RESEARCH REPORT

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

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Background: Systematic socioeconomic differences in mortality have been reported among myocardial infarction (MI) patients in many countries, including Finland. The findings have been similar irrespective of country, study period, age group, or length of follow up, but few studies have examined the disparities among other groups of coronary patients. This study examined whether similar socioeconomic differences in outcomes exist among patients with angina pectoris (AP).

Methods: The data were based on individual register linkages among a population based 40–79 year-old cohort of 61 350 patients with incident AP or MI during 1995–1998 in Finland. Two year coronary heart disease mortality and one year MI incidence and its 28 day case fatality was studied among AP patients using Cox's and logistic regression analysis, and the results compared with those of the MI patient group.

Results: A clear socioeconomic pattern was found in two year coronary heart disease (CHD) mortality: the lower the socioeconomic group the higher the mortality risk. The socioeconomic patterning of mortality was similar to that found among MI patients. Controlling for comorbidity or disease severity did not change the results. Among AP patients a similar pattern was also found in MI incidence during the follow up, but no systematic socioeconomic differences were detected in its 28 day case fatality.

Conclusions: 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.

Although coronary heart disease (CHD) mortality has consistently declined in Finland as in other industrialised nations, CHD remains the most common cause of death accounting for one fourth of all deaths in both sexes.¹ The systematic sex and socioeconomic differences in CHD mortality reported elsewhere also apply to Finland.^{2,3} Furthermore, CHD seems to account for a large part of the socioeconomic disparities reported in all cause mortality.³

Socioeconomic differences in mortality among myocardial infarction (MI) patients are well known. Reports have identified such disparities in mortality before reaching the hospital,^{4–7} in the first month after MI^{4–6,8–9} and in longer follow up periods.^{4,8–11} Results are consistent: the higher the socioeconomic status the lower the mortality risk, independent of country, age group, follow up period, or indicator of socioeconomic status. A few studies have reported socioeconomic patterning of mortality among persons with other manifestations of CHD, such as patients with unstable angina,^{12,13} angiographically confirmed CHD,¹⁴ and among men with ECG abnormalities and/or angina symptoms.¹⁵ Findings are not entirely consistent: although most studies report socioeconomic differences corresponding to those seen among MI patients,^{12,14,15} no socioeconomic disparities were found in one study.¹³

Earlier studies on socioeconomic variation in mortality among CHD patients have, in general, concentrated on MI patients or specific hospital patient groups (unstable angina, angiographically defined CHD). Many studies have been geographically restricted, and some have used ecological data on socioeconomic group (for example, car ownership or residential postcode). This study examined socioeconomic differences in outcomes of CHD among a population based

cohort of incident coronary patients aged between 40 and 79 years in 1995–98. The main focus was patients with angina pectoris (AP) and no history of MI. The aim of the study was to examine whether similar socioeconomic disparities in outcome of CHD exist in patients with chronic AP. Analysing the outcomes of angina by socioeconomic status yields valuable new information on how health care may shape socioeconomic inequities in CHD, as angina patients are already treated in the healthcare system and have therefore potentially more effective access to secondary prevention of coronary events.

DATA AND METHODS

Data

The analyses were based on register data drawn from three register sources: the register of persons granted special reimbursement for medication costs, the Finnish Hospital Discharge Register, and the Cause of Death Register. Personal identification numbers were drawn from these registers as follows:

(1) Angina pectoris patients

Personal identification numbers of patients aged 40–79 years who received the right to special reimbursement for medication due to CHD between 1 January 1995 and 1 October 1998 were drawn from a register maintained by the Social Insurance Institution (SII). The diagnostic criteria for this special reimbursement right are (1) chronic AP symptoms responding to nitrates in the presence of unequivocal ECG

Abbreviations: MI, myocardial infarction; CHD, coronary heart disease; AP, angina pectoris

changes (on exercise or at rest), or (2) diagnosed MI, or (3) a coronary revascularisation operation, or (4) CHD verified in angiography. Entitlement to reimbursement is based on a medical certificate from the attending doctor, usually a specialist, which is then reviewed and approved by a specialist at the SII. Those with prior information on hospital treatment attributable to MI or coronary revascularisation, as well as those who already had the right on 31 December 1994, were excluded from this group. To ensure identifying a pure angina cohort, those who had MI within 90 days of receiving the special reimbursement right were re-defined as MI patients. Thus, the AP patients had a rather stable form of CHD without prior evidence of MI and with the potential for secondary prevention.

