

Do Socioeconomic Disadvantages Persist Into Old Age? Self-Reported Morbidity in a 29-Year Follow-Up of the Whitehall Study

ABSTRACT

Objectives. This study examined (1) the relation of employment grade in middle age to self-reported poor health and functional limitations in old age and (2) whether socioeconomic status at approximately the time of retirement modifies health differentials in old age.

Methods. Survivors of the Whitehall Study cohort of men were resurveyed. Respondents were aged 40 to 69 years when they were originally screened in 1967 to 1970.

Results. Compared with senior administrators, men in clerical or manual (low-grade) jobs in middle age had quadruple the odds of poor physical performance in old age, triple the odds of poor general health, and double the odds of poor mental health and disability. At most, 20% of these differences were explained by baseline health or risk factors. Men who moved from low to middle grades before retirement were less likely than those who remained in low grades to have poor mental health.

Conclusions. Socioeconomic status in middle age and at approximately retirement age is associated with morbidity in old age. (*Am J Public Health.* 2001; 91:277–283)

Elizabeth Breeze, MSc, CStat, Astrid E. Fletcher, PhD, David A. Leon, PhD, Michael G. Marmot, PhD, MBBS, Robert J. Clarke, MD, MRCP, and Martin J. Shipley, MSc

There is a small but growing body of evidence from the United Kingdom that socioeconomic differentials in mortality persist into old age^{1–3} and may even be widening.^{4,5} Although rate ratios tend to be smaller for older people than for younger people in the United Kingdom and the United States,^{4–6} absolute differentials can still be large.⁵

There is little equivalent information on self-reported morbidity. Analyses of cross-sectional studies show that self-reported health and disability, respiratory function, and blood pressure are all worse among older people in disadvantaged socioeconomic groups.^{7,8} Analyses of the Office for National Statistics Longitudinal Study in England and Wales showed that adverse socioeconomic circumstances were associated with self-reported limiting long-term illness after a 20-year follow-up period among survivors.⁹

The first Whitehall Study, an investigation of male British civil servants that was initiated in the late 1960s, showed an inverse mortality gradient (all causes and major causes) across employment grades.¹⁰ The Whitehall II Study, following a later cohort, revealed gradients in morbidity in middle age across socioeconomic groups.^{11,12} A resurvey of the survivors of the first cohort enabled us to study the long-term effects of employment grade on self-reported illness in old age.

Methods

Data Source

In the Whitehall Study, 19029 men, most aged 40 to 69 years, were examined between 1967 and 1970 to identify cardiorespiratory disease and its risk factors.¹³ Participants completed a questionnaire concerning their jobs, their personal and family medical histories, and their smoking habits. Approximately two thirds of the respondents were also asked about

car ownership and physical activity related to work, and one third were asked about leisure activity in general. A clinical examination included height and weight, blood pressure, electrocardiogram, and a blood sample analyzed for cholesterol and blood sugar. Participants were registered with the National Health Service Central Register for mortality notification (99% were successfully located).

Resurvey

The resurvey took place in 1997–1998 after a successful pilot study of 400 survivors in 1996.¹⁴ The National Health Service Central Register identified the health authority in which the cohort member was registered with a family doctor. Chief executives of the relevant health authorities granted permission to the register to provide addresses of survivors (or, failing this, to forward mail to them). Invitation letters, consent forms, and questionnaires were sent to individuals, along with up to 2 reminders. A short version of the questionnaire covering priority information was sent with the second reminder. The resurvey questionnaire included questions on socioeconomic status (SES) and retirement, diseases diagnosed

Elizabeth Breeze, Astrid E. Fletcher, and David A. Leon are with the Department of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, England. Michael G. Marmot and Martin J. Shipley are with the International Centre for Health and Society, Department of Epidemiology and Public Health, University College Medical School, London. Robert J. Clarke is with the Clinical Trial Service Unit and Epidemiological Studies Unit, University of Oxford, Oxford, England.

Requests for reprints should be sent to Elizabeth Breeze, MSc, CStat, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, England (e-mail: elizabeth.breeze@lshtm.ac.uk).

This article was accepted May 24, 2000.

