PAPERS

Mortality from cardiovascular disease among interregional migrants in England and Wales

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Abstract

***Objective*—To investigate the extent to which geographical variations in mortality from ischaemic heart disease and stroke in Britain are influenced by factors in early life or in adulthood.**

***Design*—Longitudinal study of migrants.**

***Subjects*—1% sample of residents in England and Wales born before October 1939 and enumerated at the 1971 census (the Office of Population Censuses and Surveys' longitudinal study).**

***Main outcome measure*—18 221 deaths from ischaemic heart disease and 9899 deaths from stroke during 1971-88 were analysed by areas of residence in 1939 and 1971. These included 2928 deaths from ischaemic heart disease and 1608 deaths from stroke among individuals moving between 14 areas defined by the major conurbations and nine standard administrative regions of England and Wales.**

***Results*—The southeast to northwest gradient in mortality from ischaemic heart disease was related significantly to both the 1939 area (χ^2=6·09, df=1) and area in 1971 (χ^2=5·05, df=1). Geographical variations in mortality from stroke were related significantly to the 1939 area (χ^2=4·09, df=1) but the effect of area in 1971 was greater (χ^2=8·07, df=1). The effect of 1971 area on mortality from stroke was largely due to a lower risk of death from stroke among individuals moving into Greater London compared with migrants to the rest of the South East region (χ^2=4·54, df=1).**

***Conclusions*—Geographical variations in mortality from cardiovascular disease in Britain may be partly determined by genetic factors, environmental exposures, or lifestyle acquired early in life, but the risk of fatal ischaemic heart disease and stroke changes on migration between areas with differing mortality. The low risk of death from stroke associated with residence in Greater London is acquired by individuals who move there.**

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Introduction

Mortality from ischaemic heart disease and mortality from stroke show a pronounced southeast to northwest gradient in England and Wales. The reasons for this longstanding regional pattern are poorly understood.

In small areas of England and Wales current mortality for ischaemic heart disease is highly correlated with infant mortality in the same areas earlier this century.[1-3] It has therefore been suggested that the current geographical pattern of ischaemic heart disease results from past inequalities in standards of living.[2] The association, within individuals, between ischaemic heart disease and short stature, birth weight,[5 6] other measures of intrauterine growth,[7] and reduced weight at 1 year of age[5] lends support to this hypothesis. A similarly strong correlation, however, is observed between mortality from ischaemic heart disease, current infant deaths rates,[12] and the geographical association between fatal ischaemic heart disease and past infant mortality is substantially reduced after adjustment for indices of current socioeconomic deprivation.[3] These observations suggest instead that geographical variations in mortality from ischaemic heart disease may reflect living conditions in adult life rather than circumstances in childhood.

Mortality for strokes in small areas of England and Wales is highly correlated with maternal mortality and neonatal mortality in the same areas earlier this century.[8 9] This correlation not only arises from the southeast to northwest gradient typical of mortality for a range of diseases (including ischaemic heart disease) but also extends to the London boroughs, most of which in the past had low maternal and neonatal mortality and where age specific mortality from stroke (but not ischaemic heart disease) has been substantially lower than in the surrounding counties since Greater London was defined in 1931.[10] It has therefore been suggested that past differences in rates of fetal development may explain the current geographical pattern of mortality from cardiovascular disease in England and Wales.[9] In particular, the low mortality from stroke in Greater London has been attributed to the migration of relatively well nourished young women into domestic service in the capital earlier this century, who later gave birth to babies who were healthier than those of mothers who had not moved.[11]

Longitudinal studies of individuals have shown associations between reduced weight at birth or 1 year of age and a number of cardiovascular risk factors, including blood pressure, glucose tolerance, ventilatory function, and haemostatic factors.[12] These studies, however, cannot evaluate the extent to which geographical variations in mortality from cardiovascular disease are attributable to early influences, as distinct from environment, lifestyle, and medical care in adult life.

Studies of migrants can show critical periods in the development of geographical variations in disease. Previous studies of migrants within Britain have drawn conflicting conclusions in relation to cardiovascular disease. In the British regional heart study the incidence of male ischaemic heart disease was more closely related to place of examination in middle age than to birthplace,[13] whereas a national study of proportional mortality during 1969-72 suggested a significant influence from birthplace for deaths from both ischaemic heart disease and stroke.[14] We report a third study of mortality from cardiovascular disease among migrants within England and Wales.

