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Increasing incidence of tuberculosis in the young and the elderly in Scotland

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Abstract

***Background* – Since 1987 there has been an arrest in the previously established decline of tuberculosis notifications in Scotland. A study was undertaken to determine whether age contributed to this phenomenon.**

***Methods* – Notifications of tuberculosis in Scotland were quantified by year and age group for the years 1981–92 from national statistics supplied by the Information and Statistics Division. Population data were obtained from the 1981 and 1991 national censuses.**

***Results* – Age group analysis of pulmonary tuberculosis notifications showed that, in the 0–14 age group, incidence (per 10^5 population) decreased from 7·4 in 1981 to 2·6 in 1987, rising by an estimated 12·6% per annum to 3·7 in 1992. In the 65+ age group incidence declined from 30·1 in 1981 to 17·3 in 1988, and rose by an estimated 4·1% per annum to 22·2 in 1992. In the age groups 15–44 and 45–64 a continuous decrease in notification rate was seen over the period of the study.**

***Conclusions* – The plateauing of the incidence of tuberculosis in Scotland is associated with significant increases since 1987 of tuberculosis in the young and elderly. Contributions from ethnic minorities and those infected with HIV are negligible. An ageing population over the decade, with the highest tuberculosis rates seen in the older age group, may explain these findings.**

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The USA was the first country to draw attention in 1985 to a reversal of the previously well established downward trend in notifications for tuberculosis.[1 2] The most dramatic reversal occurred in New York city where many factors including HIV infection, drug abuse, immigration, and inadequate health care provisions appeared to be implicated.[3–6] A similar arrest, or even reversal, of the downward trend in tuberculosis notifications has now been reported for many western European countries.[7 8] In some such as Switzerland and Holland immigration appears to be an important factor with 51% and 41%, respectively, of all tuberculosis notifications in these countries in 1990 being of foreign residents.[7 9]

In many western European countries an increasing proportion of tuberculosis notifications in native born residents is among the elderly; in Switzerland almost 50% were aged over 65 in 1990[9] and in England and Wales in 1988 55% of notifications were aged over 55.[10] It has been suggested in the past that the arrest of the fall of tuberculosis notifications in England and Wales was due to an increase in cases among the elderly.[11] An alternative explanation, that significantly increased numbers of tuberculosis cases might be occurring among the younger HIV infected population in England and Wales, is not supported by currently available data.[12–14]

In Scotland, as in England and Wales, tuberculosis notifications have plateaued since 1987. We have sought to determine whether there are any age-related contributions to this arrest in the decline of tuberculosis notifications by examining age-specific pulmonary (and total) tuberculosis notification rates for Scotland for the years 1981–92.

Methods

Annual notifications of pulmonary and total tuberculosis cases by the age groups 0–14, 15–44, 45–64 and 65+ years were obtained from the Information and Statistics Division of the National Health Service in Scotland for the years 1981–92. Population statistics were obtained from the 1981 and 1991 censuses in Scotland and population estimates for intercurrent years from the General Register Office for Scotland.

The data were analysed to determine whether the scatter of notification rates (incidence) against time for the four age groups fitted a logarithmically declining slope or one with a decline followed by a trough and rise. Incidence rates were expressed in natural logarithms and a regression line was fitted using the method of maximum likelihood. If the log of the growth rate is represented by:

$$\log \lambda_1 = \log (b_0) + b_1 t_1 + b_2 t_1^2 + \ldots .$$

the growth rate can be estimated by differentiating the above equation to give:

$$\frac{d (\log \lambda_1)}{d t_1} = b_1 + 2 b_2 t_1 + \ldots .$$

Cubic or higher terms in t (for example, t^3) were not statistically significant in fitting the curves shown in fig 1A–D. The variance of the growth rate can be estimated from the variance of the maximum likelihood estimates obtained from the fitted regression curve. Using the variance we can test whether the growth rate is zero or not. The p value represents the probability that the rate of increase was zero.

