

## Socioeconomic variation in incidence of epilepsy: prospective community based study in south east England

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### Abstract

**Objective** To determine the incidence of epilepsy in a general practice population and its variation with socioeconomic deprivation.

**Design** Prospective surveillance for new cases over an 18 or 24 month period.

**Participants** All patients on practice registers categorised for deprivation with the Carstairs score of their postcode.

**Setting** 20 general practices in London and south east England.

**Main outcome measure** Confirmed diagnosis of epilepsy.

**Results** 190 new cases of epilepsy were identified during 369 283 person years of observation (crude incidence 51.5 (95% confidence interval 44.4 to 59.3) per 100 000 per year). The incidence was 190 (138 to 262) per 100 000 in children aged 0-4 years, 30.8 (21.3 to 44.6) in those aged 45-64 years, and 58.7 (42.5 to 81.0) in those aged  $\geq 65$  years. There was no apparent difference in incidence between males and females. The incidence showed a strong association with socioeconomic deprivation, the age and sex adjusted incidence in the most deprived fifth of the study population being 2.33 (1.46 to 3.72) times that in the least deprived fifth ( $P=0.001$  for trend across fifths). Adjustment for area (London *v* outside London) weakened the association with deprivation (rate ratio 1.62 (0.91 to 2.88),  $P=0.12$  for trend).

**Conclusions** The incidence of epilepsy seems to increase with socioeconomic deprivation, though the association may be confounded by other factors.

### Introduction

Epilepsy is associated with a wide range of markers of social and economic disadvantage, including poor academic achievement, unemployment, underemployment, and low income.<sup>1-4</sup> Because of this association it is often assumed that people who are socially and economically deprived are more likely to develop epilepsy. This hypothesis is supported to some extent by the observation that the incidence of epilepsy is higher in developing countries than in developed countries.<sup>5</sup>

A few epidemiological studies have confirmed an association between the prevalence of epilepsy and markers of social disadvantage.<sup>6</sup> Prevalence studies,

however, cannot establish the direction of causality, and the employment problems and social disadvantage experienced by people with epilepsy may cause downward social "drift."<sup>7</sup> The association between socioeconomic factors and incident epilepsy is poorly understood<sup>8</sup> and to date has not been examined within the general community with methods that prospectively ascertain cases.

The NHS and the World Health Organization aim to reduce inequalities in health.<sup>9 10</sup> This can be achieved by concentrating resources on conditions that affect socially and economically deprived people. Understanding of the role that deprivation has in epilepsy gives insight into its aetiology and management. We determined the incidence of epilepsy in an unselected community based population and its variation with socioeconomic deprivation.

### Methods

Over an 18 or 24 month period we prospectively ascertained all incident cases of epilepsy in an unselected community population served by eight general practices in London (86 989 person years) and 12 practices outside London (282 294 person years). For these practices we were sole providers of secondary care for seizure disorders.

We advertised the linkage scheme to all general practices within the region. Practices that were willing to cooperate were selected if their patient details were stored on a computerised database. The follow up time differed because of researcher funding.

The practices outside London were all in south east England. Epilepsy was defined as the occurrence of one or more unprovoked seizure. We excluded provoked seizures, acute symptomatic seizures, and febrile convulsions.

We used a range of methods to identify cases of epilepsy, including a fast track clinic and active surveillance. An audit that involved a systematic search of all individual primary care records was performed at the end of the study period. This was 24 months (1 June 1995 to 31 May 1997) in 12 practices and 18 months (1 January 1995 to 30 June 1997) in the eight remaining practices. The methods by which cases were ascertained have been fully described previously.<sup>11</sup>

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An extra table of details of the general practices can be found on [bmj.com](#)

**Table 1** Number of patients diagnosed with epilepsy and rate per 100 000 population (95% confidence interval)\*

	Epilepsy cases	Person years of follow up	Rate/100 000 population (95% confidence interval)
Age group (years):			
0-4	37	19 487	190.0 (138.0 to 262.0)
5-14	28	37 128	75.4 (52.1 to 109)
15-44	60	158 663	37.8 (29.4 to 48.7)
45-64	28	90 909	30.8 (21.3 to 44.6)
≥65	37	63 087	58.7 (42.5 to 81.0)
Sex:			
Male	96	182 040	52.7 (43.2 to 64.4)
Female	94	187 240	50.2 (41.0 to 61.5)
Area:			
London	74	86 989	85.1 (67.7 to 107)
Outside London	116	282 294	41.1 (34.3 to 49.3)
Fifths of Carstairs score:			
1 (least deprived)	27	79 257	34.1 (23.4 to 49.7)
2	28	76 115	36.8 (25.4 to 53.3)
3	40	73 620	54.3 (39.9 to 74.1)
4	36	68 198	52.8 (38.1 to 73.2)
5 (most deprived)	54	61 604	87.7 (67.1 to 114)

\*Totals differ in some cases because of missing data, accounted for in the statistical analysis.

