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Neighbourhood socioeconomic status and coronary heart disease in individuals between 40 and 50 years

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Abstract

Objective—The incidence of myocardial infarction (MI) has decreased in general but not among younger middle-aged adults. We performed a cohort study of the association between neighbourhood socioeconomic status (SES) at the age of 40 and risk of MI before the age of 50 years.

Methods—All individuals in Sweden were included in the year of their 40th birthday, if it occurred between 1998 and 2010. National registers were used to categorise neighbourhood SES into high, middle and low, and to retrieve information on incident MI and coronary heart disease (CHD). Cox regression models, adjusted for marital status, education level, immigrant status and region of residence, provided an estimate of the HRs and 95% CIs for MI or CHD.

Results—Out of 587 933 men and 563 719 women, incident MI occurred in 2877 (0.48%) men and 932 (0.17%) women; and CHD occurred in 4400 (0.74%) men and 1756 (0.31%) women during a mean follow-up of 5.5 years. Using individuals living in middle-SES neighbourhoods as referents, living in high-SES neighbourhoods was associated with lower risk of MI in both sexes (HR (95% CI): men: 0.72 (0.64 to 0.82), women: 0.66 (0.53 to 0.81)); living in low-SES

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neighbourhoods was associated with a higher risk of MI (HR (95% CI): men: 1.31 (1.20 to 1.44), women: 1.28 (1.08 to 1.50)). Similar risk estimates for CHD were found.

Conclusions—The results of our study suggest an increased risk of MI and CHD among residents from low-SES neighbourhoods and a lower risk in those from high-SES neighbourhoods compared with residents in middle-SES neighbourhoods.

INTRODUCTION

Cardiovascular diseases (CVDs) represent the leading cause of death in most countries, where coronary heart disease (CHD), and more specifically myocardial infarction (MI), is the most common cause of death among CVDs.¹² Established risk factors for CHD are hypertension, smoking, dyslipidaemia and diabetes.³ The addition of other modifiable risk factors including abdominal obesity, psychosocial stress, high-risk diet, low physical activity and regular alcohol consumption account for >90% of the population attributable risk of MI, as per the results of the INTERHEART study.⁴ There is also strong evidence showing that the socioeconomic status (SES) at the individual and neighbourhood level shapes the cardiovascular risk factors of their residents.⁵⁶ In fact, neighbourhood-level SES has been shown to be an important risk factor for CHD, independent of individual-level SES such as education level and marital status.⁷

Both the incidence of MI and cardiovascular death has declined steeply in most developed countries in recent years.⁸⁹ Yet, recent data from Norway indicates that the incidence of MI has not decreased among younger middle-aged adults, and that acute MI hospitalisations have even increased among this group.¹⁰ Recent national data from Sweden points towards an increased incidence of MI during the last decade in women aged 35–44 years.¹¹ However, whether the risk for CHD among younger middle-aged adults partly can be explained by neighbourhood SES has, to the best of our knowledge, not been explored. Therefore, the objective of this study was to explore the relationship between neighbourhood SES and incident premature CHD and MI in younger middle-aged adults; and whether that relationship is independent of individual-level socioeconomic factors such as education level, marital status, immigrant status and region in Sweden. We hypothesised that the risk of MI and CHD is higher among men and women living in low-SES and middle-SES neighbourhoods than in those living in high-SES neighbourhoods.

METHODS

Data used in this study were retrieved from a national database that contains information on the entire population of Sweden for a period of 40 years. This database is based on several Swedish registers and contains comprehensive nationwide individual-level data as well as data on neighbourhood SES. The registers used in the present study were the Total Population Register and the National Patient Register. The Swedish nationwide population and healthcare registers have exceptionally high completeness and validity.¹² Individuals were tracked using the personal identification numbers, which are assigned to each resident of Sweden. These identification numbers were replaced with serial numbers to provide anonymity. The follow-up period ran from 1 January 1998 until hospitalisation/outpatient

treatment of MI and/or CHD at the age of diagnosis before 50 years, death, emigration or the end of the study period on 31 December 2010, whichever came first.

Neighbourhood-level SES

The home addresses of all Swedish individuals have been coded to small geographic units with boundaries defined by homogeneous types of buildings. These neighbourhood areas, called small areas for market statistics, or SAMS, each contain an average of 1000 residents and were created by the Swedish government-owned statistics bureau Statistics Sweden. SAMS were used as proxies for neighbourhoods, as they were in previous research.¹³ Neighbourhood of residence is determined annually using the National Land Survey of Sweden register.

