EPIDEMIOLOGY

Health inequalities among British civil servants: the Whitehall II study

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The Whitehall study of British civil servants begun in 1967, showed a steep inverse association between social class, as assessed by grade of employment, and mortality from a wide range of diseases. Between 1985 and 1988 we investigated the degree and causes of the social gradient in morbidity in a new cohort of 10 314 civil servants (6900 men, 3414 women) aged 35–55 (the Whitehall II study). Participants were asked to answer a self-administered questionnaire and attend a screening examination.

In the 20 years separating the two studies there has been no diminution in social class difference in morbidity: we found an inverse association between employment grade and prevalence of angina, electrocardiogram evidence of ischaemia, and symptoms of chronic bronchitis. Self-perceived health status and symptoms were worse in subjects in lower status jobs. There were clear employment-grade differences in health-risk behaviours including smoking, diet, and exercise, in economic circumstances, in possible effects of early-life environment as reflected by height, in social circumstances at work (eg, monotonous work characterised by low control and low satisfaction), and in social supports.

Healthy behaviours should be encouraged across the whole of society; more attention should be paid to the social environments, job design, and the consequences of income inequality.

Lancet 1991; **337**: 1387–93.

Introduction

Inequalities in health are not confined to differences between the rich and the poor. Manual workers have higher mortality rates than non-manual, and in the UK the gap has been widening.[1,2] Among those in non-manual employment, the lower the social class, the higher the mortality rates.[3]

The Whitehall study of British civil servants[4]—all office workers in stable employment—found that after 10 years of follow-up the highest employment grade had about one-third the mortality rate of the lowest.[5] None of these men were in absolute poverty as usually understood. In the Whitehall study, differences in smoking, obesity, physical activity, blood pressure, or plasma cholesterol level could only partly explain differences in mortality.[5–7] This implies that we have to look beyond the established risk factors for explanations.

The shorter life expectancy among lower socioeconomic groups may be accompanied by a longer period in poor health, and socioeconomic differences in morbidity are similar to those observed for mortality.[8–10] The use of Registrar-General social classes instead of employment grade may lead to underestimation of the extent of mortality and morbidity differentials.

This study (Whitehall II) was set up to investigate the degree and causes of the social gradient in morbidity, to study additional factors related to the gradient in mortality, and, importantly, to include women. A new cohort of civil servants was established between 1985 and 1988. Particular attention was paid to psychosocial factors which may influence health, with a focus on stressful work environments and lack of social support as they may influence risk of cardiovascular disease.

Methods

Participants

The target population for the Whitehall II study was all men and women aged 35–55 working in the London offices of twenty civil-service departments. Members of the target population were invited to participate by letter. The response rate, after excluding those who were ineligible, was 73%. (74% among men, 71% among women). Response rate varied by employement grade, being 81% among the top three employment grade categories (defined below) and 68% among the lower three categories. The true response rates are likely to be higher, however, because around 4% of those on the list of employees had in fact moved before the study and were thus not eligible for inclusion. The final sample size was 10 314—6900 men, 3414 women.

Questionnaires

A self-administered questionnaire was posted to participants who subsequently attended for a screening examination at their place of work. The questionnaire was checked for completeness at the screening examination by an interviewer who sought missing

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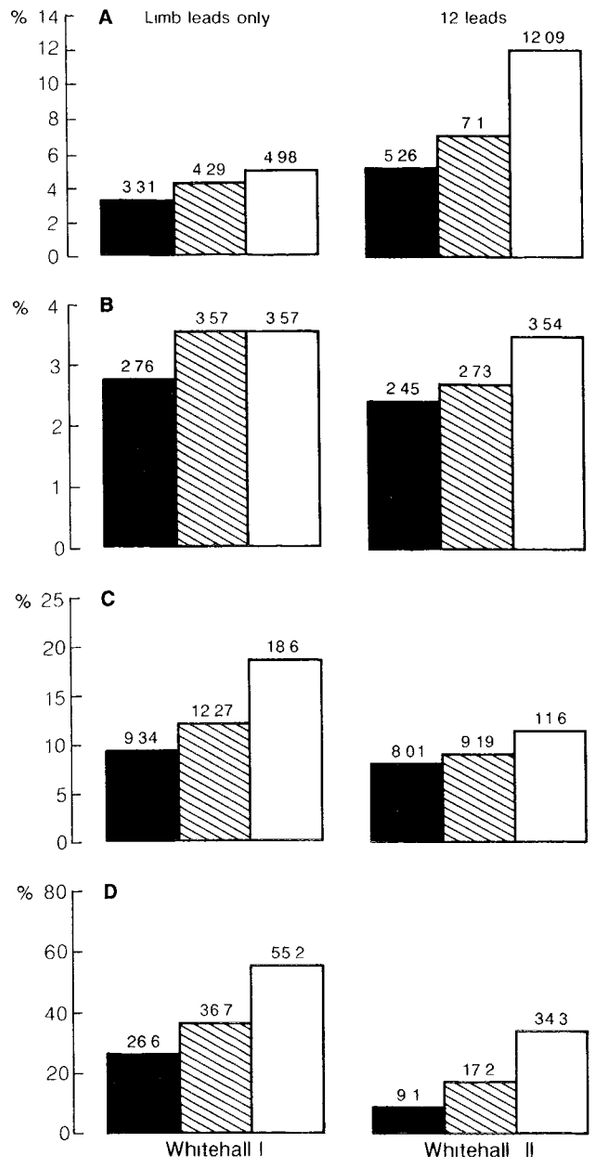

