Socioeconomic status and coronary heart disease risk factors and mortality: Married residents, three counties, Norway

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ABSTRACT

The socioeconomic gradient in coronary heart disease risk factors and mortality was examined in a population-based cohort attending a cardiovascular screening between 1977 and 1983 in three counties in Norway. The inverse socioeconomic gradient in many risk factors was stronger in women than in men and often stronger in non-smokers than smokers, particularly among women. In prospective analyses, adjusting for age and smoking, income was a significant predictor of coronary heart disease mortality among both sexes, and after controlling for numerous risk factors, income remained a significant predictor of coronary heart disease mortality among women, but not in men. The results suggest that the socioeconomic gradient in coronary heart disease risk may be stronger among women than men, and that differences in coronary heart disease risk is likely to persist even with reductions in smoking in populations of low socioeconomic status.

INTRODUCTION

In many developed countries, socioeconomic differences in coronary heart disease mortality may reflect, at least in part, differences in health care availability. Evaluation of socioeconomic differences in coronary heart disease in Scandinavian countries which have a more equitable health care delivery system than many developed countries, is worthwhile in that observed socioeconomic differences are likely to reflect differences in stressors and health-related behaviors. While numerous studies have examined the association of socioeconomic indicators and coronary heart disease risk,[1-11] few studies have included women. Also, we are unaware of studies which have separately examined the socioeconomic gradient in coronary heart disease risk factors for smokers and non-smokers, an important analysis given the strong association between smoking and socioeconomic status and coronary heart disease risk. Thus, we examine the association of education and income with coronary heart disease risk factors by gender and smoking status, and prospectively examine the risk of coronary heart disease mortality in a homogeneous cohort of Norwegian men and women.

METHODS

A nationwide population-based census was conducted in 1980 of Norwegian residents which collected information on education.[12] The census data were linked by an 11-digit personal identifier to the second cardiovascular disease and risk factors screening survey conducted between 1977 and 1983 in three Norwegian counties: Finnmark, Sogn og Fjordane, and Oppland. The survey was conducted by the National Health Screening Service of Norway (from 2001, Norwegian Institute of Public Health). All Finnmark residents aged 35-52 in 1977 (i.e. born 1925-1942); all Sogn og Fjordane residents aged 40-54 in 1980 (i.e. born in 1926-1940); and all Oppland residents aged 40-54 in 1981 (i.e. born in 1927-1941) were invited to attend the cardiovascular screening. Of 56,718 age-eligible men and women, 52,138 (91.9%) participated in the survey, of whom 43,878 (84%) were married. Thus, we limited analyses to all married individuals to avoid methodological biases associated with income and mortality differences by marital status.

Screening and laboratory analytic procedures

The screening procedures were nearly identical to those of the first screening which has been described in detail elsewhere.[13,14] All eligible residents received a letter of invitation and questionnaire by mail. The questionnaire included items on health history, including diabetes and cardiovascular disease symptoms: angina pectoris, intermittent claudication, current and former smoking, and leisure time activity. Blood pressure was measured twice with a mercury sphygmomanometer and the resting (second) blood pressure measurements were used in the analyses. Height and weight were measured and body mass index (BMI) was defined as weight (kg)/(height (m))^2. A non-fasting blood sample was taken and serum analyzed at the Central Laboratory, Ullevål Hospital, Oslo (now

Clinical Chemical Department, Ullevål University Hospital), which changed their laboratory procedures from a non-enzymatic to an enzymatic method in 1978.[13,15] Thus, total cholesterol and triglycerides measured in Finnmark were corrected to ensure comparability in values.[15] A BMI measurement was missing for 2.9% of the married participants. All other laboratory measurements or questionnaire items had missing values representing less than 1% of the study sample.

Income and education

Work-related income of the husband and wife reported in the 1980 nationwide census was combined to calculate total income. Study subjects were divided into five income groups based upon quintile cut-off points determined after excluding individuals coded as zero which included those with no or undetermined income. Individuals were grouped into 5 education categories: 7, 8-9, 10, 11-12, and 13 or more years of education. A total of 569 (1.3%) had zero or unknown income and 392 (0.9%) had missing data on education.

