manson-Siddle and Robinson 1999). Black et al. also reported that when the supply of revascularisations increased in the United Kingdom, the gender disparity decreased (Black et al. 1994).

Although the supply of cardiac procedures increased rapidly in the 1990s in Finland, socioeconomic disparities persisted. These persisting inequities may, of course, be due to remaining inadequacies in health care resources for invasive cardiac procedures in Finland. Some international comparisons support this view; for instance, revascularisation rates after MI in the late 1990s were still much lower in Finland than in North America or Australia. Although the rate of bypass operations carried out in MI patients in Finland was higher than the rates in many European countries, it was lower than in the USA, and the rate of coronary angioplasties were much less frequent. (Technological Change in Health Care (TECH) Research Network, 2001) When comparing revascularisation rates to CHD mortality in western European countries in the mid-1990s, CHD mortality in Finland was the second highest, but the revascularisation rate was at the average level (Unger 1998; World Health Organisation 1998).

If inadequate supply of cardiac procedures is the explanation for inequities in treatment, a further increase in resources should equalize access to and use of coronary procedures in socioeconomic groups. Nevertheless, it is obvious that many medical examinations and treatments requiring substantial financial or other resources will always be available to fewer patients than would benefit from them. More attention should therefore be paid to allocating scarce health care resources equitably, according to need instead of the social status of the patient.

When estimating the need for revascularisations in Finland in 2000, a Finnish expert group considered that need will more than double in the near future for angioplasties, while the supply of coronary bypass operations was considered sufficient (Tierala et al. 2001). They estimated that approximately 22,000 angiographic examinations and 10,000 coronary angioplasties are needed annually. The use of these procedures was too limited earlier, but in 2005 a total of 22,913 angiographic examinations and 8,597 coronary angioplasties were performed in Finland. The present perception is that a considerable portion of acute cases should also be examined by angiography and treated by angioplasty, if required. The estimated need for by-pass operations was about 5,000, and, indeed, about 4,300 bypass operations were performed annually in the late 1990s, but since then the number of bypass operations has decreased, being 3,943 in 2003. A group of experts pointed out that special attention should be paid to ensuring that all citizens will have as equal, as possible, access to treatment. (Tierala et al. 2001) In the latest evaluation by the Finnish Cardiac Society in 2010 there were 23,915 coronary angiographies, 8,968 PCIs and 2,110 CABGs, the number of coronary angiographies and PCIs has been stable since 2007, but the number of CABGs has been diminishing. In 2010 there were 4.3 times more PCIs than CABGs. Mustonen et al. noted that the rate of revascularisations is satisfactory and comparable to that of other European countries and there is no need to add invasive operations in the near future (Mustonen et al. 2012).

Socioeconomic inequities in operative treatment can indeed be eradicated by an increase in the overall supply of services. In a study of the socioeconomic distribution of elective surgery from 1992 to 2003 in Finland, Manderbacka et al. discovered a declining trend in inequality for coronary revascularisations (Manderbacka et al. 2009).

6.10 Health care system

The law lays down the basic nature and operating framework for the health care services, it prescribes the main primary health care and specialised medical services which all local authorities must provide. Public health care is supplemented by private health care, especially in the larger municipalities. The national system of health insurance reimburses the client for some of the charges for private health care.

There may be differences in health service provision from one municipality to another, since there are no detailed questions about the scope, content or organisation of services in the legislation.

Health services are mainly funded by municipalities from tax revenue: 35% of health care was funded from local tax revenue, 25% from central government grants financed by national taxes and 15% from health insurance revenue, the proportion of service users was 19% and 6% was funded by private sector, such as insurance companies, in 2010 (National Institute of Health and Welfare 2012).

In Finland in 2012 a household's estimated out-of-pocket payment was 18.6 % of total expenditure on health according to OECD Health data 2013 (OECD 2013). According to results from Xu et al. the proportion of households with catastrophic health expenditure was 0.44% in Finland in 1998 (Xu et al. 2003). A health centre may charge a single or annual payment for doctor's appointments. Nowadays, a single payment is EUR 14.70, which can be charged for a maximum of three appointments, and an annual payment is a maximum of EUR 29.30 per calendar year. From 2013 the city of Helsinki has not charged its own citizens for the aforementioned appointments. A maximum fee of EUR 23.90 can be charged for a visit to the health centre emergency clinic. Hospitals may charge for a visit to an outpatient department, an outpatient surgery procedure, a daily hospital fee, and for a series of treatment and rehabilitation. A hospital outpatient department fee is set at a maximum of EUR 29.30 per visit, while the fee for an outpatient surgery procedure is a maximum of EUR 96.40. The daily charge is EUR 34.80 in a hospital, covering examinations, treatment, medicine and meals. A maximum fee of EUR 43.60 can be charged for a medical certificate depending on the type of certificate. The fees were on a comparable level in the 1990s. (Ministry of Social Affairs and Health 2013)