For each patient we collected clinical and demographic data, including postcode. Data were anonymised before analysis. The postcodes were used to assign to each individual a Carstairs score of social deprivation for the enumeration district in which he or she lived. An enumeration district on average contains 140 households and is the smallest area for which census data are available. The Carstairs score is an index of deprivation based on four variables available from the 1991 census: overcrowding, social class of head of household, car ownership, and unemployment.<sup>12</sup> The distribution of the scores was banded into fifths, with the lowest fifth denoting the least deprived and the highest fifth the most deprived.

**Statistical analysis**

We calculated incidence rates of epilepsy by five year age group and by sex using person time at risk (18 or 24 months, depending on area). We based the

multivariate analysis on random effects Poisson regression with the Huber-White estimator of variance and specified practice level clustering to allow for similarity of rates within practices. We grouped Carstairs scores into fifths for analysis. Reported P values represent tests for linear trend applied to the grouped data.

**Results**

We identified 268 new cases of seizures during 369 283 person years of observation (see table A on bmj.com). We excluded 78 cases of provoked or acute seizures and febrile convulsions. The 190 remaining cases were included in the analysis, giving a crude incidence rate of 51.5 (95% confidence interval 44.4 to 59.3) per 100 000 per year.

We found a strong relation between incidence of epilepsy and age. The incidence was highest between 0 and 4 years and lowest between 45 and 64 years (table 1). Males and females had similar incidence of epilepsy. We observed a steep rise in incidence with socioeconomic deprivation (tables 1 and 2, figure). The incidence, adjusted for age and sex, in the most deprived fifth of the study population was 2.33 (1.46 to 3.72) times that in the least deprived fifth (P=0.001 for trend). There were similar socioeconomic gradients in the 0-14, 15-64, and ≥65 age groups (figure).

Populations served by London practices, however, were more deprived on average than those outside London. When we considered mean Carstairs scores of the nine most deprived practice populations, eight were based in London and the overlap in deprivation scores of individuals in London and non-London practices was small (see table A on bmj.com). When we made an additional adjustment for area, the association between epilepsy incidence and deprivation fifth was weakened and was not significant at the 5% level (table 2).

**Discussion**

This prospective study based on an unselected population represents the first to examine socioeconomic sta-

**Table 2** Rate ratios\* for fifths of Carstairs deprivation score and other explanatory factors

	Model 1 (unadjusted)		Model 2†		Model 3‡	
	Odds ratio (95% CI)	P value for trend	Odds ratio (95% CI)	P value for trend	Odds ratio (95% CI)	P value for trend
Fifth of Carstairs score:						
1 (least deprived)	1		1		1	
2	1.07 (0.67 to 1.69)		1.05 (0.66 to 1.70)		1.04 (0.65 to 1.68)	
3	1.50 (0.88 to 2.56)	<0.001	1.45 (0.84 to 2.51)	0.001	1.42 (0.81 to 2.50)	0.12
4	1.41 (1.02 to 1.94)		1.38 (0.97 to 1.96)		1.16 (0.76 to 1.77)	
5 (most deprived)	2.35 (1.53 to 3.60)		2.33 (1.46 to 3.72)		1.62 (0.91 to 2.88)	
Age group‡:						
0-4			1		1	
5-14			0.41 (0.21 to 0.79)		0.41 (0.21 to 0.79)	
15-44			0.20 (0.11 to 0.39)	0.02	0.20 (0.11 to 0.38)	0.02
45-64			0.19 (0.10 to 0.36)		0.19 (0.10 to 0.36)	
≥65			0.37 (0.18 to 0.78)		0.37 (0.18 to 0.76)	
Sex:						
Female			1		1	
Male			1.05 (0.84 to 1.32)	0.67	1.05 (0.84 to 1.31)	0.68
Area:						
London					1	
Outside London					0.59 (0.37 to 0.95)	0.03

\*All rate ratios based on models with practice level random effects and robust standard errors.