Methods

SUBJECTS

The Office of Population Censuses and Surveys' longitudinal study[15] links census information and death registrations for a 1% sample of persons in

England and Wales who were born on one of four selected days in the year and who were enumerated at the 1971 census. The linkage uses NHS numbers, which were usually derived from wartime identity numbers for individuals born before national registration on 29 September 1939. The place of enumeration (and presumed residence) of members of the longitudinal study in 1939 was derived from these numbers. This was not possible for individuals whose wartime identity numbers had changed, which affected most men born between 1900 and 1939 when they entered the armed forces. National registration preceded large scale evacuation of children and pregnant women, although some informal movements of population may have taken place before the day of enumeration.[16]

AREAS

We defined 14 areas of residence using the standard administrative regions and metropolitan counties that were defined in 1974. We regarded Greater London and the urban county of Cleveland as metropolitan counties for this purpose. We treated metropolitan counties within a standard region as single areas—namely, Merseyside and Greater Manchester; West Yorkshire and South Yorkshire; Tyne and Wear and Cleveland. Areas of enumeration in 1939 had been coded with the county boundaries operating after 1974 and the 14 areas were derived direct from these. We recoded areas of residence at the 1971 census using county boundaries operating after 1974 using published tables.[17]

We analysed mortality among members of the longitudinal study born on or before national registration day who died during 1971-88. The analysis was restricted to subjects whose area of residence was known in 1939 and was the same in 1966 as in 1971 (to exclude influences of migration shortly before death[18]). No distinction was made between subjects whose place of residence had not changed and those who had moved but remained within one of the 14 areas during 1939-1971: both groups are thereafter termed "non-migrants."

STATISTICAL ANALYSIS

Standardised mortality ratios for ischaemic heart disease (*International Classification of Diseases*, eighth and ninth revisions (ICD-9, ICD-10) codes 410-414) and stroke (ICD-8, ICD-9, codes 430-438) were calculated relative to the whole longitudinal study, with adjustment for sex, age, calendar period at risk, and a composite socioeconomic measure based on housing tenure and household car ownership as recorded at the 1971 census. The standardised mortality ratios were modelled by log linear Poisson regression with the Generalised Linear Interactive Modelling (GLIM) package[19] to adjust differences between areas of residence in 1939 for the effects of area in 1971 and vice versa.

The principal objective of our analysis was to disentangle the effects on mortality of factors operating in childhood and early adult life from those operating in middle and old age, by using area of remuneration in 1939 and 1971 as proxy measures. The mortality among people whom we classified as non-migrants cannot be used to distinguish between these effects. They can be used, however, as a measure of the geographical pattern of disease specific death rate, as discussed further below.

Our main analyses focused only on "migrants" (those members of the longitudinal study whose area of enumeration in 1939 differed from their area of residence in 1966 and 1971). Areas in 1939 and 1971 were included simultaneously as categorical variables (each with 14 levels) in a single log linear model. The model produced estimates of the mutually adjusted standardised mortality ratios associated with each area in 1939 and 1971. A general assessment of significance of the independent effects of the 1939 area and the 1971 area was made by deriving χ^2 statistics (each on 13 degrees of freedom) from changes in deviance resulting from removal of, in turn, the 1939 area and the 1971 area from the combined model. These are termed heterogeneity statistics in the tables.

A statistically more powerful test for trend of the influence of factors operating in early or later life was based on the following reasoning. If area of residence in 1939 wholly explained the geographical variation in mortality—that is, circumstances in early life rather than in middle and old age were critical—then the independent effects relating to the 1939 area among the migrants should correlate perfectly with the overall geographical pattern of disease specific mortality. Similarly, if the area in 1971 explained all of the geographical variation, then the independent effects relating to the 1971 area among the migrants should correlate perfectly with the overall pattern.

A formal assessment of the extent to which each of these extreme hypotheses was consistent with the data was made as follows. The geographical pattern of disease specific mortality was estimated from the standardised mortality ratios for non-migrants (who were excluded from subsequent modelling). The logarithms of the non-migrant standardised mortality ratios were used to assign a quantitative score to each area because the log linear models used a logarithmic transformation of death rates for the migrants.