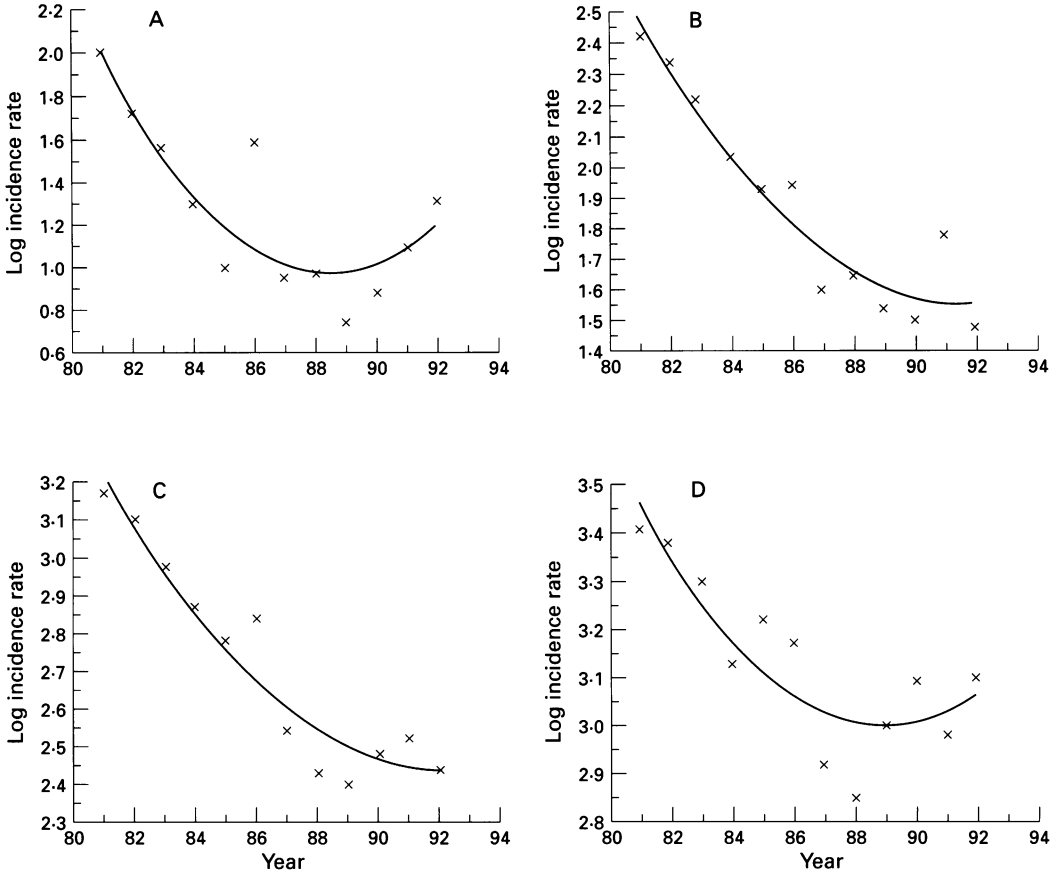

Figure 1 Regression curves of the natural logarithms of incidence (10^{-5}) of pulmonary tuberculosis against time (1981–92) for patients aged (A) 0–14, (B) 15–44, (C) 45–64, and (D) 65+ years.

Table 1 Notifications of pulmonary tuberculosis and all tuberculosis from 1981 to 1992 in Scotland

	1981	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*
Pulmonary	799	757	683	577	550	577	421	401	401	426	445	434
All tuberculosis	972	893	819	729	697	754	555	527	533	549	542	559

Results

The number of total and pulmonary tuberculosis notifications are shown in table 1. Notifications declined until 1987–8 after which a plateau was observed.

The regression curves of the natural logarithm of incidence of pulmonary tuberculosis against time are shown for the four age groups 0–14, 15–44, 45–64, and 65+ in fig 1A–D and the actual age group notification rates in table 2. Incidence rate curves for the 15–44 and 45–64 age groups declined continuously (fig 1B and C) from 11·2 and 23·8 in 1981 to 4·3 and 11·4 in 1992, respectively. For the 0–14 age group pulmonary tuberculosis incidence (10^{-5}) decreased from 7·4 in 1981 to 2·6 in 1987, rising significantly ($p<0·05$) by an estimated 12·6% per annum to 3·7 in 1992. In the 65+ age group the incidence declined from 30·1 in 1981 to 17·3 in 1988 and rose significantly ($p<0·05$) by an estimated 4·1% per annum to 22·2 in 1992. The regression curves for all tuberculosis notifications (not shown) revealed the same age group patterns with an estimated annual increase in total incidence in 1992 of 8·5% ($p<0·05$) for the 0–14 age group and 2·8% ($p=0·1$) for the 65+ age group.

Table 2 Incidence (10^{-5}) of pulmonary tuberculosis in Scotland by age group from 1981 to 1992

Year	*0-14*	*15-44*	*45-64*	*65+*
1981	7·4	11·2	23·8	30·1
1982	5·5	10·4	22·1	29·4
1983	4·8	9·2	19·8	27·2
1984	3·6	7·6	17·7	22·8
1985	2·7	6·9	16·0	25·1
1986	4·9	7·0	17·2	25·1
1987	2·6	5·0	12·7	18·5
1988	2·6	5·2	11·3	17·4
1989	2·1	4·6	11·0	20·1
1990	2·4	4·5	12·1	21·9
1991	3·0	5·9	12·4	19·7
1992	3·7	4·3	11·4	22·2