A summary index was calculated to characterise neighbourhood-level deprivation. The neighbourhood index was based on information about female and male residents aged 20–64 years, because this age group represents those who are among the most socioeconomically active in the population (ie, a group that has a stronger impact on the socioeconomic structure in the neighbourhood compared with children, younger women and men and retirees). The neighbourhood index was based on four items: low education level (<10 years of formal education), low income (income from all sources, including interest and dividends, ie, <50% of the median individual income), unemployment (excluding full-time students, those completing military service and early retirees) and receipt of social welfare. The index for the year 2000 was used to categorise neighbourhood deprivation as low (>1 SD below the mean), moderate (within one SD of the mean) and high (>1 SD above the mean).¹⁴ The neighbourhood SES each individual resided in at the age of 40, when the individuals entered the study, was used as exposure in the present study.

Neighbourhood level variables

Four categories of neighbourhood goods, services and resources were selected. The categories were:

1. fast-food restaurants (eg, pizzerias and hamburger bars)
2. bars/pubs
3. physical activity facilities (eg, swimming pools, gyms and ski facilities)
4. healthcare facilities (eg, healthcare centres, public hospitals, dentists and pharmacies).

To obtain these data, the ready-to-use nationwide GIS dataset of business contacts (ie, goods, services and resources) for November 2005 was provided to us by the Swedish company Teleadress.¹³

Individual-level sociodemographic variables

Inclusion: all individuals in Sweden entered the cohort in the year of their 40th birthday, if it occurred between 1998 and 2010. Individual-level sociodemographic variables of marital status, educational level and region of residence were defined according to the year of inclusion in the study.

Marital status was categorised as (1) married/cohabitating, (2) never married, (3) widowed or (4) divorced.

Education levels were categorised as completion of compulsory school or less (9 years), practical high school or some theoretical high school (10–12 years) and completion of theoretical high school and/or college (>12 years).

Immigrant status was categorised as born outside Sweden versus Swedish-born.

Region of residence was included because incidence of MI varies according to urban/rural status. Large cities were those with a population of 200 000 (Stockholm, Gothenburg and Malmö). We choose to categorise region of residence into big cities, northern Sweden and southern Sweden, yielding three equally sized groups.

Diabetes and hypertension diagnoses data on patients, prior to the age of 40 years, were obtained from hospital discharge diagnoses.

Outcome variable

The outcome variables in this study included incident MI and CHD. These were based on discharge diagnoses after a hospital stay or diagnoses at an outpatient visit to a specialist clinic (primary healthcare not included) of MI or CHD during the study period. Data on inpatient and outpatient diagnoses were retrieved from the Patient Register, which contains information on all hospital stays, and visits to outpatient clinics for specialised care. We searched these two registers for the following International Classification of Diseases (ICD)-10 codes:

MI: acute cardiac infarction (I21)

CHD: angina pectoris (I20), MI (I21), reinfarction within 4 weeks (I22), complications due to MI (I23), other acute forms of CHD (I24) and chronic CHD (I25).

Statistical analysis

Person-years were calculated from the start of the follow-up (1 January 1998) until diagnosis of outcomes before the age of 50 years, death, emigration or closing date on 31 December 2010. The rate of hospitalisation for MI and CHD was calculated for the total study population and for each subgroup after assessment of neighbourhood SES of individuals.

Cox regression models were used to estimate HRs and 95% CIs. To determine the crude OR of MI and CHD by level of neighbourhood SES, an unadjusted model (model A) that included only neighbourhood SES was calculated. In the next step, a model (model B) was created comprising both neighbourhood SES and individual-level variables. Model B included educational level, marital status, immigrant status and region of residence in Sweden. We also performed two secondary analyses, adjusted for the factors in model B and neighbourhood goods and services (fast food restaurants, bars/pubs, physical activity facilities and healthcare resources) to create model C. A final model (model D), adjusted for all the factors in model C and hospital discharge diagnoses of diabetes and hypertension prior to the age of 40 years, was also created.

Furthermore, we conducted a subgroup analysis in immigrants where we also adjusted for the time since immigration, using the variables in model B. The analyses were performed using the SAS statistical package (V.9.3; SAS Institute, Cary, North Carolina, USA).

RESULTS

In total, >1.1 million (1 151 652) men and women with a mean follow-up time of 5.5 years (SD 3.5 years) were included in the analysis at their 40th birthday. Their characteristics are shown in table 1. MI occurred in a total of 2788 (0.48%) men and 932 (0.17%) women during follow-up. The cumulative rates of MI per 1000 individuals are shown in table 2 for all individual-level variables. CHD occurred in 4400 (0.74%) men and 1756 (0.31%) women between the ages of 40 and 50 years. The cumulative rates of CHD per 1000 individuals are shown in table 3 for all individual-level variables.

