Socioeconomic gradient in morbidity and mortality in people with diabetes: cohort study findings from the Whitehall study and the WHO multinational study of vascular disease in diabetes

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BMJ 1998;316:100-6

Abstract

Objectives: To assess whether the inverse socioeconomic mortality gradient observed in the general population persists in diabetic people.

Design: The Whitehall cohort study and the London cohort of the WHO multinational study of vascular disease in diabetes.

Setting: London.

Subjects: 17 264 male civil servants (17 046 without diabetes, 218 with diabetes) aged 40-64 examined in 1967-9, and 300 people with diabetes aged 35-55 from London clinics examined in 1975-7. Both cohorts were followed up until January 1995.

Main outcome measures: Mortality from all causes, cardiovascular disease, and ischaemic heart disease.

Results: In both cohorts people in the lower social groups were older, had higher blood pressure, and were more likely to smoke. In the Whitehall study, the prevalence of heart disease was higher in the lowest social group compared with the highest group, by 6% among non-diabetic people ($P=0.0001$) and by 14% among diabetic subjects ($P=0.02$). In the WHO study proteinuria was more common in the lowest social group compared with the highest (27% *v* 15%, $P=0.01$), as was retinopathy (54% *v* 48%, $P=0.5$). There was a clear socioeconomic gradient in all cause mortality in both cohorts, with death rates being about twice as high in the lowest compared with the highest social groups. In the Whitehall study this gradient was similar in both diabetic and non-diabetic subjects, and it persisted for mortality from cardiovascular disease and from ischaemic heart disease. About half of the increased risk of death in the lowest social group was accounted for by blood pressure and smoking.

Conclusions: We confirm the existence of an inverse socioeconomic mortality gradient in diabetic people and suggest that this is largely due to conventional cardiovascular risk factors.

Introduction

The existence of a clear inverse gradient between socioeconomic status and mortality in the Western world is now so well accepted that studies showing associations contrary to this arouse considerable interest. One such study is the population based Finnish comparison of people with or without diabetes published in the *BMJ* in 1996,¹ which showed no socioeconomic gradient in mortality in diabetic people even though a clear gradient existed in people without diabetes. These findings are puzzling given that health related behaviours such as smoking, poor diet, and lack of exercise are more common in lower social classes²

and that access to high quality health care, a clear determinant of glycaemic control and thus health status in diabetic people, is also poorest in people of low socioeconomic status.³⁻⁵ If anything, the combination of these factors should result in a steeper socioeconomic mortality gradient for people with diabetes compared with those without. Risk factors which may account for a socioeconomic gradient in mortality risk were not measured in the Finnish study, and their counterintuitive findings cannot be explored further. Few other studies have examined the socioeconomic gradient in mortality in diabetic people,⁶⁻⁸ and none has included a non-diabetic population for comparison.

In response to the Finnish study,¹ we examined the association between socioeconomic status and mortality in two separate but complementary cohort studies. These were the first Whitehall study—of middle aged male civil servants in London—and the London component of the World Health Organisation's multinational study of vascular disease in diabetes—of men and women with diabetes drawn from London clinics. We included the first study because it has a non-diabetic comparator population, and we included the second as it collected more detailed data on risk factors for cardiovascular disease and diabetes related morbidity.

Methods

The first Whitehall study

Male civil servants, aged between 40-64 years based in Whitehall, London, were screened between 1967 and 1969.⁹ The 18 404 men were classified into grades according to their job title: administrative (such as permanent secretaries acting as advisors to government ministers), professional and executive (such as senior executive officers), clerical, and other (mainly unskilled manual workers such as porters and messengers). Employment grading was different for the 856 men from the Diplomatic Service and from the British Council, and these men have been excluded.

At examination, the presence of diabetes and smoking habits were ascertained by questionnaire, and a standardised protocol was used to measure height, weight, and blood pressure and to record an electrocardiogram. An oral glucose load (50 g) was administered after an overnight fast, and capillary blood samples were taken after 2 hours for estimating glucose and cholesterol concentrations. In people with known diabetes a casual blood sample was taken for estimating glucose.

For our analysis, we included only those men with complete data on blood pressure, blood glucose, and smoking status, and whose follow up status was known;

this resulted in the exclusion of a further 284 men. We compared all diabetic men (218)—those with newly diagnosed diabetes according to the glucose tolerance test combined with those with known diabetes according to the questionnaire—with the 17 046 men without diabetes.