TABLE 1—Resurvey Responses by Selected Characteristics: Whitehall Study, 1997–1998

	Total No. Invited to Take Part	Completed Full Questionnaire, No. (%)	Completed Short Questionnaire, No. (%)	χ^2 P
Age at resurvey, y				
<75	3029	2316 (76)	262 (9)	
75–79	2937	2236 (76)	272 (9)	
≥80	2571	1616 (63)	339 (13)	< .001
Baseline employment grade				
High	555	443 (80)	23 (4)	
Middle	6743	5052 (75)	657 (10)	
Low	1239	673 (54)	193 (16)	< .001
Baseline smoking status				
Never	2078	1588 (76)	186 (9)	
Ex-smoker	3370	2496 (74)	318 (9)	
Pipe/cigar smoker	332	249 (75)	28 (8)	
Cigarette smoker	2753	1832 (67)	341 (12)	< .001
Baseline evidence of cardiovascular disease				
Yes	1114	813 (73)	127 (11)	
No	7133	5353 (75)	746 (10)	.437
Baseline respiratory symptoms				
No phlegm	6399	4666 (73)	638 (10)	
Persistent cough/phlegm	1070	748 (70)	110 (10)	
Increasing cough/phlegm	409	267 (65)	56 (14)	
Hospital admission in past	647	481 (74)	69 (11)	.018
Total	8537	6168 (72)	873 (10)	

by a doctor, and ability to carry out everyday activities.

Outcome Measures

We used 4 measures of self-reported morbidity: general poor health, poor mental health, poor physical performance, and disability. Those rating their health as poor or very poor on a 5-point scale ranging from very good to very poor were classified as being in poor general health. Poor mental health was defined as a score below 60% of the maximum on the 5-item mental health section of the Short Form 36 Health Survey (SF-36).¹⁵ Poor physical performance was defined as a score below 40% of the maximum on the 10-item physical performance section of the SF-36, which asks people to state whether their health limits their activity extensively, a little, or not at all. Finally, disability was classified as an inability to engage in at least 1 of 5 instrumental activities of daily living (cooking a hot meal, cutting toenails, dressing oneself, doing light housework and simple repairs, and going up and down stairs and steps).

Data on mental health, physical performance, and disability were available only for those who completed the full questionnaire. The SF-36 indexes were scored as recommended.¹⁶ As a result of missing data, 4% of those completing the full questionnaire were not assigned a mental health score, 3% were not assigned a physical performance score, and fewer than 1% were excluded from the disability analyses.

Socioeconomic and Risk Factor Measures

The main baseline socioeconomic classification used was employment grade (high, middle, or low). High grades comprised senior managers and administrators; middle grades comprised executives and professionals (e.g., economists, statisticians, and scientists) in less senior positions; and low grades included clerical staff, printing room officers, security officers, messengers, and catering staff.

Other socioeconomic indicators were car ownership and, measured retrospectively at the resurvey, housing tenure at baseline (owner vs renter). These variables were found to be clear discriminators of mortality rates among older people in the United Kingdom in the 1970s,¹ were incorporated in the Townsend index of deprivation,¹⁷ and have subsequently been used as socioeconomic indicators.^{5,18}

Respondents were considered to have preexisting cardiovascular disease if they had at least 1 of the following at baseline: an abnormal electrocardiogram; self-reported symptoms of angina, claudication, or potential myocardial infarction¹⁹; medication for high blood pressure; or a hospital admission for a heart condition. We adjusted for cardiorespiratory disease clinical risk factors that existed at baseline because these risk factors are associated with later disability^{20–22} and can lead to more general problems in functioning and health. The variables used in the analyses were as follows: being in the top quintile in terms of systolic or diastolic blood

pressure or total cholesterol level (assessed with the entire 1960s cohort), body mass index of 30 kg/m² or greater, blood sugar level above 96 mg/dL, persistent or increasing duration of cough or phlegm or hospital admissions for respiratory disease, and 4 or more hospital admissions for other reasons.

Statistical Analysis

Chi-square tests for heterogeneity were used to determine univariate associations. Logistic regression (Stata 5 for Windows 3.1²³) was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for each outcome. All models included adjustment for age at resurvey (younger than 75 years, 75–79 years, 80 years or older).

Results

At the time of the resurvey, there were 8537 men from the original screening who, according to National Health Service Central Register records, were alive and living in Great Britain. Of these individuals, 6168 completed a full questionnaire (72%) and 873 a short one (10%), 209 of the latter by telephone. Seven percent of respondents had been in high employment grades at the initial screening, 12% had been in low grades, and 81% had been in middle grades. The median age of respondents at the resurvey was 77 years (range: 67–97), and the median follow-up interval was 29 years (range: 26–31).

