Childhood socioeconomic status and risk of cardiovascular disease in middle aged US women: a prospective study

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Abstract

Objective – To examine prospectively the relationship of childhood socioeconomic status and risk of cardiovascular disease in middle aged women.

Design – A prospective cohort of women with 14 years follow up data (1976–90).

Subjects – A total of 117 006 registered female nurses aged 30 to 55 years in 1976 and free of diagnosed coronary heart disease, stroke, and cancer at baseline.

Main outcome measures – Incident fatal coronary heart disease, non-fatal myocardial infarction, and stroke (fatal and non-fatal).

Results – Low socioeconomic status in childhood was associated with a modestly increased risk of incident non-fatal myocardial infarction and total cardiovascular disease in adulthood. Compared with middle aged women from white collar childhood backgrounds, the age adjusted risk of total cardiovascular disease for women from blue collar backgrounds was 1.13 (95% CI 1.02,1.24) and that of non-fatal myocardial infarction was 1.23 (95% CI 1.06,1.42). No significant increase in risk was observed for stroke or fatal coronary heart disease. Adjustment for differences in family and personal past medical history, medication use, exercise, alcohol intake, diet, birth weight, being breastfed in infancy, and adult socioeconomic circumstance somewhat attenuated the increased risks observed for women from blue collar childhood socioeconomic backgrounds. In multivariate analysis, women whose fathers had been manual labourers had the highest relative risk of total coronary heart disease (RR = 1.53; 95% CI 1.09,2.16) and non-fatal myocardial infarction (RR = 1.67; 95% CI 1.11, 2.53) when compared with women whose fathers had been employed in the professions.

Conclusion – In this group lower childhood socioeconomic status was associated with a small but significant increase in the risk of total coronary heart disease as well as non-fatal myocardial infarction. For women from the most socioeconomically disadvantaged childhood backgrounds, the association is not explained by differences in a large number of cardiovascular risk factors, by differences in adult socioeconomic status, or by differences in

indices of nutrition during gestation or infancy.

(*J Epidemiol Community Health* 1995;49:10–15)

Low socioeconomic status is associated with increased morbidity and mortality. These differences are most evident in the very young as well as those over 65 years of age, especially after the exclusion of occupationally related deaths.^{1,2} Socioeconomic status is also associated with differences in cardiovascular disease incidence³ and coronary heart disease mortality.⁴ An inverse relationship between socioeconomic status and risk of stroke and coronary heart disease has been reported in several prospective studies.⁵ Furthermore, the decline in mortality from cardiovascular disease in western societies over the past two decades has been most evident in higher socioeconomic groups.⁶ The mechanisms underlying these associations are not clear but have been the subject of recent research.

Risk factors for cardiovascular disease are more prevalent among children and adults from lower socioeconomic backgrounds.^{7–9} Social class differences in diet and physical activity in children have been described.^{4,10} In addition, previous studies of childhood socioeconomic status and risk of cardiovascular disease have failed to address adequately the problem of confounding by achieved adult socioeconomic status. For these reasons, it remains unclear whether childhood status is independently linked to risk of cardiovascular disease in adulthood.¹¹

The nurses' health study offers a unique opportunity to address these issues among women. Baseline data allowed the assignment of childhood socioeconomic status. Variability in achieved socioeconomic status of this cohort is less than in the general population. All female nurses qualify for the same socioeconomic status rating as adults on the Duncan scale,¹² which is independent of marital status and occupation of spouse.

In this report we assess whether there is a relation between childhood socioeconomic status and risk of cardiovascular disease in a large cohort of US female nurses after adjustment for a large number of cardiovascular risk factors, including sociodemographic variables.

Methods

The nurses' health study cohort was established

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Accepted for publication
October 1994

in 1976 when 121 700 registered female nurses 30–55 years of age, residing in 11 US states, completed lifestyle and medical history questionnaires sent by mail. Approximately 98% of the cohort is white.¹³ Biennial follow up questionnaires sent by mail update information on life events, cardiovascular risk status, cardiovascular disease, and other health related events. At baseline all women who reported coronary heart disease, stroke, or cancer (other than non-melanoma skin cancer) were excluded, leaving a cohort of 117 006 women available for follow up.

