Papers

Socioeconomic position in childhood and adulthood and insulin resistance: cross sectional survey using data from British women's heart and health study

Debbie A Lawlor, Shah Ebrahim, George Davey Smith

Abstract

Objective To assess the associations between childhood and adulthood social class and insulin resistance.
Design Cross sectional survey.
Setting 23 towns across England, Scotland, and Wales.
Participants 4286 women aged 60-79 years.
Main outcome measures Insulin resistance and other cardiovascular disease risk factors.
Results Belonging to manual social classes in childhood and in adulthood was independently associated with increased insulin resistance, dyslipidaemia, and general obesity. The association between childhood social class and insulin resistance was stronger than that for adult social class. The effect, on insulin resistance and other risk factors, of belonging to a manual social class at either stage in the life course was cumulative, with no evidence of an interaction between childhood and adult social class. Women who were in manual social classes in childhood remained at increased risk of insulin resistance, dyslipidaemia, and obesity—even if they moved into non-manual social classes in adulthood—compared with women who were in non-manual social classes at both stages.
Conclusions Adverse social circumstances in childhood, as well as adulthood, are strongly and independently associated with increased risk of insulin resistance and other metabolic risk factors.

Introduction

Several studies have investigated the association between socioeconomic circumstances across the life course and cardiovascular disease.[1] Most,[2–5] although not all,[6] have found that poor socioeconomic circumstances in childhood are associated with increased risk of cardiovascular disease in later life. This association is independent of adult socioeconomic position and therefore is not simply due to childhood circumstances being an indicator of the continuity of social disadvantage throughout life.[3–5] The underlying mechanism for the association is unclear. Several studies, mainly conducted in men, have found that poorer childhood socioeconomic position is associated with obesity, high blood pressure, and dyslipidaemia.[5 7–9] By contrast, in the Whitehall II study, associations between childhood socioeconomic position and adult cardiovascular disease risk factors were, on the whole, found to be weak or absent, although among women poorer childhood social class was associated with lower high density lipoprotein cholesterol and higher fibrinogen levels.[10]

High blood pressure, dyslipidaemia, and obesity are components of the insulin resistance syndrome. Components of this syndrome are known to cluster in childhood, and this clustering tracks into adulthood.[11] It has been suggested that poor social circumstances in childhood lead to insulin resistance, resulting in the insulin resistance syndrome and increased cardiovascular disease risk in later life.[8] No previous studies have directly assessed the association between childhood socioeconomic position and insulin resistance. Few studies have assessed the association between childhood social circumstances and cardiovascular disease risk factors in women, although recent studies have found that poor childhood socioeconomic circumstances are associated with increased cardiovascular disease risk in later life in women.[12 13]

We assessed the association between childhood and adulthood social class and a wide range of cardiovascular disease risk factors, including insulin resistance, in a cohort of older British women.

Methods

Participants

The British women's heart and health study is a study of women aged 60-79 randomly selected from general practitioners' lists from 23 towns across England, Scotland, and Wales. A total of 4286 women (60% of those invited) participated, and baseline data were collected between April 1999 and March 2001.

Measurements

Full details of all measurements have been reported.[14] Details of the participant's longest held occupation, and that of her father and husband, were requested. Adult social class was derived from the longest held occupation of the participant's husband for married women and her own for single women. Childhood social class was derived from the longest held occupation of the participant's father. Social class was catego-

Department of Social Medicine, University of Bristol, Bristol BS8 2PR
Debbie A Lawlor *MRC research training fellow*
Shah Ebrahim *professor*
George Davey Smith *professor*
Correspondence to: D A Lawlor d.a.lawlor@bristol.ac.uk

bmj.com 2002;325:805

Registrar general's occupational social classes

Non-manual
I Professional occupations
II Managerial and technical occupations
III(N) Skilled occupations, non-manual

Manual
III(M) Skilled occupations, manual
IV Partly-skilled occupations
V Unskilled occupations

rised into one of six social classes based on the registrar general's occupational classification (box).[15]

Blood samples were taken after a 12 hour fast. Insulin resistance was estimated according to the homoeostasis model assessment[16] as the product of fasting glucose and insulin divided by the constant 22.5. Homoeostasis model assessment scores were not calculated for 240 women who were diabetic or had a fasting glucose of ≥8 mmol/l, as the index is not valid in this group.[16] Smoking was categorised as current (including those who reported giving up within six months of attending for baseline examination), former, or never. Alcohol consumption was defined as heavy if the woman reported consuming 21 units or more of any form of alcohol per week.