†Model 2 adjusted for age and sex; model 3 adjusted for age, sex, and area.

‡For clarity results are for five age bands but models were constructed with five year age groups. Results shown for deprivation and other variables in models 2 and 3 are adjusted with this finer age stratification.

tus as a risk factor for the development of epilepsy. The overall incidence rates obtained are comparable with those from previous epidemiological studies of incidence in the United Kingdom.<sup>5</sup>

Our main observation was the relation between the incidence of epilepsy and Carstairs deprivation score. However, interpretation of this apparent association is complicated by the fact that the main contrasts in deprivation were those between the populations in London and outside London. Indeed, in the multivariable analyses, when we made additional adjustment for area (London versus outside London) the strong gradient with deprivation was somewhat weakened—though the broad pattern remained—and the association was no longer significant ( $P=0.12$  for trend). The question then is whether the observed deprivation gradient represents a “cause and effect” association or whether it is a spurious (confounded) association generated by a London versus outside London difference in some factor that affects incidence or case ascertainment, or both.

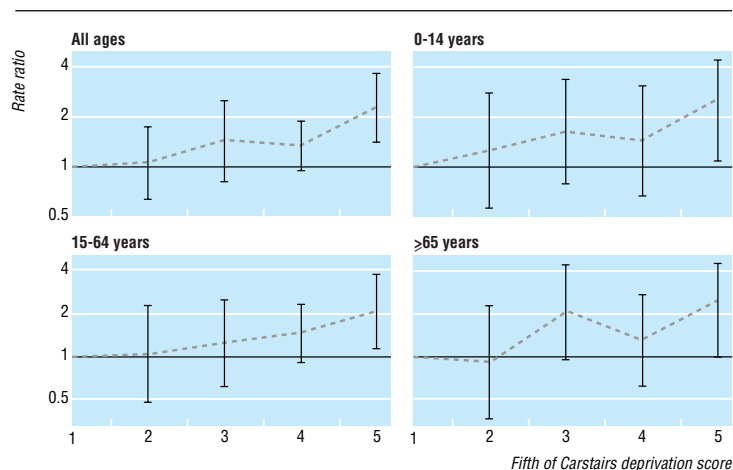
### Alternative interpretations of results

There are three possible explanations. Firstly, patients may have had different access to epilepsy services or diagnostic facilities in the two areas. We think this is unlikely to have had an appreciable effect because of our dedicated surveillance and reporting methods that included a general practice-hospital linkage scheme, with standardised access to diagnostic facilities and epilepsy services. Also an audit of all patient records in participating practices found no evidence of any systematic difference in case reporting between practices.<sup>11</sup> Thus, the procedures for reporting and referral should have minimised the possibility of variation in case identification.

Secondly, there may be differences in other demographic factors such as ethnicity. Ethnicity has been identified as a determinant of incidence in several US community based epilepsy studies, with epilepsy being more common among Afro-Americans than the white population.<sup>8 14 15</sup> In the United Kingdom, a retrospective study found epilepsy to be less prevalent among people of south Asian origin,<sup>16</sup> although this may be because of lower reporting among this group or a lower prevalence due to selective immigration.

In our study, the proportion of people of Afro-Caribbean, African, or Asian descent was relatively small and varied little between practices, though records of ethnic background were not available for individual patients. Overall, the proportion of non-white patients was no greater than 10% in any of the general practices, and it is therefore unlikely that confounding by ethnicity could account for the strong deprivation gradient we observed.

Thirdly, practices in and outside London may have differed in the accuracy and completeness of their patient registers. Because of high population mobility within inner city areas, general practices in London may be more susceptible to “list inflation”—that is, to have more people on their lists than they should because patients who move from the practice area are not removed from registry lists. Where this occurs the population at risk would be overestimated and hence the incidence of epilepsy would be underestimated. Again we believe the magnitude of this problem was small in this study because all participating practices



Age and sex adjusted rate ratios by fifth of Carstairs deprivation score

had good computerised systems and were obliged by the health authority to update their patient lists regularly. Moreover, the likely direction of bias would almost certainly act to diminish any association with socioeconomic gradient as the incidence rates would be underestimated in the more deprived practices within the London area.

