Relative contribution of early life and adult socioeconomic factors to adult morbidity in the Whitehall II study

M Marmot, M Shipley, E Brunner, H Hemingway

Abstract

***Study objective*—To determine the relative contribution of adult compared with early life socioeconomic status as predictors of morbidity attributable to coronary heart disease (CHD), chronic bronchitis and depression in the Whitehall II study of British civil servants.**

***Design*—Prospective observational study with mean 5.3 years (range 3.7–7.6) follow up.**

***Setting*—20 civil service departments originally located in London.**

***Participants*—6895 male and 3413 female office-based civil servants aged 35–55 years at baseline.**

***Outcome measures*—New cases at follow up of CHD, chronic bronchitis and depression defined using validated questionnaires.**

***Main results*—Employment grade was inversely associated with CHD, chronic bronchitis and depression in men (odds ratio per unit decrease in grade 1.30, 1.44 and 1.20 respectively). Employment grade was strongly related to father's social class. Chronic bronchitis, in women, and depression, in men, were more common among those with fathers of higher social class. When mutual adjustment was made for father's social class, grade at entry to the civil service and current grade, the strongest effects on adult morbidity were found for current grade. Among participants in whom neither parent had died ⩽70 years of age the inverse association with adult SES was maintained.**

***Conclusions*—Adult socioeconomic status was a more important predictor of morbidity attributable to coronary disease, chronic bronchitis and depression than measures of social status earlier in life. In this population, the importance of social circumstances early in life may be in the way they influence employment and social position and thus exposures in adult life.**

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International Centre for Health and Society, Department of Epidemiology and Public Health, University College London, 1–19 Torrington Place, London WC1E 6BT, UK

Correspondence to: Professor Marmot (M.Marmot@ucl.ac.uk)

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Circumstances in adulthood are important determinants of adult socioeconomic differences in disease. This has been the focus of the Whitehall studies of British civil servants.[1–5] Consistent with Barker's evidence on the fetal origins of adult cardiovascular disease,[6] the Whitehall studies show that short height is a predictor of coronary heart disease (CHD) incidence,[3] and mortality.[7] There is, however, another body of evidence that points to inequalities in health having their origin early in life, but not confined to life in utero.[8–11] Using father's social class as an index of early life circumstances, some studies have shown that father's social class predicts mortality, independent of current class,[12] the magnitude of the effect depending on the disease diagnosis. Others have not.[13] This raises the question of why father's social class is predictive of disease rates. A plausible interpretation of the west of Scotland results[12] is that cumulation of advantage and disadvantage through the life course affects mortality rates.

An alternative explanation is that father's social class is important because it is a determinant of the social circumstances in which a person lives and works in adult life, and it is these circumstances that give rise to social inequalities in disease. This alternative explanation leads to two predictions. Firstly, if there were a measure that gives a better guide to living and working circumstances in adult life than registrar general's social class, father's social class would no longer be predictive. Secondly, and related to the first, father's social class would not predict disease in a population that was relatively free of disadvantage in adult life—that is, whose circumstances had, in general, improved in contrast with their parents. These predictions can be tested in the Whitehall II study of British Civil Servants. Grade of employment is a stronger predictor of illness than registrar general's social class,[14] and unlike other study populations, the Whitehall II cohort comprises non-industrial predominantly non-manual employees.

This paper analyses the possible independent contribution of participants' employment grade and father's social class to prediction of CHD, chronic bronchitis and depression in the Whitehall II cohort of British civil servants. As a further test of the independent prediction of current social position, we examined its relation to disease in people in whom neither parent had died before the age of 70. If parents had not died prematurely, it is unlikely that family conditions, whether genetic, social or environmental predisposed to premature disease.

Methods

PARTICIPANTS

The Whitehall II study cohort comprises 10 308 persons (6895 men and 3413 women) aged 35–55 years who worked in the London offices of 20 government departments in

1985–1988 (phase 1: postal questionnaire and screening examination).[2] The response rate was 73%. The true response rates are likely to be higher, however, as around 4% of those on the provided list of employees had moved before the study began and thus were ineligible for inclusion. Participants were approached again in 1989–90 (phase 2: postal questionnaire), and in 1991–93 (phase 3: postal questionnaire and screening examination). The participation rate at these two phases was 79% and 83%, respectively; 7372 (72%) participated at all three phases. The length of follow up between phase 1 and phase 3 was 5.3 years on average (range 3.7–7.6).