Statistical analysis

Complete data on social class in both childhood and adulthood were available for 3444/4286 (80%) of the women. Only women with complete data on social class at both times were included in the analyses. Compared with women who did not have complete social class data, those with complete data were slightly younger (68.8 years *v* 69.2 years; P=0.05), had smaller waist:hip ratios (0.818 *v* 0.824; P=0.02), and were less likely to be current smokers (10.4% (35/3444) *v* 16.8% (139/842); P<0.001). No other risk factors showed substantial differences.

We used the likelihood ratio test to assess the possibility of an interaction between childhood and adult social class—for example, different effects between those in manual social classes in childhood and non-manual social class in adulthood to those in manual social classes in childhood and manual social class in adulthood—and multiple logistic regression to assess the cumulative effect of belonging to a manual social class across the life course.

In all models, robust standard errors were used to estimate 95% confidence intervals, taking into account the clustering effect of each town. Homoeostasis model assessment scores and triglyceride concentrations were log normal: geometric means are presented, and the natural log of the concentrations were used in the regression models. Stata version 7.0 was used for all analyses.

Results

Table 1 shows that, in general, there was little movement across social classes. For example, 61% of women who were in social class I in childhood were in either social class I or II in adulthood. Where mobility did occur it was most commonly upwards: 20% of women who were in social class V in childhood were in social class I or II in adulthood.

Tables 2 and 3 show the age adjusted distributions of cardiovascular disease risk factors by social class. Belonging to lower social classes in childhood was linearly associated with increased insulin resistance, reduced high density lipoprotein cholesterol, increased triglycerides, and increased general obesity. These associations remained even after adjustment for adult social class. The association between poor childhood social class and increased insulin resistance was unaffected by adjustment for adult social class. Belonging to lower social classes in adulthood was also linearly associated with increased insulin resistance, reduced high density lipoprotein cholesterol, and increased triglycerides. The association between adult social class and insulin resistance was weaker than that between childhood social class and insulin resistance and was attenuated when adjustment was made for childhood social class. Lower childhood social class was linearly associated with current smoking and was inversely associated with heavy alcohol consumption. Lower adult social class was associated with increased central obesity.

None of the associations with cardiovascular disease risk factors showed any evidence of an interaction between childhood and adulthood social class (all P values >0.2). Table 4 shows the cumulative effect of being in a manual compared with non-manual social class across both stages of the life course. Compared with women who were in non-manual social classes in both childhood and adulthood, those in manual social classes at both l stages were 58% more likely to be insulin resistant, 99% more likely to have low high density lipoprotein cholesterol concentrations, 59% more likely to have high triglyceride concentrations, and 2.4 times more likely to be obese; they also had a 75% higher odds of being current smokers. Those who were in a manual social class at just one stage in the life course were more likely to have these risk factors than were those who were in non-manual social classes in both childhood and adulthood. Women who were in manual social classes in

Table 1 Relation between social class in childhood (derived from father's occupation) and adulthood (derived from husband's occupation or own occupation if single)

Childhood social class	Adult social class: I (n=305)	II (n=769)	III non-manual (n=612)	III manual (n=954)	IV (n=481)	V (n=323)	Total (n=3444)
I	19 (17.3)	48 (43.6)	23 (20.9)	10 (9.1)	6 (5.5)	4 (3.6)	110
II	52 (16.9)	113 (36.7)	53 (17.2)	44 (14.3)	27 (8.8)	19 (6.2)	308
III non-manual	55 (13.8)	123 (30.9)	79 (19.9)	74 (18.6)	40 (10.1)	27 (6.8)	398
III manual	85 (7.4)	249 (21.7)	245 (21.3)	340 (29.6)	130 (11.3)	100 (8.7)	1149
IV	69 (6.5)	176 (16.7)	158 (15.0)	338 (32.0)	215 (20.4)	100 (9.5)	1056
V	25 (5.9)	60 (14.2)	54 (12.8)	148 (35.0)	63 (14.9)	73 (17.3)	423

Figures in parentheses are percentages of those in childhood class in each of the adult social classes.