The association between neighbourhood SES at the age of 40 and MI before the age of 50 years is shown in table 4, and the corresponding data for CHD are shown in table 5. Lower risks were seen among men and women living in high-SES neighbourhoods. Higher risks were observed in those living in low-SES neighbourhoods when using middle-SES neighbourhoods as a referent group. The risks were slightly attenuated, but still significant, when adjusted for marital status, education level, immigrant status and region of residence. The results remained significant when further adjusted for neighbourhood goods and services, and hospital diagnoses of diabetes and hypertension prior to the age of 40 years.

As a secondary analysis, we performed a subgroup analysis of the risk of MI and CHD in immigrants, adjusting for marital status, education level, region of residence and number of years in Sweden (data not shown in tables). The risk estimates were similar to those found for the whole cohort for immigrants residing in high and low SES, when using middle SES as referents; HR for men in high versus middle-SES neighbourhoods: MI 0.58 (95% CI 0.41 to 0.83) and CHD 0.64 (95% CI 0.48 to 0.84). HR for men residing in low-SES versus middle-SES neighbourhoods: MI 1.26 (95% CI 1.07 to 1.47) and CHD 1.30 (95% CI 1.14 to 1.49). For women, the results were non-significant.

DISCUSSION

In the present study, where all individuals residing in Sweden were included at their 40th birthday, living in low-SES neighbourhoods, compared with living in middle-SES neighbourhoods at the age of 40 years, was significantly associated with a higher risk of MI and CHD before the age of 50 years. Lower risks of both MI and CHD were seen in individuals living in high-SES neighbourhoods. The results remained significant after adjustment for established individual-level socioeconomic factors, neighbourhood goods and services and hospital diagnoses of diabetes and hypertension prior to the age of 40 years.

Comparisons with other studies

An analysis of death certificates in Texas revealed that individuals, who had been living in areas with a higher median house value, died of cardiovascular causes at an older age than those who had been living in areas with houses of lower value.¹⁵ Compared with the most

affluent individuals living in the most privileged neighbourhoods, the increased cardiovascular mortality risk associated with living in the most disadvantaged neighbourhoods was stark. It was the equivalent of being >10 years older at the baseline investigation among Americans aged 45–64 years old.¹⁶ Higher cardiovascular mortality has also been reported in individuals above 65 years living in low-SES neighbourhoods.¹⁷ Yet, to the best of our knowledge, there are no previous studies investigating the role of neighbourhood SES on incident MI and CHD in individuals below 50 years of age in the entire population of a country. Young individuals move around more than people in general, but most individuals have had the chance to find a job and to settle in a neighbourhood by the age of 40 years. Therefore, we build on the existing evidence by reporting striking differences in CHD risk between younger adults living in lower and those from higher SES neighbourhoods.

Possible explanation for our findings

There are some possible explanations for our findings. The association between neighbourhood SES and the risk of MI and CHD may be explained by an increased prevalence of cardiovascular risk factors among lower socioeconomic groups, and the lifestyles of the residents in the neighbourhoods. In fact, modifiable healthy lifestyle factors have been shown to be associated with established risk factors as well as incident CVD.¹⁸ Healthier lifestyles have also been reported to be followed to a higher degree in individuals with high SES as compared with those with low SES.¹⁹ Yet the individuals in the present study were 40 years old, and diabetes and hypertension are not as common in people below 50 years of age as in older individuals.²⁰ This suggests that these established risk factors do seem to be the main mediators of the higher CHD risk in individuals residing in low-SES neighbourhoods. In addition, the results remained significant when we adjusted for diagnoses of diabetes and hypertension registered in individuals discharged from hospitals prior to the age of 40 years.

Individuals residing in a low-SES neighbourhood may experience feelings of inferiority, lower social status and self-doubt.²¹ Residents in these neighbourhoods may have less money to spend, and may have been exposed to a higher degree of psychosocial²² and financial stress.²³ The physiological stress response to acute stress is known as allostasis, and its long-term effects result in a build-up of risk factors (elevated blood pressure, blood lipids, higher levels of catecholamines, poor glycaemic control, increased waist and non-normal cortisol levels) known as the allostatic load.²⁴ Allostatic load scores mirror the ‘price to pay for adaptations’, and those with high allostatic load scores have been shown to have lower self-rated health and a higher cardiovascular risk.²⁵

Certain immigrants have been shown to have higher rates of CHD than Swedish-born individuals.²⁶ As many immigrants live in low-SES neighbourhoods, parts of our results could be explained by immigrant status. Yet, we adjusted our models for immigrant status and the results remained significant, suggesting that the higher proportion of immigrants in low-SES neighbourhoods does not seem to explain the higher risk for MI and CHD. In fact the risk estimates, when immigrants were analysed separately with adjustments for time since immigration, were significant in men and had similar risk estimates in women.