To test for the correlation between non-migrant standardised mortality ratios and the independent effects of the 1939 area a model was first fitted for the migrants containing only the 1971 area (fitted as a categorical variable with 14 levels). The score variable was assigned to the migrants according to their area of residence in 1939. We used the improvement in fit (reduction in deviance) resulting from inclusion of the score variable to test for trend in standardised mortality ratios by the 1939 area (expressed in the tables as χ^2 test for trend with one degree of freedom).

We assessed similarly the effects of area in 1971 on mortality, controlling the area in 1939. In this case the score variable was assigned to the migrants according to their area of residence in 1971 and added to a model containing the 1939 area as a categorical variable with 14 levels.

Results

During 1971-88 there were 28 056 deaths from ischaemic heart disease and 13 215 from stroke among 275 772 members of the longitudinal study alive on national registration day in 1939 and traced for mortality follow up. Areas of enumeration in 1939 and residence in 1971 were known for 18 221 (65%) of the deaths from ischaemic heart disease and for 9899 (75%) of the deaths from stroke. These deaths, and the corresponding "populations at risk" were included in the analysis. The standardised mortality ratios for cardiovascular disease among members of the longitudinal study included in the analysis (ischaemic heart disease, 101; stroke, 101) were similar to those for groups excluded from the analysis (99, 98). These differences in mortality among members of the longitudinal study with and without complete geographical data were not significant ($P > 0.1$). Table I shows the age and sex distribution of deaths included in the analysis. In all, 44% of the deaths from ischaemic heart disease and 31% of the deaths from stroke included in the analysis occurred among males.

Tables II and III show standardised mortality ratios for ischaemic heart disease and stroke among non-migrants (who were excluded from subsequent modelling) and the mutually adjusted standardised mortality ratios by area of enumeration in 1939 and area of residence in 1971 among migrants. Overall, the rates of mortality from cardiovascular disease among migrants were about 10% lower than among non-migrants. After adjustment for the areas of origin and destination for the migrant group and for sex, age, calendar period, housing tenure, and car ownership, the death rate ratios comparing migrants with non-migrants were 0·90 (95% confidence interval 0·87 to 0·94) for ischaemic heart disease and 0·94 (0·88 to 0·99) for stroke.

For mortality from ischaemic heart disease (table II), the mutually adjusted effects of each area in 1939 and in 1971 correlated to a similar degree with the area specific standardised mortality rates among non-migrants, as indicated by the statistics for trend. For mortality from stroke (table III), the effects associated with area of residence in 1971 were somewhat stronger than those related to area of enumeration in 1939. This was largely due to a low rate of mortality from stroke among individuals moving from outside Greater London into Greater London (χ^2=4·54, df=1), with no significant trend among the remaining regions (χ^2=1·09, df=1). The mortality ratio for stroke comparing migrants living in Greater London in 1971 with migrants living outside Greater London but in the South East region in 1971 was 0·80 (0·65 to 0·98). In contrast, individuals moving to areas outside the South East region (in 1971) had a similar mortality from stroke whether their place of origin (in 1939) was Greater London or some other part of the South East (table III).

Separate models were fitted to the data for males and females and for members of the longitudinal study aged ≤35 years on national registration day in 1939. No significant differences in the influence of the 1939 area and the 1971 area were found for either ischaemic heart disease or stroke. The analyses that are restricted to individuals aged 0-34 years in 1939 are of greatest interest as in this group the 1939 area should more closely reflect area of birth. In this group the statistics for trend for ischaemic heart disease were significant ($P<0·05$) for both the 1939 area (χ^2=4·84) and the 1971 area (χ^2=5·88); for stroke, however, the 1971 effect was highly significant (χ^2=7·05, $P<0·01$), although the 1939 area seemed to have little influence on the risk of fatal stroke (χ^2=0·23). These analyses were based on 1247 deaths from ischaemic heart disease and 524 deaths from stroke among individuals aged 0-34 years in 1939 who moved between areas during 1939-71.