The WHO multinational study of vascular disease in diabetes

The London component of 497 patients from the WHO study was recruited from clinic attendance lists stratified by sex, age, and duration of diabetes.^{10–11} People with diabetes, defined by a clinical diagnosis, aged between 35 and 55 years were examined during 1975–7. Of these 497 patients, 378 were of European descent and the rest were African Caribbean, south Asian, or other ethnic group. Social class was assigned by occupation according to the registrar general's classification.¹² Women were assigned to the social class of their spouse if they were married and to their own if they were unmarried and working. Data on social class were missing on 78 of these patients.

Smoking habits were ascertained by questionnaire; height, weight, and blood pressure were measured according to a standardised protocol; and a 12 lead electrocardiogram was recorded. A fasting venous blood sample was taken for estimating glucose and cholesterol concentrations. Urine was tested for proteinuria, and fundoscopy was used to assess the degree of retinopathy.

Mortality follow up

Using the NHS Central Registry flagging service, we followed up the cohorts for mortality until 1 January 1995 for the WHO study (about 20 years follow up) and 31 January 1995 for the Whitehall study (about 25 years follow up). Underlying cause of death was assigned by means of ICD codes (international classification of diseases, eighth revision for the Whitehall study and ninth revision for the WHO study).

Statistical analyses

In both studies a relatively crude differentiation between insulin and non-insulin dependent diabetes was based on the use of insulin treatment. In the WHO study patients who were taking continuous insulin treatment within a year of diagnosis were classified as insulin dependent, the remainder were non-insulin dependent. We compared mortality between these types of diabetes by socioeconomic status in each study cohort and found them to be similar. Thus, we combined both types of diabetes in subsequent analyses. We examined mortality from all causes, cardiovascular disease, and ischaemic heart disease (ICD-8 and ICD-9 codes 390–458 and 410–414 respectively).

In the WHO study the presence of ischaemic heart disease was defined as a history of ischaemic heart disease or infarction, based on a doctor's diagnosis, or the presence of major Q waves (Minnesota codes 1-1 or 1-2) on the electrocardiogram. In the Whitehall study the presence of ischaemic heart disease was defined as a history of severe chest pain, a positive response to the Rose angina questionnaire,¹³ or an abnormal electrocardiogram according to Whitehall criteria.¹⁴

We adjusted continuous baseline data by regression models using the least square means approach, while we adjusted categorical variables for age by the method of direct standardisation and tested for significance using the Mantel-Haenszel test. We used person years at risk to calculate death rates by socioeconomic status (grade in the Whitehall study and social class in the WHO study). We used proportional hazards regression models to adjust for confounders in mortality, such as blood pressure and smoking status. We compared mortality ratios by employment grade between diabetic and non-diabetic subjects in the Whitehall cohort using an interaction term for grade and diabetes in the regression model. In the WHO study we used social classes I and II combined as the reference category, while in the Whitehall study we used the professional or executive grade as the reference category as the number of deaths of diabetic people in the administrative grade were too small to provide stable estimates.

Results

Background characteristics

In the Whitehall study baseline characteristics for the diabetic and non-diabetic men showed a clear gradient by job grade for age, systolic blood pressure, proportion of current smokers, and prevalence of ischaemic heart disease (table 1). The grade gradient for ischaemic heart disease seemed to be steeper in the diabetic men compared with the non-diabetic men: among the non-diabetic men, the prevalence of heart disease was only 6% higher in the lowest grade ("other") than in the highest, administrative grade, while this difference among the diabetic men was 14% ($P=0.08$ for interaction).

Table 1 Demographic characteristics by diabetes status and job grade in the Whitehall study (values are means unless stated otherwise)

	Job grade				P value	
	Administrative	Professional or executive	Clerical	Other	Trend	Interaction
No of subjects:						
Non-diabetic	939	11 902	2658	1547		
Diabetic	9	112	60	37		
Age (years):						
Non-diabetic	50	51	54	56	0.0001	} 0.9
Diabetic	54	53	56	58	0.0001	
Systolic blood pressure (mm Hg)*:						
Non-diabetic	133	136	137	137	0.0002	} 0.1
Diabetic	138	136	142	143	0.05	
Body mass index (kg/m ²)*:						
Non-diabetic	24.5	24.8	24.6	24.8	0.9	} 0.3
Diabetic	24.7	24.7	26.3	25.5	0.3	
Serum cholesterol (mmol/l)*:						
Non-diabetic	5.2	5.1	5.1	4.9	0.0001	} 1.0
Diabetic	5.1	5.3	5.0	5.2	0.5	
Blood glucose (mmol/l)*:						
Non-diabetic	4.15	4.16	4.19	4.21	0.0007	} 0.2
Diabetic	9.40	9.41	10.54	10.94	0.1	
Current smokers (%)*:						
Non-diabetic	28	37	54	61	<0.0001	} 0.2
Diabetic	22	38	36	53	0.1	
Ischaemic heart disease (%)*:						
Non-diabetic	12	15	15	18	0.001	} 0.08
Diabetic	12	11	25	26	0.02	

*Age adjusted (continuous variables) or age standardised (categorical variables).