A potential explanation for socioeconomic disparities in coronary revascularisation rates could be that the operations are performed in private hospitals or on patients treated in the special payment category (pay-beds) in public hospitals (Keskimäki et al. 1996). As part of collective labour agreement the latter system terminated in 2008. In 2003 in Finland, 13% of angiographies, 14% of angioplasties and 13% of by-pass operations were performed in private hospitals, Cordia and Mehiläinen. Their volume has increased since the late 1990s, for example, in 1999 the proportions were 9%, 4% and 8% respectively. (Finnish Heart Association) According to statistics on health insurance claims from the SII, annual applications by pay-bed patients for refunding included only about 30 to 60 bypass operations in the mid-1990s. According to the latest figures by the Finnish Cardiac Society, of invasive cardiac procedures only 4% of angiographies, 4 % of PCIs and 6% of cardiac surgery were performed in private hospitals in 2010; compared to the 1990s the invasive care of cardiovascular patients is nowadays more predominantly performed in public sector. (Mustonen et al. 2012)

In Study I the age-adjusted rates were calculated for revascularisations and angiographies performed in public hospitals, the socioeconomic patterns that

emerged were similar to those observed for all procedures in both study years. The operations performed in the private sector explained only a minor part of the socioeconomic differences observed in 1988 and 1996. For example, of the revascularisations performed on upper-white-collar employees in 1996, 14% were carried out in the private sector, while the figure was 8% for blue-collar workers aged 40 years and older. However, in some specific groups, such as elderly patients, private and pay-bed operations may have had some impact on access to services. For instance, the overall number of revascularisations performed in the private sector was 11%, but among those aged 70 years or more the proportion was almost double, at 19%. The corresponding socioeconomic disparities in operation rates were greatest in these old age groups.

Finland's partially two-tier system of ambulatory physician services may cause socioeconomic disparities in referrals to invasive CHD treatments. The mandatory health insurance reimburses only part of the costs of private services; with the result that the use of private practitioners – about 20% of all outpatient visits to doctors – is clearly concentrated among well-off patients. (Arimen 1998; Manson-Siddle and Robinson 1999)

As physicians working in private practice are often specialists, they may be more prone to recommend further investigations for their patients than are doctors in public health care, suggesting that private services may influence the distribution of invasive coronary procedures. The socioeconomic distribution of private sector patients did not change between the late 1980s and mid-1990s. (Arimen 1998)

6.11 Patient doctor relationship and patient characteristics

The focus in these studies was not the patient doctor relationship, but patient characteristics, such as socioeconomic or employment status, which may also affect treatment decisions. In Northern Ireland, results from a survey among general practitioners concerning the management of patients with stable angina suggest that general practitioners tend to refer economically active patients to revascularisation assessment and to give them higher waiting list priority (Kee et al. 1994). Similar results have been reported from Ontario, Canada (Naylor et al. 1992). Consistent with these findings, a study of the treatment of CHD in Northern Ireland suggests shorter waiting times for economically active patients and those from more affluent areas (Gaffney and Kee 1995). Patients from higher socioeconomic groups can also negotiate their treatments more effectively than those of lower socioeconomic status (Council on Ethical and Judicial Affairs 1990). Research on this topic in Finland is lacking, but some findings from the United States suggest that patient preferences may somewhat explain differences in invasive coronary treatments (Maynard et al. 1986). However, study findings are not altogether consistent (Chaturvedi et al. 1997; Hannan et al. 1999).

Other possible explanations for the disparities in procedure rates are differences between socioeconomic groups in seeking care and undergoing medical attention, especially, physician referral decisions that are socially biased. In Study II, almost 60% of those who reached the hospital alive after their first MI were already entitled to reimbursement of medicine costs due to a cardiovascular condition before the event, so they were already under medical supervision due to medication. Furthermore socioeconomic differences in the reimbursement entitlements for CHD and related conditions were small. Hospitalisation rates due to CHD after the patients' index hospitalisation for MI did not differ significantly between socioeconomic groups. The socioeconomic disparities in procedure rates could not be explained by socioeconomic differences in seeking care or undergoing medical attention.

Qualitative research in Finland by Manderbacka revealed three relevant features commonly distinguishing doctor–patient interaction: treatment decision-making, information exchange and interpersonal relationships. The doctor-centred model was more common among blue-collar workers in her study, and the shared decision-making model among those using private care. The study also found that women and people from lower socioeconomic groups were more likely to have difficulties in gaining access to services and to lack a permanent contact in primary care. Family members were mentioned only in some interviews, mainly as being involved in making the decision to seek care, and on no more than two occasions out of 30, as being directly involved in treatment decisions after the first contact. (Manderbacka 2005)

At least part of the socioeconomic disparity in CHD outcomes found in the current study is likely to be explained by socioeconomic differences in risk factor levels favouring the better off, repeatedly reported among the general population in Finland in terms of smoking, serum cholesterol and body mass index (Salomaa et al. 2003). Results from a recent survey suggest that similar risk factor differences also exist among coronary patients in Finland (Keskimäki et al. 2004). Data about these risk factors was not available in the current study, and so those differences could not be controlled for.

