

research on this issue carried out since then (that published up to 1990 being reviewed by Davey Smith *et al*).⁸

So, those who would seek to criticise or ignore research on socioeconomic deprivation and health using ecological correlation studies in which appropriate indices of deprivation have been used cannot legitimately seek support from the ecological fallacy.

- 1 McCarron PP, Davey Smith G, Womersley JJ. Deprivation and mortality in Glasgow: increasing differentials from 1980 to 1992. *BMJ* 1994;309:000-000.
- 2 McLeone P, Boddy FA. Deprivation and mortality in Scotland, 1981 and 1991. *BMJ* 1994;309:000-000.
- 3 Selvin HC. Durkheim's suicide and problems of empirical research. *American Journal of Sociology* 1958;63:607-19.
- 4 Robinson WS. Ecological correlations and the behavior of individuals. *American Sociological Review* 1950;15:351-7.
- 5 Morgenstern H. Uses of ecologic analysis in epidemiological research. *Am J Public Health* 1982;72:1336-44.
- 6 Sloggett A, Joshi H. Higher mortality in deprived areas: community or personal disadvantage? *BMJ* 1994;309:000-000.
- 7 Department of Health and Social Security. *Inequalities in health: report of a research working group*. London: DHSS, 1980.
- 8 Davey Smith G, Bartley M, Blane D. The Black report on socioeconomic inequalities in health 10 years on. *BMJ* 1990;301:373-7.

Appropriateness of deprivation indices must be ensured

Mel Bartley, David Blane

Nuffield College, Oxford
OX1 1NF
Mel Bartley, research officer
in public health policy

Academic Department of
Psychiatry, Charing Cross
and Westminster Medical
School, London W6 8RP
David Blane, lecturer in
medical sociology

Correspondence to:
Dr Bartley.

Since 1971, census information has been used to identify localities where a high proportion of households are living under adverse social and economic conditions. The initial intention was that such areas should be provided with extra resources to improve the quality of life of individual people and their families.

Underlying this exercise was the assumption that improving local facilities (by upgrading housing estates or setting up educational priority areas) could improve residents' opportunity and quality of life without changing individual circumstances such as low wages or unemployment.¹ The items from the 1971 census used for the original Department of Environment deprivation index therefore included measures of housing quality and proxy measures of income such as employment status. Other variables such as the numbers of children aged up to 14 years would not in themselves constitute "disadvantage", but they were included as a measure of the need for services. In general, area deprivation index scores measure the proportion of households within a defined small geographical unit with a combination of circumstances indicating low living standards or a high need for services, or both.

Several deprivation indices have been developed

since the original 1971 Department of Environment measure. The underprivileged area index developed by Jarman was intended as an indicator of the demand for primary medical care. Accordingly, it included items thought to indicate the likelihood of high demand such as the proportion of elderly people living alone and the number of children under 5. Two other well known measures developed by Carstairs and colleagues and by Townsend and colleagues were guided by an interest in the effects of living standards on health. They contain items that might be regarded as good indicators of the amount and stability of household income: housing tenure, car ownership, unemployment, and social class.

Deprivation indices therefore need to be understood and evaluated in terms of (a) the purpose for which they are being used and (b) the validity of the assumptions about social and economic life that they embody. This is true of the decisions to include or exclude different items. It is also true of the different types of statistical procedures used to combine items together into a summary score. Items are often converted into a standardised Z score, which expresses each one in terms of its mean value in the population and its standard error. If this were not done then items with longer scales would have more weight than those with shorter scales in the overall score. For example, the number of children in a household could vary from, say, 0 to 10, while the number of cars available would lie between 0 and 3. Simply adding these together would give children more weight than cars. Standardisation is intended to avoid this problem, though this is easier for some items than for others. On the other hand, some components may deliberately be weighted more heavily if they are thought to be more important—for example, in the Jarman index "pensioners living alone" is weighted highest, whereas in the Department of the Environment's 1981 index unemployment has double the weight of other variables.

Information on the relation between mortality and deprivation in individual people can be obtained by linking death certificates to census information. This is what the longitudinal study of the Office of Population Censuses and Surveys makes possible—though only for 1% of the population. As a growing number of people find themselves without a single stable occupation, social class is becoming less satisfactory as a measure of living standards and lifestyle. The use of additional measures of disadvantage, both in the form of linked individual data and in the form of small area statistics, will therefore become increasingly valuable in estimating social variations in health.

1 Holterman S. Areas of urban deprivation in Great Britain: an analysis of 1971 Census data. *Social Trends* 1975;6:33-47.

Relation between rates of leg amputation and distal arterial reconstructive surgery

J A Michaels, P Rutter, J Collin, F M Legg,
R B Galland for the Oxford Regional Vascular
Audit Group

Nuffield Department of
Surgery, Oxford
University, John Radcliffe
Hospital, Oxford
J A Michaels, clinical lecturer
P Rutter, consultant surgeon
J Collin, reader in surgery
F M Legg, clinical audit
assistant
R B Galland, consultant
surgeon

Correspondence to:
Mr J A Michaels, Northern
General Hospital NHS
Trust, Sheffield S5 7AU.

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A recent audit of vascular surgical practice in the Oxford region showed distinct variation between districts in the rate and level of leg amputations for occlusive arterial disease.¹ There were also considerable differences between districts in the volume and nature of reconstructive arterial surgery. Arterial

bypass grafting of the calf or foot, operations largely reserved for limb salvage, were undertaken in only two hospitals in the region.

We carried out a six month prospective audit to study in greater detail the relation between distal reconstructive arterial surgery and leg amputation.

Subjects, methods, and results

The Oxford region has a total population of 2.5 million, with eight districts serving populations of 150 000 to 550 000. On the basis of the previous audit we divided districts into three high volume and five low volume districts, depending on whether they were carrying out above or below the average rate of arterial reconstructions for the region.¹

Vascular surgeons in each district were invited to participate in a prospective audit of all leg amputations