There may be other factors affecting the health in neighbourhoods such as access to healthcare and pharmacies. Prescribed cardiovascular drugs have also been shown to be in agreement with guidelines to a higher degree in high-SES neighbourhoods than in low-SES neighbourhoods.²⁷ Yet, the results were still significant when we adjusted for neighbourhood goods and services including access to pharmacies and healthcare.

Clinical implications

Our findings are particularly important to note as they are observed in a country with universal healthcare, thus keeping constant an important potential confounder in the association between neighbourhood SES and CHD-related outcomes. However, despite the fact that Sweden has a healthcare system approaching socialised medicine, psychosocial factors have repeatedly been shown to have an effect on cardiovascular health.²² In a society with equal opportunities for health screening and intervention, more effort should be directed towards identification of vulnerable groups such as those living in low-SES neighbourhoods. Risk prediction models in high-risk groups (eg, individuals with diabetes) for CHD suggest that factors such as age, sex, smoking status, glycaemic control, cholesterol levels and blood pressure should be closely monitored.³ A recent study of long-term prognosis, after coronary artery bypass grafting, showed a considerable excess risk in patients with type 1 diabetes.²⁸ Neither individual-level SES nor neighbourhood level SES was, however, included in those models. Alternative risk prediction models have been developed, where QRISK2 included residing in neighbourhoods with different SES scores.^{29,30} The performance of the QRISK score has in fact been shown to be better than the Framingham model in identifying high risk for CVD. We argue that neighbourhood and individual-level SES should be given more attention in the clinical setting, when physicians and other healthcare workers estimate the CHD risk of patients.

Limitations and strengths

One of the limitations of this study was the lack of some data on established cardiovascular risk factors. One of the major strengths of the present study was that we were able to include all individuals residing in Sweden at their 40th birthday, with data on their neighbourhood SES as well as data on individual-level SES, and follow them for cardiovascular events until the age of 50 years. We believe that the internal validity is higher with this methodology, than if all individuals below 50 years would have been included, since many people live in different locations in their early years of adulthood. The use of the Total Population Register may be of particular importance, since individuals in low resource settings have lower participation rates in surveys. Another strength is the Patient Register and the Cause of Death Register in Sweden, which have been reviewed for validity and completeness,¹² thus enabling a long-term evaluation of the outcomes without any significant loss to follow-up.

Given the high internal validity of the study, we believe that the study also has external validity and that the results may be generalisable for estimating the risks in high-SES and low-SES neighbourhoods in other western countries.

CONCLUSIONS

The results of this study suggest a significantly increased risk of premature MI and CHD in the younger middle-aged Swedish population who lived in neighbourhoods with low or middle SES, compared with those individuals from high-SES neighbourhoods. This relationship was independent of individuals' education level, marital status, immigrant status and their region of residence in Sweden. The inclusion of neighbourhood SES in predictive models of CHD may significantly improve the identification of individuals who are at high risk for premature CHD, and enable timely preventive treatment for individuals living in deprived neighbourhoods. Further efforts to reduce cardiovascular risk in younger adults living in deprived neighbourhoods are imperative.

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Key messages

What is already known on this subject?

Neighbourhood socioeconomic status (SES) has been shown to be an important risk factor for coronary heart disease (CHD), independent of individual-level SES, among older individuals.

What might this study add?

After adjusting for individual-level socioeconomic factors, living in low-SES neighbourhoods compared with living in middle-SES neighbourhoods at the age of 40 was significantly associated with 31% higher relative risk of myocardial infarction and CHD before the age of 50 years.

How might this impact on clinical practice?

The inclusion of neighbourhood SES in predictive models of CHD may significantly improve the identification of individuals who are at high risk for premature CHD, and enable timely preventive treatment for individuals living in deprived neighbourhoods. Further efforts to reduce cardiovascular risk among younger adults living in deprived neighbourhoods are imperative.

