Socioeconomic deprivation and notification rates for tuberculosis in London during 1982-91

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See pp 967, 974 and editorial by Darbyshire

Abstract

Objectives—To investigate the association between four sociodemographic measures (unemployment, overcrowding, low social class, and the proportion of migrants from areas of high prevalence of tuberculosis) and average level and rate of change of notification rates for tuberculosis.

Design—Ecological analysis of both the average and the rate of change of standardised annual notification rates for tuberculosis from 1982-91 and sociodemographic measures from the 1981 and 1991 censuses.

Setting—32 London boroughs.

Subjects and data—Sociodemographic measures from the 1981 and 1991 censuses and tuberculosis notification rates for 1982-91.

Main outcome measures—A measure of the association between average levels and rate of change in tuberculosis notification rates and four sociodemographic measures in 1981 and between the rate of change in tuberculosis notification rates between 1981 and 1991 and changes in sociodemographic measures between 1981 and 1991.

Results—The average level of notifications was correlated with overcrowding and the proportion of migrants but not with unemployment or social class. No significant association was found between the rate of change in notification rates and sociodemographic measures in 1981. An association was found between increases in unemployment and the rate of change in notification rates, but the effect was small. Changes in the levels of unemployment explained 23% of the variation between boroughs in the rate of change in their notification rates.

Conclusion—The average tuberculosis notification rates were related to overcrowding and the proportion of migrants in 1981. Only increases in unemployment from 1981 to 1991, however, were significantly associated with the rate of change in notifications over the same period.

Introduction

Notification rates of tuberculosis in England and Wales, standardised for age, declined between 1982 and 1987 but have failed to decline further since then in men and women (fig 1). Had the decline continued, about 4000 fewer cases would have been notified from 1988 to 1992 (data not presented). This is not unique to England and Wales; notification rates have recently increased in the United States and in some European countries.¹⁻³

In Britain, as elsewhere, tuberculosis is associated with poverty. Higher notification rates have been seen in poorer sections of the community,^{4,5} and among homeless people.^{6,7} There is also a steep social class gradient in mortality from tuberculosis.⁸ The recent increase in tuberculosis in some parts of the

United States has been attributed to deprivation in the inner cities, homelessness, and decline in treatment and prevention programmes, as well as to the HIV epidemic.⁹⁻¹¹ The causes of the halt in the fall in tuberculosis rates in England and Wales remain unclear.¹²

Tuberculosis notification rates have increased in three of the four Thames regional health authorities (administrative areas that include London) in the past few years.¹³ We investigated whether certain sociodemographic measures in 1981 were associated with the average levels and the rate of change in tuberculosis notification rates in London boroughs from 1982 to 1991 and if changes in these sociodemographic variables were associated with the rate of change in tuberculosis notification rates over the same period.

Methods

Annual notification rates of all forms of tuberculosis for each borough from 1982 to 1991 were standardised by the indirect method. The period starting in 1982 was used because this was the first year that patients given chemoprophylaxis were not notified as cases of tuberculosis.¹⁴ The annual expected number of notifications of tuberculosis for each borough and each year was obtained by applying the age-sex specific national notification rates for 1982 to the population of the boroughs for each year. Standardised notification ratios were calculated by dividing the observed number of cases for each borough and year by these expected numbers. The study population data by year, age, sex, and borough were derived from the 1981 census, annually adjusted by using total population estimates published by the Office of Population Censuses and Surveys.

Standard methods were used to produce two statistically independent summary measures to describe the standardised notification ratios over time in each borough.¹⁵ A Poisson regression model of standardised notification ratios over the 10 year study period was calculated for each borough separately. Time was included in the model as a linear term representing deviations from the central value over the decade of observations. The weighting variable used in the model was the number of expected notifications. The average level of notification in the borough, represented by the average standardised notification ratio for each borough over the 10 years was derived by taking exponentials of the coefficients for the intercepts in the models. The rate of change in tuberculosis for each borough over the period, represented by the annual proportional change in the standardised notification ratio averaged over the 10 year study period, was similarly derived by taking exponentials of the slope coefficients in the same models.