(2) MI patients

Personal identification numbers of 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. Additionally, 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 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 stated 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.

Variables

Data on outcome variables during the follow up and sociodemographic variables were individually linked to the study data from administrative registers by the relevant register authorities using the personal identification numbers. The latter were removed from the data before transfer to the research team.

The outcome variables used in this study were: (1) two year CHD and all cause mortality, (2) first MI in one year

follow up, (3) 0–27 day case fatality of MI. Both 0–27 day case fatality of MI and mortality differences among AP patients were compared with those of the MI group. Among MI patients CHD mortality was followed up after the acute phase (28–729 days). Information about MI was derived from the Finnish Hospital Discharge Register (ICD9 code 410 and ICD10 codes I21–I22, and if discharged alive, a minimum of four days of hospitalisation) and from the Cause of Death Register (ICD9 codes 410–414 and 798 and ICD10 codes I20–I22, I24–I25, I46.1, I46.9, R96, and R98). Information on CHD and all cause mortality was derived from the Cause of Death Register.

Data on sociodemographics came from the 1993 and 1995 population censuses and the Employment Statistics covering 1994–1998 compiled by Statistics Finland. Five year age bands were used in the analyses. Disposable family income for the year preceding data entry was derived from the 1994–1997 registers of taxes and welfare benefits. It was adjusted for family size using the OECD equivalence scale.¹⁶ For statistical analysis the study population was grouped into thirds.

Data on entitlements to reimbursement of medicine costs attributable to other chronic diseases at the time of entering the follow up were obtained from the SII. We classified these disease categories into five groups for the analyses (heart failure, cardiac arrhythmia, hypertension, diabetes, and other chronic diseases) and used them as proxies for comorbidities. Data on annual use of short acting and long acting nitrates during the year of entering the follow up were derived from the SII Prescription Register and used as a proxy for disease severity. Consumption of nitrates was expressed using a defined daily dose (DDD) and 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 of mortality.

The study protocol was approved by the research ethics committee of the National Research and Development Centre for Welfare and Health (STAKES).

Methods

Age adjusted event rates were calculated for MI and all mortality variables (direct method) using the whole incident AP and MI population as standard. Two year CHD (and total) mortality and MI incidence was examined using Cox's

Table 1 Study population

	Men		Women	
	AP patients	MI patients	AP patients	MI patients
Number	15113	21827	13238	11172
Mean age (SD)	62.82 (9.10)	64.21 (9.96)	66.85 (8.42)	70.44 (8.14)
Disposable income third*	%	%	%	%
Highest	43.4	34.5	30.7	20.2
Middle	33.0	33.1	35.5	31.6
Lowest	23.7	32.4	33.8	48.2
Entitlement to reimbursed medicine costs for comorbid conditions†				
Heart failure	3.1	12.0	5.5	20.4
Arrhythmia	2.2	3.6	1.9	3.8
Hypertension	21.4	31.6	27.6	45.1
Diabetes	8.4	12.8	8.5	21.1
Other diseases‡	10.3	13.4	18.0	23.6
Use of nitrates§				
0 DDD	21.8	25.3	15.3	26.4
1–99 DDD	32.2	35.0	33.1	29.1
100–349 DDD	36.1	33.3	40.5	36.4
350 or more DDD	10.0	6.3	11.1	8.1

*Family disposable income per consumption unit in the calendar year preceding follow up. †Entitlements to special reimbursement of medicine costs at start of follow up. ‡Includes chronic diseases such as asthma and chronic obstructive pulmonary disease, severe mental disorders, thyroid insufficiency, multiple sclerosis, Parkinson's disease, epilepsy, malignant tumours, sarcoidosis, rheumatoid arthritis, ulcerative colitis, Crohn's disease, and gouty arthritis. §Consumption of nitrates in defined daily doses (DDD) in the calendar year when follow up began. Among MI patients only those who survived the acute phase (28 days).