Thus, we consider that these explanations are unlikely to account for the deprivation gradient we observed, and we conclude that the evidence is in favour of poor socioeconomic status being a risk factor for the development of epilepsy. This is a pattern similar to that seen for a range of other conditions such as coronary artery disease and many cancers, whose incidences show strong gradients with socioeconomic class.<sup>13</sup>

### Possible mechanisms

The pathophysiological mechanisms by which low socioeconomic status might increase risk of epilepsy are not clear. But several other risk factors such as incidence of birth defects, trauma, infection, and poor nutrition are known to be more common among socioeconomically deprived populations. These would certainly provide a plausible reason for a higher incidence of epilepsy in more disadvantaged groups. Genetic factors may also have a role. The children of parents with epilepsy are more likely to develop seizures, and when one parent is affected the probability of a child developing epilepsy before the age of 20 years is raised from 1% in the general population to 6%.<sup>17</sup> The genetic basis for many epilepsies is increasingly being recognised, although the relation between genetic factors and social disadvantage is likely to be complex. Although children of parents with epilepsy may be socially disadvantaged because of their parent's condition, genes associated with epilepsy may also be important in determining educational achievement and other aspects of medical health.

We thank the general practitioners in the participating practices who allowed us access to their surgeries and assisted in the identification of patients with epilepsy. We also thank Dr Ben Armstrong for advice on statistical methods.

Contributors: DCH, PW, JWS, and GSL conceived and designed the study. AE and BKM were responsible for case ascertainment and reviewed all cases. JWS confirmed the diagnosis in all cases. DCH collected all data on the denominator populations. GSL, SS, and PW designed and performed the statistical analysis.

### What is already known on this topic

Epilepsy is associated with a wide range of markers of social and economic disadvantage

A small number of epidemiological studies have confirmed this association but have not established the direction of causality

### What this study adds

The incidence of epilepsy, adjusted for age and sex, in the most deprived fifth of the study population was 2.3 times that in the least deprived fifth

Socioeconomic deprivation is an important risk factor for the development of epilepsy, though the results may partly reflect differences in incidence within and outside London

DCH, PW, and JWS wrote the manuscript. All authors reviewed and approved the final draft. JWS is guarantor.

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## Detection of depression and anxiety in primary care: follow up study

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Research shows that general practitioners fail to diagnose up to half of cases of depression or anxiety.<sup>1</sup> Many studies are cross sectional and have been criticised because, unlike primary care itself, they contain no longitudinal element. They do not always indicate whether undetected depression is important clinically or whether it is diagnosed at a later date, persists undetected, or causes disability.

We aimed to determine whether depression or anxiety not diagnosed during one general practice consultation is diagnosed during follow up or is self limiting and of no clinical importance.

### Participants, methods, and results

We followed up consecutive attenders at a general practice in north Bristol in 1997.<sup>2</sup> The original sample represented patients attending morning and evening surgeries and all doctors in the practice.

We interviewed 179 patients with the 12 item general health questionnaire and 12 item short form health survey.<sup>3,4</sup> We followed up 71% (160/227) of patients still in the practice and 43% (28/65) of those who had moved. Patients who scored 3 or more on the general health questionnaire received a more detailed

psychiatric assessment with the clinical interview schedule.<sup>5</sup> We analysed the general practitioners' records for psychological diagnoses, treatments, and referrals during the follow up period.

Patients who were followed up were older (48.5 v 43.3 years), were more likely to be female (76% v 68%), and had lower mean scores on the general health questionnaire (3.6, 95% confidence interval 3 to 4.1, v 4.2, 3.5 to 4.9) than those we did not follow up (67 declined, 37 were untraceable, and nine questionnaires were incomplete). None of these differences was statistically significant. Overall, the results of the questionnaire showed that 88/179 (49%, 42% to 57%) patients had depression or anxiety in the original study, but only 34 (39%, 28% to 50%) of these had received a diagnosis of depression or anxiety at that time. Of the 54 who had not received a diagnosis during the original study, 22 received a diagnosis during the three years of follow up (figure).

Of the 56 patients who received a diagnosis, 38 (68%, 54% to 80%) were treated with antidepressants. Twelve (21%, 12% to 34%) were referred to psychiatric services.

Psychological diagnoses had never been made in 32 of the 88 patients; 16/88 (18%; 11% to 28%)