Table 2 Cardiovascular disease risk factors in British women aged 60-79 related to childhood social class. Values are age adjusted mean or prevalence (95% confidence interval)

	Childhood social class						Difference (95% CI) per increase in social class grade*	
Risk factor	I (n=110)	II (n=308)	III non-manual (n=398)	III manual (n=1149)	IV (n=1056)	V (n=423)	Adjusted for age	Adjusted for age and adult social class
Insulin resistance (homoeostasis model assessment)†	1.43 (1.27 to 1.62)	1.53 (1.42 to 1.65)	1.51 (1.42 to 1.62)	1.66 (1.60 to 1.73)	1.77 (1.70 to 1.85)	1.75 (1.64 to 1.87)	0.006 (0.003 to 0.008)	0.006 (0.003 to 0.008)
Systolic blood pressure (mm Hg)	147.7 (143.2 to 52.2)	146.2 (143.5 to 48.9)	146.7 (144.2 to 149.1)	147.9 (146.5 to 149.3)	147.0 (145.5 to 148.5)	148.1 (145.8 to 150.5)	0.03 (–0.07 to 0.12)	0.02 (–0.07 to 0.11)
Diastolic blood pressure (mm Hg)	80.6 (78.4 to 82.8)	80.0 (78.7 to 81.3)	79.4 (78.3 to 80.6)	79.3 (78.6 to 80.0)	78.9 (78.2 to 79.7)	80.0 (78.9 to 81.2)	–0.02 (–0.06 to 0.03)	–0.01 (–0.06 to 0.03)
Low density lipoprotein cholesterol (mmol/l)	4.35 (4.13 to 4.56)	4.11 (3.98 to 4.23)	4.08 (3.96 to 4.19)	4.19 (4.12 to 4.25)	4.15 (4.08 to 4.22)	4.26 (4.15 to 4.37)	0.001 (–0.003 to 0.005)	0.001 (–0.003 to 0.005)
High density lipoprotein cholesterol (mmol/l)	1.71 (1.62 to 1.79)	1.76 (1.71 to 1.81)	1.74 (1.70 to 1.79)	1.65 (1.63 to 1.68)	1.59 (1.56 to 1.62)	1.63 (1.59 to 1.68)	–0.005 (–0.007 to –0.003)	–0.003 (–0.005 to –0.002)
Triglycerides†	1.69 (1.55 to 1.84)	1.56 (1.48 to 1.65)	1.51 (1.44 to 1.59)	1.70 (1.65 to 1.74)	1.70 (1.65 to 1.75)	1.69 (1.61 to 1.76)	0.002 (0.000 to 0.004)	0.001 (0.000 to 0.003)
Body mass index (kg/m^2)	26.7 (25.8 to 27.6)	26.9 (26.4 to 27.5)	27.0 (26.5 to 27.5)	27.5 (27.2 to 27.8)	28.1 (27.8 to 28.4)	27.7 (27.2 to 28.2)	0.04 (0.02 to 0.06)	0.03 (0.01 to 0.05)
Waist:hip ratio	0.823 (0.810 to 0.836)	0.815 (0.807 to 0.823)	0.818 (0.811 to 0.825)	0.815 (0.811 to 0.819)	0.820 (0.816 to 0.824)	0.822 (0.815 to 0.828)	0.000 (–0.000 to 0.001)	0.000 (–0.000 to 0.001)
Ever smoked (%)	40.0 (31.3 to 49.4)	39.5 (34.2 to 45.1)	39.9 (35.2 to 44.8)	42.1 (39.3 to 45.0)	45.1 (42.1 to 48.1)	44.9 (40.2 to 49.7)	1.00 (0.99 to 1.02)	1.00 (0.99 to 1.01)
Current smoker (%)	5.3 (2.4 to 11.3)	7.6 (5.2 to 11.2)	7.8 (5.6 to 10.9)	9.0 (7.5 to 10.8)	12.8 (10.9 to 14.9)	11.8 (9.1 to 15.2)	1.02 (1.01 to 1.04)	1.02 (1.01 to 1.04)
Heavy alcohol intake (%)	7.3 (3.7 to 14.0)	4.0 (2.3 to 6.9)	2.5 (1.3 to 4.6)	2.9 (2.0 to 4.1)	0.9 (0.4 to 1.6)	2.1 (1.1 to 4.0)	0.95 (0.93 to 0.98)	0.96 (0.94 to 0.98)

*Age (and adult social class) adjusted regression coefficient per increase in social class grade for continuous variables and odds ratios per increase in social class grade for categorical variables.
†Geometric means and logged values in difference per increase in social class grade.

childhood and had moved up into non-manual social classes in adulthood remained at higher risk of insulin resistance, dyslipidaemia, and obesity than those who were in non-manual social classes at both stages.