Table 2 Two year CHD and all cause mortality among AP and MI patients aged 40–79 years by income in Finland 1995–98

		AP patients (0–729 days)				MI patients (28–729 days*)			
		CHD mortality		All cause mortality		CHD mortality		All cause mortality	
Men	Income third	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	Highest	4.2	4.0 to 4.5	7.5	7.2 to 7.8	7.4	7.0 to 7.7	9.8	9.4 to 10.1
	Middle	4.1	3.9 to 4.4	9.0	8.6 to 9.3	8.2	7.9 to 8.5	11.5	11.1 to 11.9
	Lowest	6.0	5.8 to 6.3	10.8	10.5 to 11.2	9.8	9.5 to 10.2	14.0	13.5 to 14.4
	All	4.6	4.3 to 4.8	8.8	8.5 to 9.2	8.4	8.0 to 8.7	11.7	11.3 to 12.0
Women	Income third	%	95% CI	%	95% CI	%	95% CI	%	95% CI
	Highest	1.5	1.3 to 1.6	3.1	2.9 to 3.4	5.4	5.0 to 5.7	8.6	8.2 to 9.0
	Middle	1.8	1.6 to 2.0	4.4	4.1 to 4.7	7.3	6.9 to 7.7	11.0	10.6 to 11.5
	Lowest	2.5	2.3 to 2.7	4.7	4.4 to 5.0	9.0	8.6–9.4	13.0	12.6 to 13.5
	All	1.9	1.7 to 2.1	4.1	3.8 to 4.3	7.6	7.3 to 8.0	11.3	10.8 to 11.7

*MI patients followed up after the acute phase.

regression analysis in calculating the hazard ratios and their 95% confidence intervals by income controlling for age only, and age, comorbidity, and disease severity. An observation was censored at the end of the two year follow up or at the time of death during the follow up. Logistic regression models were then calculated for 28 day case fatality of MI by income, controlling for age only (five year age bands), and age and comorbidities. The results are presented as odds ratios and their 95% confidence intervals. The statistical significance of differences in the socioeconomic patterning of each outcome variable by type of onset of CHD (AP compared with MI) was examined by entering both patient groups in the same model and testing for the interaction between type of onset and socioeconomic group. All models were fitted for men and women separately, and models were also fitted using individual level register data on education and occupational class as indicators of socioeconomic status. As the results were similar to those found by income, they are not presented. The statistical analyses were performed using the SAS 9.1 software.

RESULTS

Altogether, 15 113 men and 13 238 women aged 40–79 received the right to special reimbursement for medication attributable CHD in the period 1 January 1995–1 October 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 comorbid conditions studied was lower among them and they used nitrates

slightly more often than MI patients during the year they entered the follow up (table 1).

CHD mortality during the two year follow up

CHD mortality during the two year follow up was 5% among AP men and 2% among AP women, for both MI men and women the two year mortality rate was 8% (table 2). Compared with 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 comorbidity and disease severity (nitrate use) did not change the pattern although it decreased the differences (table 3). The socioeconomic patterning of CHD mortality was also similar to MI patient group among both men and women. The socioeconomic patterning was similar also in all cause mortality in both patient groups in both sexes.

MI incidence and 28 day case fatality

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). In Cox's regression analysis a clear socioeconomic pattern was seen among men: compared with the highest income group, the hazard ratios for MI were 1.27 (1.03 to 1.56) for the middle income group and 1.58 (1.27 to 1.96) for the lowest income group. Controlling for comorbidity and disease severity did not change the results. Among women with AP no socioeconomic differences were found in MI incidence.

Table 3 Relative income differences in two year CHD mortality among AP patients controlling for age only, and age, disease severity, and comorbidity (hazard ratios and their 95% CIs)

		Controlling for age only		Controlling for age, comorbidity*, and disease severity†	
Men	Income third	HR	95% CI	HR	95% CI
AP	Highest	1.00		1.00	
	Middle	1.16	0.94 to 1.43	1.12	0.91 to 1.39
	Lowest	1.72	1.39 to 2.12	1.67	1.35 to 2.07
	All				
MI‡	Highest	1.00		1.00	
	Middle	1.14	0.97 to 1.34	1.11	0.94 to 1.30
	Lowest	1.39	1.18 to 1.63	1.35	1.15 to 1.59
	All				
Women	Income third				
	Highest	1.00		1.00	
	Middle	1.37	0.93 to 2.02	1.32	0.89 to 1.94
	Lowest	1.84	1.27 to 2.67	1.68	1.16 to 2.44
MI‡	Highest	1.00		1.00	
	Middle	1.00	0.80 to 1.25	0.97	0.77 to 1.22
	Lowest	1.26	1.02 to 1.55	1.17	0.95 to 1.43
	All				

*Entitlement to reimbursed medicine costs for five separate comorbid conditions (see table 1). †Use of nitrates (DDD, see table 1). ‡MI patients followed up after the acute phase.