SOCIOECONOMIC STATUS MEASURES

At phase 1, participants completed a self administered questionnaire that provided details of the socioeconomic status of the participants and their parents: age on leaving full time education and father's registrar general social class.[2] These details were only included in versions 3 and 4 of the phase 1 questionnaire, which was administered to the last 7697 participants. Height, an indicator of early life environment, was measured at the phase 1 screening examination. Quartiles of height were sex specific. Participants reported their civil service grade title, currently and on first entering the civil service. This was assigned to one of six grades based on salary scale. Grade 1 consists of participants in Unified Grades 1–6 (annual salary range at 1 August 1992, £28 904–£87 620), grade 2 is equivalent to Unified Grade 7 (£25 330–£36 019), grade 3 is Senior Executive Officer (£18 082–£25 554), grade 4 is Higher Executive Officer (£14 456–£20 850), grade 5 Executive Officer (£8,517–16,668) and grade 6 Clerical and Office Support staff (£6483–£11 917). In previous analyses of Whitehall II,[2] for comparisons with the original cohort, a three level variable for grade was constructed by combining grades 1 and 2 (high grade); 3, 4 and 5 (intermediate grade); grade 6 (low grade). This is used in the present analyses.

OUTCOME MEASURES

Three self reported incidence measures were used: CHD, chronic bronchitis and depression. For each of these outcomes, prevalent cases at phase 1 were excluded from analysis (n=914, 828, 2002 for CHD, chronic bronchitis and depression respectively). To be included as a new case, the participant had to have responded positively to the measure at phase 2 or 3. It is possible that lifetime measures of social position would be related to prevalent disease; and "current" employment grade to incident disease. In fact the results for prevalent and incident disease were broadly similar. Only the results for incident disease are presented here.

At each phase, CHD was defined as the participant having reported any one of three indicators: (a) angina pectoris from the Rose questionnaire,[15] (b) severe pain across the chest that lasted half an hour or more, (c) doctor diagnosed, or suspected, a heart attack or angina pectoris. These three categories showed similar relations to employment grade.[3] Chronic bronchitis was defined using the Medical Research Council questionnaire.[15] Depression was assessed using a subset of items from the General Health Questionnaire[16] whose validity in relation to the Clinical Interview Schedule in this population has been previously reported.[17] Participants whose depression score was three or more (score range, 0–12) were defined as cases (prevalence 20%) at that phase.

AGE AT PARENTAL DEATH

At each phase, participants reported whether either parent had died and, if so, their age at death. These responses were combined and grouped according to whether either parent died at or before age 70. By the time of phase 3, participants were aged 40–60. We would expect there to be only a small fraction of participants with both parents still alive and aged 70 or less.

STATISTICAL ANALYSIS

Statistical analysis was performed using SAS computer software.[18] The associations between the socioeconomic status measures and the incident outcomes were described using odds ratios and 95% confidence intervals. These were computed using logistic regression models that enabled age, participant's current employment grade and length of follow up to be adjusted for in the analysis. Tests of trend were based on regression analysis with the relevant factor entered as a continuous variable. The magnitude of these trends has been summarised by presenting the odds ratio and 95% confidence intervals associated with an increase in one category of each factor. Analyses showed that the relations of father's social class, first and current employment grade with the outcomes could be adequately described using a linear trend. To improve precision, therefore, odds ratios and 95% confidence intervals for lowest versus highest socioeconomic status were estimated using these linear trends across the original six levels of each measure.

Results

Table 1 shows the distribution of father's social class, height and own education according to current employment grade at the time of the phase 1 examination of the Whitehall II cohort. As anticipated there were associations between current and early life social status and height. The relation between grade and father's social class was stronger in women. The relation between father's social class and height (not shown) could all be "explained" by the relation between grade and height.