Prevalence of cardiorespiratory disease and smoking among men aged 40–54 in the Whitehall I (1967–69) and Whitehall II (1985–88) studies (age-adjusted percentages).

(A) Probable and possible ECG ischaemia, (B) angina pectoris, (C) chronic bronchitis, (D) current cigarette smokers. Administrators (■), professional/executive (▨), clerical/support (□).

information. The questionnaire included these items: (1) social and demographic data—ie, age, sex, marital status, family structure, parents' occupation and education, employment history; (2) health status measures—ie, the London School of Hygiene cardiovascular questionnaire on angina pectoris and possible myocardial infarction,[11] the Medical Research Council chronic bronchitis questionnaire,[11] the General Household Survey long-standing illness question,[10] and questions on past medical history of doctor-diagnosed illness, current medications, minor illnesses, symptoms, self-rated health status, minor psychiatric morbidity as assessed by the thirty-item general health questionnaire,[12] and the affect balance scale; (3) work characteristics based on the occupational strain model of job demands and decision latitude;[13] (4) social networks and type of social supports; (5) health behaviours—ie, smoking, dietary pattern, alcohol consumption, physical activity; and (6) the Framingham type A score,[14] and questions on hostility,[15] locus of control (the degree to which subjects think they have control over what happens to their health), stressful life events,[16] and personal difficulties.

Subjects were asked about presence of seventeen different symptoms, covering most body systems, in the previous 14 days. Positive responses to these questions was summed to produce the symptom score. Health in the last year was self-rated from very good to poor. Reports of health as being average or worse were combined. A separate set of questions covered common disorders of each body system within the last year.

Work characteristics were assessed with a sixty-seven-item self-report questionnaire. Questions were assembled into eight a priori groups: work pace, conflicting demands, variety and skill use, control, coping strategies, job clarity and feedback, perceived job importance, and job satisfaction. Principal-component analysis broadly supported these groupings, but indicated that two questions from "control" should be omitted, and that coping strategies and job clarity and feedback should be amalgamated into a single group, which we named social supports at work. Within each group, a work index was created by summing question scores and dividing each score into tertiles. Results are reported as the percentage of participants falling into the top tertile of these measures.

Life events were assessed by eight self-report questions concerning experiences in the previous 12 months.[15] Questions on social networks were derived from the Berkman and Syme index.[17] Types of social support were assessed by fifteen self-report questions on up to four nominated close friends or relatives. Three types of social support were confirmed by principal-components analysis: confiding/emotional support, practical support, and negative aspects of support.

Screening examination

At the screening examination, blood pressure was measured twice in the sitting position after 5 min rest with the Hawksley random-zero sphygmomanometer. Height and weight were recorded. Blood was taken and the cholesterol concentration determined by the cholesterol oxidase/peroxidase colorimetric method (BCL kit). Electrocardiograms (ECGs) were recorded with the 'Mingorec' system (Siemens) on magnetic tape. Tapes were analysed at Dr Peter Mcfarlane's laboratory (Department of Medical Cardiology, University of Glasgow) where Minnesota codes[11] were assigned by computer. The criterion for probable ischaemia on ECG was the presence of Q waves with Minnesota codes 1-1 to 1-2; possible ischaemia included any Q wave with codes 1-1 to 1-3, S-T or T waves (codes 4-1 to 4-4 or 5-1 to 5-3), or left-bundle branch block code 7-1-1. All ECG tracings that were "ischaemia probable or possible" by computer were independently coded by an experienced coder. For an ECG to be considered to show possible or probable ischaemia, it had to be labelled as such by both the computer and the human coder.