Table 2 Baseline characteristics by social class of diabetic people in the WHO multinational study of vascular disease in diabetes (values are means unless stated otherwise)

	Social class				P value for trend
	I and II	III non-manual	III manual	IV and V	
No of subjects	121	67	71	41	
Men (%)	57	45	70	49	0.8
Insulin dependent diabetes (%)*	69	61	51	54	0.01
Subjects with non-insulin dependent diabetes taking insulin (%)*	40	19	25	15	0.4
Heart disease (%)*	5	1	10	13	0.01
Current smoker (%)*	23	41	48	43	0.001
Proteinuria (%)*	15	12	28	27	0.01
Retinopathy (%)*	48	47	52	54	0.5
Age (years)	46	46	48	48	0.2
Duration of diabetes (years)	18	17	14	14	0.04
Body mass index (kg/m ²)*	24.3	25.0	25.4	26.1	0.04
Systolic blood pressure (mm Hg)*	134	135	134	141	0.3
Serum cholesterol (mmol/l)*	6.1	6.1	6.0	6.0	0.9
Glycated haemoglobin HbA _{1c} (%)*	9.3	9.6	9.6	9.3	0.5
Plasma glucose (mmol/l)*	12.5	12.6	11.7	13.3	0.6
Serum fasting triglyceride (mmol/l)*	1.18	1.05	1.10	1.24	0.8

*Age adjusted (continuous variables) or age standardised (categorical variables).

In the WHO study of diabetic men and women clear socioeconomic gradients were observed for duration of diabetes, obesity, proportion of current smokers, and prevalence of ischaemic heart disease (table 2). In both cohorts blood glucose concentrations were higher in the lowest socioeconomic groups in diabetic people, but this trend was not significant. In

the WHO study the proportion of people with insulin dependent diabetes differed by social class, such that people with insulin dependent diabetes formed a greater proportion of all those in the highest social classes (I and II). Excluding people with insulin dependent diabetes, insulin use was more prevalent in the highest social classes than in the lowest (40% v 15%, $P=0.4$). Proteinuria and retinopathy were more common in the lower social classes, but this trend was significant only for proteinuria.

Mortality ratios

Mortality from all causes, cardiovascular disease, and ischaemic heart disease increased with decreasing socioeconomic status in both diabetic and non-diabetic men in the Whitehall cohort (table 3). There was no clear evidence that the socioeconomic gradient in mortality differed by diabetes status. After adjustments were made for blood pressure and smoking, the gradient in mortality was attenuated but remained significant: among those in the lowest job grade, the amount by which mortality was increased was roughly halved when we adjusted for smoking and blood pressure. However, further adjustment for blood glucose concentration made no difference to the mortality ratios.

The WHO study also showed similar mortality gradients by socioeconomic status (table 4). Mortality from all causes was over twice as high among those from social classes IV and V compared with those from social classes I and II ($P=0.01$ for trend). Clear risk

Table 3 Numbers of deaths and mortality ratios (95% confidence intervals) by job grade and diabetes status in the Whitehall study