Three ecological relations were examined. The first related for each borough the average level of notifi-

FIG 1—Age standardised notification rates for tuberculosis from 1982 to 1991 for England and Wales

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BMJ 1995;310:963-6

cations to the four sociodemographic measures (unemployment, overcrowding, social class IV and V, and proportion of migrants) based on the 1981 census for the same borough. Simple bivariate correlations would have been uninterpretable because of known strong collinearity between the sociodemographic predictor variables. Multiple linear regression was therefore used to regress the average standardised notification ratio in each of the London boroughs against the level of these variables in each borough. The second relation examined was between the rate of change in notifications over time and the values of the four sociodemographic measures in 1981, at the beginning of the decade. The third relation explored was between changes in the sociodemographic variables from 1981 to 1991 and the rate of change in tuberculosis rates over the same time period. The intercept and slope estimates from the Poisson models used to represent the dependent variables in these ecological analyses had approximately normal distributions, so the use of multiple linear regression was appropriate. The linear regressions were weighted by the inverse of the variance of each borough's respective summary measures of the standardised notification ratios so that undue weight was not given to boroughs with small numbers.

The measures of deprivation were based on data from the 1981 census used for the Townsend¹⁶ or Carstairs index¹⁷ and comprised proportion of economically active people unemployed; proportion of households with more than one person per room (overcrowding); and proportion of people in households with a head in social class IV or V. The variable used for the proportion of migrants from areas with relatively high incidence rates for tuberculosis was proportion of people born outside the United Kingdom and living in a household whose head was born in the new Commonwealth and Pakistan, the term used to denote former colonial territories which achieved independence after 1945. This last variable included those born in the countries constituting

Average number of notifications for tuberculosis a year from 1982 to 1991, average notification rate (10 year average standardised notification ratio), and rate of change in tuberculosis rates (percentage annual change in standardised notification ratios) for each London borough

Average No of cases a year	Average standardised notification ratio	Annual change in standardised notification ratio (%)
167	429	-8.1
129	424	0.4
83	357	-2.3
83	281	-4.0
109	246	-6.9
67	241	1.3
68	237	-4.6
76	230	-1.2
78	215	-1.6
63	215	1.4
59	206	-0.8
47	201	-2.1
57	193	-4.8
40	193	-1.3
47	185	-1.4
70	178	-6.7
54	170	3.5
69	152	2.3
47	136	-3.4
55	118	-0.5
40	114	-4.6
38	108	-5.9
27	108	-2.0
28	87	-2.6
19	82	-6.5
29	75	-0.4
13	65	-0.8
19	59	-5.7
13	51	-10.2
17	47	-7.6
19	42	-5.4
10	40	6.2

south Asia as well as African and Caribbean countries which were in the British Commonwealth (migrants from new Commonwealth countries).

Other characteristics based on data from the census included in the Carstairs or Townsend indices are proportion of people in households that are not owner occupied or proportion of people in households with no access to a car. At the ecological level used here these were all found to be closely correlated with the proportion of economically active people unemployed. Unemployment was therefore chosen to represent these household based indices of socioeconomic status on the assumption that, as an individual measure, unemployment was subject to less error.

Results

The table shows the average levels and rate of change in tuberculosis notifications in London boroughs. There was no clear pattern relating the average levels to the rate of change.

Figure 2 shows the socioeconomic indices for each London borough in 1981 and their 10 year average level of notification rates for tuberculosis. In the linear regression analysis an independent significant association was found between the average notification rate and both overcrowding and proportion of migrants. For each additional 1% in the proportion of overcrowded households the average notification rate was 12% higher (95% confidence interval 4.8% to 19.4%, $P=0.0022$); whereas for each additional 1% in the proportion of migrants the notification rates were 5% higher (2.7% to 8.1%, $P=0.0004$). No independent association was found with unemployment ($P=0.8$) or social class ($P=0.7$).