Response rates were lowest among men in low employment grades, older men, smokers,

TABLE 2—Distribution (%) of Characteristics of Resurvey Respondents, by Employment Grade at Baseline: Whitehall Study, 1997–1998

	Employment Grade at Baseline, %			χ^2 P
	High (n=466)	Middle (n=5708)	Low (n=866)	
Resurvey				
Age, y				
<75	37.8	37.5	30.1	
75–79	38.2	36.4	29.3	
≥80	24.0	26.1	40.5	<.001
Net income <\$16 500	0.9	8.2	47.8	<.001
Had risen 1 grade category	...	39.7	50.8	<.001
Had paid job after leaving Civil Service	44.9	22.8	18.7	<.001
Cardiovascular disease				
Angina	11.4	14.5	16.7	.03
Heart attack	10.5	11.4	15.0	.006
Stroke	7.3	8.4	8.2	.74
Baseline				
Cardiovascular disease	11.4	13.3	14.5	.26
Top quintile				
Systolic blood pressure	7.3	12.7	15.6	<.001
Diastolic blood pressure	10.7	13.3	13.6	.27
Total cholesterol ^a	23.4	19.0	16.8	.15
Body mass index >30 kg/m ²	1.5	2.7	4.2	.01
Blood sugar >96 mg/dL ^a	3.9	4.3	5.0	.52
Respiratory symptoms				
No respiratory problem	78.1	75.7	71.8	
Persistent phlegm	9.2	12.0	15.4	
Increasing phlegm	2.8	4.3	7.2	
Hospital admission for respiratory disease	9.9	8.0	5.7	<.001
Ever had 4 or more hospital admissions (not cardiovascular or respiratory)	11.2	8.9	11.0	.05
Smoking status				
Never smoked	33.3	25.2	20.8	
Ex-smoker	36.1	41.5	32.3	
Smoked 1–9 cigarettes or pipe/cigar	16.6	12.8	12.3	
Smoked 10–19 cigarettes	6.2	11.2	20.9	
Smoked 20 or more cigarettes	7.7	9.4	13.8	<.001
Physical activity ^a				
Walked to work, min				
0–9	20.6	18.6	19.6	
10–19	43.9	43.9	44.6	
≥20	35.5	37.5	35.8	.83
Leisure activity				
None	18.7	19.9	25.5	
Inactive	6.0	7.8	13.2	
Moderately active	38.7	44.4	36.5	
Active	36.7	27.9	24.8	<.001
Other socioeconomic measures				
Rented accommodation	4.8	9.2	38.9	<.001
No car ^a	6.6	14.7	51.3	<.001
Not married	4.7	8.0	21.7	<.001

^aSample sizes were smaller for this variable.

and those with increasing symptoms of cough or phlegm at baseline (Table 1). Table 2 shows that socioeconomic indicators were strongly correlated with employment grade, as were smoking, leisure activity, and respiratory disease. Men in the lower employment grades were more likely to be in the top quintile in terms of systolic blood pressure and more likely to have a body mass index above 30 kg/m².

Twenty-one percent of respondents experienced at least 1 of the outcomes, and these individuals differed markedly from the other

participants. Whereas two thirds of men with poor mental health scores had low ratings on at least 1 of the 5 items of the SF-36 scale, only 6% of the remaining cohort did; those with poor physical performance ratings were limited by their health in at least 7 activities, whereas only 30% of the remaining participants were limited in more than 3 activities.

Respondents in low employment grades were at greatest risk of adverse outcomes for nearly all of the component morbidity items (Table 3), the differentials being greatest for

the more severe physical limitations. In comparison with those in the high employment grades, men in the middle employment grades had a statistically significant excess risk for 8 of the physical performance limitations.

Figure 1 shows that higher percentages of respondents in low employment grades were at risk for each of the morbidity outcomes. These individuals had more than 4 times the odds of poor physical performance relative to men in high employment grades, 3 times the odds of poor general health, and 2.5 times the odds of poor mental health or a disability (Table 4). Staff in middle employment grades had a statistically significant excess risk of poor general health and poor physical performance.

Baseline clinical indicators of cardiorespiratory disease, clinical risk factors, and risk behavior (smoking) reduced the odds ratios for men in the low employment grades by at most 20%. The other baseline indicators of SES neither reduced the estimates of employment effects nor explained a substantially larger portion of the outcomes (data not shown). Not being married at the original screening was an additional factor involved in poor mental health status at follow-up, but it only marginally reduced the excess odds associated with being in the low employment grades.