Table 4 Incidence of first MI among AP patients and 28 day case fatality of first MI among both AP and MI patients aged 40–79 years by income in Finland, 1995–98

		AP patients				MI patients	
		MI incidence		0–27 day case fatality		0–27 day case fatality	
Men	Income third	%	95% CI	%	95% CI	%	95% CI
	Highest	3.6	3.3 to 3.9	58.1	54.0 to 62.2	41.9	41.2 to 42.5
	Middle	4.1	3.8 to 4.4	50.2	46.0 to 54.3	48.3	47.6 to 48.9
	Lowest	5.2	4.8 to 5.5	64.2	60.2 to 68.2	56.8	56.1 to 57.5
	All	4.2	3.9 to 4.4	56.5	52.4 to 60.7	48.9	48.3 to 49.6
Women	Highest	2.3	2.1 to 2.6	32.9	27.5 to 38.3	34.8	34.0 to 35.7
	Middle	1.9	1.7 to 2.1	46.8	41.1 to 52.6	38.7	37.8 to 39.6
	Lowest	2.4	2.1 to 2.6	46.1	40.4 to 51.9	46.6	45.7 to 47.5
	All	2.1	1.9 to 2.3	44.9	39.2 to 50.6	41.0	40.1 to 41.9

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 with those whose disease started as MI (table 4). 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 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 comorbidity did not change the results (table 5).

DISCUSSION

This study examined whether socioeconomic disparities exist in outcomes of CHD among a cohort of incident angina patients and whether these potential differences are similar to those reported earlier among MI patients. A clear socioeconomic pattern was found in mortality in the two year follow up: the higher the socioeconomic position, the lower the mortality. The socioeconomic patterning of mortality was similar in both patient groups among both sexes. Socioeconomic differences were also found in MI incidence during the one year follow up among AP patients. Our finding of a socioeconomic patterning of mortality among AP

patients is in line with earlier results among MI patients in Finland^{4 17} and elsewhere.^{8–11 18}

One strength of our study was our ability to identify a cohort of angina patients via the special reimbursement right register. While the strict criteria and approval procedure are likely to have minimised false positive cases, it is probable that some patients with onset of CHD during the study years were not granted this entitlement and thus were not covered by our data. However, these were probably less severe cases than those studied here. Another possible source of bias is the reclassification of those having MI within 90 days of receiving the reimbursement right as MI patients. This was done to identify a pure AP cohort, as special reimbursement right can, in some cases, be backdated two months. The reclassification may have affected both MI incidence and case fatality estimates for AP patients in our study, but assuming that MI incidence and case fatality do not change abruptly just after CHD patients have received their entitlement to special reimbursement, an error of this type should not bias our results significantly. The accuracy of the Finnish Hospital Discharge Register is generally good, and about 95% of hospital discharges have been recorded in the register,¹⁹ which has also been validated for CHD diagnoses.^{20 21} According to Rapola *et al*,²² register diagnoses of MI and CHD death were reasonably valid when compared with diagnoses made with standard criteria. Another strength of our data is that they were based on individually linked data on mortality, sociodemographics, comorbidity, and nitrate use, enabling ecological bias to be avoided.

At least part of the socioeconomic disparities in CHD outcomes found in our study is likely to be explained by socioeconomic differences in risk factor levels favouring the

Table 5 Relative income group differences in 28 day case fatality of first MI among AP and MI patients, controlling for age only and for age and comorbidity (odds ratios and their 95% CIs)

		Controlling for age		Controlling for age and comorbidity*	
Men	Income third	OR	95% CI	OR	95% CI
	Highest	1.00		1.00	
	Middle	0.74	0.49 to 1.12	0.71	0.47 to 1.08
	Lowest	1.31	0.85 to 2.04	1.32	0.85 to 2.04
	All	1.00		1.00	
MI	Highest	1.00		1.00	
	Middle	1.38	1.29 to 1.48	1.35	1.26 to 1.45
	Lowest	1.94	1.81 to 2.08	1.93	1.80 to 2.07
Women	Highest	1.00		1.00	
	Middle	1.68	0.87 to 3.25	1.65	0.85 to 3.19
	Lowest	1.49	0.82 to 2.74	1.44	0.78 to 2.64
	All	1.00		1.00	
	Highest	1.00		1.00	
MI	Middle	1.22	1.09 to 1.37	1.20	1.07 to 1.35
	Lowest	1.49	1.34 to 1.67	1.44	1.29 to 1.61

*Entitlement to reimbursed medicine costs for five separate comorbid conditions (see table 1).