Table 2, for men, shows the relation to three disease end points of current grade, father's social class, height and age at leaving full time education. There was a monotonic association between grade of employment, but not participant's own education, and incidence of CHD, chronic bronchitis and depression. Father's social class was not significantly related to CHD or bronchitis but was positively related to

Table 1 Distribution (%) of father's social class, height and own education by own employment grade in men and women

	Men Employment grade			Women Employment grade		
	High	Intermediate	Low	High	Intermediate	Low
Father's social class (n=4774 men: 2206 women)						
IV or V	8	11	15	1	11	19
IIIm	28	33	36	17	33	44
IInm	17	17	17	13	13	11
I or II	48	39	32	69	43	25
Total (n)	100 (1742)	100 (2561)	100 (471)	100 (199)	100 (891)	100 (1116)
Height (quartile) (n=6886 men: 3412 women)						
Q1 (shortest)	20	27	48	14	22	35
Q2	24	25	21	19	22	25
Q3	26	25	18	26	27	24
Q4 (tallest)	30	23	13	41	30	16
Total (n)	100 (2644)	100 (3602)	100 (640)	100 (381)	100 (1336)	100 (1695)
Age at leaving full time education (y) (n=5178 men: 2503 women)						
≤16	13	32	55	3	35	68
17–18	20	31	18	14	29	18
≥19	67	37	28	83	36	15
Total (n)	100 (1869)	100 (2789)	100 (520)	100 (216)	100 (984)	100 (1303)

depression. The tallest men had the lowest incidence of CHD and the trend, shorter height higher disease, was statistically significant. This relation was independent of employment grade. Height was not related to chronic bronchitis or depression.

Table 3, shows the same analyses for women. As with men, there was a graded inverse association between grade of employment and CHD. The relation between grade and chronic bronchitis was in the same direction but the trend was not statistically significant. There was no relation between grade and depression, but more highly educated women were more at risk of depression. There were no significant relations between parental variables and CHD although there was a suggestion that father's social class was related to CHD incidence. Surprisingly, women whose fathers were of lower social class had lower incidence of chronic bronchitis and depression

Comparisons of the independent effects on morbidity of father's social class, employment grade when entering the civil service, and employment grade at phase 1 of the Whitehall II study are shown in table 4. For men, father's social class was not an independent predictor of CHD or chronic bronchitis. For women, there was an association (non-significant) between father's social class and CHD. Interestingly, both first grade and current grade seem to make some contribution to prediction of CHD and, in men, chronic bronchitis. In contrast, among men, first grade and father's social class were positively associated with the onset of depression.

Table 5 shows that among the group with "long lived" parents, grade of employment

Table 2 Incidence of coronary heart disease, chronic bronchitis, and depression by employment grade, father's social class, height and own education. Men—odds ratios adjusted for (a) age and (b) age and employment grade

	Coronary heart disease			Chronic bronchitis			Depression		
		Odds ratio (95% CI)			Odds ratio (95% CI)			Odds ratio (95% CI)	
	Events	Age adjusted	Age and grade adjusted	Events	Age adjusted	Age and grade adjusted	Events	Age adjusted	Age and grade adjusted
Employment grade									
Low	33	1.57		44	2.39		93	1.50	
Intermediate	225	1.36		144	1.14		522	1.17	
High	144	1.0		99	1.0		370	1.0	
Trend*		1.30 (1.1, 1.5) (p=0.003)			1.44 (1.2, 1.7) (p=0.0002)			1.20 (1.1, 1.4) (p=0.009)	
Father's social class									
IV or V	23	0.86	0.83 (0.5, 1.3)	19	0.94	0.85 (0.5, 1.4)	64	0.71	0.67 (0.5, 1.0)
IIIm	98	1.05	1.02 (0.8, 1.4)	71	1.18	1.11 (0.8, 1.5)	212	0.86	0.82 (0.6, 1.0)
IInm	40	0.79	0.77 (0.5, 1.1)	30	0.91	0.86 (0.6, 1.3)	113	0.98	0.95 (0.7, 1.3)
I or II	116	1.0	1.0	81	1.0	1.0	284	1.0	1.0
Trend*		1.0 (0.9, 1.1) (p=0.93)	0.98 (0.9, 1.1) (p=0.77)		1.04 (0.9, 1.2) (p=0.61)	1.0 (0.9, 1.2) (p=0.99)		0.91 (0.8, 1.0) (p=0.07)	0.89 (0.8, 1.0) (p=0.02)
Height (quartile)									
Q1 (shortest)	115	1.49	1.36(1.0, 1.9)	88	1.20	1.00 (0.7, 1.4)	249	1.13	1.03 (0.8, 1.3)
Q2	114	1.64	1.58 (1.2, 2.1)	60	0.86	0.82 (0.6, 1.2)	242	1.13	1.09 (0.9, 1.4)
Q3	95	1.33	1.30 (0.9, 1.8)	65	0.87	0.85 (0.6, 1.2)	262	1.18	1.17 (0.9, 1.5)
Q4 (tallest)	77	1.0	1.0	73	1.0	1.0	230	1.0	1.0
Trend*		1.14 (1.0, 1.3) (p=0.005)	1.11 (1.0, 1.2) (p=0.03)		1.06 (1.0, 1.2) (p=0.33)	1.0 (0.9, 1.1) (p=0.99)		1.03 (1.0, 1.1) (p=0.44)	1.0 (0.9, 1.1) (p=0.95)
Age at leaving full time education (y)									
≤16	91	1.10	1.01 (0.7, 1.4)	59	1.00	0.79 (0.5, 1.1)	189	0.86	0.74 (0.6, 1.0)
17–18	76	0.94	0.89 (0.7, 1.2)	58	1.06	0.97 (0.7, 1.4)	193	0.81	0.75 (0.6, 1.0)
≥19	137	1.0	1.0	99	1.0	1.0	354	1.0	1.0
Trend*		1.04 (0.9, 1.2) (p=0.58)	1.0 (0.9, 1.2) (p=0.97)		1.01 (0.9, 1.2) (p=0.94)	0.89 (0.8, 1.1) (p=0.20)		0.91 (0.8, 1.0) (p=0.14)	0.85 (0.8, 1.0) (p=0.01)