Studies have also reported socioeconomic differences in other aspects of the treatment of CHD patients, both in Finland and elsewhere. Patients from higher socioeconomic groups reportedly receive more effective treatment after MI, including thrombolytic treatment (Salomaa et al. 2001), revascularisation operations (Alter et al. 1999; Salomaa et al. 2001; Hetemaa et al. 2004), and prescribed beta-blockers, antithrombotic drugs and cholesterol lowering drugs at discharge from hospital (Salomaa et al. 2001). Similar findings have been reported among CHD patients in general (Ancona et al. 2000; Hetemaa et al. 2003). Together with earlier research, our results suggest that in order to reduce socioeconomic differences in CHD outcomes, targeted measures such as improving the effectiveness of disease management practices for the treatment and secondary prevention of CHD are needed to even up disparities in access to, and quality of, care between patients of different socioeconomic standing.

7 Conclusions

An increase in supply of invasive operations diminished the socioeconomic differences in their use. Although revascularisations in Finland increased 2.5 times overall, some socioeconomic and gender inequities persisted in the use of cardiac operations relative to need in the mid-1990s. To improve equity, a further increase in resources may be needed, and practices taking socioeconomic and gender equity into account should be developed for the referral of CHD patients to hospital investigations.

Socioeconomic disparities were observed in the receipt of invasive cardiac procedures after first events among hospitalised MI patients. The socioeconomic differences in procedure rates already existed in the 28 days after infarction and were generally constant during the two year follow up.

Socioeconomic disparities in undergoing invasive coronary procedures among AP patients without MI were similar to those in MI patients. Controlling for regional variation (hospital district), co-morbidity and disease severity (nitrate use) did not change the pattern, although it decreased the differences.

Socioeconomic differences in CHD outcomes also exist among angina patients. These results suggest that targeted measures of secondary prevention are needed among CHD patients with lower socioeconomic status so as to reduce socioeconomic disparities in fatal and non-fatal coronary events.

The results imply that those of higher socioeconomic status benefit first from new health interventions and treatments, especially if the supply of technology or resources is scarce. The lower use of these high technology interventions or treatments is associated with lower socioeconomic status, resulting in inequity. These discrepancies seem to disappear or diminish over time as rates of procedures or treatments increase.

8 Suggestions for future research and practical implications

The studies in this thesis are part of the research tradition maintained in the National Institute for Health and Welfare. The current studies were carried out in the 1990s and early 2000s, with data from the 1980s and 1990s, and significant changes have been implemented in health care and treatment practices since then. In a research project ‘Regional Disparities, Social Segregation and Socioeconomic Patterning: Where Do Inequities in Access to Health Care Arise?’, covering data from the early 1990s to 2003, socioeconomic and spatial differences in health care use and health service organisation were analysed by the National Institute for Health and Welfare. One of the four broad topics was the impact of the organisation of health services on regional and socioeconomic inequities in access to specialised hospital care. One out of the seven surgical procedures selected for case study was coronary revascularisations. Although instant revascularisation by angioplasty may save a patient’s life in certain cases, and, in any case, the duration of hospital care can be shortened and the need of new hospital treatments reduced, there are still areas in Finland where cardiologists are not on call.

Further research is needed to evaluate the socioeconomic, gender and spatial differences in CHD treatments and mortality in Finland, since the rates of the revascularisations have multiplied, the prevalence of CHD has increased in the older age-groups, especially among women, and the secondary prevention has improved. Such trends can be evaluated.

Research focussing on socioeconomic differences in health and the use of health services is needed, especially due to coming changes in Finnish health care system. Disparities in operational treatments have been evaluated repetitively, the use of other health services are also worthy of research.

It is vital that, regardless of the way that the service system is organized and funded, and even with insufficient resources, all patients should have access to health care and have treatments according to their need, not according to the social category to which they belong or their gender. Attention should be paid to the equitable distribution of scarce health care resources

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Helsinki 18.9.2014

A handwritten signature in black ink, appearing to read "Kirsi Helmaa". The signature is fluid and cursive, with a large initial 'K' and a long, sweeping underline.

APPENDIX TABLES

TABLE 1. Selection of studies on socioeconomic differences in cardiac treatments.