TABLE I—*Number of deaths included in the analysis, by cause of death and age and sex*

	Death from ischaemic heart disease (n=18 221)		Death from stroke (n=9899)	
Age in 1939 (years)	Males	Females	Males	Females
<35	3846	3849	1043	1987
35-44	3001	3862	1281	2812
≥45	1247	2416	758	2018
All ages	8094	10127	3082	6817

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TABLE II—*Standardised mortality ratios* (number of deaths) for ischaemic heart disease by area of enumeration in 1939 and area of residence in 1971*

		Migrants	
Area†	Non-migrants	By 1939 area	By 1971 area
Greater London	90 (1969)	86 (843)	81 (344)
East Anglia region	91 (499)	90 (82)	101 (122)
South West region	94 (1229)	84 (175)	91 (359)
South East region excluding Greater London	95 (2176)	83 (382)	91 (897)
West Midlands (county)	96 (865)	110 (193)	97 (91)
West Midlands region excluding West Midlands county	96 (616)	97 (134)	79 (140)
East Midlands region	100 (1240)	85 (143)	89 (139)
Yorkshire and Humberside region excluding South and West Yorkshire	108 (492)	88 (85)	79 (92)
Merseyside and Greater Manchester	112 (1617)	93 (227)	103 (161)
Wales	115 (1086)	96 (128)	102 (123)
North West region excluding Merseyside and Greater Manchester	119 (781)	94 (138)	96 (177)
South and West Yorkshire	119 (1462)	109 (192)	104 (108)
Northern region excluding Tyne and Wear and Cleveland	120 (604)	92 (133)	89 (57)
Tyne and Wear and Cleveland	123 (657)	116 (73)	104 (118)
All areas	103 (15 293)	91 (2928)	91 (2928)
χ^2 Heterogeneity (13 df)		20·45	16·56
P value		0·08	0·22
χ^2 For trend‡ (1 df)		6·09	5·05
P value		0·014	0·025

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*Relative to whole of longitudinal study's population (standardised mortality ratio=100).
All standardised mortality ratios are adjusted for age, calendar period, housing tenure, and car ownership. 1939 effects are adjusted additionally for area in 1971 and vice versa.
†Based on nine standard administrative regions in England and Wales and listed in ascending order of standardised mortality ratio for non-migrants.
‡Test for linear trend with scores derived from log: standardised mortality ratio for non-migrants.

TABLE III—*Standardised mortality ratios* (number of deaths) for stroke by area of enumeration in 1939 and area of residence in 1971*

		Migrants	
Area†	Non-migrants	By 1939 area	By 1971 area
Greater London	77 (953)	87 (477)	75 (178)
Rest of South East region	94 (1220)	90 (214)	94 (513)
South West region	97 (710)	94 (105)	92 (209)
East Anglia region	103 (306)	96 (44)	79 (56)
East Midlands region	105 (689)	111 (94)	117 (90)
Merseyside and Greater Manchester	107 (847)	86 (121)	96 (73)
South and West Yorkshire	107 (692)	86 (88)	101 (56)
West Midlands county	109 (504)	101 (96)	85 (39)
Yorkshire and Humberside region excluding South and West Yorkshire	111 (272)	104 (51)	93 (53)
West Midlands region excluding West Midlands county	112 (376)	99 (68)	96 (84)
Tyne and Wear and Cleveland	115 (325)	119 (40)	92 (55)
Wales	121 (602)	108 (75)	100 (64)
North West region excluding Merseyside and Greater Manchester	122 (434)	87 (65)	111 (102)
Northern region excluding Tyne and Wear and Cleveland	137 (361)	104 (70)	111 (36)
All areas	102 (8291)	93 (1608)	93 (1608)
χ^2 Heterogeneity (13 df)		11·64	16·42
P value		0·55	0·22
χ^2 For trend‡ (1 df)		4·09	8·07
P value		0·04	0·005

Based on unpublished data from Office of Population Censuses and Surveys; crown copyright reserved.
*Relative to whole of longitudinal study's population (standardised mortality ratio=100).
All standardised mortality ratios adjusted for age, calendar period, housing tenure, and car ownership. 1939 effects adjusted for area in 1971 and vice versa.
†Based on nine standard administrative regions in England and Wales and listed in ascending order of standardised mortality ratio for non-migrants.
‡Test for linear trend with scores derived from log: standardised mortality ratio for non-migrants.

Discussion

STUDIES OF MIGRATION

The well known regional differences in mortality from ischaemic heart disease and stroke seen in routine vital statistics for England and Wales were mirrored among the non-migrants in the Office of Population Censuses and Surveys' longitudinal study. The movement of individuals between areas provides an opportunity to investigate the age at which geographical variations in environmental exposure and in lifestyle influence the development of cardiovascular disease. If such factors operate early in life then movement in adult life between areas with different rates of disease should have little effect on risk. Conversely, if these factors exert their influence in middle and old age then area of origin should have little influence on the development of cardiovascular disease.

