

with live attenuated micro-organisms.<sup>3 7 8</sup> We believe that only one case of paralytic paralysis associated with oral poliomyelitis vaccine has been reported in a child with HIV infection from Romania.<sup>12</sup> Thus oral poliomyelitis vaccine seems to be safe when given during the first year of life.<sup>1 7 10 13</sup> To our knowledge, our case is the first report of poliomyelitis associated with poliomyelitis vaccination in a child infected with HIV from Africa. In countries where HIV infection is endemic and the risk of infection with wild type poliomyelitis virus is high, the benefits of immunisation outweigh the apparently low risk of paralysis due to vaccination with oral poliomyelitis vaccine.

We thank Dr E N Sibanda, Department of Immunology, University of Zimbabwe, Harare, for his help.

Contributors: IC and RvF are both responsible for all aspects of this paper and are guarantors for the study.

Funding: None.

Competing interests: None declared.

- 1 Anonymous. Acute flaccid paralysis surveillance, 1992, Zimbabwe. *Wkly Epidemiol Rec* 1993;68:264-6.
- 2 Wright PF, Kim-Farley RJ, de Quadros CA, Robertson SE, Scott RM, Ward NA, et al. Strategies for the global eradication of poliomyelitis by the year 2000. *N Engl J Med* 1992;325:1774-9.

- 3 Robertson SE. The immunological basis for immunization. VI. Poliomyelitis. WHO/EPL/GEN 1993;16:1-24. (Available from WHO Geneva.)
- 4 Gomo Z, Sikunda D. The immunoglobulin levels in infants attending a routine health clinic at Mbare polyclinic. *Central African Journal of Medicine* 1992;38:281-6.
- 5 Anonymous. WHO case definitions for AIDS surveillance in adults and adolescents. *Wkly Epidemiol Rec* 1994;69:273-5.
- 6 Van Niekerk ABW, Schoub BD, Chezzi C, Blackburn NK, Vries JB, Baard J. Outbreak of poliomyelitis in Namibia. *Lancet* 1994;343:51.
- 7 Ryder RW, Oxtoby MJ, Mvula M, Batter V, Baende E, Nsa W, et al. Safety and immunogenicity of bacille Calmette-Guérin, diphtheria-tetanus-pertussis, and oral polio vaccines in newborn children in Zaire infected with human immunodeficiency virus type 1. *J Pediatr* 1993;122:697-702.
- 8 Barbi M, Biffi MR, Binda S, Clerici-Schoeller M, Ferraris G, Luraschi C, et al. Immunization in children with HIV seropositivity at birth: antibody response to polio vaccine and tetanus toxoid. *AIDS* 1992;6:1465-9.
- 9 Kroon FP, van Dissel JT, Labadie J, van Loon AM, van Furth R. Antibody response to diphtheria, tetanus, and poliomyelitis vaccines in relation to the number of CD4+ T lymphocytes in adults infected with human immunodeficiency virus. *Clin Infect Dis* 1995;21:1197-203.
- 10 Nikwane BM, Wassilak SGF, Orenstein WA, Bart KJ, Schonberger LB, Hinman AR, et al. Vaccine-associated paralytic poliomyelitis: 1973 through 1984. *JAMA* 1987;257:1335-40.
- 11 Strebel PM, Sutter RW, Cochi SL, Biellik RJ, Brink EW, Kew OM, et al. Epidemiology of poliomyelitis in the United States one decade after the last reported case of indigenous wild virus-associated disease. *Clin Infect Dis* 1992;14:568-79.
- 12 Ion-Nedelcu N, Dobrescu A, Strebel PM, Sutter RW. Vaccine-associated paralytic poliomyelitis and HIV infection. *Lancet* 1994;343:51-2.
- 13 McLaughlin M, Thomas P, Onorato I, Oleske J, Nicholas S, Krasinski K, et al. Live virus vaccines in human immunodeficiency virus-infected children: a retrospective survey. *Pediatrics* 1988;82:229-33.

(Accepted 16 April 1998)

## Postcodes as useful markers of social class: population based study in 26 000 British households

John Danesh, Simon Gault, Jo Semmence, Paul Appleby, Richard Peto

Markers of poverty or of low social class are associated with many diseases and potential causes of disease, but medical studies often fail to record sufficient information on socioeconomic status.<sup>1</sup> Postcodes of individuals are, however, often available in Britain, and commercial software exists that estimates household income from the postcode alone. We assessed how informative postcode income estimates are, either about reported household income or about other characteristics related to social class in a large, population based survey of British residents.