What this paper adds

- Earlier studies on socioeconomic variation in mortality among CHD patients have mainly concentrated on MI patients or specific hospital patient groups.
- This paper examined socioeconomic differences in outcomes of CHD among a population based cohort of incident angina pectoris patients without prior evidence of MI and with the potential for secondary prevention.
- The socioeconomic gradient in survival of patients with AP as the initial manifestation of CHD would seem to be fairly similar to that of patients with MI as the initial manifestation.
- Our results may show socioeconomic differences in access to or success of secondary prevention in ambulatory care among patients with diagnosed, chronic CHD.

better off, repeatedly reported among the general population in Finland in terms of smoking, serum cholesterol, and body mass index.²³ Results from a recent survey suggest that similar risk factor differences also exist among coronary patients in Finland.²⁴ We were not able to control for these differences. However, our data did include several factors that influence CHD outcomes and could potentially have an effect on socioeconomic differences in outcomes. Firstly, comorbid conditions, especially heart failure, hypertension, diabetes, and arrhythmia, are likely to have an effect. In our data, special reimbursement right for these conditions was used as a proxy for these diseases. 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, comorbidities failed to explain socioeconomic differences in CHD outcomes. Similar findings have been reported earlier concerning diabetes and cerebrovascular disease.⁸

Secondly, severity of the disease is likely to have an effect on disease outcomes. We used data on nitrate use in the year the follow up started as proxy for disease severity. Although nitrate use was strongly associated with MI incidence and CHD mortality, the adjustment for nitrate use did not diminish socioeconomic differences in these outcomes.

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. The only pronounced difference between the two patient groups was the lack of a systematic socioeconomic gradient in 28 day case fatality among AP patients who had an MI during follow up, whereas a clear gradient was seen in case fatality in the MI group. The lack of gradient was attributable to unexpectedly high case fatality in the highest income group in men and in the middle group among women, which may be related to small numbers, particularly for women. However, over the longer follow up (two years) a socioeconomic gradient in risk of CHD death was clearly evident. On the other hand, some aspects of equal access to secondary prevention among patients with AP may diminish the gradient. Another factor that may suggest chance is the high case fatality of first MI among male AP patients. The number of events among AP patients was comparatively small, and the differences between income groups were statistically insignificant.

The results presented above refer to the late 1990s, since when the frequency of coronary revascularisations has

Policy implications

Targeted measures are needed to develop coronary heart disease care to guarantee efficient coverage of secondary prevention among all patients to reduce socioeconomic differences in fatal and non-fatal coronary events.

increased by about one third.²⁵ Earlier research has shown that this increase has also resulted in more equitable distribution of operations.²⁶ Additionally, statins became eligible for special reimbursement for CHD patients in 2000, after our study period, and the use of statins had increased 1.5-fold by 2002, with 54% of CHD patients using them in 2002.²⁷

In conclusion, the socioeconomic gradient in survival of patients with AP as the initial manifestation of CHD would seem to be fairly similar to that of patients with MI as the initial manifestation. Considering that the angina patients in our study had a diagnosed, chronic condition recognised and more or less actively treated by the healthcare system, these results may point to socioeconomic disparities in the quality of care, such as access to or success of secondary prevention of CHD. An earlier Finnish study has suggested that such differences do exist among coronary patients in access to and continuity of ambulatory care, as well as in doctor-patient interaction.²⁸ Additionally, studies have reported socioeconomic differences in other aspects of treatment of CHD patients both in Finland and elsewhere. Patients from higher socioeconomic groups reportedly receive more effective treatment after MI, including thrombolytic treatment,⁴ revascularisation operations,^{4 10 29} and prescribed β blockers, antithrombotic drugs and cholesterol lowering drugs at discharge from hospital.⁴ Similar findings have been reported among CHD patients in general.^{18 26} Together with earlier research, our results suggest that to reduce socioeconomic differences in CHD outcomes targeted measures, such as improving the effectiveness of disease management practices for 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.

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APHORISM OF THE MONTH

“Don’t follow the yellow brick road.”

Following the “beaten path” in public health without questioning, without critique, is a dangerous strategy. Just ask a lemming!

Lowell Levin