Discussion

The age group analysis estimates significant increases of pulmonary tuberculosis by 1992 in the age groups 0–14 and 65+ years. The estimated rate of increase in the incidence rate for the elderly is lower and less significant than that for the young, but the rise is from a trough rate which is approximately seven times higher (table 2). Since the 0–14 year population is approximately equal to the over 65 population (1×10^6 and $0·8 \times 10^6$, respectively, in 1991[15]),

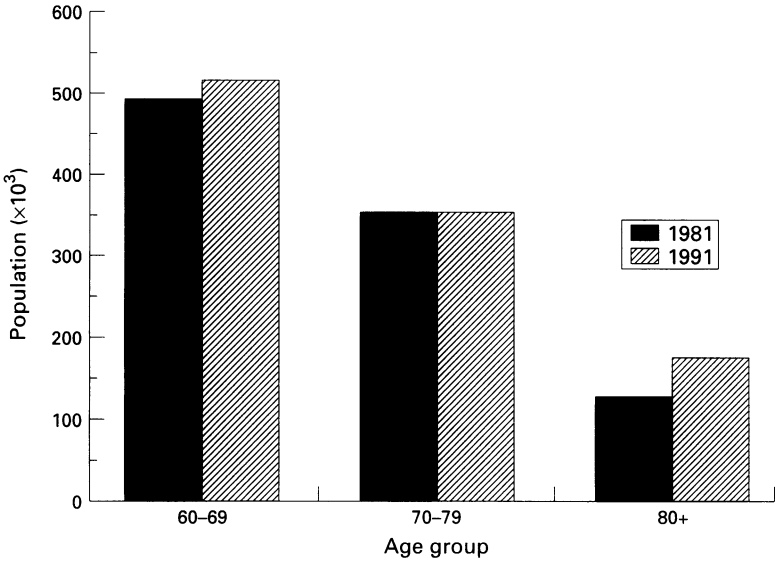

Figure 2 Scottish population for the years 1981 and 1991 by age groups.

the estimated increase in terms of tuberculosis case numbers will be approximately twice as high in the elderly group.

Immigration is unlikely to be the explanation for these significant increases. Scotland has a stable immigrant population with fewer than 3% born overseas; fewer than 1% are from the Indian subcontinent[16] of whom less than 7% are aged over 55 years. National notification rates by ethnic group are not available for the 12 year period analysed, but in 1993 rates for the population from the Indian subcontinent were 20 times higher than for the white population[17] which is in keeping with observations in England and Wales in 1988.[10] Regional data from Lothian, where ethnic status is recorded, and national data based on positive cultures from the Scottish Mycobacteria Reference Laboratory (B Watt, personal communication) show no increase in disease in immigrant patients from 1981.

The pattern of increase in notification rates observed is also not that which would be expected if HIV infection was responsible for the increase in tuberculosis (2055 cumulative HIV positive individuals in Scotland by the end of 1993).[18] In Edinburgh where 1033 cumulative HIV positive individuals were reported by the end of 1993[19] only five cases of tuberculosis had been observed in HIV positive patients.[20] The Scottish national tuberculosis survey carried out in 1993 in which voluntary anonymous HIV testing was performed in patients aged <65 years found only eight cases of HIV infection (1·6%) in 497 notifications.[17] HIV infection is therefore unlikely to be responsible for the observed changes.

The most likely explanation for the observed rate of increase of notifications in the 65+ age group is the increasing number of increasingly elderly individuals in the population. Figure 2 shows the Scottish population numbers at 10 year intervals from 60 to 80+ years taken from the 1981 and 1991 population censuses. There are more people aged over 60 years in 1991 and there is a shift to the older age groups. Notification rates for tuberculosis increase with increasing age as shown in the Scottish national survey of tuberculosis notifications carried out in 1993 in which the notification rate increased progressively from 20·5 per 10^5 population in the 60–69 age group to 53·1 per 10^5 population in the 90+ age group.[17]

The reason for the small (in real numbers) but nevertheless significant increase in the 0–14 age group is less clear. It is tempting to postulate that this is a manifestation of the "grandparent syndrome" – that is, an increase in disease in the elderly leading to an increase in transmission of infection and resultant disease in the susceptible young. However, notification figures in this age group are known to be less reliable (due to the inclusion of some patients receiving chemoprophylaxis) and we would not wish to emphasise this finding.

The age-specific trends which we described are worrying and emphasise the need for continuing and improved surveillance of tuberculosis in Scotland as in other parts of the developed world to detect early trends. Surveillance should include notification rates according to age, sex, ethnic group, and bacteriological status, as well as improved monitoring and reporting of the incidence of natural positive reactors detected in the school BCG vaccination programme.

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