Discussion

Belonging to manual social classes in childhood and in adulthood are independently associated with increased insulin resistance, dyslipidaemia, and general obesity in older women. The association between poorer childhood social class and insulin resistance is particularly strong and is independent of adult social class. Women who belonged to manual social classes in childhood but who had moved up into non-manual social classes in adulthood remained at higher risk of insulin resistance, dyslipidaemia, and obesity than women who were in non-manual social classes at both stages.

Table 3 Cardiovascular disease risk factors in British women aged 60-79 related to adult social class. Values are age adjusted mean or prevalence (95% confidence interval)

	Adult social class						Difference (95% CI) per increase in social class grade*	
Risk factor	I (n=305)	II (n=769)	III non-manual (n=612)	III manual (n=954)	IV (n=481)	V (n=323)	Adjusted for age	Adjusted for age and childhood social class
Insulin resistance (homoeostasis model assessment)†	1.58 (1.46 to 1.70)	1.61 (1.54 to 1.69)	1.64 (1.55 to 1.73)	1.70 (1.63 to 1.78)	1.73 (1.63 to 1.85)	1.72 (1.60 to 1.86)	0.003 (0.001 to 0.005)	0.002 (–0.001 to 0.004)
Systolic blood pressure (mm Hg)	146.9 (144.2 to 149.6)	147.2 (145.5 to 148.9)	147.9 (145.9 to 149.8)	146.6 (145.1 to 148.2)	149.0 (146.7 to 151.2)	146.1 (144.4 to 149.8)	0.02 (–0.06 to 0.10)	0.02 (–0.06 to 0.10)
Diastolic blood pressure (mm Hg)	80.3 (79.0 to 81.6)	79.3 (78.5 to 80.1)	79.4 (78.5 to 80.4)	79.5 (78.7 to 80.2)	79.2 (78.1 to 80.3)	78.8 (77.5 to 80.2)	–0.02 (–0.06 to 0.01)	–0.02 (–0.06 to 0.02)
Low density lipoprotein cholesterol (mmol/l)	4.10 (3.98 to 4.23)	4.23 (4.15 to 4.31)	4.14 (4.05 to 4.23)	4.12 (4.05 to 4.20)	4.21 (4.10 to 4.31)	4.22 (4.09 to 4.34)	0.001 (–0.003 to 0.005)	0.001 (–0.003 to 0.004)
High density lipoprotein cholesterol (mmol/l)	1.75 (1.70 to 1.80)	1.72 (1.69 to 1.76)	1.68 (1.65 to 1.72)	1.60 (1.57 to 1.63)	1.57 (1.53 to 1.62)	1.61 (1.56 to 1.67)	–0.005 (–0.006 to –0.003)	–0.004 (–0.006 to –0.003)
Triglycerides†	1.60 (1.52 to 1.69)	1.61 (1.55 to 1.66)	1.60 (1.54 to 1.66)	1.71 (1.66 to 1.77)	1.72 (1.65 to 1.80)	1.72 (1.63 to 1.81)	0.002 (0.001 to 0.004)	0.002 (0.001 to 0.004)
Body mass index (kg/m^2)	27.1 (26.6 to 27.7)	27.0 (26.6 to 27.3)	27.3 (26.9 to 27.7)	27.8 (27.5 to 28.2)	28.2 (27.7 to 28.7)	28.0 (27.5 to 28.6)	0.04 (0.02 to 0.05)	0.03 (0.01 to 0.05)
Waist:hip ratio	0.816 (0.809 to 0.824)	0.812 (0.807 to 0.817)	0.814 (0.808 to 0.820)	0.819 (0.815 to 0.824)	0.824 (0.818 to 0.831)	0.827 (0.819 to 0.835)	0.001 (0.000 to 0.002)	0.001 (0.000 to 0.002)
Ever smoked (%)	36.2 (31.0 to 41.7)	41.0 (37.6 to 44.5)	42.6 (38.7 to 46.5)	44.5 (41.4 to 47.7)	42.8 (38.5 to 47.3)	48.9 (43.5 to 54.4)	1.01 (1.00 to 1.02)	1.01 (1.00 to 1.02)
Current smoker (%)	6.7 (4.4 to 10.1)	9.3 (7.5 to 11.6)	9.1 (7.1 to 11.6)	11.8 (9.9 to 14.0)	10.8 (8.3 to 13.9)	11.2 (8.2 to 15.1)	1.01 (1.00 to 1.02)	1.01 (1.00 to 1.02)
Heavy alcohol intake (%)	3.3 (1.8 to 6.0)	3.5 (2.4 to 5.1)	2.1 (1.2 to 3.6)	2.1 (1.4 to 3.3)	1.3 (0.6 to 2.8)	1.6 (0.7 to 3.8)	0.98 (0.97 to 1.00)	0.98 (0.96 to 1.00)