After adjustment for all baseline characteristics that were independent risk factors for the morbidity outcomes, employment grade at baseline remained a significant factor in all of the outcomes (Table 4). Compared with men in the high employment grades, those in the middle grades had statistically significant excess odds of poor physical performance, and those in the low grades had excess risks for all 4 morbidity outcomes.

We looked for evidence of additional socioeconomic factors measured at resurvey that could ameliorate, or add to, disadvantages experienced in middle age. After adjustment for other factors, having a job after retirement was not associated with any of the outcomes. However, Table 5 shows that low income after leaving the Civil Service (less than \$16 500 per year in 1997–1998) was associated with an approximate doubling of the risk of 3 of the outcomes among those in the middle employment grades but not those in the low grades. On the other hand, moving up a grade category between screening and retirement was associated with a smaller risk of poor mental health among those in the low employment grades.

Finally, we examined lifetime cardiovascular disease reported at the resurvey as a possible factor on the causal pathway between SES and poor health or functional limitations. As can be seen in Table 2, there were inverse associations between a diagnosis of angina or

TABLE 3—Odds Ratios for Morbidity Outcomes, by Baseline Employment Grade, Adjusted for Age at Resurvey: Whitehall Study, 1997–1998

Morbidity Measure	Sample, No. (%)	Baseline Employment Grade			P
		High, OR	Middle, OR (95% CI)	Low, OR (95% CI)	
Mental health					
Nervous most/all of the time	5899 (1.4)	1.00	1.06 (0.4, 2.7)	2.26 (0.8, 6.2)	.045
Down in dumps most/all of the time	5902 (0.7)	1.00	1.57 (0.4, 6.6)	1.72 (0.3, 8.9)	.78
Calm none/little of the time	5958 (7.1)	1.00	1.02 (0.7, 1.5)	1.52 (1.0, 2.4)	.027
Downhearted most/all of the time	5929 (1.5)	1.00	3.10 (0.8, 12.7)	5.82 (1.3, 25.4)	.011
Happy none/little of the time	6022 (5.3)	1.00	1.41 (0.8, 2.4)	2.16 (1.2, 3.9)	.010
Physical performance limited extensively by health in:					
Vigorous activities	6005 (31.2)	1.00	1.11 (0.9, 1.4)	1.49 (1.1, 2.0)	.002
Moderate activities	6031 (8.4)	1.00	1.31 (0.9, 2.0)	2.54 (1.6, 4.0)	<.001
Lifting or carrying groceries	6019 (5.9)	1.00	2.63 (1.3, 5.2)	6.17 (3.1, 12.5)	<.001
Climbing several flights of stairs	6027 (16.9)	1.00	2.11 (1.5, 3.0)	3.63 (2.5, 5.3)	<.001
Climbing 1 flight of stairs	6003 (4.8)	1.00	3.19 (1.4, 7.2)	8.16 (3.5, 19.0)	<.001
Bending, kneeling, stooping	6039 (10.9)	1.00	2.05 (1.3, 3.2)	3.94 (2.5, 6.3)	<.001
Walking more than half a mile	6029 (14.8)	1.00	1.64 (1.2, 2.3)	2.86 (1.9, 4.2)	<.001
Walking half a mile	5954 (10.0)	1.00	1.92 (1.2, 3.0)	3.63 (2.2, 5.9)	<.001
Walking 100 yards	5960 (4.1)	1.00	4.23 (1.6, 11.5)	9.05 (3.2, 25.2)	<.001
Bathing and dressing oneself	6052 (3.4)	1.00	3.22 (1.2, 8.8)	9.00 (3.2, 25.1)	<.001
Activities of daily living					
Unable to do:					
Cutting toenails	6111 (8.6)	1.00	1.60 (1.0, 2.5)	3.21 (2.0, 5.2)	<.001
Cooking a hot meal	6078 (4.6)	1.00	1.15 (0.7, 1.9)	1.86 (1.0, 3.3)	.015
Light housework, simple repairs	6098 (3.5)	1.00	1.50 (0.8, 3.0)	3.17 (1.5, 6.6)	<.001
Unable to do or difficulty with ^a :					
Dressing self	6106 (6.3)	1.00	1.69 (1.0, 2.8)	2.64 (1.5, 4.6)	.001
Going up and down stairs/steps	6104 (17.4)	1.00	1.81 (1.3, 2.5)	3.08 (2.2, 4.4)	<.001

Note. OR=odds ratio; CI=confidence interval.

^aToo few were unable to do the task to allow the outcome to be modeled.