Angina was diagnosed according to the criteria used previously[18]—ie, pain located over the sternum or in both left chest and left arm that comes on with exertion, that causes the person to stop, and that goes away in 10 min or less.

Grade of employment

We obtained information on grade of employment by asking all participants to give their civil service grade title. On the basis of salary the civil service identifies twelve non-industrial grades which, in order of decreasing salary, comprise seven "unified grades", and senior executive officer (SEO), higher executive officer (HEO), executive officer (EO), clerical officer, and clerical assistant. Other professional and technical staff are assigned by the civil service to one of these grades on the basis of salary. For analysis, we have combined unified grades 1–6 into one group and the bottom two clerical grades into another, thus producing six categories. Category 1 represents the highest status jobs and category 6 the lowest. The first two categories (unified grades 1–6 and unified grade 7) are roughly equivalent to Administrative grade in the original Whitehall study. SEO, HEO, and EO correspond roughly to Professional and Executive, and the clerical category (which includes a small number of office-support staff) corresponds to the Clerical and "Other" grades in the first study.[6] At Jan 1, 1987, annual salaries ranged from £62 100 for a permanent secretary to £3061 for the lowest paid office-support grade.

Statistical methods

Age was adjusted for by 5-year age groups, with the study population as the standard. Tests of trend were done by assessing

TABLE I—MORBIDITY PREVALENCE BY CIVIL SERVICE EMPLOYMENT GRADE CATEGORY (AGE-ADJUSTED)

—	Sex	Employment category*						Total sample	Test for trend (p)†
		1	2	3	4	5	6		
Number in each category	M	1026	1627	1228	1496	881	642	6900	..
	F	122	264	198	480	660	1690	3414	..
Mean age (yr)	M	46·9	44·2	43·5	42·5	43·4	44·6	6900	⩽0·001
	F	44·1	43·0	42·1	42·9	45·5	46·7	3414	⩽0·001
Probable ischaemia on ECG (%)	M	1·3	0·9	1·1	1·2	1·4	2·1	6896	0·05 –⩽0·1
	F	0	0	0·7	0·1	0·7	1·1	3412	0·01 –⩽0·05
Probable/possible ischaemia on ECG (%)	M	6·4	4·9	5·0	6·5	6·7	10·5	6896	⩽0·001
	F	3·6	3·3	3·0	6·5	7·8	7·3	3412	0·001–⩽0·01
Angina by questionnaire (%)	M	1·7	2·4	2·5	3·1	1·9	2·9	6835	NS
	F	1·8	1·6	2·9	3·3	5·8	4·0	3351	0·01 –⩽0·05
Probable/possible ischaemia on ECG or angina (%)	M	7·6	7·0	7·3	9·3	8·4	12·3	6835	⩽0·001
	F	4·5	5·0	5·5	9·8	13·3	11·1	3357	⩽0·001
History of diabetes (%)	M	0·3	0·6	0·8	0·8	1·7	1·7	6852	⩽0·001
	F	0·9	0·6	0	0	0·8	1·4	3386	0·01–⩽0·05
Mean number of symptoms	M	2·1	2·4	2·5	2·5	2·6	2·6	5151	⩽0·001
	F	3·2	3·3	3·1	3·1	3·2	3·0	2442	NS
Self-rated health average or worse (%)	M	15·3	19·5	21·5	22·8	27·5	33·7	6874	⩽0·001
	F	26·2	25·5	28·7	28·9	34·4	42·1	3404	⩽0·001
Regular cough with phlegm in winter (%)	M	6·7	7·3	6·9	9·2	11·0	10·9	6850	⩽0·001
	F	4·2	6·1	10·3	6·4	6·5	8·6	3364	0·05 –⩽0·1
Long-standing illness (%)	M	29·9	30·4	30·1	31·6	31·8	36·4	5157	0·001–⩽0·01
	F	30·2	35·8	26·7	33·7	31·6	30·5	2485	NS
Any health problems last year (%)	M	69·0	68·0	67·3	67·7	66·5	70·7	5148	NS
	F	69·8	70·6	73·5	72·3	75·3	75·6	2463	0·01 –⩽0·05
Drug therapy for hypertension (%)	M	2·1	2·1	2·1	2·7	4·8	5·2	6673	⩽0·001
	F	3·7	4·4	4·1	2·9	3·5	4·3	3338	NS
Pre-menstrual "bloating" (%)	F	2·2	8·6	9·6	10·9	16·8	19·6	1939	⩽0·001

*Category 1 = unified grades 1–6, 2 = unified grade 7, 3 = SEO, 4 = HEO, 5 = EO (and professional equivalents for categories 3–5), 6 = clerical officer/office support.
†NS = p > 0·1

the significance of employment grade category in linear regression models with age group as a covariate for continuous outcomes, and by Cochran-Mantel-Haenszel tests of association of dichotomous outcomes with employment grade category, stratified by age group (SAS computer software v 5·18 [SAS, Cary, USA], procedures GLM and FREQ).