Our study was undertaken principally to investigate whether evidence existed from migrant effects to support the hypothesis that fetal development or living circumstances in early life have an important role in determining the risk of ischaemic heart disease and stroke in adult life.[12] Two other studies of migration have been conducted with the same objective. Information on place of birth and death from death certificates was used by Osmond *et al* in an analysis based on considerably larger numbers than are used in our study.[14] Although they found a significant effect of birthplace on both mortality from ischaemic heart disease and mortality from stroke, the influence of area of death was greater (as judged from the conditional χ^2 statistics reported[14]).

An important limitation of that study was the use of proportional mortality ratios, which depend as much on the geographical pattern of other causes of death as on death rates for cardiovascular disease. Our use of age standardised mortality ratios is much more valid, and we excluded effects relating to migration shortly before death—these effects could not be distinguished by Osmond *et al*.[14]

In a prospective study of incident cases of ischaemic heart disease Elford *et al* tried to disentangle the independent effects on risk of place of birth and place of residence in middle age.[13] However, their analysis, which was based on only 24 ischaemic heart disease events among men who had moved between the south and the rest of Britain, lacked power to discriminate conclusively between the effects of place of birth and place of examination in middle age. Although our data are restricted to mortality, rather than incidence, we used much greater numbers and national coverage and included both males and females.

Each of these two previous studies of migration used area of birth as an indicator of place of residence in early life. In our analysis the only information available on area of origin was district of enumeration in 1939. This may have differed from the area of usual residence at that time because of formal or informal evacuation, although this was not considered to be an important influence in statistical reports of the national registration data.[16] In addition, an unknown proportion of members of the longitudinal study migrated between areas after birth but before 1939. Thus our analysis is likely to underestimate the influence of area of birth as an indicator of environmental or lifestyle influences in very early life. Our estimates of the effect of the 1971 area are more robust, because we restricted the analysis to members of the longitudinal study who had not moved between areas during 1966-71.

A common problem in studies of migrant populations is that the risk of disease among migrants tends to differ from that among non-migrants because of socioeconomic confounding or selection bias (typically a "healthy migrant" effect). We have previously described measures of socioeconomic status among interregional migrants in the longitudinal study, which show that the migrants tend to have similar characteristics to those living in the region to which the migrants move.[20] The standardised mortality ratios for ischaemic heart disease and stroke among migrants within Britain were significantly lower than the respective standardised mortality ratios among non-migrants even after adjustment for housing tenure and car ownership in 1971. The magnitude of these differences, however, was modest compared with the variation between areas.

Our analysis of the independent effects of the 1939 region and the 1971 region on risk of fatal ischaemic heart disease or stroke takes account of these possible biases in three ways. Firstly, the analysis was restricted to the migrant groups. Secondly, we adjusted throughout for measures of socioeconomic status obtained in 1971. Finally, our method of adjustment for the 1939 region in the assessment of the effects of the 1971 region (and vice versa) allows for the possibility that migrants from (or to) a particular region may share unusual socioeconomic or health related characteristics.

ISCHAEMIC HEART DISEASE

Our results suggest that the southeast to northwest gradient in mortality from ischaemic heart disease in England and Wales is related in almost equal measure to region of origin and to region of residence in late adult life. This observation is consistent with the suggestion that the risk of ischaemic heart disease is partly determined by the intrauterine environment or by living conditions in early childhood.[2 5-7] It could also reflect, however, the influence of genetic factors or lifestyles acquired early in life.

After adjustment for the region of origin among interregional migrants the risk of ischaemic heart disease among them was significantly influenced by their region of residence in later life. This implies that changes in environment, lifestyle, or medical care associated with migration within England and Wales can modify the effects of genetic constitution or "programming" by the intrauterine or early childhood environment. The factors underlying this change in disease risk and the degree to which these factors may be modifiable require further investigation.

STROKE

It is unlikely that any single explanation underlies all the observed geographical differences in mortality from stroke. Regional differences in mortality from stroke seem to be influenced partly by factors that operate early in life—including genetic variation, geographical differences in fetal development or childhood environment, and lifestyles determined by childhood experience.