In 1980, a validated, semiquantitative food frequency questionnaire as well as questions assessing physical activity were added to the follow up and have been updated regularly.^{14,15} A total of 88 366 nurses free of prevalent cardiovascular disease or cancer completed and returned the 1980 diet questionnaire.

In the 1992 questionnaire 88 968 participants completed information on their birth weight, whether they were breastfed as infants and, if currently married or widowed, their husband's highest educational attainment.

EXPOSURE DATA

In 1976 each woman was asked to state the occupation of her parents when she was aged 16 years, in a form that allowed coding of responses consistent with the USA census book codes for occupations.¹⁶ This classification, which has been used by the Census Bureau since 1940,¹⁷ assigns each subject to one of eight separate categories (listed below). These categories correlate strongly with socioeconomic status ratings calculated by the validated method devised by Duncan^{12,17} for the population of the USA at a time contemporary to the childhood and youth of the members of the nurses' health study cohort. This method specifically correlates with household income and occupational prestige, variables which indicate educational and other environmental opportunities available to children.¹⁷

The only exception is for the category "farmer". The Duncan score is said to underestimate their true economic wellbeing which is enhanced by an active "barter" economy.^{12,16,17} These categories (listed in descending order by Duncan's socioeconomic score) are as follows:

- (1) Professional/technical;
- (2) Managers/officials/proprietors;
- (3) Clerical and kindred workers;
- (4) Skilled blue collar;
- (5) Semi-skilled blue collar;
- (6) Domestic and service workers;
- (7) Farmers/farm workers;
- (8) Labourers (except farm workers).

To increase statistical power while retaining the validity of the measure of childhood socioeconomic status, these categories were consolidated into three groups – white collar (categories 1, 2, 3), blue collar (categories 4, 5, 6, 8), and farmer (category 7). Childhood socioeconomic status was assigned on the basis of the father's occupation, a method comparable with previously published studies.¹⁸ Of

the remainder, the father was either unemployed, retired, or his occupational status could not be determined. All women whose fathers were known to be dead by the time each woman was 16 years old were placed in the "father deceased" category. This was determined by an algorithm which compared the father's date of death with the study participant's date of birth. Only 1861 women did not supply sufficient information to enable their classification into one of these four categories.

In 1976 and 1984, participants were asked whether their father or mother had suffered a myocardial infarction and if so, at what age. If a participant indicated that either or both parents had suffered an infarction before age 60 years, the participant was considered to have a positive parental history of early-onset myocardial infarction.

In 1992, participants who were currently married or widowed were asked to indicate their husband's highest level of education. A total of 6649 women were divorced and were not asked to complete this question. Education levels are highly correlated with socioeconomic status.¹⁹ Responses were categorised as no high school, some high school, high school graduate, college graduate, graduate school. Of the 88 968 women who completed the 1992 questionnaire, 74 668 indicated they were either currently married or were widowed. Of these, all but 163 provided information of their husband's educational attainment.

In 1976, cigarette smoking was categorised as never, former, and current, with current smokers categorised as 1–14 cigarettes/d, 15–24/d, 25+ /d. Information on smoking status was updated biennially. Questions about physician-diagnosed hypertension, hypercholesterolaemia, and diabetes were also first asked in 1976 and updated biennially.

Also in 1976, weight was recorded and then updated in every biennial questionnaire. In a validation study among 184 cohort members living in the Boston area, these self reported weights correlated highly with those measured by a technician.²⁰ Height was taken from the 1976 questionnaire. Body mass index was calculated as weight (in kg) divided by the height (in m²) and was categorised into quintiles.

In 1980, a history of regular aspirin use was obtained and updated biennially. We calculated the average number of tablets or capsules taken per week and categorised aspirin use as <1 aspirin per wk, 1–6/wk, >6/wk. In 1976, information on postmenopausal hormone and oral contraceptive use was collected and updated biennially. Hormone replacement therapy and oral contraceptive use were categorised as current, past, or never.