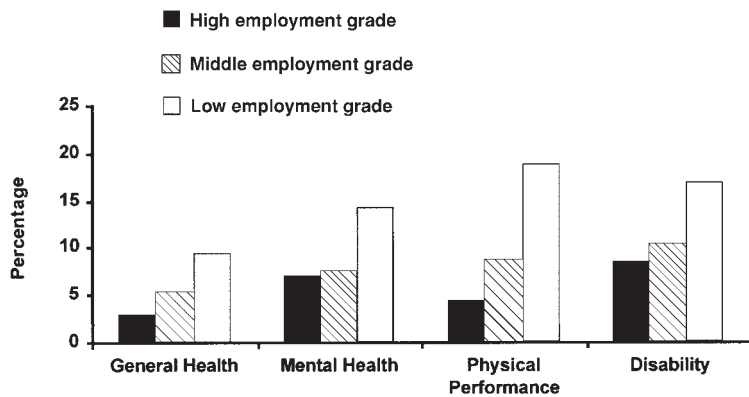


FIGURE 1—Prevalence of poor outcomes (%) at resurvey, by employment grade at baseline: Whitehall Study, 1997–1998.

heart attack and baseline employment grade. These 2 conditions were also associated with poor health (odds ratios of 2.5 and 3.5, respectively, after adjustment for all baseline health indicators, age, and employment grade) and poor physical performance (ORs of 1.9 and 2.1, respectively). Heart attack was also associated with disability (OR=1.5) and poor mental health (OR=1.3). However, the associations between employment grade and these outcomes were essentially unchanged when

experience of angina and heart attack was taken into account.

Discussion

The survivors of the 1960s Whitehall cohort were mostly in good health, with only 21% having any of the morbidity outcomes. Each of 4 self-reported morbidity outcomes was more prevalent among men in lower Civil Ser-

vice employment grades than among men in high grades nearly 30 years after screening. Men in the low employment grades had a 4-fold risk of physical performance limited by health, a 3-fold risk of poor health, and more than a 2-fold risk of poor mental health and disability.

Previous research has shown that combining socioeconomic indicators yields stronger gradients in mortality than using a single measure.^{1,18} In the present analysis, neither car ownership nor housing tenure in middle age added to the predictive power of employment grade with regard to the 4 outcomes.

Before it is concluded that SES in middle age is responsible for the associations found, possible biases should be considered. First, the response rate was lower among those in the low employment grades. Because baseline data were available for nonrespondents, we assessed the implications of this difference. We ran models assuming that nonrespondents who had any other risk factors (e.g., heavy smoking or high body mass index) would have experienced the adverse morbidity outcomes. Under these assumptions, those in the low grades still had more than 3 times the risk of poor physical performance and twice the risk of the other morbidity outcomes. Although the assumptions were crude, they suggest that nonresponse differentials did not substantially bias the estimated effects of employment grade.

TABLE 4—Odds Ratios for Outcomes, by Baseline Employment Grade, Adjusted for Age at Resurvey and Other Independent Baseline Risk Factors: Whitehall Study, 1997–1998

Outcome	Baseline Grade	Adjusted for Age, OR (95% CI)	Fully Adjusted, ^a OR (95% CI)
Rated health as poor/very poor* (n=6951)	High	1.00	1.00
	Middle	1.75 (1.0, 3.0)	1.62 (0.9, 2.8)
	Low	3.06 (1.7, 5.5)	2.50 (1.4, 4.5)
Poor mental health score* (n=5921)	High	1.00	1.00
	Middle	1.10 (0.7, 1.6)	1.05 (0.7, 1.5)
	Low	2.19 (1.4, 3.4)	1.88 (1.2, 2.9)
Poor physical performance score* (n=5965)	High	1.00	1.00
	Middle	2.04 (1.3, 3.3)	1.93 (1.2, 3.1)
	Low	4.32 (2.6, 7.2)	3.67 (2.2, 6.2)
Unable to do at least 1 activity of daily living* (n=6080)	High	1.00	1.00
	Middle	1.22 (0.8, 1.7)	1.15 (0.8, 1.6)
	Low	2.36 (1.6, 3.5)	2.05 (1.4, 3.1)

Note. OR=odds ratio; CI=confidence interval.