Follow-up identification of mortality and cause of death

The mortality and emigration experience of the cohort as of December 31, 1992 was determined by linkage to the Norwegian Register and Causes of Death (ICD) 8th revision was used for deaths through 1985, and the 9th revision for deaths between 1986 and 1992. Coronary heart disease deaths were determined by codes 410-411, 412.0-412.3, 413 for the 8th revision, and by codes 410-413, 414,0-414.1, 414.3, 414.9 for the 9th revision.[16,17]

Statistical methods

The baseline risk factor characteristics associated with income and educational level were examined in unadjusted bivariate analyses: chi-square tests for trend for dichotomous variables and an analysis of variance tests of linearity for continuous variables. Age-adjusted logistic regression analyses with gender by education or income interaction terms were used to test for differences in the slope of risk factor prevalence between men and women. Because the zero income category also included individuals with undetermined income, data concerning the zero category are presented in all tables but this category was omitted from all statistical tests examining trends by income level. Age and multivariate adjusted (predicted) mean levels of BMI, systolic and diastolic blood pressure, total cholesterol and triglycerides by income and education level were calculated using general linear models.[18] We examined the possibility for smoking by socioeconomic status interactions in analyses of risk factor levels.

Mortality rates were based upon person-years of follow-up from the date of screening until the date of death, emigration, or censoring on December 31, 1992, whichever came first. Age-adjusted rates were calculated using the direct method with the distribution of person-years of the total study cohort in age groups 35-44, 45-50, and 51-56 as the standard population. Age-adjusted and multiple-adjusted hazard rate ratios were obtained by Cox proportional hazards analyses conducted separately for men and women. In addition to conducting the hazards analyses on categorical education and income groups, we also conducted analyses examining education and income as continuous variables. In order to facilitate interpretation of the analyses of income as a continuous variable in Cox proportional hazards analyses, total income was multiplied by 2.35 (the ratio of the Consumer Price Index of 1995 and 1980), and divided by 100,000 Norwegian crowns (NOK). Thus, the beta coefficient represents the change in mortality risk associated with a one unit (i.e. 100,000 NOK) increase in income. For education, the beta coefficient represents the risk associated per increasing education category (7, 8-9, 10, and ≥ 11 years of education).

In order to evaluate whether the additional adjustment for age-attained modified the proportional hazards beta coefficients obtained, we reran analyses using Epi-Cure statistical software package, which allows for adjustment for age-attained in the proportional hazards model.[19] SPSS Version 8.0 was used for all analyses presented.[18]

RESULTS

Baseline Characteristics by socioeconomic status

Age at the baseline screening was inversely related to education and income: the mean age was 48 for those with 7 years versus 45 for those with 13 or more years of education; 47 and 48 in men and women in the first quintile versus 46 and 45 for those in the highest quintile income category (linear trend, $p < 0.05$, table 1). In unadjusted analyses significant trends in the prevalence of numerous risk factors were noted by education and income level (table 1). The prevalence of current smoking, for example, decreased from 39% to 18% from the lowest to the highest education category among women and from 55% to 26% respectively among men (χ^2 trend, $p < 0.05$). In contrast, we observed no decrease in smoking prevalence by increasing income level among women, whereas there was a decrease in prevalence by increasing income level among men. Modest increases in the prevalence of former smoking were noted for both sexes by increasing education and income level (χ^2 trend, $p < 0.05$). In addition, the prevalence of the following risk factors all decreased with increasing education and income level among women and men: leisure time inactivity, obesity (BMI ≥ 30kg/m^2), high systolic blood pressure (≥ 170 mmHg), high diastolic blood pressure (≥ 100 mmHg), high total cholesterol (≥ 8.0 mmol/l), and

Table 1. Mean age, and percent distribution of baseline characteristics by education, income, and gender among married residents, three counties, Norway (n=43,878).