In contrast with this finding the rate of change in notification rates showed no relation with any of the sociodemographic characteristics in 1981. This lack of association is apparent in figure 3. Some boroughs had high levels of deprivation and proportions of migrants from new Commonwealth countries but falling notification rates, whereas other boroughs had rising notification rates for similar levels of deprivation and

FIG 2—Scatter plots of average tuberculosis rates from 1982 to 1991 (10 year average standardised notification ratio) against percentage unemployed, living in overcrowded accommodation, in social class IV/V, and migrated from new Commonwealth countries in 1981 in London boroughs

proportions of migrants. One borough had low levels of deprivation and proportions of migrants but rising notification rates.

Unemployment was higher in all boroughs in 1991 compared with 1981. The extent to which unemployment rose was associated with the variation in the rate of change of notification between boroughs (fig 4). Overall, notification rates fell in boroughs with small increases in unemployment and increased in boroughs with large increases in unemployment. In the regression analysis for every additional 1% in unemployment between 1981 and 1991 the rate of change in tuberculosis rates was 0.9% higher (0.3% to 1.4%, $P=0.0056$). No other changes in the sociodemographic variables were significantly associated with the rate of change in tuberculosis rates (change in proportion of migrants from new Commonwealth countries, $P=0.9$; change in social class, $P=0.07$; change in overcrowding, $P=0.1$). Levels of unemployment explained 23% of the variation between boroughs in the rate of change of notification rates.

Discussion

In this ecological study the average levels of and the rate of change in rates of tuberculosis between 1982 and 1991 for each London borough showed different associations with sociodemographic measures. The average levels were associated independently with overcrowding and the proportion of migrants, although not with unemployment or social class distribution.

Overcrowding is a risk factor for tuberculosis and has recently been shown as important in an ecological analysis of childhood tuberculosis in New York.¹⁸ This has also been found in our study, where for each 1% increase in the numbers living in overcrowded accommodation the average notification rate for tuberculosis increased by 12%.

The high rates of tuberculosis in migrants from areas such as south Asia influence, as expected,

FIG 3—Scatter plots of rate of change in tuberculosis rates from 1982 to 1991 (percentage annual change in standardised notification ratio) against percentage unemployed, living in overcrowded accommodation, in social class IV/V, and migrated from new Commonwealth countries in 1981 in London boroughs

FIG 4—Scatter plots of rate of change in tuberculosis rates from 1982 to 1991 (percentage annual change in standardised notification ratio) against difference in percentage unemployed, living in overcrowded accommodation, in social class IV/V, and migrated from new Commonwealth countries from 1981 to 1991 in London boroughs

the overall rate of notification rates in individual geographical areas. Notification rates for tuberculosis, however, are declining in the population of south Asian origin as well as in the native population.¹⁹ The lack of association with unemployment and social class is consistent with overcrowding mediating much of the association between social deprivation and tuberculosis risk. It is also possible, however, that the study was lacking in power to detect a separate but weak association with unemployment and social class.

In contrast, no relation was found between the rate of change in tuberculosis notifications between 1982 and 1991 and any of the four sociodemographic variables in 1981. There was, however, some relation between the increase in unemployment between 1981 and 1991 and the rate of change in tuberculosis rates in the same time period. Increasing unemployment was associated with an increase or a slower fall in tuberculosis rates from 1981 to 1991. This effect, however, could explain only a small part of the failure of tuberculosis rates to decline.