*Trend gives the odds ratio (95% CI) per unit change from the reference group in explanatory variable and p value for test of significance from 1.0.

Table 3 Incidence of coronary heart disease, chronic bronchitis, and depression by employment grade, father's social class, height and own education . Women—odds ratios adjusted for (a) age and (b) age and employment grade

	Coronary heart disease			*Chronic bronchitis*			*Depression*		
		Odds ratio (95% CI)			*Odds ratio (95% CI)*			*Odds ratio (95% CI)*	
	Events	*Age adjusted*	*Age and grade adjusted*	*Events*	*Age adjusted*	*Age and grade adjusted*	*Events*	*Age adjusted*	*Age and grade adjusted*
Employment grade									
Low	140	1.64		74	1.74		246	0.94	
Intermediate	92	1.18		54	1.61		233	1.03	
High	25	1.0		10	1.0		74	1.0	
Trend*		1.32 (1.1, 1.6) (p=0.009)			1.21 (0.9, 1.6) (p=0.16)			0.96 (0.8, 1.1) (p=0.58)	
Father's social class									
IV or V	25	1.32	1.20 (0.7, 2.1)	5	0.29	0.25 (0.1, 0.7)	43	0.76	0.76 (0.5, 1.2)
IIIm	61	1.28	1.19 (0.8, 1.8)	34	0.81	0.71 (0.4, 1.2)	127	0.90	0.90 (0.6, 1.3)
IInm	19	1.17	1.13 (0.6, 2.0)	15	1.09	1.03 (0.5, 1.9)	50	1.05	1.06 (0.7, 1.7)
I or II	46	1.0	1.0	38	1.0	1.0	150	1.0	1.0
Trend*		1.11 (1.0, 1.3) (p=0.20)	1.07 (0.9, 1.3) (p=0.41)		0.79 (0.7, 1.0) (p=0.020)	0.75 (0.6, 0.9) (p=0.005)		0.93 (0.8, 1.1) (p=0.23)	0.93 (0.6, 1.5) (p=0.25)
Height (quartile)									
Q1 (shortest)	85	1.48	1.34 (0.9, 1.9)	39	1.21	1.15 (0.7, 1.9)	137	0.93	0.96 (0.7, 1.3)
Q2	66	1.26	1.19 (0.8, 1.8)	41	1.43	1.38 (0.8, 2.3)	132	1.02	1.04 (0.8, 1.4)
Q3	48	0.79	0.76 (0.5, 1.2)	29	0.91	0.89 (0.5, 1.15)	143	0.92	0.94 (0.7, 1.3)
Q4 (tallest)	57	1.0	1.0	29	1.0	1.0	141	1.0	1.0
Trend*		1.19 (1.1, 1.3) (p=0.005)	1.15 (1.0, 1.3) (p=0.03)		1.10 (1.0, 1.3) (p=0.21)	1.09 (0.9, 1.3) (p=0.29)		0.99 (0.9, 1.1) (p=0.82)	1.0 (0.9, 1.1) (p=0.98)
Age at leaving full time education (y)									
≤16	94	1.15	0.95 (0.6, 1.15)	54	1.15	0.94 (0.5, 1.7)	185	0.74	0.76 (0.5, 1.1)
17–18	37	0.98	0.89 (0.5, 1.4)	25	1.24	1.06 (0.6, 1.9)	92	0.69	0.68 (0.5, 1.0)
≥19	45	1.0	1.0	24	1.0	1.0	139	1.0	1.0
Trend*		1.08 (0.9, 1.3) (p=0.44)	0.98 (0.8, 1.2) (p=0.89)		1.06 (0.8, 1.4) (p=0.66)	0.96 (0.7, 1.3) (p=0.77)		0.87 (0.7, 1.0) (p=0.08)	0.88 (0.7, 1.1) (p=0.17)