	Job grade				P value for trend
	Administrative	Professional or executive	Clerical	Other	
Deaths from all causes					
No of deaths/population:					
Non-diabetic	285/939	4485/11902	1500/2658	1028/1547	
Diabetic	2/9	69/112	44/60	33/37	
Age adjusted mortality ratio:					
Non-diabetic	0.77 (0.7 to 0.9)	1.00	1.40 (1.3 to 1.5)	1.54 (1.4 to 1.7)	0.0001
Diabetic	0.22 (0.1 to 0.9)	1.00	1.49 (1.0 to 2.2)	1.72 (1.1 to 2.7)	0.0003
Fully adjusted mortality ratio*:					
Non-diabetic	0.82 (0.7 to 0.9)	1.00	1.30 (1.2 to 1.4)	1.33 (1.2 to 1.4)	0.0001
Diabetic	0.19 (0.1 to 0.8)	1.00	1.37 (0.9 to 2.1)	1.47 (0.9 to 2.3)	0.002
Deaths from cardiovascular disease					
No of deaths/population:					
Non-diabetic	150/936	2301/11891	741/2655	470/1545	
Diabetic	1/9	44/112	28/60	18/37	
Age adjusted mortality ratio:					
Non-diabetic	0.79 (0.7 to 0.9)	1.00	1.33 (1.2 to 1.5)	1.35 (1.2 to 1.5)	0.001
Diabetic	0.17 (0.0 to 1.3)	1.00	1.40 (0.9 to 2.3)	1.35 (0.8 to 2.4)	0.03
Fully adjusted mortality ratio*:					
Non-diabetic	0.85 (0.7 to 1.0)	1.00	1.24 (1.1 to 1.4)	1.17 (1.1 to 1.3)	0.001
Diabetic	0.13 (0.0 to 0.9)	1.00	1.27 (0.8 to 2.1)	1.14 (0.6 to 2.1)	0.07
Deaths from ischaemic heart disease					
No of deaths/population:					
Non-diabetic	101/936	1584/11891	492/2655	318/1545	
Diabetic	1/9	35/112	23/60	13/37	
Age adjusted mortality ratio:					
Non-diabetic	0.78 (0.6 to 1.0)	1.00	1.31 (1.2 to 1.5)	1.37 (1.2 to 1.6)	0.0001
Diabetic	0.22 (0.0 to 1.6)	1.00	1.45 (0.8 to 2.5)	1.31 (0.7 to 2.6)	0.07
Fully adjusted mortality ratio*:					
Non-diabetic	0.83 (0.7 to 1.0)	1.00	1.22 (1.1 to 1.4)	1.20 (1.1 to 1.4)	0.0001
Diabetic	0.16 (0.0 to 1.2)	1.00	1.26 (0.7 to 2.2)	1.02 (0.5 to 2.1)	0.2

*Adjusted for age, blood pressure, and smoking.

Table 4 Numbers of deaths and mortality ratios (95% confidence intervals) by social class in the WHO multinational study of vascular disease in diabetes

	Social class				P value for trend
	I and II	III non-manual	III manual	IV and V	
Deaths from all causes					
No of deaths/population	30/121	22/67	23/71	20/41	
Age adjusted mortality ratio	1.00	1.22 (0.7 to 2.2)	1.10 (0.6 to 1.9)	2.11 (1.2 to 3.8)	0.04
Fully adjusted mortality ratio*	1.00	1.02 (0.6 to 1.9)	0.96 (0.5 to 1.7)	1.72 (1.0 to 3.1)	0.2
Deaths from cardiovascular disease					
No of deaths/population	13/121	10/67	18/71	13/41	
Age adjusted mortality ratio	1.00	1.27 (0.6 to 2.9)	1.86 (0.9 to 3.8)	3.00 (1.4 to 6.5)	0.004
Fully adjusted mortality ratio*	1.00	0.95 (0.4 to 2.2)	1.52 (0.7 to 3.2)	2.13 (1.0 to 4.7)	0.04
Deaths from ischaemic heart disease					
No of deaths/population	13/121	7/67	14/71	10/41	
Age adjusted mortality ratio	1.00	0.88 (0.4 to 2.2)	1.40 (0.7 to 3.0)	2.27 (1.0 to 5.2)	0.05
Fully adjusted mortality ratio*	1.00	0.66 (0.3 to 1.7)	1.19 (0.5 to 2.6)	1.61 (0.7 to 3.8)	0.2

*Adjusted for age, blood pressure, and smoking.

factors for mortality included age, smoking status, blood pressure, and proteinuria.^{15 16} The gradient in mortality from all causes persisted after we made adjustments for smoking and systolic blood pressure. Further adjustment for proteinuria made a significant contribution to the model, but barely altered the gradient. Similar socioeconomic gradients were observed for mortality from cardiovascular disease and from ischaemic heart disease.

Discussion

We confirm, in two separate cohorts, the existence of a clear inverse relation between socioeconomic status and mortality in diabetic people.¹⁷ The most likely explanation for this gradient in mortality is cardiovascular disease and its risk factors. In this and other studies cardiovascular risk factors, in particular smoking, are less favourable in those of low socioeconomic status.^{5 18–20} In the Whitehall study the gradient in mortality in the diabetic men was similar to that of the non-diabetic population. Adjustment for key risk factors such as blood pressure and smoking attenuated this relation to a large extent, roughly halving the increase in relative risk in the lowest job grade (from 1.54 to 1.33 in non-diabetic men, and from 1.72 to 1.47 in diabetic men).