SES	(n)	Mean age	Current smoker	Former smoker	No leisure time acti-vity	Body mass index ≥30 (kg/m^2)	Systolic blood pressure ≥ 170 (mmHg)	Diastolic blood pressure ≥ 100 (mmHg)	Cardiovascu-lar disease history*	Total-cholesterol ≥ 8.0 (mmol/l)	Triglyce-rides ≥ 3.5 (mmol/l)
Women											
Education (years)											
7	8351	47.8	39	14	19	15	7	10	16	12	4
8-9	8099	45.4	32	15	17	11	4	7	12	6	3
10	3319	45.9	31	16	14	8	3	6	10	6	2
11-12	1114	46.1	24	20	14	6	3	6	9	6	2
13-16	1198	45.0	18	19	14	4	2	5	8	3	1
Income (quintiles)											
0**	329	48.0	38	19	33	22	9	15	26	15	8
1	4786	47.3	30	12	22	16	7	11	17	11	4
2	4309	46.8	33	14	18	13	6	10	15	9	4
3	4307	46.3	35	14	15	10	4	7	12	7	3
4	4306	45.9	35	17	14	8	3	6	10	7	2
5	4204	45.6	34	19	15	6	2	5	9	6	2
Men											
Education (years)											
7	7533	47.8	55	29	16	9	5	14	16	9	12
8-9	6229	45.7	46	31	16	8	4	12	11	7	11
10	3337	46.2	41	31	15	6	3	12	11	8	11
11-12	2045	45.9	41	34	13	7	3	13	12	7	11
13-16	2251	45.3	26	33	11	4	3	10	8	4	8
Income (quintiles)											
0**	240	47.2	63	27	25	12	4	20	33	21	20
1	3786	47.1	50	29	19	10	5	15	16	9	12
2	4419	46.8	47	30	15	8	4	13	14	7	12
3	4475	46.5	46	31	13	7	4	13	12	7	12
4	4417	46.3	45	33	14	6	4	11	11	8	11
5	4300	45.7	41	31	16	7	3	11	10	7	9

All baseline characteristics had chi-square test for trend p-values $<$ 0.05 by income and education level
* History of diabetes or cardiovascular disease or symptoms at baseline
** Zero or unknown income group excluded from tests for trend

high triglyceride levels (≥ 3.5 mmol/l) (χ^2 trend, $p < 0.05$). Also, the prevalence of those reporting a history of diabetes or cardiovascular disease or symptoms decreased with increasing level of education and income among women and men (χ^2 trend, $p < 0.05$).

The prevalence of obesity and hypertension showed a more striking socioeconomic-related decrease among women than among men (table 1): Among women, the prevalence of obesity and systolic hypertension was 3 times higher and the prevalence of diastolic hypertension was 2 times higher in the lowest compared to the highest education group. In contrast, among men the prevalence of obesity was only 2 times higher, and the prevalence of systolic and diastolic hypertension 1.6 and 1.4 times higher in the lowest compared to the highest education group (age-adjusted differences in slope for each risk factor between men and women, $p < 0.01$).

In the analyses of risk factors examined as continuous variables, the socioeconomic status gradient was often steeper among women than among men. Also, when smoking interactions were identified, the socioeconomic status gradient was often steeper among non-smokers than among smokers, particularly in women. In analyses of age-adjusted mean BMI, we identified significant smoking by income and smoking by education interactions for women and men (table 2). Non-smokers had a greater decline in mean body mass index with increasing level of education and income than smokers. For women non-smokers, the beta coefficient for education was –0.6 kg/m^2 (SE=0.03), and the beta coefficient for income was –0.5 kg/m^2 (SE=0.02), versus beta coefficient of –0.3 kg/m^2 (SE=0.05) for education and income among smokers ($p < 0.05$ for all coefficients). In contrast, men non-smokers had modest decreases and smokers had imperceptible changes in age-adjusted BMI by education and income level. For male non-smokers, the beta coefficient for education was –0.3 kg/m^2 (SE=0.02) and for income was –0.12 kg/m^2 (SE=0.02, $p < 0.05$), while for smokers the beta coefficient for education was –0.06 (SE=0.03, $p < 0.05$) and for income was 0.02 kg/m^2 (SE=0.02, non-significant).

Similarly, socioeconomic status-related decreases in mean systolic blood pressure were greater among women and men non-smokers than smokers after controlling for age and body mass index, with women non-smokers having the greatest socioeconomic status-

Table 2. Adjusted mean body mass index+ and systolic blood pressure++ by education, income, smoking, and gender among married residents, three counties, Norway (n=43,878).