Period	N Agegroup	Indicator of socioeconomic position	Study population	End point	Result
Britton,A.; Shipley,M.; Marmot,M.; Hemingway,H. 2004, Does access to cardiac investigation and treatment contribute to social and ethnic differences in coronary heart disease? Whitehall II prospective cohort study, BMJ, 2004, 329, 7461, 318, England					
1985–2000	10,308 aged 35–55 years	occupation, civil service employment grade	Whitehall II England London	exercise ECG angiography and revascularisation secondary prevention drugs	Inverse social gradients existed in incident coronary morbidity and mortality. South Asian participants also had higher rates than white participants. After adjustment for clinical need, social position showed no association with the use of cardiac procedures or secondary prevention drugs.
Callier, J.G., Brown, S.C., Parsons, S., Ardoin, P.J. & Cruise, P. 2004, “The effect of race and gender on invasive treatment for cardiovascular disease”, Journal of cultural diversity, vol. 11, no. 3, pp. 80-87.					
Between July 1998 and July 2000	3,015 every age-group	race gender	CHD USA Louisiana	invasive procedures	African Americans were less likely than Caucasians to receive a CABG. No statistical significance for gender disparities.
Coory, M., Scott, I.A. & Baade, P. 2002, “Differential effect of socioeconomic status on rates of invasive coronary procedures across the public and private sectors in Queensland, Australia”, Journal of epidemiology and community health, vol. 56, no. 3, pp. 233-234.					
1998	3,531 aged 30–89 years	education and skilled employment in neighborhood	AMI Australia Queensland	invasive procedures	Residents of high SES areas were more likely to undergo angiography and angioplasty than residents of low SES areas. Rates of bypass surgery were similar across the SES groups.
Hetemaa, T., Keskimaki, I., Manderbacka, K., Leyland, A.H. & Koskinen, S. 2003, “How did the recent increase in the supply of coronary operations in Finland affect socioeconomic and gender equity in their use?”, Journal of epidemiology and community health, vol. 57, no. 3, pp. 178-185.					
1988 and 1996	Finnish population 2.1–2.4 milj. aged ≥40 years	social class, education and income	CHD Finland	invasive procedures	Although revascularisations in Finland increased 2.5-fold overall, some socioeconomic and gender inequities persisted in the use of cardiac operations relative to need.
Hetemaa, T., Keskimaki, I., Salomaa, V., Mahonen, M., Manderbacka, K. & Koskinen, S. 2004, “Socioeconomic inequities in invasive cardiac procedures after first myocardial infarction in Finland in 1995”, Journal of clinical epidemiology, vol. 57, no. 3, pp. 301-308.					
1995	5,172 aged 40–74 years	social class, education and income	first AMI Finland	invasive procedures	Men in the lowest income third underwent 25 % fewer procedures than men in the highest third. Among women, the corresponding difference was 43 %.
Hetemaa, T., Manderbacka, K., Reunanen, A., Koskinen, S. & Keskimaki, I. 2006, “Socioeconomic inequities in invasive cardiac procedures among patients with incident angina pectoris or myocardial infarction”, Scandinavian journal of public health, vol. 34, no. 2, pp. 116-123.					
1995–98	49,846 aged 45–79 years	social class, education and income	first MI and AP Finland	invasive procedures	Socioeconomic disparities in receiving invasive coronary procedures among AP patients without MI were similar to those in MI patients.

Table 1.

Korda, R.J., Clements, M.S. & Kelman, C.W. 2009, "Universal health care no guarantee of equity: comparison of socioeconomic inequalities in the receipt of coronary procedures in patients with acute myocardial infarction and angina", <i>BMC public health</i> , vol. 9, pp. 460.					
2001–03	AMI 5,539 AP 7,401 aged ≥35 years	area-based measure, the SEIFA Index of Disadvantage	AMI and AP Australia	invasive proce- dures	In the AMI patient cohort, socioeconomic gradients were not evident except that disadvantaged women were more likely than advantaged women to undergo CABG. In the AP patient group there were clear socioeconomic gradients for all procedures, favouring more advantaged patients. Compared with patients in the most disadvantaged quintile of socioeconomic status, patients in the least disadvantaged quintile were 11 % (1–21 %) more likely to receive angiography, 52 % (29–80%) more likely to undergo angioplasty and 30 % (3–55 %) more likely to undergo CABG.
Manson-Siddle, C.J. & Robinson, M.B. 1998, "Super Profile analysis of socioeconomic variations in coronary investigation and revascularisation rates", <i>Journal of epidemiology and community health</i> , vol. 52, no. 8, pp. 507-512.					
Between April 1992 and March 1994	population of 360,000 aged ≥25 years	Super Profile classification (combine 120 census vari- ables that indi- cate depriv- ation)	England Yorkshire Region	investigation and revascularisation rates	Wide socioeconomic variations in coronary investigation and revascularisation In some districts, with higher heart disease mortality but much lower procedure rates, there is a decreasing trend from the affluent to the deprived suggesting considerable inequity.
Manson-Siddle, C.J. & Robinson, M.B. 1999, "Does increased investment in coronary angiography and revascularisation reduce socioeconomic inequalities in utilisation?", <i>Journal of epidemiology and community health</i> , vol. 53, no. 9, pp. 572-577.					
1992– 1996	aged ≥25 years	Super Profile Lifestyle groups	IHD+ invasive procedure England Yorkshire Region	invasive procedures	After additional resource input began, the trend for angiographies across socioeconomic groups clearly became more equitable, although increased equity for revascularisations is less apparent.
Philbin, E.F., McCullough, P.A., DiSalvo, T.G., Dec, G.W., Jenkins, P.L. & Weaver, W.D. 2000, "Socioeconomic status is an important determinant of the use of invasive procedures after acute myocardial infarction in New York State", <i>Circulation</i> , vol. 102, no. 19 Suppl 3, pp. III107-15.					
1995	28,698	income, household income postal ZIP codes and census data	AMI USA New York State	invasive procedures	After adjustment, patients in the highest quintile of income compared to patients in the lowest quintile were 22% more likely to undergo catheterization, 74% more likely to undergo PTCA. 48% more likely to undergo CABG, 76% more likely to undergo any revascularization procedure.