The 1980 questionnaire inquired about the frequency of vigorous exercise. Activity levels were assessed by the number of "sweat inducing" exercise sessions per week. This method has been validated in several studies.^{21–23} We divided the cohort into those women who exercised vigorously at least once per week, and those who did not.

Also in 1980, alcohol intake was assessed in the semiquantitative food frequency ques-

tionnaire. Alcohol consumption was updated in 1984 and then biennially. Daily alcohol consumption was categorised as nil, 1–4.9 g/d, 5–14.9 g/d, >14.9 g/d. In this cohort the validity of self reported alcohol intake is high.^{24 25}

Dietary intake of trans fatty acids is associated with the risk of incident coronary heart disease.²⁶ For the current analysis, the energy adjusted dietary intake of trans fatty acids was assessed and divided into quintiles. Vitamin E intake is also associated with the risk of incident coronary heart disease.²⁷ As much of the observed benefit was attributable to oral vitamin E supplementation, quantification of intake for the current analysis included oral supplements. Vitamin E intake was categorised by quintiles.

In the 1992 questionnaire, participants reported whether they had been breastfed as infants. Responses fell into one of the categories “yes”, “no”, or “don’t know”. Of the 87 917 women who answered this question, 14 586 indicated they “don’t know”. In the same questionnaire, they were also asked to indicate if their birth weight (in lb) fell within the categories: not sure; <5; 5 to 5.5; 5.5 + to 7; 7 + to 8.5; 8.5 + to 10; 10 +. Of the 87 314 women who answered this question, 16 924 indicated they were “not sure”.

ASCERTAINMENT OF CARDIOVASCULAR OUTCOMES

Reports of non-fatal and fatal cardiovascular outcomes were assessed by standard methods²⁸ which included physician review of medical records. A diagnosis of myocardial infarction was confirmed if the relevant World Health Organization criteria were met.²⁹ These require the presence of symptoms and either typical electrocardiograph changes or elevation of cardiac enzymes. Medical records to validate reports of coronary artery bypass grafting were obtained for events dating from 1978 onwards.³⁰

A diagnosis of stroke was confirmed if the event was characterised by a typical neurological defect of rapid or sudden onset, lasting at least 24 hours and attributable to a cerebrovascular event which was not secondary to infection or neoplasia. Subdural haematomas were excluded from analysis. Total non-fatal

and fatal cardiovascular disease comprised the sum of non-fatal myocardial infarction and non-fatal stroke, and fatal coronary heart disease and fatal stroke respectively.

Most deaths were reported by relatives or postal authorities. The National Death Index was searched biennially for non-responders. In suspected cases of cardiovascular death, permission to review medical records was sought from the next of kin.

STATISTICAL ANALYSIS

Incidence rates were computed for non-fatal myocardial infarction and fatal coronary heart disease, non-fatal and fatal stroke, and non-fatal and fatal cardiovascular disease. The cohort at risk included only those who were free of cardiovascular disease at the beginning of each follow up interval.

Rates were obtained by dividing incident cases by person years in each exposure category. All relative risks were age adjusted and 95% confidence intervals (95% CI) were calculated. Proportional hazards models were used to evaluate the effects of childhood socioeconomic status while controlling for known and suspected cardiovascular risk factors. When a diagnosis of a cardiovascular end point was made, follow up was stopped.

Where a significant association between socioeconomic status and age adjusted rates of cardiovascular diseases was found, we progressively added known and suspected risk factors for cardiovascular disease^{13 26–28 31–33} to the multivariate models. This was done to determine whether differences in any of these variables provided a plausible explanation for any differences in risk of incident cardiovascular diseases between the childhood socioeconomic status groups.

Only those end points that occurred between the return of the 1976 questionnaire and 1 June 1990 were included in the age adjusted as well as the multivariate analyses. Since information on aspirin, exercise, alcohol intake, and diet were first sought in 1980, multivariate modelling including these variables was restricted to those end points that occurred after that date. In order to compare the effects of the addition of these variables with age adjusted findings, we also calculated age adjusted relative risks for outcomes occurring between 1980 and 1 June 1990.

Since information on spouses’ education, participant’s birth weight, and breastfed status were collected in 1992, these variables could only be used in models where non-fatal disease was the outcome.