Results

Morbidity by grade of employment

The figure shows rates of prevalence of ECG abnormalities, angina pectoris, chronic bronchitis, and smoking. For comparison with Whitehall I, employment grades are grouped into three broad classes and data are restricted to men aged 40–54. In Whitehall I, ECGs were recorded with limb leads only, therefore a lower prevalence of ischaemia would be expected compared with that recorded with the full 12-lead ECGs used in this study. There appears to be no decrease in the difference in prevalence of ischaemia depending on employment category over the 20 years separating Whitehall I and Whitehall II. The relative difference between clerical officers and administrators appears to be greater. For angina pectoris, the difference between grades has changed little in 20 years. The overall prevalence of chronic bronchitis—ie, cough with phlegm production—is considerably lower for men aged 40–54 in Whitehall II than in the previous study, but the relative difference between the grades is similar. The findings for chronic bronchitis are likely to be related to smoking. The figure shows that prevalence of smoking among civil servants has decreased but the striking inverse association with job status persists.

Table I shows morbidity figures for each employment grade category. In general, the lower the job status (ie, the higher the employment category number) the higher the prevalence of ischaemic heart disease. Women report higher prevalence of angina than men, despite the lower prevalence of ischaemic ECGs. Among men there was an inverse association between job status and number of symptoms reported in the last 14 days, likelihood of rating health as average or poor as opposed to good or very good, and a prior

TABLE II—SOCIODEMOGRAPHIC FACTORS BY EMPLOYMENT GRADE CATEGORY* (AGE-ADJUSTED)

—	Sex	Employment category†						Total sample
		1	2	3	4	5	6	
Father in manual social class (%)	M	29·9	36·9	45·2	43·2	45·7	50·6	4778
	F	16·1	19·8	29·6	36·0	53·7	62·0	2207
Married or cohabiting (%)	M	89·2	88·5	84·7	76·4	74·6	57·0	6880
	F	58·8	56·1	50·9	51·4	56·4	67·6	3396
Education at university or polytechnic (%)	M	69·3	57·1	30·7	25·7	21·2	19·3	5164
	F	79·2	66·5	49·0	30·3	14·7	8·6	2476
Owner-occupier (%)	M	98·8	98·6	98·2	93·9	89·0	59·2	6856
	F	96·3	97·8	94·2	95·1	82·0	66·8	3376
Council rented accommodation (%)	M	0·1	0·4	0·3	1·9	5·9	23·1	6856
	F	1·8	0·3	0·4	2·1	8·5	24·2	3376
Household has use of car/van (%)	M	97·5	93·6	91·8	83·2	75·7	55·6	6881
	F	89·9	87·2	75·2	75·3	71·1	69·8	3392

*In all cases p ⩽ 0·001 on test for trend. †See footnote to table I for definition

TABLE III—PHYSIOLOGICAL MEASUREMENTS, HEALTH BEHAVIOURS, AND FAMILY HISTORY BY EMPLOYMENT GRADE CATEGORY (AGE-ADJUSTED)