If conventional risk factors for heart disease cannot fully account for the socioeconomic gradient in mortality in people with and without diabetes, other explanations need to be sought. A clear candidate is blood glucose. Surprisingly though, we and others have found at best a weak relation between socioeconomic status and blood glucose concentration in diabetic people,^{18 21–23} and in comparison with other cardiovascular risk factors in non-diabetic people the socioeconomic gradient in blood glucose is either relatively weak²⁴ or has little effect on the socioeconomic gradient in mortality.²⁵ It is therefore not surprising that adjustment for blood glucose in our analysis had little effect on the mortality ratios.

A more likely candidate in people with diabetes is renal disease. Proteinuria is a potent risk factor for morbidity and mortality from cardiovascular disease,^{15 26 27} and we confirm that there was a clear socioeconomic gradient in proteinuria in the WHO study.¹⁸ The reasons for this increased risk of proteinuria with a poorer socioeconomic status are unclear, but

it may be associated with uncontrolled hypertension and poor quality health care. But, while proteinuria was strongly related to the risk of death in the WHO study,¹⁵ adjustment for it made little difference to the socioeconomic gradient in mortality.

Comparison with Finnish study

It is not clear why the Finnish study showed no socioeconomic gradient in mortality in people with diabetes,¹ and any explanation needs to take account of the fact that they observed a gradient in the non-diabetic population—thus, the existence of a more egalitarian society in Finland is an unlikely explanation. A more plausible possibility is that these findings may in part be accounted for by a biased sample. Only people receiving some form of medication for diabetes were included in that study, and we and others have shown that drug use in diabetes is closely associated with social class; insulin use in people with non-insulin dependent diabetes is greater in higher social classes.²⁰ In some studies,^{28 29} though not all,³⁰ insulin use has been associated with an increase in mortality risk. Again, this may serve to attenuate the expected socioeconomic gradient in mortality. Further, in most populations mortality from insulin dependent diabetes is generally greater than that for non-insulin dependent diabetes (except for men in the London cohort in the WHO study),¹⁵ and, as the proportion of people with insulin dependent diabetes is greatest in the highest social classes, this would also serve to attenuate any socioeconomic gradient in mortality.

Limitations of this study

Clinic based studies are often criticised as the sample selected may be biased by referral practices. Thus, it could be argued that, among people in the lower social classes, only those who are relatively sick attend the clinic at all, while both sick and well people in higher social groups attend clinic regularly. This is less likely to be true 20 years ago, when the concept of shared care with general practice was not established and the vast majority of people with diabetes attended a hospital clinic. Further, patients were eligible for entry into the clinic based WHO study after only one visit to the participating clinic. Findings in this sample were similar to those from a general sample of a working population (the Whitehall study), indicating that our clinic population is unlikely to be seriously biased.

Key messages

- People in lower social classes tend to have higher mortality than those in higher classes, but a Finnish study found no such socioeconomic gradient in mortality among diabetic people
- In response to this research we examined mortality in two large studies with 20 year follow up of 17 264 Whitehall civil servants (218 with diabetes) and 300 patients attending diabetes clinics in London
- Mortality was twice as high in diabetic people in the lowest socioeconomic groups as in those in the highest groups
- This difference was largely due to higher rates of smoking and high blood pressure in the lowest social groups, while blood glucose concentration had little impact on the relation
- These results emphasise the importance of improving conventional cardiovascular risk factors and reducing social inequality for reducing mortality in diabetic people

A potential problem is that different measures of socioeconomic status were used in these two studies. However, both used occupation as the classifier, and it is argued that civil service grades provide a more precise gradation of socioeconomic status as measured by occupation, as each grade is more homogeneous than a social class grouping.³¹ Further, other studies examining mortality by socioeconomic status in the general population also used different techniques for classifying socioeconomic status, varying from an area deprivation score to educational status,³²⁻³⁴ and the findings were similar no matter what definition of socioeconomic status was used.

Conclusion

People with diabetes have an increased risk of premature death compared with the general population, and many of these early deaths are due to cardiovascular disease.¹⁵ From our results, we conclude that mortality risk, principally for cardiovascular disease, increases as socioeconomic status declines in diabetic people. These findings highlight the urgent need to reduce the risks of cardiovascular disease in diabetic people and emphasise the importance of addressing socioeconomic inequalities in health in all groups of people. While attention has recently been focused on the effect of tight glycaemic control on diabetic patients' subsequent risk of disease,³⁵⁻³⁶ the importance of conventional risk factors for cardiovascular disease such as smoking and blood pressure should not be forgotten, especially as the impact of these risk factors seems to be greater than that of blood glucose itself.