### Methods and results

The family resources survey involves personal interviews with members of private households in England, Scotland, and Wales selected by stratified clustered probability sample.<sup>2</sup> During 1995-6, 26 445 (70%) of 37 712 eligible households gave answers to questions on socioeconomic characteristics. Reported weekly household income was taken as the sum of all sources of pretaxation income (excluding housing benefit) reported by household members. During 1985 to 1993 members of 11 million households, or about half of all households in Britain, provided information to a marketing company about annual income and gave a complete address that included a full postcode—that is, 6 or 7 characters.

This information was used to produce commercial software that estimates household incomes from postcodes. After adjustments for regional variation and for inflation in reported income levels, the pretaxation

incomes of at least six households were used to calculate a weighted average income for that postcode. When there were fewer than six responses, the income information was combined with the data for respondents with neighbouring postcodes until a reliable estimate could be made. Parts of this database are updated annually. We compared household income estimates obtained by FIND (a commercially available software program) with information reported in the family resources survey. Matching of the data was carried out at the Office for National Statistics. The investigators in this study were provided with columns of numerical data without any personal identifiers.

The overall correlation coefficient between postcode estimates and reported values of weekly household income for 26 282 individuals was moderate (0.40, 99% confidence interval 0.39 to 0.42;  $2P < 0.0001$ ). When households were ranked in three equal sized groups on the basis of postcode income estimates, there were substantial and highly significant differences in reported weekly income, duration of education, home ownership, membership of higher social classes, and access to various consumer goods ( $2P < 0.0001$  for each) (see table).

### Comment

Postcode income estimates are easily available in Britain and can be useful markers of social class. As UK postcodes are usually shared by only 15 to 20 households,<sup>3</sup> these estimates should more accurately predict the social class of individuals than can more

Clinical Trial Service Unit and Epidemiological Studies Unit, University of Oxford, Radcliffe Infirmary, Oxford OX2 6HE

John Danesh, Merton College junior research fellow

Richard Peto, professor of medical statistics and epidemiology

Family Resources Survey, Department of Social Security, London WC2N 6HT

Simon Gault, assistant statistician

Jo Semmence, statistician

Imperial Cancer Research Fund Cancer Epidemiology Unit, Radcliffe Infirmary, Oxford OX2 6HE  
Paul Appleby, research officer

Correspondence: Dr Danesh john.danesh@balliol.ox.ac.uk

BMJ 1999;318:843-5

Markers of social class by thirds of income estimates based on postcode for 26 282 individuals. Values are numbers (percentages) of individuals, unless stated otherwise

Characteristic	Thirds of income estimated by postcode			P value
	Low income (n=8760)	Middle income (n=8760)	High income (n=8762)	
Reported mean (SD) weekly income (£)	229 (2)	337 (3)	533 (5)	<0.0001
Social class I-II by occupation	690 (8)	1773 (20)	3553 (41)	<0.0001
Homeowner	3586 (41)	6306 (72)	7342 (84)	<0.0001
Educated after age 16	1084 (13)	2098 (24)	3883 (45)	<0.0001
Access to:				
Dishwasher	504 (6)	1385 (16)	3074 (35)	<0.0001
Tumble dryer	3634 (42)	4294 (49)	5141 (59)	<0.0001
Microwave oven	5532 (63)	6138 (70)	6566 (75)	<0.0001
Washing machine	7396 (84)	7851 (90)	8183 (93)	<0.0001
Freezer	2488 (28)	3436 (39)	4296 (49)	<0.0001
Video	6186 (71)	6830 (78)	7315 (84)	<0.0001
Colour television	8329 (95)	8464 (97)	8552 (98)	<0.0001
Black and white television	1709 (20)	1800 (21)	1857 (21)	<0.01
Telephone	7402 (85)	8154 (93)	8537 (98)	<0.0001
Cooker	8676 (99)	8682 (99)	8700 (99)	NS

aggregated data, such as information derived from enumeration districts or electoral wards,<sup>4</sup> or, in the United States, from zip codes,<sup>1</sup> which are usually based on several hundred households.