*Trend gives the odds ratio (95% CI) per unit change from the reference group in explanatory variable and p value for test of significance from 1.0.

Table 4 Odds ratios for the effects of lowest versus highest socioeconomic status at three different stages of life. Values are age adjusted odds ratios (95% CI) and then further adjusted for the other social class indicators ("simultaneous")*

	Men			*Women*		
	Father's social class	*First grade*	*Current grade*	*Father's social class*	*First grade*	*Current grade*
CHD						
(men: 268 events/3093: women 149/1353)						
Age adjusted	1.10 (0.7, 1.8)	1.57 (0.9, 2.7)	1.57 (1.0, 2.4)	1.69 (0.9, 3.2)	7.38 (1.4, 38.2)	2.28 (1.1, 4.6)
Simultaneous	1.00 (0.6, 1.7)	1.24 (0.7, 0.4)	1.44 (0.9, 2.4)	1.30 (0.7, 2.6)	4.10 (0.6, 30.1)	1.38 (0.6, 3.3)
Chronic bronchitis						
(men: 191 events/3872: women 91/1729)						
Age adjusted	1.17 (0.7, 2.1)	3.13 (1.5, 6.4)	2.59 (1.6, 4.2)	0.47 (0.2, 1.1)	1.16 (0.3, 4.8)	1.89 (0.8, 4.5)
Simultaneous	0.95 (0.5, 1.7)	1.88 (0.8, 4.3)	2.05 (1.2, 3.6)	0.36 (0.2, 0.9)	0.45 (0.1, 2.8)	3.56 (1.1, 11.6)
Depression						
(men: 423 events/3131: women 245/1301)						
Age adjusted	0.62 (0.4, 0.9)	0.80 (0.5, 1.2)	1.66 (1.2, 2.4)	0.78 (0.5, 1.3)	0.91 (0.4, 2.4)	0.93 (0.6, 1.5)
Simultaneous	0.60 (0.4, 0.9)	0.49 (0.3, 0.8)	2.39 (1.6, 3.6)	0.78 (0.4, 1.4)	1.06 (0.3, 3.7)	0.98 (0.5, 1.9)

*Odds ratio estimated from fitting linear trend across six levels for each socioeconomic status measure (see methods).

continues to predict all three end points in men and CHD in women. In women, grade only predicted chronic bronchitis if at least one parent died "prematurely". The percentage of participants in whom either parent died prematurely varied little by sex or among the three measures of morbidity (ranging from 47.4% (2695 of 5680) to 52.7% (1406 of 2669)). The age adjusted rates of each morbidity comparing those with, to those without death of either parent aged under 70 years, was different from unity only for chronic bronchitis in women (rate ratio 1.37 (95CI% 1.0, 1.8)).