*Difference: age (and childhood social class) adjusted regression coefficient per increase in social class grade for continuous variables and odds ratios per increase in social class grade for categorical variables.
†Geometric means and logged values in difference per increase in social class grade.

Table 4 Odds ratio (95% confidence interval) for cardiovascular risk factors in British women aged 60-79 according to social class

Cardiovascular risk factor	Non-manual social class in childhood: Non-manual class in adulthood (n=565)	Non-manual social class in childhood: Manual class in adulthood (n=251)	Manual social class in childhood: Non-manual class in adulthood (n=1121)	Manual social class in childhood: Manual class in adulthood (n=1507)
High insulin resistance (top fourth (≥2.45) homoeostasis model assessment)	1.00	1.29 (0.86 to 1.93)	1.33 (1.01 to 1.74)	1.58 (1.22 to 2.05)
Hypertensive (blood pressure ≥160/90)	1.00	1.23 (0.90 to 1.68)	1.23 (0.99 to 1.52)	1.22 (0.99 to 1.50)
High low density lipoprotein cholesterol (top fourth to ≥4.80 mmol/l)	1.00	1.24 (0.86 to 1.78)	1.25 (0.97 to 1.59)	1.13 (0.89 to 1.43)
Low high density lipoprotein cholesterol (bottom fourth to ≤1.30 mmol/l)	1.00	1.45 (1.00 to 2.09)	1.29 (1.00 to 1.67)	1.99 (1.55 to 2.54)
High triglyceride (top fourth to ≥2.25mmol/l)	1.00	1.35 (0.93 to 1.98)	1.44 (1.11 to 1.87)	1.59 (1.23 to 2.04)
Obese (body mass index ≥30 kg/m^2)	1.00	1.73 (1.18 to 2.51)	1.68 (1.28 to 2.19)	2.38 (1.84 to 3.07)
Centrally obese (waist:hip ratio ≥0.85)	1.00	1.19 (0.85 to 1.66)	0.89 (0.71 to 1.11)	1.05 (0.85 to 1.30)
Ever smoked	1.00	1.05 (0.77 to 1.42)	1.08 (0.88 to 1.33)	1.29 (1.06 to 1.57)
Current smoker	1.00	1.15 (0.66 to 2.00)	1.38 (0.95 to 2.01)	1.75 (1.23 to 2.49)
Heavy alcohol intake (≥21 units per week)	1.00	0.70 (0.29 to 1.65)	0.58 (0.33 to 1.02)	0.38 (0.21 to 0.68)

This is the first study to assess directly the association between childhood socioeconomic circumstances and insulin resistance. The results support the idea that poor social circumstances in childhood lead to insulin resistance and the insulin resistance syndrome, with these risk factors tracking through childhood and resulting in increased risk of cardiovascular disease in later life. Leg length, which is associated with poor nutrition in infancy and childhood,[17] is associated with insulin resistance and cardiovascular disease in adulthood.[18 19] Poor nutrition in childhood may be one mechanism through which poor social circumstances in childhood lead to increased insulin resistance, which then persists into adulthood. The recent finding of an association between low birth weight of offspring and increased maternal insulin resistance in later life suggests a common genetic link,[20] although genetic factors are unlikely to explain the association between social circumstances in childhood and insulin resistance in adulthood.