		Body mass index		Systolic blood pressure	
	(n)	Smoker	Non-smoker	Smoker	Non-smoker
Women					
Education (years)					
7	8151	24.4	26.1*	133.6	135.4*
8-9	7931	24.4	25.5	133.1	133.9
10	3251	23.6	24.7	131.6	131.5
11-12	1087	23.7	24.3	129.6	129.6
13-16	1170	23.7	23.9	131.7	128.6
Income (quintiles)					
0 or unknown ¥	309	24.7	26.8	137.2	133.7
1	4672	25.0	26.1*	133.9	135.5*
2	4232	24.4	26.0	133.8	135.1
3	4247	24.1	25.9	132.5	133.8
4	4202	23.9	25.8	133.0	131.9
5	4082	23.8	25.6	131.0	130.0
Men					
Education (years)					
7	7202	25.1	26.4*	136.7	137.8*
8-9	6026	25.0	26.0	137.5	137.1
10	3245	25.1	25.7	136.2	136.1
11-12	1962	25.1	25.7	137.1	135.7
13-16	2170	24.6	24.9	135.1	133.9
Income (quintiles)					
0 or unknown ¥	233	25.1	26.4	137.0	136.8
1	3702	25.1	26.0*	137.8	137.5
2	4241	25.0	25.7	137.6	137.4
3	4309	25.1	25.7	136.8	136.6
4	4251	25.0	24.9	136.3	136.1
5	4096	25.1	25.6	135.3	135.0

+ Adjusted for age
++ Adjusted for age and body mass index
¥ Zero category omitted from statistical tests
* Smoking by education or income interaction term, $p < 0.05$

related decline in systolic blood pressure (table 2). For women non-smokers, the beta coefficient for education was –1.8 mmHg (SE=0.1) and for income was –1.4 mmHg (SE=0.1), while for women smokers the beta coefficient for education was –0.9 mmHg (SE=0.1) and for income was –0.8 mmHg (SE=0.1, $p < 0.05$ for smoking by socioeconomic status interaction and beta coefficients). Among men, the beta coefficient for education among non-smokers was –0.9 mmHg (SE=0.1, $p < 0.05$) versus that of –0.2 mmHg (SE=0.1) for smokers ($p < 0.05$ for smoking by education interaction). Similar overall decreases in systolic blood pressure were observed by income level among men, but the slopes for smokers and non-smokers were similar: for smokers and non-smokers combined the beta coefficient was –0.6 mmHg (SE=0.1, $p < 0.05$).

Adjusted mean diastolic blood pressure decreased slightly with increasing level of education and income, with greater decreases observed among women than men but no differences in slope noted by smoking status. Among women, mean diastolic blood pressure decreased from 84.1 mmHg to 82.4 mmHg from the lowest to highest level of education and income after adjusting for age, BMI, and smoking (beta coefficient = –0.5, SE=0.05, $p < 0.05$). Among men, adjusted mean diastolic blood pressure decreased from 87.3 to 86.6 mmHg from lowest to highest level of education and from 87.7 to 86.5 mmHg from lowest to highest level of income ($p < 0.05$).

In analyses of total cholesterol, adjusting for age, BMI, and time since last meal, we also observed greater socioeconomic status-related decreases among women than among men, but no differences in slope by smoking status (table 3). Women had a 0.6 mmol/l decrease in adjusted mean total cholesterol from the lowest to highest education category and a 0.2 mmol/l decrease from the lowest to highest income category. In contrast, men had a 0.3 mmol/l decrease in adjusted mean total cholesterol from lowest to highest education category ($p < 0.05$) and no significant trend by income level.

In analyses of adjusted mean triglyceride levels, we identified similar decreases for both sexes by income and education (table 3). To illustrate, adjusted mean

Table 3. Adjusted[+] mean total serum cholesterol and systolic blood pressure by education, income, smoking, and gender among married residents, three counties, Norway (n=43,878).

		Total serum cholesterol		Triglycerides	
	(n)	Smoker	Non-smoker	Smoker	Non-smoker
Women					
Education (years)					
7	8151	6.62	6.44	1.69	1.40*
8-9	7931	6.25	6.11	1.65	1.40
10	3251	6.21	6.05	1.57	1.35
11-12	1087	6.29	5.99	1.53	1.34
13-16	1170	6.08	5.74	1.45	1.30
Income (quintiles)					
0 or unknown ¥	309	6.63	6.31	1.80	1.58*
1	4672	6.58	6.28	1.71	1.40
2	4232	6.46	6.16	1.72	1.40
3	4247	6.44	6.14	1.64	1.41
4	4202	6.41	6.11	1.61	1.37
5	4082	6.38	6.06	1.55	1.31
Men					
Education (years)					
7	7202	6.48	6.31*	2.20	2.07NS
8-9	6026	6.36	6.16	2.22	2.08
10	3245	6.44	6.16	2.20	2.07
11-12	1962	6.41	6.12	2.23	2.10
13-16	2170	6.31	6.02	2.14	2.01
Income (quintiles)					
0 or unknown ¥	233	6.82	6.60	2.34	2.55
1	3702	6.48	6.24NS	2.21	2.08
2	4241	6.39	6.15	2.24	2.11
3	4309	6.36	6.16	2.23	2.10
4	4251	6.41	6.17	2.19	2.06
5	4096	6.42	6.18	2.11	1.98