It is striking, however, that the low risk of fatal stroke among non-migrants in Greater London (table III) also occurs among those people who migrated to the capital during 1939-71. This shows that the low mortality from stroke in Greater London cannot be fully explained by better fetal development of infants born in London to selectively healthy domestic workers who migrated from the countryside in the early part of this century, as has been previously hypothesised.[11]

The pronounced difference in mortality from stroke between London and the rest of the South East region is not an artefact of selective migration during adult life as it occurs even for members of the longitudinal study who did not move between the capital and another part of the South East during 32 years (table III). Further studies are required to evaluate whether a spurious difference may have arisen from variations in clinical diagnosis, death certification, or survival among patients with stroke (which may or may not be related to standards of medical care). If such influences can be excluded the reduced risk of stroke in Greater London deserves further attention, because it may reflect unrecognised protective factors that exert their influence in mainly adult life and are therefore more effective targets for prevention than determinants operating perinatally.

Key messages

- Geographical variations in mortality from ischaemic heart disease and stroke in England and Wales have persisted for decades but are poorly explained
- In a large nationally representative cohort these variations persisted after adjustment for indices of socioeconomic status
- Similar variations were found among individuals who lived in the same area in 1939 as in 1971, suggesting that the geographical pattern of mortality from cardiovascular disease cannot be attributed to selective migration
- Mortality from cardiovascular disease was influenced by factors associated with area of residence in adult life, but circumstances earlier in life seem to have some independent influence
- The low risk of fatal stroke associated with living in Greater London was acquired by individuals who lived there, regardless of place of residence 40 years previously

RISK FACTORS

The longitudinal study's dataset is derived purely from record linkage and provides no information on individual lifestyles or on the physiological mechanisms that underlie the associations that we have observed. Some relevant aspects of lifestyle, such as smoking and dietary habits, may be determined as much by regional differences in upbringing as by social and cultural influences in adult life. We plan similar analyses of mortality from lung cancer and chronic obstructive airways disease, which may suggest whether smoking habits are more strongly related to area of upbringing or to area of residence later in life.

Raised blood pressure is an important risk factor for both ischaemic heart disease and stroke. Several studies have found an inverse association between blood pressure and birth weight,[21] suggesting that fetal growth may influence the risk of subsequent hypertension and thereby of death from stroke. On the other hand, middle aged men who had moved between regions of Britain tended to acquire the average blood pressure associated with their area of examination, rather than their area of birth.[22] Geographical variations in average blood pressure thus seem to be determined in adult life rather than perinatally.

We are not aware of any other studies that have reported levels of cardiovascular risk factors among interregional migrants within mainland Britain. Analyses of other national datasets should, where possible, address the critical age at which geographical variations in levels of each important risk factor are determined. Such information is required to place the scientifically exciting observations relating to the early life origins of adult diseases[12] into their proper public health perspective.

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KEYWORDS

The lazy writer's best friend

Raymond Williams's *Keywords* was first published in 1976. He analysed difficult words like alienation, culture, society, and unemployment. The key in the title was a metaphor for the way in which each of the 130 or so words discussed in the book opened up problematic areas of meaning and usage. *Keyword* is an apt label, too, for the disconnected terms that indexers use to indicate the content of scientific articles. These words unlock access to electronic methods of information retrieval.

But used as an adjective, key has become exanthematous in medical writing. In the past few weeks I have come across key advisers, key areas, key articles, key axes, key characteristics, key elements, key features, key findings, key individuals, key informants, key issues, key messages, key objectives, key opportunities, key overviews, key papers, key parameters, key participants, key parts, key points, key posts, key publications, key references, key roles, key sequences, key studies, key targets, key terms, and key workers. One article in a recent issue of the *BMJ* contained key clinicians, key purchasers, key players, key factors, and a key relationship. Its main points were summarised in a box with the caption key messages.

The word was made to work hard even before it was adopted as an easy intensifier. As well as identifying the object that opens locks and winds clocks, we use it in music in two senses (minor key and piano key), in architecture (keystone), in botany (ash keys), in cartography (key to symbols), in communications (morse key, typewriter key), in engineering (the metal bar that stops a pulley or a propeller from rotating around its shaft), and in photography (high key and low key lighting).

The Penguin Dictionary of Troublesome Words is uncompromising: "Key is perhaps the lazy writer's best friend . . . it spares [them] the annoyance of having to think of a more precise word and the challenge of making [their] writing interesting."

Shall we give key a rest?—C N MARTYN *is a clinical scientist at the MRC Environmental Epidemiology Unit, Southampton*