Table 1.

Rasmussen, J.N., Rasmussen, S., Gislason, G.H., Abildstrom, S.Z., Schramm, T.K., Torp-Pedersen, C., Kober, L., Diderichsen, F., Osler, M. & Madsen, M. 2007, "Persistent socio-economic differences in revascularization after acute myocardial infarction despite a universal health care system-a Danish study", *Cardiovascular drugs and therapy / sponsored by the International Society of Cardiovascular Pharmacotherapy*, vol. 21, no. 6, pp. 449-457.

1996–2004	38,803 aged 30–74 years	income and education	first AMI Denmark	CABG acute PCI (within 2 days of admission) non-acute PCI (after the third day) time to revascularization within 6 months	No educational gradient was found for CABG. Educational gradient for non-acute and acute PCI decreased during the period and by the end of the period, more patients with low than high education received acute PCI. Income differences in CABG and non-acute PCI persisted, whereas no such differences were seen for acute PCI.
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TABLE 2. Selection of studies on socioeconomic differences in CHD and all cause mortality.

Period	N Agegroup	Indicator of socioeconomic position	Study population	End point	Result
Alter, D.A., Chong, A., Austin, P.C., Mustard, C., Iron, K., Williams, J.I., Morgan, C.D., Tu, J.V., Irvine, J., Naylor, C.D. & SESAMI Study Group 2006, "Socioeconomic status and mortality after acute myocardial infarction", <i>Annals of Internal Medicine</i> , vol. 144, no. 2, pp. 82-93.					
December 1999 to February 2003	3407 aged <65 and ≥65 years	income and education, self-reported measures	AMI Canada Ontario	2-year mortality rates	Age, past cardiovascular events, and current vascular risk factors accounted for most of the income-mortality gradient after acute MI. High-income vs. low-income tertile, 0.77 (CI, 0.54 to 1.10); P = 0.150.
Barakat, K., Stevenson, S., Wilkinson, P., Suliman, A., Ranjadayalan, K. & Timmis, A.D. 2001, "Socioeconomic differentials in recurrent ischaemia and mortality after acute myocardial infarction", <i>Heart (British Cardiac Society)</i> , vol. 85, no. 4, pp. 390-394.					
January 1988 and December 1996	1417 aged 54–73 years	Carstairs socioeconomic deprivation score	AMI England London	30 day and one year survival	A strong association between early recurrent ischaemic events and socioeconomic deprivation that is not accounted for by clinical presentation or treatment. This association appears to be attenuated over time.
Bernheim, S.M., Spertus, J.A., Reid, K.J., Bradley, E.H., Desai, R.A., Peterson, E.D., Rathore, S.S., Normand, S.L., Jones, P.G., Rahimi, A. & Krumholz, H.M. 2007, "Socioeconomic disparities in outcomes after acute myocardial infarction", <i>American Heart Journal</i> , vol. 153, no. 2, pp. 313-319.					
January 1, 2003 to June 28, 2004	2,142 aged ≥18 years	income and education self-reported household income and education level	AMI USA the PREMIER Registry	1-year all-cause mortality and all-cause rehospitalization	Patients with low SES had worse clinical status at admission and received poorer quality of care. Patients' baseline clinical status largely explained the relationship between SES and mortality. Income disparities of rehospitalization existed after adjustment for all other factors: HR 1.39 (95% CI 1.01–1.90, lowest to highest income group).
Cesana, G., Ferrario, M., Gigante, S., Segna, R., Toso, C. & Achilli, F. 2001, "Socio-occupational differences in acute myocardial infarction case-fatality and coronary care in a northern Italian population", <i>International journal of epidemiology</i> , vol. 30 Suppl 1, pp. S53-8.					
1993–1994	1,077 35–64 year old male	occupation	MONICA Italy	28-day case-fatality	An increasing rate of case-fatality for decreasing levels of socio-occupational class was found. The social gradient resulted mainly from the higher incidence of out-of-hospital cardiac arrests.