Results

Between 1976 and 1990 we documented 949 cases of non-fatal myocardial infarction, 364 cases of fatal coronary heart disease, 634 cases of non-fatal stroke, and 194 cases of fatal stroke. In age adjusted analyses (table 1), women from blue collar and “father deceased” childhood backgrounds had a small but significantly increased risk of non-fatal myocardial infarction,

Table 1 Age standardised relative risks (95% CI) of cardiovascular diseases by childhood socioeconomic status 1976–90

	White collar	Blue collar	Farmer	Father deceased*
No of women	41 225	54 396	9764	9760
Person years exposure	563 577	742 515	133 051	131 024
Cardiovascular disease†:				
Total RR(CI)	1.00	1.13(1.03,1.24)	0.89(0.75,1.06)	1.23(1.05,1.44)
Non-fatal	1.00	1.17(1.04,1.31)	0.92(0.76,1.12)	1.28(1.08,1.54)
Fatal	1.00	1.03(0.86,1.24)	0.81(0.59,1.11)	1.14(0.85,1.53)
Coronary heart disease:				
Total RR(CI)	1.00	1.17(1.03,1.33)	0.85(0.69,1.06)	1.29(1.06,1.57)
Non-fatal MI	1.00	1.23(1.06,1.42)	0.93(0.72,1.19)	1.35(1.08,1.69)
(Cases)	(285)	(481)	(81)	(102)
Fatal	1.00	1.09(0.86,1.37)	0.69(0.46,1.05)	1.20(0.84,1.72)
(Cases)	(119)	(179)	(27)	(39)
Stroke:				
Total RR(CI)	1.00	1.01(0.86,1.18)	0.96(0.74,1.23)	1.17(0.91,1.47)
Non-fatal	1.00	1.02(0.86,1.22)	0.95(0.71,1.26)	1.22(0.93,1.60)
(Cases)	(210)	(295)	(61)	(68)
Fatal	1.00	0.95(0.69,1.30)	0.96(0.57,1.60)	1.07(0.64,1.78)
(Cases)	(68)	(88)	(19)	(19)

* Father deceased when cohort member was aged 16 years.
† Coronary heart disease and stroke.

Table 2 Age standardised relative risks (95% CI) of cardiovascular diseases by childhood socioeconomic status 1980–90

	White collar	Blue collar	Farmer	Father deceased*
No of women	40 140	52 914	9499	9416
Person years exposure	391 044	514 647	92 239	91 747
Cardiovascular disease†:				
Total RR(CI)	1.00	1.13(1.01,1.26)	0.94(0.78,1.13)	1.13(0.94,1.35)
Non-fatal	1.00	1.16(1.02,1.31)	0.98(0.79,1.21)	1.20(0.98,1.47)
Fatal	1.00	1.04(0.85,1.29)	0.79(0.55,1.14)	0.93(0.65,1.33)
Coronary heart disease:				
Total RR(CI)	1.00	1.19(1.03,1.37)	0.92(0.71,1.17)	1.22(0.97,1.53)
Non-fatal MI	1.00	1.25(1.06,1.47)	1.03(0.79,1.36)	1.34(1.03,1.73)
(Cases)	(223)	(384)	(70)	(79)
Fatal	1.00	1.07(0.82,1.39)	0.65(0.40,1.04)	0.93(0.59,1.45)
(Cases)	(94)	(139)	(20)	(24)
Stroke:				
Total RR(CI)	1.00	1.00(0.84,1.19)	0.96(0.73,1.27)	1.03(0.78,1.37)
Non-fatal	1.00	0.98(0.80,1.19)	0.93(0.68,1.27)	1.03(0.75,1.42)
(Cases)	(176)	(236)	(50)	(48)
Fatal	1.00	1.06(0.74,1.50)	1.05(0.60,1.84)	0.95(0.52,1.75)
(Cases)	(52)	(75)	(16)	(13)

* Father deceased when cohort member was aged 16 years.
† Coronary heart disease and stroke.