Table 5 Odds ratios (95% CI) for lowest versus highest current grade for the effect on incidence of CHD, chronic bronchitis and depression, by age at parental death*

	Men Either parent died aged ≤70		*Women Either parent died aged ≤70*	
	No	*Yes*	*No*	*Yes*
CHD	1.96 (1.2, 3.3)	1.58 (1.0, 2.5)	2.03 (1.0, 4.3)	1.98 (1.0, 3.9)
Chronic bronchitis	2.08 (1.2, 3.7)	2.49 (1.5, 4.3)	0.78 (0.3, 1.8)	4.23 (1.4, 13.2)
Depression	1.65 (1.1, 2.5)	1.46 (0.98, 2.17)	0.83 (0.5, 1.4)	1.01 (0.6, 1.8)

*Odds ratios estimated from fitting linear trend across six employment grade levels (see methods).

Discussion

In the Whitehall II study, current socioeconomic status in adulthood, rather than father's social class, predicted adult morbidity from CHD, chronic bronchitis and depression. This finding may be considered in the context of three different ways in which factors from early life might influence subsequent disease risk. The first is a latency model. Barker's findings are consistent with this, showing a clear association between low birth weight or thinness at birth and subsequent cardiovascular disease.[19] Although size at birth is linked to social circumstances, his studies report effects on coronary risk independent of social class. A second model is cumulation of advantage and disadvantage through the lifecourse.[20–22] Studies that have examined social circumstances in childhood and beyond do show an effect on blood pressure, obesity (Wadsworth *et al*, unpublished data) and measures of health status.[22] A third model is the pathway model[23] in which childhood circumstances may not affect

adult risk directly. As our analyses of intergenerational occupational mobility show, childhood circumstances determine adult circumstances and these, in turn, affect disease risk.

Studies that have examined the effects of social circumstances at different stages of the life course in relation to cardiovascular disease present a mixed picture.[24] Consistent with the Whitehall II findings, the Kuopio study of men born 1934–52 showed no childhood effect after adjustment for adult socioeconomic position.[13] By contrast, in a Swedish cohort,[25] born 1946–55, where it is reasonable to speculate that socioeconomic conditions would have been more favourable than at the time of birth of the Kuopio cohort in east Finland, childhood socioeconomic factors did seem to have an independent effect on CHD risk. The west of Scotland cohort, born in the early part of the century, found substantial childhood effects additional to, and independent of those associated with adult social position.[26] In the British Regional Heart Study of men born 1919–38, there was no childhood social class effect on myocardial infarction in men who were themselves in manual occupations; there was an effect among men in non-manual occupations.[27] The Nurses Health study showed a modest effect of father's occupation on risk of coronary disease. The effect may have been small because in this cohort of nurses adult occupation was relatively homogeneous.[28]

What might explain the weaker effects of father's social class than current socioeconomic status in Whitehall II and the discrepancy with the findings of other studies? Firstly, the result in Whitehall II might arise if there were a lack of civil servants with disadvantaged parents. While it is true that there are fewer Whitehall II participants with fathers from a manual background than in the general population, the numbers are large enough to detect effects if present (the proportions from a manual background in Whitehall II compared with the 1946 birth cohort were: men 41.4% versus 74.0% and women 51.5% versus 74.6%). Furthermore, the absence of Whitehall II participants in manual classes may be less significant in the 1980s and 1990s than previously because of changes in British occupational structure. Manual work has declined and unskilled non-manual work with low decision authority and low wages has expanded. In these terms[29] clerical and other support staff in the civil service are a group at considerable social disadvantage.

Precision of measurement of socioeconomic status provides a second possible explanation for the lack of early life effects observed in Whitehall II. Adult socioeconomic status based on civil service employment grade may be more precisely measured than parental socioeconomic status based on recall of occupation coded into registrar general's social class. The validity of the registrar general classification has been questionned and is currently being replaced. Civil service employment grade by contrast captures aspects of work and social life more strongly related to a broad range of health outcomes. However, other studies have used recalled father's registrar general's social class and find early life effects. In Whitehall II, father's social class was not clearly associated with adult morbidity in univariate or multivariate analyses.

KEY POINTS
- Early life circumstances may affect adult morbidity directly or because they predict adult social circumstances.
- Among over 7000 civil servants, current employment grade was inversely associated with coronary disease, bronchitis and depression, an effect stronger than that of father's social class or grade at entry to the civil service.
- These associations were largely independent of intergenerational effects, as indicated by premature parental death.
- These data suggest that early life circumstances are important because they influence adult social circumstances, which in turn influence disease risk.