Table 1

	Men (N=587 933)				Women (N=563 719)									
	High		Low		High		Low							
	No	Percent	No	Percent	No	Percent	No	Percent						
Year at entry														
1998–2000	20 204	18	63 506	17	19 556	20	103 266	18	61 738	17	17 139	20	99 680	
2001–2003	23 832	21	84 725	22	22 541	23	131 098	21	80 396	22	20 033	23	124 686	
2004–2006	30 823	27	102 776	27	24 915	26	158 514	31 293	27	97 867	27	22 468	26	151 628
2007–2010	37 509	33	127 373	34	30 173	31	195 055	38 826	34	121 982	34	26 917	31	187 725
Family income														
Low	14 400	13	71 883	19	30 474	31	116 757	24 372	21	110 635	31	36 760	42	171 767
Middle low	22 409	20	76 888	20	19 900	20	119 197	35 001	30	109 977	30	23 833	28	168 811
Middle high	30 059	27	98 984	26	23 321	24	152 364	31 313	27	86 062	24	17 823	21	135 198
High	45 500	40	130 625	35	23 490	24	199 615	24 493	21	55 309	15	8 141	9	87 943
Marital status														
Married	63 714	57	163 553	43	38 261	39	265 528	70 575	61	183 214	51	38 735	45	292 524
Unmarried	41 467	37	181 452	48	45 619	47	268 538	34 120	30	132 832	37	29 751	34	196 703
Divorced	7052	6	32 910	9	13 155	14	53 117	10 098	9	44 381	12	17 409	20	71 888
Widowed	135	0	465	0	150	0	750	386	0	1556	0	662	1	2604
Educational level														
Compulsory	8365	7	54 463	14	19 363	20	82 191	6044	5	37 749	10	17 664	20	61 457
Secondary school	39 821	35	179 882	48	40 377	42	260 080	33 445	29	143 608	40	31 074	36	208 127
College/university	61 993	55	134 252	35	29 211	30	225 456	73 634	64	170 767	47	29 878	35	274 279
Unknown	2189	2	9783	3	8234	8	20 206	2056	2	9859	3	7941	9	19 856
Immigrant status														
Born in Sweden	104 093	93	338 858	90	61 272	63	504 223	105 420	92	319 464	88	53 517	62	478 401
Born outside	8275	7	39 522	10	35 913	37	83 710	9759	8	42 519	12	33 040	38	85 318
Region of residence														
Big cities	48 670	43	146 476	39	48 255	50	243 401	50 609	44	142 110	39	42 513	49	235 232

Men (N=587 933)										Women (N=563 719)									
	High		Middle		Low		All	High		Middle		Low		All					
	No	Percent	No	Percent	No	Percent		No	Percent	No	Percent	No	Percent						
Southern Sweden	40 618	36	147 092	39	33 432	34	221 142	41 237	36	139 718	39	30 196	35	211 151					
Northern Sweden	23 064	21	84 748	22	15 439	16	123 251	23 316	20	80 095	22	13 810	16	117 221					
Unknown	16	0	64	0	59	0	139	17	0	60	0	38	0	115					
Hospitalisation of hypertension																			
No	111 260	99	373 617	99	95 691	98	580 568	114 323	99	358 722	99	85 499	99	558 544					
Yes	1108	1	4763	1	1494	2	7365	856	1	3261	1	1058	1	5175					
Hospitalisation of diabetes																			
No	111 560	99	374 303	99	95 532	98	581 395	114 648	100	359 270	99	85 552	99	559 470					
Yes	808	1	4077	1	1653	2	6538	531	0	2713	1	1005	1	4249					
All	112 368		378 380		97 185		587 933	115 179		361 983		86 557		563 719					

Table 2

Cumulative rates of MI (per 1000 individuals) in men and women in neighbourhoods with low, middle and high SES