—	Sex	Employment category*						Total sample	Test for trend (p)†
		1	2	3	4	5	6		
Physiological measurements									
Mean cholesterol (mmol/l)	M	6·05	5·97	5·93	6·02	6·0	6·0	6865	NS
	F	5·79	5·85	5·8	5·8	5·9	5·86	3375	NS
Mean systolic blood pressure (mm Hg)	M	124 3	124·6	123·9	124·8	125·4	125·4	6886	0·001–⩽0·01
	F	117·6	120·5	120·6	119·2	119·7	119·5	3413	NS
Mean diastolic blood pressure (mm Hg)	M	77·6	77·5	77·6	77·9	78 8	79·1	6886	⩽0·001
	F	74·0	75·2	75·3	74·3	74·8	74·9	3412	NS
Mean body mass index	M	24 6	24·4	24·6	24·5	24·8	25·1	6888	⩽0·001
	F	23·7	23·7	24·3	24·1	24·5	25·3	3412	⩽0·001
Obese (%)	M	4·1	3·7	4·6	5·1	6·0	10·7	6888	⩽0·001
	F	7·4	4·6	7·9	7·8	10·3	13·2	3412	⩽0·001
Mean height (cm)	M	177·8	177·1	176·9	176·3	174·3	172·9	6890	⩽0·001
	F	165·5	165·1	165·3	163·1	162·8	160·7	3413	⩽0·001
Health behaviours									
Current smokers (%)	M	8·3	10·2	13·0	18·4	21·9	33·6	6892	⩽0·001
	F	18·3	11·6	15·2	20·3	22·7	27·5	3408	⩽0·001
Mean units of alcohol in last 7 days	M	14·6	12·6	12·9	12·9	11·6	10·1	6845	⩽0·001
	F	12·1	9·8	9·3	7·0	5 2	3·6	3375	⩽0·001
No moderate or vigorous exercise (%)	M	5·1	5·4	4·9	7·5	16·2	30·5	6662	⩽0·001
	F	12·0	14·7	10·8	13 2	19·7	31 1	3221	⩽0·001
Usually use skimmed or semi-skimmed milk (%)	M	44·2	39·3	35·1	31·8	27·8	21 2	6869	⩽0·001
	F	39·5	48·3	49·8	46·2	40·5	34·4	3389	⩽0·001
Mainly wholemeal bread (%)	M	47·7	45·2	43·6	37·2	37·5	32·2	6867	⩽0·001
	F	57·2	52·9	58·2	55·4	43·8	35·5	3380	⩽0·001
Eat fresh fruit or veg less than daily (%)	M	34·0	39·6	40·6	47·9	52·5	61·7	6881	⩽0·001
	F	17·7	20·4	28·4	29·7	36·4	43·6	3400	⩽0·001
Family history									
Parent had heart attack (%)	M	26·1	28·1	26·1	26·1	24·0	22·5	6649	0·001–⩽0·01
	F	39·2	36·4	24·7	29·8	22·6	24·5	3234	⩽0·001
Sibling had heart attack (%)	M	2·0	2·3	2·7	3·2	4·4	3·8	5496	0·001–⩽0·01
	F	0·8	1·7	1·0	4·3	4·8	6·4	2804	⩽0·001

*See footnote to table I for definition. †NS = p > 0 1.

diagnosis of hypertension or diabetes. In general, women reported greater morbidity than men. The relation with grade was less consistent. In addition to a higher prevalence of premenstrual bloating, women of lower job status were more likely to report premenstrual irritability and breast tenderness (data not shown).

Sociodemographic characteristics by employment category

Sociodemographic characteristics according to employment category are shown in table II. Subjects in lower status jobs were less likely to have had higher education, and were more likely to have had fathers in manual social classes, to live in council or rented accommodation, and to have no household access to a car. The higher the job status, the more likely that men were married or cohabiting. Conversely, the highest percentage of married women were in employment category 6.

Potential explanations—biological and behavioural risk factors

The grade differences in morbidity parallel those seen previously for mortality. Table III shows data on biological and behavioural risk factors by employment category. Plasma cholesterol concentrations do not differ by category, and the small inverse association between job status and blood pressure in men was reduced from that seen in the Whitehall I study. There was a significant inverse relation between mean body-mass index (weight/height^2) and job status, but, especially in men, the differences were small. However, obesity (body-mass index greater than 30) was more prevalent in lower status jobs, especially in the clerical grade. As in Whitehall I, height correlated with job status.

The risk factor that differed most between employment categories was smoking (figure, table III). Women had a higher prevalence of smoking than men in all but the clerical and office-support category. Moderate or vigorous exercise was less common among subjects in lower status jobs. As a rough indicator of dietary pattern, consumption of skimmed and semi-skimmed milk, wholemeal bread, and fresh fruit and vegetables was greatest in higher status jobs. Average alcohol consumption also correlated with job status, strikingly so for women. Reports of parents having had a heart attack were more frequent in higher status jobs; a positive family history of heart attack among siblings was more common in lower status jobs.

Potential explanations—psychosocial characteristics

Table IV shows differences in psychosocial characteristics. Fewer of those in lower status jobs report control over their working lives, having varied work, or having to work at a fast pace. Overall, fewer subjects in lower status jobs were satisfied with their work situation.

Social relations are expressed quantitatively as extent of social networks, and qualitatively as the nature of social supports. More subjects in lower status jobs reported visiting relatives once a month or more, while more in higher status jobs visited friends. Fewer people in lower status jobs were involved in hobbies. Fewer men in lower status jobs had a confidante in whom they could entrust their problems or received practical support; more reported negative reactions from persons close to them. Patterns were less clear in women.