Table 3 Relative risks (95% CI) of coronary heart disease by childhood socioeconomic status in multivariate analysis

	White collar	Blue collar	Farmer	Father deceased*
Non-fatal myocardial infarction				
Model 1	1.00	1.19(1.03,1.38)	1.07(0.83,1.37)	1.33(1.06,1.67)
2	1.00	1.19(1.03,1.38)	1.12(0.88,1.44)	1.29(1.03,1.62)
3+	1.00	1.20(1.02,1.41)	1.19(0.91,1.56)	1.25(0.98,1.61)
4+	1.00	1.18(1.01,1.39)	1.16(0.89,1.51)	1.24(0.97,1.60)
5+	1.00	1.18(1.01,1.39)	1.17(0.90,1.53)	1.20(0.93,1.54)
6+	1.00	1.17(0.99,1.37)	1.15(0.88,1.50)	1.18(0.92,1.52)
Fatal coronary heart disease				
Model 1	1.00	0.98(0.75,1.27)	0.76(0.48,1.22)	1.12(0.74,1.68)
2	1.00	0.97(0.75,1.26)	0.79(0.49,1.26)	1.09(0.73,1.64)
3+	1.00	0.97(0.73,1.28)	0.72(0.43,1.22)	0.95(0.60,1.51)
4+	1.00	0.94(0.72,1.25)	0.69(0.41,1.16)	0.93(0.59,1.48)
Total coronary heart disease				
Model 1	1.00	1.14(1.00,1.29)	0.99(0.79,1.23)	1.28(1.05,1.56)
2	1.00	1.13(1.00,1.39)	1.03(0.83,1.29)	1.24(1.02,1.51)
3+	1.00	1.14(0.99,1.31)	1.06(0.84,1.35)	1.18(0.94,1.46)
4+	1.00	1.12(0.98,1.29)	1.03(0.81,1.30)	1.16(0.93,1.45)
5+	1.00	1.12(0.97,1.29)	1.04(0.82,1.32)	1.11(0.89,1.38)
6+	1.00	1.11(0.96,1.27)	1.02(0.81,1.30)	1.10(0.88,1.37)

Model: 1 = Age, plus body mass index, smoking. 2 = 1, plus parental MI <60 y, past history of hypertension, hypercholesterolaemia, diabetes. 3 = 2, plus aspirin (1–6 per week vs 0 or >6), hormone replacement therapy, past oral contraceptive use. 4 = 3, plus alcohol, exercise, trans fatty acids (energy adjusted), quintiles vitamin E. 5 = 4, plus breastfed, birth weight, adult height. 6 = 5, plus spouses' education.
* Father deceased when cohort member was aged 16 years.
+ Denotes follow up for period 1980–90, when extra study variables used in models 3 and 4 were measured.

total coronary heart, and cardiovascular disease in the range of 15–30%, compared with women from white collar childhood backgrounds. In the same model, women from “farmer” childhood backgrounds had an apparent small but non-significant decrease in the risk of fatal coronary heart disease (RR=0.69; 95% CI 0.46,1.05) and fatal cardiovascular disease (RR=0.81; 95% CI 0.59,1.11). We also observed an apparent small but non-significant elevation in risk of non-fatal stroke (RR=1.22; 95% CI 0.93,1.60) and total stroke (RR=1.17; 95% CI 0.91,1.47) in the “father deceased” group.

Between 1980 and 1990 we documented

756 cases of non-fatal myocardial infarction, 277 cases of fatal coronary heart disease, 510 cases of non-fatal stroke, and 156 cases of fatal stroke. When we limited analysis to this period (table 2), the increased risks observed among the “father deceased” group for non-fatal, fatal and total stroke, non-fatal and total cardiovascular disease, and total coronary heart disease were no longer apparent.

The small but significantly increased risk of total cardiovascular and coronary heart disease in the blue collar and “father deceased” groups was largely due to an increased risk of non-fatal myocardial infarction. The relative risk of non-fatal myocardial infarction and total coronary heart disease fell slightly within the blue collar group when data on body mass index and cigarette smoking were added to the model (table 3). For this group the addition of variables collected in 1980 had little effect on the relative risks, but did widen the confidence intervals because of the smaller numbers of cases in the restricted analysis. The relative risks for outcomes increased slightly among the farmer group but fell markedly among the “father deceased” group.