	Men						Women					
	High			Low			All			High		
	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI
Year at entry												
1998–2000	6.8	5.8	8.1	10.5	9.8	11.3	16.2	14.5	18.1	10.9	10.3	11.5
2001–2003	4.5	3.8	5.5	6.7	6.2	7.3	10.3	9.1	11.8	6.9	6.5	7.4
2004–2006	2.3	1.9	2.9	3.4	3.1	3.8	5.7	4.8	6.7	3.6	3.3	3.9
2007–2010	0.3	0.2	0.6	1.0	0.8	1.2	1.8	1.3	2.3	1.0	0.9	1.1
Family income												
Low	4.6	3.6	5.8	7.0	6.5	7.7	10.1	9.0	11.3	7.5	7.1	8.1
Middle low	3.8	3.1	4.7	5.3	4.8	5.9	8.5	7.4	9.9	5.6	5.2	6.0
Middle high	3.1	2.6	3.8	4.4	4.0	4.8	7.0	6.0	8.1	4.6	4.2	4.9
High	1.9	1.5	2.3	2.8	2.5	3.1	4.4	3.7	5.4	2.8	2.5	3.0
Marital status												
Married	2.9	2.5	3.3	4.3	4.0	4.6	8.3	7.5	9.3	4.5	4.3	4.8
Unmarried	2.9	2.4	3.5	4.2	3.9	4.5	6.5	5.8	7.2	4.4	4.1	4.6
Divorced	3.7	2.5	5.4	7.6	6.7	8.6	9.8	8.3	11.7	7.6	6.9	8.4
Widowed	22.2	7.2	68.9	4.3	1.1	17.2	13.3	3.3	53.3	9.3	4.4	19.6
Educational level												
Compulsory	5.3	3.9	7.1	7.2	6.5	7.9	11.1	9.7	12.7	7.9	7.3	8.5
Secondary school	3.6	3.1	4.3	4.5	4.2	4.8	7.7	6.9	8.6	4.9	4.6	5.1
College/university	2.3	1.9	2.7	3.5	3.2	3.9	6.2	5.3	7.1	3.5	3.3	3.8
Unknown	1.4	0.4	4.2	3.9	2.8	5.3	4.9	3.6	6.6	4.0	3.2	5.0
Immigrant status												
Born in Sweden	2.9	2.5	3.2	4.2	4.0	4.4	6.3	5.7	7.0	4.2	4.0	4.4
Born outside	4.1	2.9	5.8	7.4	6.6	8.3	10.0	9.0	11.1	8.2	7.6	8.8
Region of residence												
Big cities	2.8	2.4	3.3	4.8	4.5	5.2	8.6	7.9	9.5	5.2	4.9	5.4

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	Men										Women									
	High					Low					All					High				
	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI
Southern Sweden	2.4	1.9	2.9	3.9	3.6	4.3	6.2	4.3	5.4	7.1	4.0	3.7	4.3	1.0	0.8	1.4	1.5	1.3	1.7	1.3
Northern Sweden	4.3	3.5	5.2	5.1	4.6	5.6	7.8	5.7	6.6	9.4	5.3	4.9	5.7	1.0	0.7	1.5	2.2	1.9	2.6	1.8
Unknown	0.0			0.0		16.9		51.1		120.3	7.2	1.0								
Hospitalisation of hypertension																				
No	2.5	2.2	2.8	3.8	3.6	4.0	6.4	4.1	5.9	6.9	4.0	3.8	4.1	0.8	0.7	1.0	1.3	1.2	1.5	1.2
Yes	47.8	36.5	62.6	61.9	55.3	69.4	87.7	71.1	73.9	104.1	65.0	59.5	71.1	16.4	9.7	27.6	39.6	33.3	47.0	30.6
Hospitalisation of diabetes																				
No	2.8	2.5	3.2	4.1	3.9	4.3	6.7	4.4	6.2	7.2	4.3	4.1	4.4	0.8	0.7	1.0	1.4	1.3	1.6	1.3
Yes	18.6	11.2	30.8	45.1	39.1	52.1	63.5	52.0	52.5	76.9	46.5	41.6	52.0	20.7	11.5	37.4	35.0	28.6	42.8	28.1
All	2.9	2.6	3.3	4.5	4.3	4.7	7.7	4.9	7.1	8.2	4.7	4.6	4.9	0.9	0.8	1.1	1.7	1.5	1.8	1.6

CR, cumulative rate per 1000 individuals; MI, myocardial infarction; SES, socioeconomic status.

Table 3

Relative rates of CHD (per 1000 individuals) in men and women in neighbourhoods with low, middle and high SES