We thank staff at the Office of National Statistics for their work in flagging patients in both cohorts for mortality.

Contributors: NC developed the idea for these analyses, performed the analyses on the dataset of the WHO study, and wrote and revised the paper. JJ was jointly responsible for the design of the WHO study, refined the study idea, and commented extensively on the manuscript. MJS performed and helped to interpret the analyses of the Whitehall study. JAF was jointly responsible for the design of the WHO study and commented on the manuscript. NC is guarantor of the whole study, and MJS is guarantor for the analyses of the Whitehall study.

Funding: The WHO multinational study for vascular disease in diabetes was funded by a project grant from the British Diabetic Association.

Conflict of interest: None.

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(Accepted 16 September 1997)

Commentary: Problems in Finnish or British data—or a true difference?

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Chaturvedi et al report a clear class gradient in mortality among diabetic people. In two separate data sets the death rate in the lowest socioeconomic group was roughly twice that in the highest group. In our recent study, covering the total Finnish population, we only found a non-significant 7% excess mortality among diabetic women in the lowest class compared with the highest class.¹ Among diabetic men the corresponding excess was significant but still small (25%). The discrepancy between our results and those of Chaturvedi et al may reflect deficiencies in the Finnish or British data sets, or both, or reveal a true difference between the countries.

Reliability of Finnish data

Because of our large data set, including 11 215 deaths among diabetic people, random variation could have had only a minor effect on our findings. The validity of the results can, however, be questioned. As the mortality follow up was complete, we are left with the possibility that the method of case ascertainment produced biased results. In the Finnish study diabetic people were identified on the basis of entitlement to free medicines for the treatment of diabetes, while the British study also included people with diabetes treated by diet alone.

If diet treated diabetes, with better than average prognosis, is particularly common in the higher social classes, the exclusion of people with diet treated diabetes might have biased the Finnish results.² Secondly, in the higher social classes a particularly large proportion of drug treated diabetic people may have insulin dependent diabetes,² which tends to increase the risk of death more than non-insulin dependent diabetes.³ Thus, analysing both types of diabetes together might have artificially diluted the socioeconomic differentials in mortality. Thirdly, if a particularly large proportion of white collar employees with mild diabetes did not bother to obtain entitlement to free drugs, our results would also be biased.

All three potential sources of bias would be expected to have only a minor impact on younger diabetic people, most of whom suffer from insulin-dependent diabetes. As we found no socioeconomic gradient in mortality among women aged 30-49 and only a slight gradient among men of the same age, it seems unlikely that these potential sources of error played a decisive role in our results. Moreover, the national drug register data and analyses of

representative population samples gave very similar estimates of the prevalence of drug treated diabetes.⁴

Reliability of British data

The second main question is whether the British data are reliable. Could the observed socioeconomic gradient in mortality be the result of random variation or of problems in the representativeness of the British datasets?

Random variation might have played a role in the British study. The wide confidence intervals around the mortality ratios include the corresponding values found in the Finnish study. However, the similarity of the findings from two separate datasets increases confidence in the British results.

Civil servants in London and patients of diabetes clinics in London may not be representative of the total British population. On the other hand, there is no obvious reason why the results, particularly in the Whitehall study, would be very different from those in the total population. Tables 1 and 2 in Chaturvedi et al's paper do, however, raise questions about health related selection. Among people with diabetes, heart disease seems to have been much more common in the lower than in the higher social classes. This difference is far greater than that in the non-diabetic population, and, paradoxically, diabetes seems actually to decrease the probability of heart disease in the higher social classes. Could this finding be partly explained by either early retirement or a decline in socioeconomic position among those diabetic members of the higher classes who develop heart disease? Could such selection influence the results more in Britain than in Finland, where pensioners were included in the analysis and were classified according to their former occupation?

Possibility of a true difference

The final main alternative is that there really is a true difference between the countries. In the British data there are clear socioeconomic differences in most risk factors, including smoking and blood pressure. The Finnish data do not include direct information on risk factors, but indirect evidence, based on mortality from specific causes, suggests that among people with diabetes there are only small class differences in smoking.

Further research should be carried out to assess whether (and why) the situation truly differs between

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