In studies confined to men, childhood social class is associated with components of the insulin resistance syndrome.[5 7 8] In a study of women and men, childhood socioeconomic position was, in general, only weakly associated with a range of cardiovascular disease risk factors in later life, but in women childhood social position was related to low levels of high density lipoprotein cholesterol and increased fibrinogen levels in adulthood.[10]

In our study, childhood manual social class was independently associated with an increased likelihood of smoking in adulthood. This was not found in two studies confined to men only,[5 7] but other studies have reported this association in women.[10 21] Family background and social circumstances in childhood may influence starting smoking, whereas adult occupation and social circumstances may affect the likelihood of stopping smoking.[1] There is evidence of sex differences in the likelihood of stopping smoking, with women smokers being less likely to stop and more likely to cut down their smoking than men.[22] The association between childhood manual social class and adult smoking in women, but not men, may reflect sex differences in being able to stop smoking.

Limitations of the study

Our response (60%) was moderate but is consistent with other baseline data collection in large epidemiological surveys, including the health survey for England, in which participants were visited in their own homes.[23] Distributions of cardiovascular risk factors for women in our study were similar to those for older women in the health survey for England.[23] The social class distribution of the women in our study was similar to that found for the 1991 census (52% manual social class in British women's heart and health study *v* 55% older adults in the 1991 census). Response bias is therefore unlikely to have had an important effect on our results.

Women with data on childhood and adult social class were less likely to be smokers and had smaller waist:hip ratios than those without these data. Many of the women without occupational (and therefore social class) data are likely to be those whose fathers and husbands were unemployed long term; this would be consistent with the particularly high prevalence of smoking among those who did not have data on social class. Including these women with those in manual social classes may increase the magnitude of the associations with smoking and central obesity but would not alter our overall conclusions. We relied on self report of occupations, which may be less accurate for the father's than for the husband's occupation, although any misclassification would weaken associations between childhood social class and adult risk factors and would therefore not alter our main conclusions. All occupations were classified using the registrar general's classification of occupations for 1980. This may have introduced inaccuracies in social class classification for fathers' occupations in the 1930s to 1950s. However, over the past century, few occupations have substantially changed status and, in particular, jobs classified as manual or non-manual have not changed between these broad categorisations.[24]

Implications

Poor socioeconomic position in childhood and in adulthood is associated with insulin resistance, components of the insulin resistance syndrome, and smoking in women. The increased risk of insulin resistance associated with manual childhood social class remains, even if women move up into non-manual social classes in adulthood. These findings highlight the importance of a life course approach to the prevention of cardiovascular disease and reducing socioeconomic inequalities in cardiovascular disease.[1]

What is already known on this topic

Poor childhood social circumstances are, independently of adult social circumstances, associated with increased cardiovascular disease risk

They are associated with some components of the insulin resistance syndrome, and adverse childhood environmental factors, possibly poor nutrition, may lead to insulin resistance and to adult cardiovascular disease

Evidence on the association between childhood social circumstances and insulin resistance in adulthood, and between childhood social circumstances and cardiovascular disease risk factors in women, is scarce

What this study adds

Belonging to manual social classes in childhood and in adulthood is independently associated with increased insulin resistance, dyslipidaemia, and obesity in older women

Women who were in manual social classes in childhood remained at increased risk of insulin resistance, dyslipidaemia, and obesity, even if they had moved into non-manual social classes in adulthood

The British women's heart and health study is co-directed by Shah Ebrahim, Peter Whincup, Goya Wannamethee, and Debbie A Lawlor. We thank Carol Bedford, Alison Emerton, Nicola Frecknall, Karen Jones, Mark Taylor, and Katherine Wornell for collecting and entering data, all of the general practitioners and their staff who have supported data collection, and the women who have participated in the study.

Contributors: All authors developed the study aim and design. DAL undertook the initial analysis and wrote the initial draft of the paper. All authors contributed to the final version. DAL will act as guarantor.

Funding: The British women's heart and health study is funded by the Department of Health. DAL is funded by a Medical Research Council/Department of Health training fellowship. The views expressed in this publication are those of the authors and not necessarily those of the Department of Health or Medical Research Council.

Competing interests: None declared.