Consequently, postcode estimates may serve various epidemiological purposes, particularly when it is not feasible to collect detailed information on social class in large studies. Firstly, they can be used to help standardise for the effects of social class, which may be important when the occurrence of a disease and its possible risk factors are both related to poverty. Looking at the strength of an association before and after such statistical adjustment can suggest how much full adjustment for social class, if that were possible, would have modified the association. This comparison might then lead investigators to make more detailed measurements of social class in a subset of participants. Secondly, income estimates derived from postcodes might help to assess bias when a proportion of eligible people refuse to participate in a study. Most epidemiological reports show that people who fail to return questionnaires or to give blood samples are of lower social class than volunteers.<sup>5</sup> The effects of such biases are difficult to establish, especially if surveying the non-respondents again is impracticable, but postcode

income estimates can help with this and other aspects of medical research in Britain.

Emily Banks, Robert Clarke, Rory Collins, Jeyanthi John, and Martin Vessey commented helpfully. Charles Lound of the Office for National Statistics helped with data management, Rom Rahman of QAS Systems provided postcode estimates, and Ian Liddicoat of Market Information Consultancy provided details about "FIND" methodology.

Contributors: JD initiated the study, performed the statistical analyses, interpreted the data, and drafted the paper. All authors discussed the main issues, interpreted the data, and edited the draft. JD is guarantor for the study.

Funding: JD was supported by Merton College and a Frohlich award.

Competing interests: None declared.

- 1 Davey Smith G, Neaton JD, Wentworth D, Stamler R, Stamler J, for the MRFIT Research Group. Mortality differences between black and white men in the USA: contribution of income and other risk factors among men screened for the MRFIT trial. *Lancet* 1998;351:934-9.
- 2 Semmence J, Easto V, Gault S, Hussain M, Fincham P, Hall P, et al. *Family resources survey: Great Britain 1995-96*. London: Stationery Office, 1997.
- 3 Gatrell AC. On the spatial representation and accuracy of address-based data in the United Kingdom. *Int J Geographic Inform Syst* 1989;3:335-48.
- 4 Ben-Shlomo Y, White IR, Marmot M. Does the variation in the socioeconomic characteristics of an area affect mortality? *BMJ* 1996;312:1013-4.
- 5 Austin H, Hill HA, Flanders D, Greenburg R. Limitations in the application of the case-control methodology. *Epidemiol Rev* 1994;16:65-76.

(Accepted 4 December 1998)

## Commentary: Socioeconomic position should be measured accurately

Yoav Ben-Shlomo, George Davey Smith

Department of Social Medicine, University of Bristol, Bristol BS8 2PR

Yoav Ben-Shlomo, senior lecturer in clinical epidemiology  
George Davey Smith, professor of clinical epidemiology

Measures of deprivation based on area of residence have been used for several decades as ecological markers of a person's socioeconomic position. In the United States, median income of residents of areas such as census tracts and zip codes have been used; in the United Kingdom researchers have mainly relied on aggregate deprivation scores based on census measures, such as housing tenure, car ownership, and social class. The study by Danesh et al represents one of the first attempts in Britain to use income data rather than a composite, census based index. A single, direct meas-

ure is theoretically attractive if one argues that income underlies social inequalities in health through increased access to better living conditions and a healthier lifestyle.<sup>1</sup> Furthermore, the authors have classified areas to postcode level rather than to larger areas such as enumeration district or ward; this reduces the likelihood that any observed association is influenced by the "ecological fallacy."<sup>2</sup>

Their work fails to address two fundamental questions. Firstly, is this new measure any better than existing methods? The authors' results show only a

moderate correlation between their postcode aggregate income measure and individual data. It would have been useful if they had compared this with census scores based on enumeration district and ward. Smaller is not always better with respect to area based measures. Geronimus and Bound found little improvement in predicting self reported health when comparing data at census tract level (5000 individuals) with zip code data (25 000 individuals).<sup>3</sup> The optimal population size for categorising the contextual nature of areas will depend on the nature of this contextual effect, and this cannot be assumed to be better indexed by aggregate measures for areas with smaller populations. At a postcode level one must also be concerned with possible sampling error and more importantly the systematic bias introduced by respondents who reply to a commercial survey.