[+] Adjusted for age (years), body mass index (kg/m^2), and time since last meal (hours)
* Smoking by education or income interaction term, $p \leq 0.05$
¥ Zero category omitted from statistical tests
NS = All trends significant unless noted NS (nonsignificant)

triglyceride levels among women smokers decreased 0.2 mmol/l and for non-smokers decreased 0.1 mmol/l from the lowest to highest education and income level ($p \leq 0.05$ for smoking by socioeconomic status interactions and beta coefficients). Among men the adjusted mean triglyceride levels decreased 0.1 mmol/l from the lowest to highest income level for both smokers and non-smokers ($p \leq 0.05$), while no education trends were noted.

Mortality follow-up

A total of 119 coronary heart disease deaths were identified among the women and 613 among the men during the 9 to 16 years of follow-up from the baseline evaluation. Age-adjusted coronary heart disease mortality rates per 10,000 person years decreased by increasing level of education and income among both sexes (table 4). Those in the highest category of education and income had significantly or borderline significantly reduced risk of coronary heart disease mortality compared to those in the lowest education or first quintile income group (table 4). Education, when examined as a continuous variable, was significantly related to a reduced risk of age-adjusted coronary heart disease mortality for women as well as men (table 5). After additional adjustment for smoking, education was of borderline significance ($p \leq 0.10$) among women only, while income (in Norwegian kroner increments) remained significant for both women and men. After adjustment for numerous coronary heart disease risk factors (age, smoking, systolic blood pressure, total cholesterol, triglycerides, and a history of diabetes or cardiovascular disease or symptoms), income remained a significant predictor of coronary heart disease mortality among women, but not men (table 5). Additional analyses including age attained did not alter the education and income hazard coefficients and rate ratios and are not presented.

DISCUSSION

The prevalence of cardiovascular risk factors at the baseline evaluation decreased with increasing level of education and income among the married women and

Table 4. Age-adjusted coronary heart disease mortality rates and relative risks* by education and income among residents, three counties, Norway (n=43,878).

	Women					Men				
	(n)	Person-years of follow-up	Cases (no.)	Age-adjusted rate**	Age-adjusted RR (95% CI)	(n)	Person-years of follow-up	Cases (no.)	Age-adjusted rate**	Age-adjusted RR (95% CI)
Education (years)										
7	8351	103881	62	5.5	Referent	7533	91592	274	27.3	Referent
8-9	8099	97933	35	3.8	0.8 (0.5–1.2)	6229	74368	138	19.9	0.8 (0.6–0.9)
10	3319	40275	13	3.4	0.7 (0.4–1.2)	3337	40235	84	21.3	0.8 (0.6–1.0)
≥ 11	2312	27845	5	2.0	0.4 (0.2–1.0)	4306	51747	86	18.4	0.7 (0.5–0.9)
Total	22081		115			21405		582		
Income										
0 or unknown	329	3889	8	16.0	2.6 (1.2–5.6)	240	2025	40	186.9	7.1 (5.0–10.2)
1	4786	59202	41	6.7	Referent	3786	45728	124	26.0	Referent
2	4309	51832	27	5.1	0.8 (0.5–1.3)	4419	52382	125	23.3	0.9 (0.7–1.2)
3	4307	51970	14	2.7	0.4 (0.2–0.8)	4475	53424	123	23.1	0.9 (0.7–1.2)
4	4306	52612	19	3.7	0.6 (0.3–1.0)	4417	53383	111	21.1	0.8 (0.6–1.1)
5	4204	52148	10	2.1	0.3 (0.2–0.6)	43000	52982	90	18.1	0.7 (0.5–0.9)
Total	22241		119			21637		613		

* Cox proportional hazards
** Per 10,000 person-years

Table 5. Adjusted beta coefficients[+] for coronary heart disease mortality by education and income among married residents, three counties, Norway (n=43,878).

	Education		Income[++]	
Model	Beta coefficient	(SE)	Beta coefficient	(SE)
Model A				
Women	–0.26	(0.11)**	–0.34	(0.09)***
Men	–0.12	(0.04)***	–0.11	(0.04)***
Model B				
Women	–0.19	(0.11)*	–0.36	(0.09)***
Men	–0.06	(0.04)	–0.09	(0.04)***
Model C				
Women	–0.03	(0.11)	–0.23	(0.09)***
Men	–0.02	(0.04)	–0.02	(0.04)

[+] Cox proportional hazards examining education (years) and income (per 100,000 kroner increments) as continuous variables.
[++] Excluding zero or unknown income groups in analyses.