When we refined the categories of white collar and blue collar into the occupational classification scheme of Edwards¹⁷ as shown in table 4 (apart from the “farmer group” for which these data are given in table 3), we observed the largest increase in risks found in the present analyses. The relative risk of total coronary heart disease was 1.53 (95% CI 1.09, 2.16) and that of non-fatal myocardial infarction was 1.67 (95% CI 1.11,2.53) in the lowest (labourer) compared with the highest (professional) childhood socioeconomic group after adjustment for all potential confounding variables. In multivariate analysis a significant trend of increased risk of non-fatal myocardial infarction (p=0.045) with decreased childhood socioeconomic status was observed.

Discussion

In this prospective cohort study we observed a small but significantly increased risk of total cardiovascular disease (defined as coronary heart disease and stroke) among women from blue collar childhood backgrounds compared with women from white collar childhood backgrounds. The apparent small increase in risk of cardiovascular disease among women from lower socioeconomic backgrounds was due largely to an excess of coronary heart disease. While the larger number of cases of heart dis-

Table 4 Relative risks (95% CI) of coronary heart disease (CHD) by disaggregated childhood socioeconomic status in multivariate analysis

	Professional	Manager	Clerical	Skilled blue collar	Semi-skilled blue collar	Domestic	Labourer
No of women	12 377	17 171	11 677	27 203	17 432	6100	3661
Person years exposure	169 198	234 803	159 576	371 093	238 297	83 257	49 868
Total CHD	1.00	1.13	0.87	1.12	1.02	1.26	1.53
Model 6+		(0.87,1.47)	(0.64,1.18)	(0.88,1.42)	(0.79,1.32)	(0.92,1.73)	(1.09,2.16)
Fatal CHD	1.00	0.70	0.69	0.69	0.69	0.85	1.30
Model 4+		(0.43,1.15)	(0.40,1.20)	(0.44,1.07)	(0.43,1.12)	(0.46,1.55)	(0.70,2.41)
Non-fatal MI	1.00	1.35	0.93	1.32	1.19	1.46	1.67
Model 6+		(0.94,1.84)	(0.65,1.34)	(0.99,1.77)	(0.87,1.63)	(1.01,2.11)	(1.11,2.53)

Model: see table 3. MI = myocardial infarction.

ease than stroke may account for this, it should also be noted that risk factors for myocardial infarction and stroke differ.³⁴

The small increase in risk for women in the blue collar group was not explained fully by differences in confounding or intermediate variables. In particular, when we disaggregated the childhood socioeconomic categories and compared the most disadvantaged with the most advantaged group in multivariate analysis, there was an excess risk of total coronary heart disease and non-fatal myocardial infarction in the range of 50–70%. This excess is similar to that reported for middle aged men in the Kuopio study,³⁵ which used paternal occupation in association with other parental variables to assign childhood socioeconomic status within three categories. In that study, adjustment for cardiovascular risk factors and adult socioeconomic status weakened but did not eliminate the association between childhood socioeconomic status and prevalent ischaemic heart disease.

When we adjusted associations for differences in cardiovascular risk factors and socio-demographic variables, the risk estimates were attenuated for women whose fathers were deceased but were increased among women in the farmer group. This raises the possibility that some of the increased incidence of coronary heart disease in the former and decreased incidence in the latter were due to differences in risk factors in adulthood which were associated with childhood socioeconomic status.

Recent reviews have examined longitudinal and case-control studies of the association between early life environment and adult cardiovascular disease,^{11,36} and concluded that the observed associations were compromised by inadequate handling of confounding variables, in particular of adult socioeconomic status. This may lead to an overestimation of the risk associated with lower childhood socioeconomic status. Our analysis was performed among a cohort of female registered nurses, a relatively homogeneous group for adult socioeconomic status. In addition, we adjusted for differences in the socioeconomic status of spouses of the cohort members.