Table 2.

Chaix, B., Rosvall, M. & Merlo, J. 2007, "Neighborhood socioeconomic deprivation and residential instability: effects on incidence of ischemic heart disease and survival after myocardial infarction", <i>Epidemiology</i> (Cambridge, Mass.), vol. 18, no. 1, pp. 104-111.					
1987–2002 CHD	27-year longitudinal cohort, 52,084 (baseline: 1 January 1996) reaching age 50 to 64 years in 1996	neighborhood socioeconomic position and residential stability	cohort Sweden Malmö, Helsingborg, and Lund	incidence, 1-day case-fatality, and long-term survival after acute myocardial infarction	The incidence of CHD increased with neighborhood socioeconomic deprivation but was only weakly associated with neighborhood residential instability. A markedly higher 1-day case-fatality (4.9; 1.8–15) and shorter survival time after MI among individuals still alive 28 days after MI (4.3; 1.2–17) in neighborhoods with a high versus low residential instability.
Gerber, Yariv, B., Yael, G., Uri, D. & Yaacov for the Israel Study Group on First Acute Myocardial Infarction 2010, "Neighborhood Socioeconomic Context and Long-Term Survival After Myocardial Infarction", <i>Circulation</i> , vol. 121, no. 3, pp. 375-383.					
1992–2005	1,179 ≤65 years of age discharged after incident MI in 1992 to 1993	education, income, and employment census-derived index for neighborhood	AMI Israel	all-cause and cardiac mortality	Neighborhood SES is strongly associated with long-term survival after MI. The association is partly, but not entirely, attributable to individual SES and clinical characteristics.
Greenwood, D., Packham, C., Muir, K. & Madeley, R. 1995, "How do economic status and social support influence survival after initial recovery from acute myocardial infarction?", <i>Social science & medicine</i> (1982), vol. 40, no. 5, pp. 639-647.					
November 1986 and February 1988	1,701	car-ownership social support	AMI England ASSET	death from all causes	Patients with no car were at approximately 40% higher risk of dying following AMI than car-owners (hazard ratio 1.4, P = 0.007, 95% CI 1.1–1.8). Lack of social contacts or being unmarried were not significantly associated with survival after adjusting for car-ownership and clinical variables.
Lynch, J., Krause, N., Kaplan, G.A., Tuomilehto, J. & Salonen, J.T. 1997, "Workplace conditions, socioeconomic status, and the risk of mortality and acute myocardial infarction: the Kuopio Ischemic Heart Disease Risk Factor Study", <i>American Journal of Public Health</i> , vol. 87, no. 4, pp. 617-622.					
March 1984 and December 1989 follow-up December 1994	2,297 42, 48, 54, or 60 years	income and work environment	AMI Finland Kuopio	all-cause mortality cardiovascular mortality incident acute myocardial infarction	The negative effects of workplace conditions on mortality and of myocardial infarction risk depended on income level and were largely mediated by known risk factors (64–75%).
Manderbacka, K., Hetemaa, T., Keskimäki, I., Luukkainen, P., Koskinen, S. & Reunanen, A. 2006, "Are there socioeconomic differences in myocardial infarction event rates and fatality among patients with angina pectoris?", <i>Journal of epidemiology and community health</i> , vol. 60, no. 5, pp. 442-447.					
1995–1998	61,350 40–79 year-old	income	incident AP or MI Finland	Two year coronary heart disease mortality	One year MI incidence and its 28 day case fatality. Socioeconomic differences in CHD outcomes also exist among angina patients.

Table 2.

Morrison, C., Woodward, M., Leslie, W. & Tunstall-Pedoe, H. 1997, "Effect of socioeconomic group on incidence of, management of, and survival after myocardial infarction and coronary death: analysis of community coronary event register", *BMJ (Clinical research ed.)*, vol. 314, no. 7080, pp. 541-546.