^aThe models included adjustment for the following baseline factors found to be independently associated with outcomes: self-rated health (age, clinical signs of cardiovascular disease, top quintile diastolic blood pressure, body mass index >30 kg/m², respiratory symptoms, ever hospitalised at least 4 times for reasons other than cardio-respiratory disease, smoking habit); mental health score (age, married or not, smoking habit); physical performance score (age, high body mass index, respiratory symptoms, hospitalised for non cardio-respiratory disease, smoking habit); disability (age, high body mass index, high blood sugar level/diabetic, respiratory symptoms, smoking habit).

*P<.001.

TABLE 5—Association of Selected Health Outcomes With Characteristics After Retirement, by Employment Grade: Whitehall Study Resurvey, 1997–1998

Outcome	Characteristic at Resurvey	Employment Grade ^a		Interaction P
		Middle, OR (95% CI)	Low, OR (95% CI)	
Poor mental health score	Income < \$16 500 (vs higher)	1.95 (1.4, 2.8)	0.81 (0.5, 1.4)	.012
	Higher grade category at retirement (vs same/lower)	0.82 (0.6, 1.0)	0.44 (0.3, 0.8)	.033
Poor physical performance score	Income < \$16 500 (vs higher)	2.05 (1.5, 2.9)	1.05 (0.6, 1.7)	.020
	Higher grade category at retirement (vs same/lower)	1.00 (0.8, 1.3)	0.64 (0.4, 1.0)	.19
Unable to do at least 1 activity of daily living	Income < \$16 500 (vs higher)	1.79 (1.3, 2.4)	0.98 (0.6, 1.6)	.027
	Higher grade category at retirement (vs same/lower)	0.92 (0.7, 1.1)	0.71 (0.4, 1.1)	.46

Note. Odds ratios were adjusted for age and independent risk factors. OR=odds ratio; CI=confidence interval.

^aToo few of those in high grades had low incomes to allow separate analyses, and, by definition, they could not rise a category.

Second, we considered the possibility that men in the lower employment grades might have a more negative outlook generally. Excluding those who reported being “nervous most of the time” or “happy little of the time” did not substantially alter the results (data not shown).

While self-reported measures are subjective, they are predictive of mortality independently of clinical health.^{24,25} McCallum et al.²⁶ attributed their finding of a contrary effect to individuals’ basing their subjective ratings on objective comorbidities and disability. Self-reported functional status has also been associated with mortality in old age.^{27,28} Methodological studies of the SF-36 suggest that it is reasonably sensitive to lower levels of morbidity,²⁹ that it is reliable and internally consistent,³⁰ and that it is suitable for use with older people.³¹

There are several possible explanations for an employment grade differential in old age. First,

ill health could precede low socioeconomic status. However, health disadvantages in middle age seem to be an unlikely explanation of differentials in old age. After adjustment for baseline health, behavior, and marital status, the odds ratios for respondents in low vs high employment grades were 3.7 (95% CI=2.2, 6.2) for poor physical performance, 2.5 (95% CI=1.4, 4.5) for poor health, 2.0 (95% CI=1.4, 3.1) for disability, and 1.9 (95% CI=1.2, 2.9) for poor mental health. Participants in the resurvey had already survived nearly 30 years. Only 18% of the original low-grade cohort members could take part, most having died. By definition, the survivors must have been less vulnerable to fatal disease than their deceased colleagues, yet those in the low employment grades were still more likely to have severe morbidity in old age than those who had been in the higher grades in middle age.

Second, there could have been a cumulation of psychological stress affecting biological coping

mechanisms (e.g., cortisol production, decrease in parasympathetic activity).³² In a later cohort of civil servants (Whitehall II), degree of control in one’s job explained a substantial proportion of differences in coronary heart disease incidence among the different grades^{33,34} and was associated with psychiatric disorders.³⁵ This could not be tested with the Whitehall I cohort.

Third, there could have been cumulating disadvantages in regard to material resources, opportunities to promote health, and lifestyle between the baseline and resurvey. We have information on the cohort at only 2 points in time. There was some evidence that circumstances arising in later life could add to or ameliorate disadvantages. Having a low income exacerbated health problems for middle-grade staff, whereas rising a grade category ameliorated risk of poor mental health among staff who had been in the low employment grades. Although we cannot rule out a health selection

effect, we do not believe that it wholly accounts for the differences. Men in middle employment grades who had low incomes in retirement were slightly more likely to have left the Civil Service for medical reasons (7% vs 4%) or because of redundancy (17% vs 15%), but these differences were not sufficient to account for a 2-fold increase in risk. While being mentally fit might have increased the chances of rising a grade, the greater job control in a higher employment grade might have improved mental health.