TABLE IV—PSYCHOSOCIAL CHARACTERISTICS BY EMPLOYMENT GRADE CATEGORY (AGE-ADJUSTED)

	Sex	Employment category*						Total sample	Test for trend (p)†
		1	2	3	4	5	6		
Work characteristics‡									
High control (%)	M	59·3	49 7	43·1	31·6	24·7	11·8	6877	⩽0·001
	F	51·2	45·4	47·1	31·2	20·1	10·2	3341	⩽0·001
Varied work (%)	M	70·5	52·1	41·9	27·1	18·2	3·9	6875	⩽0·001
	F	71·2	55·2	40·5	31·7	14·0	4·7	3356	⩽0·001
Fast pace (%)	M	58·0	43·6	34·7	27·9	20·8	15·8	6878	⩽0·001
	F	60·9	50·3	43·7	31·1	29·7	18·0	3356	⩽0·001
High satisfaction (%)	M	58·2	38·7	34·1	29·5	29·4	29·8	6865	⩽0·001
	F	57·5	42·2	40·3	36·6	41·6	47·7	3337	NS
Social network/activities									
See at least 3 relatives per month (%)	M	22·1	24·8	29·0	27·2	29·7	30·6	6426	⩽0·001
	F	18·9	23·7	21·1	24·1	30·4	44·9	3187	⩽0·001
See at least 3 friends per month (%)	M	65·3	61·3	58·5	58·6	56·4	50·2	5162	⩽0·001
	F	71·1	62·8	67·1	63·6	52·9	49·0	2473	⩽0·001
No hobbies (%)	M	12·4	12·9	12·7	15·0	23·0	25·4	6453	⩽0·001
	F	12·5	15·4	11·3	11·9	18·3	27·5	3044	⩽0·001
Social support from closest person‡									
Confiding/emotional support (%)	M	31·3	33·7	28·3	28·3	34·6	26·1	5021	0·05 –⩽0·01
	F	37·3	33·8	33·0	32·5	32·9	31·8	2380	NS
Practical support (%)	M	41·1	40·0	37·2	33·0	36·4	29·1	5022	⩽0·001
	F	21·8	25·9	26·8	17·1	24·0	28·0	2384	0·05 –⩽0·1
Negative aspects of support (%)	M	25·0	28·4	31·3	30·9	38·1	39·0	5010	⩽0·001
	F	33·0	32·5	28·3	36·4	28·3	33·8	2379	NS
Events and difficulties									
Two or more major life events (%)	M	29·6	31·6	35·1	37·9	39·9	41·9	6758	⩽0·001
	F	41·1	43·6	35·5	42·8	46·5	49·2	3247	⩽0·001
Sometimes not enough money (%)	M	7·0	12·6	21·5	26·4	34·4	37·2	4977	⩽0·001
	F	7·7	6·9	9·6	13·2	24·4	34·4	2282	⩽0·001
Some difficulty paying bills (%)	M	11·0	16·2	22·8	24·7	29·6	29·6	5167	⩽0·001
	F	15·2	13·2	11·8	15·7	18·1	26·9	2490	⩽0·001
Other									
Type A (defined as upper tertile) (%)	M	51·3	40·2	36·9	27·8	20·4	12·8	6729	⩽0·01
	F	62·6	54·6	44·0	39·0	29·0	17·6	3228	⩽0·001
Hostility score	M	9·7	10·2	10·9	11·3	12·7	14·7	4266	⩽0·001
	F	9·5	9·5	9·4	10·1	10·4	12·3	1772	⩽0·001
Believe one can reduce risk of	M	71·6	72·2	70·8	66·8	65·5	52·4	5136	⩽0·001
of heart attack (%)	F	58·1	61·6	69·7	68·4	65·0	53 7	2487	⩽0·001

*See footnote to table I for definition. †NS = p > 0·1 ‡Upper tertile of distribution.

More subjects in lower status jobs were likely to have reported two or more of eight potentially stressful life events in the previous year, and to report difficulties paying bills or with money in general.

Despite their lower rate of heart disease, more of the participants in higher status jobs had type A behaviour. It has been suggested[19,20] that the major component of type A behaviour responsible for the link to heart disease is hostility—subjects in higher status jobs had lower scores on the Cook-Medley hostility scale. As one measure of perceived control over their health, fewer participants in lower status jobs believed that it was possible to reduce the risk of heart attack.