	Men						Women																	
	High		Middle		Low		All		High		Middle		Low		All									
	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI	CR	95% CI								
entry																								
2000	11.5	10.1	13.1	17.4	16.4	18.4	25.8	23.6	28.1	17.8	17.0	18.6	3.9	3.2	4.9	7.2	6.6	7.9	10.7	9.2	12.3	7.1	6.6	7.7
2003	7.0	6.0	8.1	10.6	10.0	11.4	15.7	14.2	17.5	10.8	10.3	11.4	2.9	2.3	3.7	4.5	4.1	5.0	6.8	5.7	8.0	4.6	4.2	5.0
2006	3.4	2.8	4.1	5.2	4.8	5.7	8.4	7.3	9.6	5.4	5.0	5.7	1.5	1.1	2.0	2.3	2.1	2.7	3.6	2.9	4.5	2.4	2.1	2.6
2010	0.6	0.4	0.9	1.5	1.3	1.7	2.5	2.0	3.1	1.5	1.3	1.7	0.5	0.4	0.8	0.5	0.4	0.7	1.2	0.8	1.6	0.6	0.5	0.8
income																								
low	7.2	5.9	8.7	10.9	10.2	11.7	16.1	14.7	17.6	11.8	11.2	12.4	2.5	1.9	3.2	3.6	3.2	3.9	5.7	4.9	6.5	3.9	3.6	4.2
middle	6.2	5.3	7.3	8.6	8.0	9.3	13.3	11.8	15.0	9.0	8.4	9.5	2.3	1.8	2.8	3.3	3.0	3.6	5.2	4.4	6.2	3.3	3.1	3.6
high	5.2	4.4	6.1	7.0	6.5	7.5	10.0	8.8	11.4	7.1	6.7	7.5	1.8	1.3	2.3	3.0	2.6	3.3	4.9	4.0	6.0	2.9	2.7	3.2
status																								
married	2.8	2.3	3.3	4.5	4.2	4.9	6.6	5.7	7.8	4.4	4.1	4.7	1.1	0.7	1.6	1.7	1.4	2.1	1.6	0.9	2.8	1.5	1.3	1.8
unmarried	4.7	4.2	5.2	7.0	6.6	7.4	13.2	12.1	14.4	7.3	7.0	7.7	1.7	1.4	2.0	3.1	2.8	3.3	4.8	4.1	5.5	3.0	2.8	3.2
education level																								
primary school	4.5	3.9	5.2	6.6	6.2	7.0	9.6	8.8	10.6	6.8	6.5	7.1	2.1	1.6	2.6	2.6	2.3	2.9	4.2	3.5	5.0	2.8	2.5	3.0
secondary school	5.2	3.8	7.2	11.9	10.8	13.1	14.8	12.9	17.1	11.7	10.8	12.7	2.7	1.8	3.9	4.1	3.5	4.7	7.0	5.8	8.3	4.6	4.1	5.1
university	29.6	11.1	78.9	8.6	3.2	22.9	13.3	3.3	53.3	13.3	7.2	24.8	2.6	0.4	18.4	7.7	4.4	13.6	3.0	0.8	12.1	5.8	3.5	9.6
own																								
rent status																								
in Sweden	4.5	4.1	4.9	6.8	6.5	7.1	9.7	9.0	10.5	6.7	6.5	6.9	1.8	1.6	2.1	3.0	2.8	3.2	5.2	4.6	5.9	3.0	2.8	3.1
outside	6.8	5.2	8.8	10.9	9.9	11.9	15.3	14.0	16.6	12.3	11.6	13.1	2.7	1.8	3.9	3.7	3.1	4.3	4.6	4.0	5.4	3.9	3.5	4.4
of residence																								
ities	4.5	4.0	5.2	7.6	7.2	8.1	13.5	12.5	14.5	8.1	7.8	8.5	1.9	1.6	2.4	3.0	2.7	3.3	5.7	5.0	6.5	3.2	3.0	3.5

Heart. Author manuscript; available in PMC 2016 May 15.

	Men						Women																	
	Middle			Low			All			Middle			Low			All								
	CR	95% CI		CR	95% CI		CR	95% CI		CR	95% CI		CR	95% CI		CR	95% CI							
Sweden	3.6	3.1	4.3	6.1	5.7	6.5	9.2	8.2	10.3	6.1	5.8	6.4	1.6	1.2	2.0	2.5	2.2	2.8	4.1	3.4	4.9	2.5	2.3	2.8
Sweden	6.8	5.8	7.9	8.5	7.9	9.2	12.0	10.4	13.8	8.6	8.1	9.2	2.5	1.9	3.2	4.2	3.7	4.6	4.9	3.8	6.2	3.9	3.6	4.3
own	0.0			0.0			16.9	2.4	120.3	7.2	1.0	51.1	0.0			0.0			0.0			0.0		
Utilisation of hypertension																								
	3.9	3.5	4.2	5.9	5.7	6.2	9.7	9.1	10.3	6.1	5.9	6.4	1.6	1.4	1.9	2.4	2.3	2.6	4.1	3.7	4.6	2.5	2.4	2.7
Heart. Author manuscript	86.6	70.9	105.8	109.0	100.0	118.8	144.6	126.5	165.2	112.8	105.4	120.8	43.2	31.3	59.7	70.2	61.7	79.9	76.6	61.6	95.2	67.1	60.4	74.5
Utilisation of diabetes																								
	4.5	4.1	4.9	6.5	6.3	6.8	10.2	9.6	10.8	6.7	6.5	6.9	1.7	1.5	2.0	2.6	2.5	2.8	4.2	3.8	4.7	2.7	2.5	2.8
	29.7	19.9	44.3	70.9	63.2	79.5	103.4	89.0	120.2	74.0	67.7	80.9	39.5	25.8	60.7	60.1	51.5	70.1	71.6	56.9	90.3	60.2	53.3	68.1
	4.5	4.3	5.1	7.2	7.0	7.5	11.8	11.1	12.5	7.5	7.3	7.7	1.9	1.7	2.2	3.0	2.9	3.2	5.0	4.5	5.5	3.1	3.0	3.3