The socioeconomic differentials found in this study probably underestimate those in the general population in that all of the men in the cohort had experienced relatively good employment and pension provisions in the Civil Service. Moreover, the resurvey respondents had better self-perceived health than that reported in other studies. The mean scores for the mental health and physical performance scales were 82.1% and 77.3%, respectively, as compared with 79.7% and 64.4% found in population studies in 3 local districts in Britain³⁶ and mean scores ranging from 68% to 73% and 54% to 72% in 6 localities in outer London.³⁷

The findings in this article add to our previously reported evidence^{2,9} of long-term socioeconomic effects on morbidity. Moreover, the further differentiation in outcomes by SES in retirement suggests that there is a continuing accumulation of disadvantage in old age. Strong socioeconomic differentials were found among the survivors of a privileged and relatively healthy group. □

Contributors

E. Breeze helped design the documents, carried out the analyses, and drafted the paper. A.E. Fletcher, D.A. Leon, M.G. Marmot, R.J. Clarke, and M.J. Shipley all commented on drafts and approved the final version. R.J. Clarke was instrumental in initiating and designing the resurvey and coordinating the fieldwork; all of the authors participated in the steering committee for the study.

Acknowledgments

The British Heart Foundation funded the resurvey, including support for Elizabeth Breeze and Martin J. Shipley. Michael J. Marmot was supported by a Medical Research Council research professorship. The survey was approved by the ethics committees of the London School of Hygiene and Tropical Medicine, the University of Oxford, and University College London.

We would like to thank all of the participants who completed questionnaires. Assistance provided by staff from the health authorities and the Office for National Statistics was invaluable. We also gratefully acknowledge the contributions of the team at the Clinical Trials Unit in Oxford (Rory Collins, Dr Linda Youngman, Pamela Bell, Paul Sherliker, and Smita Shah).