It is possible that the effect of differences in childhood socioeconomic status among women in this study was confounded by the socioeconomic status of their spouses and hence by the economic wellbeing of the woman's domestic arrangements. While educational attainment is an important variable in assessing adult socioeconomic status,¹⁹ some caveats apply in assessing its validity in this analysis. We assessed spouses' educational status only in 1992. For some, this person may not be the same spouse preceding the woman's cardiovascular event. No information on spouses' educational attainment was available for cases of fatal cardiovascular disease. Finally, almost 17% of the cohort were either unmarried in 1992 or gave no reply to this question. However, inclusion of this variable in multivariate modelling did not materially affect the risk estimates.

We used the father's and not the mother's

occupation to determine childhood socioeconomic status.³⁷ An analysis of the distribution of mother's listed occupation in this cohort showed that over 66% were employed in domestic duties and analyses of models based solely on mother's occupation showed no increased risk for any group.

A recent case-control study suggested differences in coronary heart disease rates among adult men from different (adult) socioeconomic groups could be explained by differences in serum high density lipoprotein cholesterol.¹⁸ The possible role of adult blood lipid subfractions in accounting for the differences in the present study could not be determined, as haematological variables were not ascertained in this cohort.

It has been argued that early life environmental factors such as fetal nutrition or being breastfed in infancy might have long term effects on the risk of cardiovascular disease. Babies who are small at birth or during infancy have increased rates of cardiovascular disease and non-insulin dependent diabetes mellitus as adults.³⁸ Adult height, which is positively related to childhood nutritional status and inversely related to the adult risk of cardiovascular disease,³⁹ has been used in a number of studies as a proxy for childhood socioeconomic experience.^{40,42} However, inclusion of these variables in multivariate modelling did not explain the observed associations between childhood socioeconomic status and cardiovascular outcomes among women from blue collar childhood backgrounds.

The associations observed in this cohort may have been due to unequal access to medical intervention in some groups when cardiovascular disease symptoms such as angina pectoris first appeared. While this potential source of bias might be particularly important in a nation without universal health care, when we analysed the rate of coronary artery bypass grafting, women from blue collar childhood backgrounds were somewhat *more* likely to have had this procedure after adjustment for age (RR=1.19; 95% CI 1.02,1.39). This may explain, at least partly, the apparently stronger association between lower childhood socioeconomic status and incidence of myocardial infarction than mortality from coronary heart disease. Although nurses from lower childhood socioeconomic backgrounds were more likely to suffer a myocardial infarct, to the extent that medical interventions (such as bypass grafting) were effective, any association between childhood socioeconomic status and mortality in this cohort may have been underestimated.

All participants in the cohort were selected from registers of the State Boards of Nursing. Thus, all cohort members were health professionals with recognised nursing credentials. If women from lower socioeconomic backgrounds were under-represented in this cohort, then our ability to detect a stronger effect of poverty or absolute deprivation during childhood on risk of coronary heart disease in adulthood would be limited.

In summary, our findings indicate that low childhood socioeconomic status is associated

with a small but significant increase in risk of coronary heart disease in middle aged women. The increased risk among women from blue collar backgrounds was not fully explained by differences in a large number of risk factors for cardiovascular disease. This was particularly so for those women from the most disadvantaged childhood socioeconomic background. Although the magnitude of the association is modest, the public health impact could be substantial.⁴³ Increased preventive efforts targeting modifiable cardiovascular risk factors among children and adolescents before risk behaviour becomes established has been advocated.⁴⁴ These data suggest that such effort should be targetted towards the socio-economically disadvantaged.

Our results suggest that neither differences in fetal nutrition as evidenced by birth weight, nor differences in adult environmental circumstances, could explain the association between childhood socioeconomic circumstances and risk of adult cardiovascular disease observed in our cohort. There is some evidence linking nutritional status in early and middle childhood years to the risk of subsequent cardiovascular disease.^{45,46} If these findings are confirmed, nutritionally based intervention programmes in childhood may offer a means of addressing the imbalance in the later life risk of cardiovascular disease.

A hypothesis worthy of investigation is whether directly addressing socioeconomic deprivation in childhood might be of added effectiveness in reducing the risk of coronary heart disease in later life.

Supported by research grants (HL 24074, HL 34594, CA 40935 and CA 40356) from the National Institutes of Health, USA.

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