Model A: age-adjusted.
Model B: age- and smoking-adjusted.
Model C: adjusted for age (years), smoking (yes/no), systolic blood pressure (mmHg), total cholesterol and triglycerides (mmol/l), and history of diabetes or cardiovascular disease or symptoms (yes/no).

* p-value ≤ 0.10; ** p-value ≤ 0.05; *** p-value ≤ 0.01.

men in the three counties examined. However, for obesity, systolic and diastolic hypertension, and elevated total cholesterol and triglyceride levels, more striking socioeconomic-related decreases were observed among women than among men. Multivariate analyses of risk factors as continuous variables showed similar gender differences in the socioeconomic status gradient and a stronger association among non-smokers compared to smokers.

In the analyses of coronary heart disease mortality, the inverse gradient in coronary heart disease risk is apparent by educational level among both sexes, but the relatively small number of individuals in the higher education categories reduced the statistical power to observe significant mortality trends by educational level. Only age-adjusted trends were significant among men, while age and smoking adjusted trends were of significance or borderline significance among women.

In contrast, the inverse trend in coronary heart disease mortality observed with income level was significant for both women and men after adjustment for smoking. But, after adjusting for a full range of known risk factors, income remained a significant predictor of coronary heart disease mortality only among women.

The greater magnitude of the socioeconomic-related risk factor and mortality differences observed among women relative to men was unexpected. Mortality differences by socioeconomic status are generally considered to be greater in men than women.[20] However, the preponderance of the evidence for sex differences relates to total mortality and not coronary heart disease mortality. Only a few studies have reported greater differences in selected heart disease risk factors or mortality by socioeconomic status in women than in men. For example, among nearly 8,000 residents of a rural Swedish county, differences in resting blood pressure by educational level were more pronounced for women than for men.[21] In England and Wales, the socioeconomic status gradient for ischemic heart disease was steeper for women than for men[22], and in the US National Longitudinal Mortality Study, white women had the strongest inverse gradient in the coronary heart disease mortality by educational level.[23] Because the women in this cohort may represent a more homogeneous group than that of the men, education and income-related effects may be more readily discernible among women. Men, sharing similar income or educational level, may represent a heterogeneous group with the respect to work-related and other lifestyle stressors.

Our findings are consistent with several studies that have found that low level of education, income, or other socioeconomic indicators is related to a greater prevalence of smoking, obesity, leisure time inactivity, and hypertension.[1,2,24,25-29] The inverse association of socioeconomic status with smoking, leisure time inactivity, and to a lesser extent obesity, has been consistent in the literature,[30] while inconsistencies have been noted for hypertension or blood pressure,[24,25,28,31] and total cholesterol.[1,9,24,26-28,31-32] Our results are in accordance with the 1972 Oslo Study and the 1974-76 Norwegian County Study.[33]

A strength of our data is that we were able to examine socioeconomic status-related risk factor differences by smoking status and control for smoking in the prospective analyses of coronary heart disease mortality. Our data indicate that most of the socioeconomic inequalities in coronary heart disease mortality are due to differences in traditional cardiovascular risk factors. In contrast, analyses of the Oslo Study 1972 and the first cardiovascular survey conducted in 1974-76 in the same three counties (Oppland, Sogn og Fjordane, Finnmark) showed that coronary heart disease mortality differences by socioeconomic status in men were generally greater than would be expected from the risk factor differences.[33] However, the study by Thürmer included the Oslo Study.[26] She found that the gradient with education was steepest in Oslo.

The cohort we examined was a homogeneous one: all were married and there was little variation in education and income. The difference between the 10th and 90th percentile of income (excluding the zero income category) was 280,000 Norwegian kroner. The magnitude of the socioeconomic-related differences observed over small increments of education or income in this population is striking evidence of the importance of socioeconomic status as a risk factor in coronary heart disease. Furthermore, in additional analyses of this cohort, men's CHD mortality rates decreased with increasing level of wives' education within each stratum of men's education, with the exception of men in the lowest (7 years) education category.[34] The results suggest that partner's educational level could add valuable information to studies designed to characterize and measure the influence of socioeconomic status.

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