Discussion

Our findings show that socioeconomic differences in health status have persisted over the 20 years separating the two Whitehall studies. The relative magnitude of these differences is difficult to assess. In the Whitehall I cohort, grade differences in prevalence of ischaemic heart disease were considerably less than the threefold difference between the lowest and highest grades in ischaemic heart disease mortality found at subsequent follow-up.[21] If the same applies to the Whitehall II cohort, subsequent disease differences will be even greater than those reported here.

The differences between grades in self-perceived ill-health are substantial: compared with those in employment category 1, twice as many in category 6 rate their health as average or worse, nearly twice as many have chronic cough and sputum, and there is a striking excess in the frequency of premenstrual symptoms. The main national figures on morbidity have hitherto come from the General Household Survey questions on longstanding illness.[10] We found that longstanding illness was reported more frequently by lower employment grade men but not women.

Self-reported data are of special interest. There is an established link between perceived health and other measures of health status. Thus, the question on "overall rating of health as poor or average" is a powerful predictor of mortality,[22] as are the questions on angina pectoris.[18] In addition to their relation to underlying "true" pathology, they reflect a burden of perceived ill-health that shows a clear social class gradient.

We believe that employment grade within the civil service, with its strong relation to income, is a more precise classification of socioeconomic position than Registrar-General's social classes, based on occupation. Homogeneity within grades is high, and differences between grades fairly distinct. We judge, therefore, that ours is a suitable population for exploring reasons for persistant social-class differences in health. It is likely that these findings will apply to white collar employees of other large organisations.

The Black Report,[23] and subsequent discussions,[24,25] considered that social-class differences could be due to artefact, to selection, to material conditions, or to life-style. In the present study, grade was measured precisely and there is little likelihood of artefact in assignment of social position. Health selection is of course a possibility.

Differential recruitment into or exit from grades on health grounds could produce grade differences in health status. An analysis of the relation between speed of promotion and initial health status will be published elsewhere; however, health-related downward mobility has been shown not to account for national social-class mortality differences.[26]

Previously, we concluded that, important though they were, grade differences in established coronary-risk factors could not account for the observed differences in coronary and other diseases. The Whitehall II study throws up a number of possible explanations for these differences.

First, the differences in height by employment category indicate differences in early environment. In the Whitehall I cohort, height was inversely related to mortality.[5] This is consistent with work suggesting that early-life environment predicts disease in adult life.[27] Some of the health risk associated with short height derives from the association between height and socioeconomic position in adulthood.[7] When considering the possible effects of early environment on mortality risk it is important to take socioeconomic position in later life into account, particularly since deprivation in infancy and in adulthood are likely to be strongly related.[28]

Second, grade differences in behaviours were found in both Whitehall studies. The grade difference in frequency of smoking persists. There were also grade differences, favouring the higher status jobs, in leisure-time physical activity and in indicators of healthy eating, though answers to questions on nutrient intake may be more a measure of health consciousness than of actual intake. Consistent with different attitudes to health is the lower degree of belief among those with lower status jobs that they could take action to help prevent a heart attack.

Third, social circumstances differed between employment categories. Because grade correlates with income, those lower down the grade hierarchy were more likely to report financial and housing difficulties and to rent their accommodation. Housing tenure predicts mortality independent of occupationally defined social class.[29] Patterns of social activity differed, with clear indication of less, and less satisfactory, social support among those with lower status jobs.

Fourth, work environment is perceived differently between grades. Impressive evidence has accumulated that jobs characterised by low control, low opportunity to learn and develop skills, and high psychological work load are associated with increased risk of cardiovascular disease.[13,30] Men with lower status jobs report less control, less use of skills, and less variety at work. To the extent that having to work fast is a measure of psychological work load, those with lower status jobs report having to do this less often. It may, however, also be a measure of job involvement and variety.

A notable exception to the pattern of lower status job–higher risk, is type A behaviour, the behaviour pattern that may predispose to heart disease. There is no hint from these data that differences in type A behaviour could account for grade differences in disease. It is worth noting that hostility, which has been associated with heart disease,[19,20] was more prevalent in those with lower job status.

It should be emphasised that the usual pattern of association between job status and health measures is a gradient. It is not simply that those in the lowest status jobs had the worst health and the greatest clustering of potential risk factors.

It is important to understand the factors determining mortality and morbidity differences. Were it possible to reduce the mortality rate of clerical officers in the civil service to that of administrators, they would have less than half their current death rate. Our data suggest that healthy behaviours should be encouraged across the whole of society, not just among the more privileged. They also suggest that attention should be paid to the social environment, job design, and the consequences of income inequality.