There may be several reasons for our results. Firstly, the methodological constraints of ecological studies are well established²⁰: changes in unemployment may in fact represent other factors which have a direct effect on tuberculosis rates in London; and other factors, which increase the rates of tuberculosis only a little, may not be detectable when the difference in rates of disease and sociodemographic levels between population groups in London boroughs are being compared. The fact that a clear association between levels of tuberculosis notifications, overcrowding, and the proportion of migrants was found, however, suggests that in this study the ecological methods were reasonably robust. This was despite the fact that the measure of migration available at a borough level in the 1981 census included migrants from countries in Africa and the Caribbean as well as south Asia. The former groups have a lower risk of tuberculosis than those of south Asian origin.²¹

Secondly, changes in the trends in notification rates

Key messages

- Notification rates for tuberculosis were declining in most developed countries until the middle of the past decade when they stabilised and subsequently began to increase
- Sociodemographic variables such as poverty, overcrowding, and migration (from parts of the world with relatively high rates of tuberculosis) are known to be associated with higher rates of tuberculosis
- The recent rates of change in notification rates in London boroughs in the past decade do not seem to be associated with the absolute levels of overcrowding, unemployment, social class distribution, or proportion of migrants as measured in the 1981 census
- An association, however, was found between changes in unemployment levels between 1981 and 1991 and the rates of change in tuberculosis notification rates in the same period, but the effect was small
- Further research is necessary to determine the reasons for the association found and to investigate the other factors contributing to the changing rates of tuberculosis in the developed world

since 1982 may be due to some extent to artefact. Changes over time in the percentage of cases notified or ascertained in each borough may be obscuring some of the associations between the risk factors investigated and trends in notifications. Published reports of cross sectional surveys in England and Scotland estimate that 27-40% of cases may not be notified.^{22 23} There is little available information on the time trends in the completeness of notifications of cases of tuberculosis or on trends in the ascertainment rate of cases.

Finally, and most likely, the finding of a small association between the rates of change in notification rates for tuberculosis and changes in sociodemographic variables may be true, but in addition the rates of change in notifications are being affected by factors other than those well established for tuberculosis such as migration and overcrowding. These other factors may include more specific aspects of poor living conditions (like homelessness); incomplete case finding and management; the prevalence of HIV infection in the local population, although the effect of this is likely to be small²⁴; and migration from countries with a moderate risk of tuberculosis not included in this analysis, which may have contributed to some local increases.

Our results suggest that the failure of tuberculosis notification rates to decline may not be easily explained

in terms of persisting socioeconomic deprivation or the proportion of migrants from new Commonwealth countries in the population as measured in 1981. Nor do changes in these sociodemographic measures from 1981 to 1991 account for the failure of tuberculosis rates to decline apart from probably a small contribution from increased unemployment. Further studies are needed to investigate why the rates have stopped declining. These include studies to validate the notification rates, analyses with concurrent and individual measures of deprivation and risk of tuberculosis, and confirmation and clarification of the contribution from unemployment or associated factors.

We acknowledge the financial support for this study from the Public Health Laboratory Service and thank the staff of the Respiratory Disease Section of the Communicable Disease Surveillance Centre for their help.

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(Accepted 30 December 1994)

ONE HUNDRED YEARS AGO

A GREAT FRENCH SURGEON.

We regret to have to announce the death of M. Verneuil, the *doyen* of French surgeons. M. Verneuil, who has passed away in ripe old age, full of honours and surrounded by troops of admiring friends, has filled all the higher offices of his profession in Paris, as Professor of the Faculty, surgeon of the hospitals, member of the French Academy, President of the Surgical Society. He was able, originaive, and eloquent, a great clinician, an eminent orator, a fairly good operator, and well versed in English as well as French literature, which is more than can be said of most of his contemporaries. After floundering for a quarter of a

century in the quagmire of the dirty and fatal methods of French surgery, favoured by his contemporaries, Velpeau, Chassaignac, Maisonneuve, with the terrible results which brought the French surgical school of the Empire to so low a repute, he found salvation in the doctrines and practice of Listerism, which, however, he vainly sought to modify and partly succeeded in spoiling. With many weaknesses, including that of a childish and misplaced Chauvinism, he succeeded in raising the French surgery of his period from absolute ignominy, and by his profuse eloquence maintained the character of his school for interesting powers of exposition. (*BMJ* 1895;ii:1343.)