1 Davey Smith G, Ben-Shlomo Y, Lynch J. Life course approaches to inequalities in coronary heart disease risk. In: Stansfeld S, Marmot M, eds. *Stress and the heart. Psychosocial pathways to coronary heart disease.* London: BMJ Books, 2002;20-49.
2 Kaplan GA, Salonen JT. Socioeconomic conditions in childhood and ischaemic heart disease during middle age. *BMJ* 1990;301:1121-3.
3 Davey Smith G, Hart C, Blane D, Hole D. Adverse socioeconomic conditions in childhood and cause specific adult mortality: prospective observational study. *BMJ* 1998;316:1631-5.
4 Davey Smith G, McCarron P, Okasha M, McEwen J. Social circumstances in childhood and cardiovascular disease mortality: prospective observational study of Glasgow University students. *J Epidemiol Community Health* 2001;55:340-1.
5 Wannamethee SG, Whincup PH, Shaper G, Walker M. Influence of fathers' social class on cardiovascular disease in middle-aged men. *Lancet* 1996;348:1259-63.
6 Marmot M, Shipley M, Brunner E, Hemingway H. Relative contribution of early life and adult socioeconomic factors to adult morbidity in the Whitehall II study. *J Epidemiol Community Health* 2001;55:301-7.
7 Blane D, Hart CL, Davey Smith G, Gillis CR, Hole DJ, Hawthorne VM. Association of cardiovascular disease risk factors with socioeconomic position during childhood and during adulthood. *BMJ* 1996;313:1434-8.
8 Davey Smith G, Hart C. Insulin resistance syndrome and childhood social conditions. *Lancet* 1997;349:284-5.
9 Parsons TJ, Power C, Logan S, Summerbell CD. Childhood predictors of adult obesity: a systematic review. *Int J Obesity* 1999;23:S1-107.
10 Brunner E, Shipley MJ, Blane D, Davey Smith G, Marmot MG. When does cardiovascular risk start? Past and present socioeconomic circumstances and risk factors in adulthood. *J Epidemiol Community Health* 1999;53:757-64.
11 Bao W, Srinivasan SR, Wattigney WA, Berenson GS. Persistence of multiple cardiovascular risk clustering related to syndrome X from childhood to young adulthood. The Bogalusa heart study. *Arch Intern Med* 1994;154:1842-7.
12 Heslop P, Davey Smith G, Macleod J, Hart C. The socioeconomic position of women, risk factors and mortality. *Soc Sci Med* 2001;53:477-85.
13 Wamala SP, Lynch J, Kaplan GA. Women's exposure to early and later life socioeconomic disadvantage and coronary heart disease risk: the Stockholm female coronary risk study. *Int J Epidemiol* 2001;30:275-84.
14 Lawlor DA, Bedford C, Taylor M, Ebrahim S. Geographic variation in cardiovascular disease, risk factors and their control in older women: British women's heart and health study. *J Epidemiol Community Health* (in press).
15 Office of Population Censuses and Surveys. *Classification of occupations and coding index.* London: HMSO, 1980.
16 Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC. Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia* 1985;28:412-9.
17 Wadsworth MEJ, Hardy RJ, Paul AA, Marshall SF, Cole TJ. Leg and trunk length at 43 years in relation to childhood health, diet and family circumstances; evidence from the 1946 national birth cohort. *Int J Epidemiol* 2002;31:383-90.
18 Davey Smith G, Gunnell D, Sweetnam P, Yarnell J, Elwood P. Leg length, insulin resistance and coronary heart disease risk: the Caerphilly study. *J Epidemiol Community Health* 2001;55:867-72.
19 Lawlor DA, Ebrahim S, Davey Smith G. The association between components of height and type II diabetes and insulin resistance: British women's heart and health study. *Diabetologia* 2002;45:1097-106.
20 Lawlor DA, Davey Smith G, Ebrahim S. Birth weight of offspring and insulin resistance in late adulthood: cross sectional survey using data from British women's heart and health study. *BMJ* 2002;325:359-62.
21 Graham H, Hunt K. Socioeconomic influences on women's smoking status in adulthood: insights from the west of Scotland twenty-07 study. *Health Bull* 1998;57:757-65.
22 Ernster V, Kaufman N, Nichter M, Samet J, Yoon S-Y. Women and tobacco: moving from policy to action. *Bull World Health Organ* 2000;78:891-901.
23 Erens B, Primatesta P. *Health survey for England 1998: cardiovascular disease.* London: Stationary Office, 1999.
24 Rose D. Official social classifications in the UK. *Social Research Update* 1995;July:1-7.

(Accepted 15 May 2002)