We thank all participating Civil Service departments and their welfare, personnel and establishment officers, and the Civil Service Central Monitoring Service, the Civil Service Occupational Health Service, Dr George Sorrie, Dr Adrian Semmence, and all participating civil servants.

We also thank Prof Geoffrey Rose and Mrs Ceridwen Rose, Prof Barry Lewis, Dr Brenda Slavin, Mr Edward Kearney and staff, Dr Peter Macfarlane, Dr Tom Spuhler, Ms Julie Moore (project co-ordinator), and Prof John Bunker for their valuable contributions.

This study was supported by the Medical Research Council, Health and Safety Executive, and National Heart Lung and Blood Institute (2 ROI HL36310–04). G. D. S. was a Wellcome Fellow; F. N. was a New Zealand Medical Research Council Fellow.

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Seasonality of disease in Kuwait

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To compare the seasonal variation in total mortality and deaths from cardiovascular, respiratory, and malignant disease, data were collected from North-East Scotland (Grampian region) and Kuwait. Seasonal differences were similar, in both timing and degree, for total mortality and deaths from circulatory disease, but were greater in Kuwait for respiratory disease. Peak mortality was during winter in both areas: in Grampian, when the climate is most uncomfortable, and in Kuwait, when the climate is at its most comfortable. Socioeconomic changes in Kuwait have been accompanied by a rapid fall in the degree of seasonality (deseasonality) for both total and infant mortality. These findings suggest that mortality peaks in winter, not because of a seasonally low temperature, but because of a seasonal fall in mean temperature irrespective of the annual mean temperature.

Lancet 1991; **337:** 1393–97.

Introduction

The improvements in hygiene, living standards, health care, and medical facilities in Kuwait now allow for comparisons of the seasonality of disease to be made between two northern hemisphere countries with very different climates. Kuwait is at latitude 30° North, and the Grampian region of Scotland lies at 57° North. The seasonality of mortality in Grampian has been studied by us, recorded separately,[1] and is outlined here for comparison with Kuwait. Over 60% of deaths in Grampian are due to cardiovascular and respiratory disease (CVRD), while about 20% are attributable to malignant disease, and the remainder are caused by all other diseases (AOD) and by injuries and poisoning (IP). Seasonality exists for CVRD, AOD, and IP but not for malignant disease.

Materials and methods

Kuwait 1981–84; 1986–88

Monthly mortality data were obtained from the Ministry of Public Health and from the Ministry of Planning in Kuwait. For the years 1981–84, data were provided as a 56-item basic tabulation list, and for 1986–88 were based on the International Classification of Diseases 9th revision. For a comparison between infant and adult deaths, data were taken from United Nations Demographic Yearbooks 1974, 1979, and 1985.[2]

Scotland (Grampian) 1974–88

Mortality data were compiled by the Registrar General and obtained from the Department of Community Medicine, University of Aberdeen.

Climatic data

For Kuwait, data were obtained for the years 1955–73.[3] For two weather stations in Aberdeen, Scotland, data were taken from the thirty years Meteorological Office records (UK) for 1960 (Dyce)[4] and 1982 (Craibstone).[5] Photoperiods were obtained from the Nautical Almanac.[6]

Analysis

Cosinor analysis was applied to assess seasonality.[7] This technique is reliable provided data fit a unimodal sinusoidal curve; the best fit of a cosine-function curve to annual data is then calculated. In cosinor analysis, the year is taken as 360 degrees and the midpoint of each month of the year is assigned an angular value, t, for January (15 degrees) through to December (345 degrees). Multiple regression analysis is completed between monthly data and sin (t) and cos (t). This analysis gives the multiple correlation coefficient (r), its statistical significance (p), and the angular position in the year (converted to the nearest month) where the fitted sinusoidal regression line has its highest value.

We calculated the mean value per month, M, which was given a value of 100%. Individual months were expressed as a percentage above and below this mean. The extent of the seasonal fluctuation is called the amplitude. The amplitude, A, was measured as the percentage above the mean for the month of highest value (the acrophase). The terms acrophase, zenith, and peak are used synonymously. With this method the nadir comes six months after the acrophase. Significance refers to the presence or absence of seasonality. The cosinor analysis established the 95% confidence limits, but to keep the illustrations as simple as possible they have been shown only in fig 1. The r value of the cosinor analysis gives a guide to the level of significance.

Results

Climate

Temperature differences are shown in fig 1. The July reading in Aberdeen is similar to January in Kuwait. The

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