Employment grade may partly capture aspects of parental socioeconomic status, indeed current grade was strongly related to father's social class. In this population, the importance of social circumstances early in life may be in the way they influence employment and social position and thus exposures in adult life. Consistent with this are the results of an analysis with participants cross classified by grade (high versus low) and father's social class (high versus low). Only 107 men were in the downwardly mobile group. Of the high grade men, 1186 of 2953 came from low social class. Their heart disease rate was the same as that of high grade men with advantaged background but lower than that of low grade men. Similar results were found for women.

The finding on parents' age at death is perhaps the strongest argument against a parental disadvantage (either social or genetic) explanation of socioeconomic inequalities in health. If parents survive beyond the age of 70, they could be thought of as neither genetically nor environmentally predisposed to illness. The fact that the social gradient holds up in this subgroup points to the effect of current social circumstances. The main exception was for chronic bronchitis in women where an effect of grade was evident only in "susceptibles"—that is, those with a parent who had died prematurely.

We predicted that, if anything, father's social class would be a stronger predictor of adult morbidity in women. Women's social standing may be more persistently influenced by their family background, especially if there is a "glass ceiling" limiting women's promotion chances.[30] Support for this view is in table 1, which shows that of the high grade men 48% had fathers in social class I and II; the figure for women was 69%. Coming from an advantaged background has a bigger effect on achieved employment grade in women than men. Furthermore, smoking among adult women was more common among those whose father's were in

manual social class.[5] It was surprising therefore to find that chronic bronchitis and depression in women was more frequent among those with higher social class fathers. This may reflect the pressures on women of higher status being greater than among men. This is an area of further inquiry in the Whitehall II study. Alternatively, there may be differential selection effects by grade of employment in women: depression could be a bigger barrier to employment in low status than in high status women. Only five women whose father's were in social class IV or V had chronic bronchitis making the estimate of this effect unstable.

Although the cumulation model may apply in other circumstances, it is the latency and pathway models that would seem to find most support in these Whitehall II findings.

The significant relation between short height and coronary risk, independent of grade of employment, is consistent with a long term effect of early life—a latency model. The pathway model suggests that early social circumstances influence grade at entry to the civil service and promotion to current grade. Height could also play a part in influencing promotion chances and hence be part of a pathway process. These in turn reflect current social circumstances that account for the socioeconomic differences in our three end points.

The findings on depression raise the question of depression affecting social mobility. Men and women whose fathers were of higher social class were at higher risk of depression. Similarly, high grade at entry to the civil service was predictive of depression, in contrast with "current" grade where low grade predicted depression. If "incident" depression in people who were not depressed at baseline were, in fact, a recurrence of depressive symptoms in people with a long history, an explanation of these findings is that depression retarded promotion in the civil service. This is consistent with findings on mobility in the first five years of Whitehall II.[31]

This explanation could not apply to CHD. Low starting grade is associated with increased CHD risk. This would be predicted by a pathway model in which general social advantage facilitated entry into the civil service at a high level and was associated with lower CHD risk.[32] Lower current grade is thus reflective of current circumstances, including power relations in the workplace that are related to CHD.[32]

Although the instruments used to assess the disease end points have been validated, such self report measures may entail some social class bias.[33] These cannot explain the relations between grade of employment and the three diseases as an array of other analyses show similar findings.[34] It is not obvious why social class bias in reporting disease should weaken associations with social class of background. Nevertheless as "harder" end points accumulate, these findings can be further tested.

The findings reported here in relation to disease end points from Whitehall II are consistent with our previous analysis of cardiovascular risk factors in this cohort.[5] In men, smoking, physical inactivity and a range of metabolic risk factors are primarily associated with current employment grade and not with father's social class. Obesity was linked both to current employment grade and father's social class. These risk factor findings are similar to those previously reported from Scotland.[21]

In a prospective study of over 7000 civil servants we found that incident adult morbidity was more strongly related to adult employment grade than father's social class. These findings are consistent with a "pathway" interpretation. This emphasises the importance for policy addressing early life disadvantage[11] in this case because it influences adult circumstances rather than influencing disease directly. A further implication for policy is that improvement in the conditions in which adults live and work is likely to improve disease risk independent of earlier disadvantage.

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