ronary heart disease; CR, cumulative rate per 1000 individuals, SES, socioeconomic status.

Table 4

HRs of MI (ICD-10 I21) before the age of 50 years in neighbourhoods with low, middle and high SES

Group	Individuals at risk	First events	Incidence rate per 10 000 person-years (95% CI)	Model A HR (95% CI)	Model B HR (95% CI)	Model C HR (95% CI)	Model D HR (95% CI)
Men							
High	112 368	331	5.39 (4.84 to 6.00)	0.64 (0.57 to 0.72)	0.72 (0.64 to 0.82)	0.73 (0.64 to 0.82)	0.75 (0.66 to 0.84)
Middle	378 380	1712	8.40 (8.01 to 8.81)	1.00	1.00	1.00	1.00
Low	97 185	745	13.75 (12.80 to 14.77)	1.62 (1.49 to 1.77)	1.31 (1.20 to 1.44)	1.29 (1.17 to 1.41)	1.24 (1.13 to 1.36)
Women							
High	115 179	107	1.70 (1.41 to 2.05)	0.55 (0.45 to 0.68)	0.66 (0.53 to 0.81)	0.65 (0.53 to 0.80)	0.67 (0.55 to 0.83)
Middle	361 983	607	3.08 (2.84 to 3.34)	1.00	1.00	1.00	1.00
Low	86 557	218	4.46 (3.91 to 5.09)	1.44 (1.23 to 1.68)	1.28 (1.08 to 1.50)	1.27 (1.08 to 1.49)	1.17 (1.00 to 1.38)

Model A: crude model. Model B: adjusted for marital status, educational level, immigrant status and region of residence. Model C: adjusted for factors in model B and neighbourhood goods and services (fast-food restaurants, bars/pubs, physical activity facilities and healthcare resources). Model D: adjusted for factors in model C and hospitalisation for hypertension and hospitalisation for diabetes prior to the age of 40 years.

ICD, International Classification of Diseases; MI, myocardial infarction; SES, socioeconomic status.

Table 5

HRs of CHDs before the age of 50 years in neighbourhoods with low, middle and high SES

Group	Individuals at risk	First events	Incidence rate per 10 000 person-years (95% CI)	Model A HR (95% CI)	Model B HR (95% CI)	Model C HR (95% CI)	Model D HR (95% CI)
Men							
High	112 368	525	8.55 (7.85 to 9.31)	0.64 (0.58 to 0.70)	0.71 (0.64 to 0.78)	0.71 (0.64 to 0.78)	0.73 (0.66 to 0.80)
Middle	378 380	2732	13.40 (12.91 to 13.91)	1.00	1.00	1.00	1.00
Low	97 185	1143	21.10 (19.91 to 22.36)	1.56 (1.46 to 1.67)	1.29 (1.20 to 1.39)	1.27 (1.18 to 1.37)	1.23 (1.14 to 1.32)
Women							
High	115 179	220	3.49 (3.06 to 3.98)	0.62 (0.54 to 0.72)	0.72 (0.62 to 0.83)	0.72 (0.62 to 0.83)	0.74 (0.64 to 0.85)
Middle	361 983	1104	5.61 (5.29 to 5.95)	1.00	1.00	1.00	1.00
Low	86 557	432	8.83 (8.04 to 9.70)	1.56 (1.40 to 1.75)	1.34 (1.19 to 1.51)	1.34 (1.19 to 1.51)	1.24 (1.10 to 1.40)

Model A: crude model. Model B: adjusted for marital status, educational level, immigrant status and region of residence. Model C: adjusted for factors in model B and neighbourhood goods and services (fast-food restaurants, bars/pubs, physical activity facilities and healthcare resources). Model D: adjusted for factors in model C and hospitalisation for hypertension and hospitalisation for diabetes prior to the age of 40 years.

CHD, coronary heart disease; SES, socioeconomic status.