1985–1991	3,991 men and 1551 women aged 25–64 years	Carstairs and Morris deprivation score	MONICA Scotland Glasgow	Rate of coronary events proportion of subjects reaching hospital alive case fatality in admitted patients and in community overall	Socioeconomic group affects not only death rates from myocardial infarction but also event rates and chance of admission. Because social deprivation is associated with so many more deaths outside hospital, primary and secondary prevention are more likely than acute hospital care to reduce the socioeconomic variation in mortality.
Peltonen, M., Rosen, M., Lundberg, V. & Asplund, K. 2000, "Social patterning of myocardial infarction and stroke in Sweden: incidence and survival", <i>American Journal of Epidemiology</i> , vol. 151, no. 3, pp. 283-292.					
1985–1994	3,466 all first-ever AMI (ages 25-64 years) and 4,215 stroke (ages 25-74 years) events	occupation	MONICA Sweden	AMI and stroke incidence rates 28-day and 1-year case fatality	Incidence rates for both AMI and stroke showed a distinct social pattern, with high rates in workers and self-employed nonprofessionals and low rates in professionals. The pattern was similar in men and women. In men, early survival after an AMI follows the same socioeconomic pattern, whereas it is less clear if socioeconomic differences in survival contribute to explain differences in mortality in AMI among women and mortality in stroke (both sexes). The high case fatality among male workers and self-employed professionals with AMI is, in turn, attributed to a very marked increase in the risk for sudden death.
Salomaa, V., Niemela, M., Miettinen, H., Ketonen, M., Immonen-Raiha, P., Koskinen, S., Mahonen, M., Lehto, S., Vuorenmaa, T., Palomaki, P., Mustaniemi, H., Kaarsalo, E., Arstila, M., Torppa, J., Kuulasmaa, K., Puska, P., Pyorala, K. & Tuomilehto, J. 2000, "Relationship of socioeconomic status to the incidence and prehospital, 28-day, and 1-year mortality rates of acute coronary events in the FINMONICA myocardial infarction register study", <i>Circulation</i> , vol. 101, no. 16, pp. 1913-1918.					
1983–1992	6,485 first MI events among men and 1942 among women 35–64 years	income and education	first AMI Finland MONICA	case fatality in days ≤ 1 , 2–27 and 28–365	The excess CHD mortality and morbidity rates among persons with low SES are considerable. For 28-day mortality rates, the corresponding rate ratios were 3.18 (95% CI 2.82 to 3.58) and 2.33 (95% CI 2.03 to 2.68) in the low- and middle-income categories compared with the high-income category. Differences between the 2 education levels were somewhat smaller than those between the 2 extremes of the 3 income groups, but the pattern was consistent. Significant differentials were observed for prehospital mortality rates, and they remained similar up to 1 year after the MI. Findings among the women were consistent with those among the men.

TABLE 3. Selection of studies on socioeconomic differences in cardiac operations and mortality.

Period	N	Indicator of socioeconomic position	Study population	End point	Result
Alter, D.A., Naylor, C.D., Austin, P. & Tu, J.V. 1999, "Effects of socioeconomic status on access to invasive cardiac procedures and on mortality after acute myocardial infarction", <i>The New England journal of medicine</i> , vol. 341, no. 18, pp. 1359-1367.					
April 1994 to March 1997	51,591	income (neighborhood)	AMI Canada Ontario	rates of use and waiting times for angiography and revascularization death rates at one year	Increase in neighborhood income from the lowest to the highest quintile were associated with a 23 % increase in rates of use and a 45 % decrease in waiting times to angiography. After angiography no significant disparities in revascularization existed. Each \$10,000 increase in the neighborhood median income was associated with a 10 % reduction in the risk of death within one year.
Chang, W.C., Kaul, P., Westerhout, C.M., Graham, M.M. & Armstrong, P.W. 2007, "Effects of socioeconomic status on mortality after acute myocardial infarction", <i>The American Journal of Medicine</i> , vol. 120, no. 1, pp. 33-39.					
April 1998 to March 2002	5,622	neighborhood median household income	AMI Canada Alberta	1-year all-cause mortality revascularisation	In patients belonging to the lowest versus the highest socioeconomic status quartile, the risk of presenting to the emergency department was 72% higher (P <.001); at 1 year, revascularization was lower (36% vs 48%, P <.001), and mortality higher (19.1% vs 9.1%, P <.001).
Feder, G., Crook, A.M., Magee, P., Banerjee, S., Timmis, A.D. & Hemingway, H. 2002, "Ethnic differences in invasive management of coronary disease: prospective cohort study of patients undergoing angiography", <i>BMJ (Clinical research ed.)</i> , vol. 324, no. 7336, pp. 511-516.					
15 April 1996 to 14 April 1997	502 south Asian 2,974 white	race	CHD England London	revascularisation non-fatal MI mortality non-fatal MI	Among patients deemed appropriate for revascularisation the south Asian patients are less likely than white patients to receive it. CABG:HR 0.74(0.58 to 0.91, P=0.007). PCI: HR 0.69(0.47-1.00, P=0.058). no differences in mortality and non-fatal MI.
Lumme, S., Layland, A.H., Keskimäki, I. 2008, " Multilevel modeling of regional variation in equity in health care", <i>Medical care</i> , vol. 46, no. 9, pp. 976-983.					
2001-2003	Finnish population 2.1 mil. aged 45-84 years	income	CHD Finland	revascularisations CHD incidence CHD mortality	For women, the revascularization rates were significantly higher in the second lowest and middle income quintiles compared with the lowest group and for men all income groups were significantly higher than the lowest. A clear gradient showing high rates for the worse off was seen in both genders for CHD incidence and CHD mortality.