Secondly, can researchers manage without individual measures of socioeconomic position? Sometimes individual data are simply not collected or the quality of such data is extremely poor—for example, routinely collected health services data. Here, the use of a postcode based measure is invaluable for testing whether area based deprivation may be related to access to health care.<sup>4</sup> However, the use of area based measures is less justifiable when researchers are prospectively collecting data as part of a large trial or observational study. Many studies show that both individual and area based measures seem to have independent effects on health outcomes, possibly as a result of the contextual effects of residing in poor neighbourhoods. To measure one and not the other will result in an underestimation of potential effects associated with socioeconomic position. Analyses

based solely on an area measure of socioeconomic position can be highly misleading, especially if other risk factors are measured at an individual level. For example, it has been argued that variations in mortality by area based deprivation can be almost fully accounted for by smoking.<sup>5</sup> However, applying the relative risk associated with individual smoking behaviour to mortality differences by area based deprivation underestimates the importance of individual socioeconomic position. Individual measures produce much steeper gradients of mortality risk than area based deprivation measures. We hope that the area based income measure introduced by Danesh et al will not be used in this way.

Researchers should, when possible, continue to measure both individual and area based measures of socioeconomic position. Relying on ecological measures alone rather than using both would be analogous to asking people whether they smoked but not measuring how many years or the number of cigarettes they smoked.

- 1 Blane DB, Bartley M, Davey Smith G. Disease aetiology and materialist explanations of socio-economic mortality differentials. *Eur J Public Health* 1997;7:385-91.
- 2 Piantadosi S, Byar DP, Green SB. The ecological fallacy. *Am J Epidemiol* 1988;127:893-904.
- 3 Geronimus AT, Bound J. Use of census-based aggregate variables to proxy for socioeconomic group: evidence from national samples. *Am J Epidemiol* 1998;148:475-86.
- 4 Ben-Shlomo Y, Chaturvedi N. Assessing equity in access to health care provision in the UK: does where you live affect your chances of getting a coronary artery bypass graft? *J Epidemiol Community Health* 1994;49:200-4.
- 5 Law MR, Morris JK. Why is mortality higher in poorer areas in more northern areas of England and Wales. *J Epidemiol Community Health* 1998;52:344-52.

## Drug points

### Transient hemiparesis with topiramate

Linda J Stephen, Jan E Maxwell, Martin J Brodie, Epilepsy Unit, Department of Medicine and Therapeutics, Western Infirmary, Glasgow G11 6NT

Topiramate is an antiepileptic drug licensed as add on treatment for use in patients with refractory partial onset seizures with or without secondary generalisation.<sup>1</sup> Its triple mechanism of action is thought to entail sodium channel blockade, attenuation of responses induced by kainate, and enhancement of inhibition mediated by  $\gamma$ -aminobutyric acid.<sup>2</sup> We report two cases of hemiparesis with topiramate that resolved on withdrawal of treatment.

A 41 year old man with cerebral palsy resulting in right sided weakness experienced daily complex partial seizures despite taking carbamazepine retard, sodium valproate slow release, gabapentin, and diazepam. Substitution of lamotrigine for carbamazepine and gabapentin had little effect on his seizure frequency. Topiramate was introduced over a month up to 25 mg twice daily with good effect. During this time, however, he developed fatigue, left sided weakness, and slurred speech. He was unable to weight bear and had to rely totally on his carers. On examination, his reflexes were brisk on the newly affected side, with reduced power and tone. Computed tomography showed only gross left hemispheric atrophy.

The left sided weakness slowly resolved over eight weeks after topiramate treatment was withdrawn.

A 59 year old woman had poorly controlled secondary generalised seizures after herpes simplex encephalitis despite treatment with carbamazepine slow release and phenytoin. Magnetic resonance imaging showed extensive anterior infarction in the left temporal lobe. Topiramate treatment was introduced over two months up to a dose of 100 mg twice daily. During this time she developed reduced tone and power in her right arm and leg. Repeat magnetic resonance imaging showed no further changes. She regained normal power within two weeks of topiramate withdrawal.

To our knowledge, these are the first reported cases of hemiparesis linked with topiramate treatment. It may be relevant that both patients already had compromised neurological function. The Committee on Safety of Medicines and the drug manufacturer have been informed. Awareness of this side effect will avoid inappropriate investigation and encourage rapid withdrawal of topiramate treatment.

- 1 Wilson EA, Brodie MJ. New antiepileptic drugs. In: Brodie MJ, Treiman DM, eds. *Modern management of epilepsy*. London: Ballière-Tindall, 1996:723-47. (Ballière's clinical neurology.)
- 2 Dichter MA, Brodie MJ. New antiepileptic drugs. *N Engl J Med* 1996;334:1583-90.