References

- Goldblatt P. Mortality and alternative social classifications. In: Goldblatt O, ed. *1971–1981 Longitudinal Study. Mortality and Social Organization*. London, England: Her Majesty's Stationery Office; 1990:174–176.
- Breeze E, Sloggett A, Fletcher A. Socioeconomic and demographic predictors of mortality and institutional residence among middle-aged and older people: results from the Longitudinal Study. *J Epidemiol Community Health*. 1999; 53:765–774.
- Marmot MG, Shipley MJ. Do socioeconomic differences in mortality persist after retirement? 25 year follow-up of civil servants from the first Whitehall Study. *BMJ*. 1996;313:1177–1180.
- Hattersley L. Expectation of life by social class. In: Drever F, Whitehead M, eds. *Health Inequalities: Decennial Supplement*. London, England: Her Majesty's Stationery Office; 1997: 73–82. DS series 15.
- Smith J, Harding S. Mortality of women and men using alternative social classifications. In: Drever F, Whitehead M, eds. *Health Inequalities: Decennial Supplement*. London, England: Her Majesty's Stationery Office; 1997:168–185. DS series 15.
- Kallan J. Effects of sociodemographic variables on adult mortality in the United States: comparisons by sex, age and cause of death. *Soc Biol*. 1997;44:136–147.
- Arber S, Ginn J. Gender and inequalities in health in later life. *Soc Sci Med*. 1993;36:33–46.
- Prescott-Clarke P, Primatesta P. *Health Survey for England 1995: Volume 1. Findings*. London, England: Her Majesty's Stationery Office; 1997.
- Breeze E, Sloggett A, Fletcher A. Socioeconomic status and transitions in status in old age in relation to limiting long-term illness measured at the 1991 census. Results from the UK Longitudinal Survey. *Eur J Public Health*. 1999; 9:265–270.
- Marmot MG, Shipley MJ, Rose G. Inequalities in death—specific explanations of a general pattern? *Lancet*. 1984;1:1003–1006.
- Marmot MG, Smith GD, Stansfeld S, et al. Health inequalities among British civil servants: the Whitehall II Study. *Lancet*. 1991;337: 1387–1393.
- Hemingway H, Nicholson A, Stafford M, Roberts R, Marmot M. The impact of socioeconomic status on health functioning as assessed by the SF-36 questionnaire: the Whitehall II Study. *Am J Public Health*. 1997;87: 1484–1490.
- Reid DD, Hamilton PJS, Keen H, Brett GZ, Jarrett RJ, Rose G. Cardiorespiratory disease and diabetes among middle-aged male civil servants. *Lancet*. 1974:469–473.
- Clarke R, Breeze E, Sherliker P, et al. Design, objectives, and lessons from a pilot 25 year follow up resurvey of survivors in the Whitehall Study of London civil servants. *J Epidemiol Community Health*. 1998;52:364–369.
- Ware JE, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36), I: conceptual framework and item selection. *Med Care*. 1992;30:473–483.
- Ware JE, Snow KK, Kosinski M, Gandek B. *SF-36 Health Survey: Manual and Interpretation Guide*. Boston, Mass: Health Institute, New England Medical Center; 1993:18–19.
- Morris R, Carstairs V. Which deprivation? A comparison of selected deprivation indices. *J Public Health Med*. 1991;13:318–326.
- Davey Smith G, Shipley MJ, Rose G. Magnitude and causes of socioeconomic differentials in mortality: further evidence from the Whitehall Study. *J Epidemiol Community Health*. 1990; 44:265–270.
- Bulpitt CJ, Shipley MJ, Demirovic J, Ebi-Kryston KL, Markowe HLJ, Rose G. Predicting death from coronary heart disease using a questionnaire. *Int J Epidemiol*. 1990;19:899–904.
- Pinsky JL, Branch LG, Jette AM, et al. Framingham Disability Study: relationship of disability to cardiovascular risk among persons free of diagnosed cardiovascular disease. *Am J Epidemiol*. 1985;122:644–656.
- Jette AM, Pinsky JL, Branch LG, Wolf PA, Feinleib M. The Framingham Disability Study: physical disability among community-dwelling survivors of stroke. *J Clin Epidemiol*. 1988;8: 719–726.
- Pinsky JL, Jette AM, Branch LG, Kannel WB, Feinleib M. The Framingham Disability Study: relationship of various coronary heart disease manifestations to disability in older persons living in the community. *Am J Public Health*. 1990; 80:1363–1367.
- Stata Statistical Software Release 5.0*. College Station, Tex: Stata Corp; 1997.
- Mossey JM, Shapiro E. Self-rated health: a predictor of mortality among the elderly. *Am J Public Health*. 1982;72:800–808.
- Schoenfeld DE, Malmrose LC, Blazer DG, Gold DT, Seeman TE. Self-rated health and mortality in the high-functioning elderly—a closer look at healthy individuals: MacArthur field study of successful aging. *J Gerontol*. 1994;49: M109–M115.
- McCallum J, Shadbolt B, Wang D. Self-rated health and survival: a 7-year follow-up study of Australian elderly. *Am J Public Health*. 1994; 84:1100–1105.
- Scott WK, Macera CA, Cornman CB, Sharpe PA. Functional health status as a predictor of mortality in men and women over 65. *J Clin Epidemiol*. 1997;50:291–296.
- Grand A, Grosclaude P, Bocquet H, Pous J, Albarede JL. Disability, psychosocial factors and mortality among the elderly in a rural French population. *J Clin Epidemiol*. 1990;43:773–782.
- Brazier JE, Walters SJ, Nicholl JP, Kohler B. Using the SF-36 and Euroqol on an elderly population. *Qual Life Res*. 1996;5:195–204.
- Andresen EM, Bowley N, Rothenberg MPA, Panzer R, Katz P. Test-retest performance of a mailed version of the Medical Outcomes Study 36-Item Short-Form Health Survey among older adults. *Med Care*. 1996;34:1165–1170.
- Lyons RA, Perry HM, Littlepage BNC. Evidence for the validity of the Short-Form 36 questionnaire (SF-36) in an elderly population. *Age Ageing*. 1994;23:182–184.
- Brunner E. Stress and the biology of inequality. *BMJ*. 1997;314:1472–1476.
- Bosma H, Marmot MG, Hemingway H, Nicholson AC, Brunner E, Stansfeld SA. Low job control and risk of coronary heart disease in the Whitehall II (prospective cohort) Study. *BMJ*. 1997;314:558–565.

34. Marmot MG, Bosma H, Hemingway H, Brunner E, Stansfeld S. Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *Lancet*. 1997;350:235–239.
35. Stansfeld SA, North FM, White I, Marmot MG. Work characteristics and psychiatric disorder in civil servants in London. *J Epidemiol Community Health*. 1995;49:48–53.
36. Lyons RA, Crome P, Monaghan S, Killalea D, Daley JA. Health status and disability among elderly people in three UK districts. *Age Ageing*. 1997;26:203–209.
37. Ong BN, Jordan K. Health experiences of elderly people in an outer London area. *Soc Res Online* [serial online]. March 31, 1997; doc 2.