Table 3.

Mak, K.H., Kark, J.D., Chia, K.S., Tan, C., Foong, B.H. & Chew, S.K. 2004, "Ethnic differences in utilization of invasive cardiac procedures and in long-term survival following acute myocardial infarction", <i>Clinical cardiology</i> , vol. 27, no. 5, pp. 275-280.					
1991 to 1999	10,294 Chinese, Malays, and South Asians	race	AMI Singapore	angiography revascularisation mortality	Malays received substantially less angiography (34.0%) and revascularization (11.4%) than Chinese (41.9%, 17.9%) and South Asians (40.0%, 16.3%). Mortality in median 4.1 follow-up years: Malays adjusted HR, 1.28(1.15-1.42) compared with Chinese.
Pilote, L., Tu, J.V., Humphries, K., Behouli, H., Belisle, P., Austin, P.C. & Joseph, L. 2007, "Socioeconomic status, access to health care, and outcomes after acute myocardial infarction in Canada's universal health care system", <i>Medical care</i> , vol. 45, no. 7, pp. 638-646.					
1996 to 2001	145,882	characteristics of the postal region	AMI Canada Quebec, Ontario, and British Columbia	use of cardiac drugs invasive procedures, 30-day and one year all cause mortality readmissions for cardiac complications	Generally no associations between the SES variables and access to cardiac medications or invasive cardiac procedures. Only increased 1-year mortality among patients living in less-affluent regions in British Columbia. The results suggest that intermediary factors other than SES, such as cardiovascular risk factors, likely account for observed "wealth-health" gradients in Canada. Implementation of a universal drug coverage policy could decrease socioeconomic disparities in access to health care.
Rao, S.V., Schulman, K.A., Curtis, L.H., Gersh, B.J. & Jollis, J.G. 2004, "Socioeconomic status and outcome following acute myocardial infarction in elderly patients", <i>Archives of Internal Medicine</i> , vol. 164, no. 10, pp. 1128-1133.					
January 1994 to February 1996.	132,130 elderly Medicare beneficiaries	income; the median income of the ZIP code of residence	AMI USA	medical treatment revascularisation 30-day and 1-year mortality	Significant socioeconomic disparities in medical treatment and mortality. Income was independently associated with short- and long-term mortality. Revascularization rates were similar among income groups.
Rosvall, M., Chaix, B., Lynch, J., Lindstrom, M. & Merlo, J. 2008, "The association between socioeconomic position, use of revascularization procedures and five-year survival after recovery from acute myocardial infarction", <i>BMC public health</i> , vol. 8, pp. 44.					
1993 to 1996	45 to 84-year-old patients (16,041 women and 30,366 men)	income: cumulative income	first AMI Sweden	revascularization 5-year survival	Low SEP groups receive revascularization less often than high SEP groups. Patients with high income had a better long-term survival after recovery from their AMI compared to patients with low income.

Table 3.

Salomaa, V., Miettinen, H., Niemela, M., Ketonen, M., Mahonen, M., Immonen-Raiha, P., Lehto, S., Vuorenmaa, T., Koskinen, S., Palomaki, P., Mustaniemi, H., Kaarsalo, E., Arstila, M., Torppa, J., Kuulasmaa, K., Puska, P., Pyorala, K. & Tuomilehto, J. 2001, "Relation of socioeconomic position to the case fatality, prognosis and treatment of myocardial infarction events; the FINMONICA MI Register Study", *Journal of Epidemiology & Community Health*, vol. 55, no. 7, pp. 475-482.

1983–1992	6485 first MI events among men and 1942 among women 35–64 years	income and education	first AMI Finland MONICA	case fatality in days ≤ 1, 2–27 and 28–365 In 1988–1992 thrombolysis angiography revascularisation	Considerable socioeconomic differences were observed in the case fatality of first coronary events both before hospitalisation and among patients hospitalised alive. Case fatality explained a half of the CHD mortality difference between the low and the high income groups among men and more than a third among women. Thrombolysis was given to 25.2% of men in the high income group and 20.9% in the low income group. Among women, the corresponding numbers were 12.6% and 14.3%. During 28 days, angiography was significantly more often performed on men of the high income group than men of the low income group. During one year after the event, revascularisation was performed on 20% of the men in the high income group and 10% of the men in the low income group. Among women, the frequency of angiography and revascularisation did not differ by income group.
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