

# Tuberculosis: spatial and demographic incidence in Bradford, 1980–2

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**SUMMARY** Between 1980 and 1982 the incidence of tuberculosis in Bradford Health Authority was approximately 20 times higher among the New Commonwealth and Pakistani population than the rest of the population. It was also possible to see a clustering of cases within this time period, spatially and demographically—in certain age groups and by sex. The difference between the two populations was not due to race but rather reflects the socioeconomic position that the New Commonwealth and Pakistani population has within Bradford as a whole. The incidence of non-Asian tuberculosis rose in 1982 due to an outbreak among unvaccinated young adults. Much still needs to be done to eradicate the environmental conditions within which the tubercle bacillus thrives as well as to educate the population at risk.

Tuberculosis was generally believed to be declining in the United Kingdom. However, recent outbreaks have been reported in the national press<sup>1</sup> and medical journals,<sup>2,3</sup> indicating that this disease is not as yet completely under control. In a health authority such as Bradford, it is easy to assume that ethnicity explains the high incidence of tuberculosis. In 1978–9 the estimated annual tuberculosis notification rate for the United Kingdom as a whole was 16.4/100 000.<sup>4</sup> The Indian and Pakistani/Bangladeshi ethnic groups had notification rates 30 and 31 times higher respectively.

Past trends of tuberculosis occurrence within the health authority have reflected not only improvements in housing conditions but also the pattern of immigration into Bradford. Hence there has been an overall decline in tuberculosis in Bradford Health Authority since 1955 (when records were first begun at the chest clinic). Contained within this trend are two rises in incidence in 1960–4 and 1966–9 due, firstly, to the immigration of Pakistani and Bangladeshi men to work here and, latterly, to the arrival of their wives and dependents. Race as an attribute needs to be considered in its true position in the socioeconomic environment.

The purpose of this paper is, first, to identify and locate cases of tuberculosis spatially within the study area; and, secondly, to examine the social geography and environment of the health authority to see if this would provide further explanation for the incidence, spatially and demographically.

## Method

In this study the occurrence of tuberculosis is examined in relation to the social environment, that is, the housing environment and socioeconomic characteristics of Bradford Health Authority by city wards.

The initial data on cases of tuberculosis were derived from two sources: the local Environmental Health Office, which keeps information on all the tuberculosis cases notified in Bradford Health Authority, and the medical records at Bradford Chest Clinic. The spatial aspect of tuberculosis incidence, including address, post code, and ward, was studied by mapping all the notified cases of tuberculosis to see if any clustering was visible. The use of Poisson distribution mapping<sup>5,6</sup> to investigate the spatial clustering of cases was considered, but tuberculosis, being an infectious disease, violates one of the underlying assumptions of this technique in that the observed cases are not independent of each other. Thus a purely subjective assessment of clustering was made. Demographic data on the tuberculosis notifications included age at notification, date of birth, sex, and ethnic origin. Bradford's social environment and population was also studied subjectively to see if the population among which tuberculosis occurred was representative of Bradford's population as a whole. The data for this were contained in the 1981 Census, Small Area Statistics. Since the Health Authority

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does not exactly follow the ward boundaries of Bradford Metropolitan District, census data for the wards and ward areas concerned (Fig. 1) were obtained using the SASPAC package.<sup>7</sup> Both direct census figures and new derived variables (some defined by Coulter<sup>8</sup>) were obtained using this package.

- The pertinent variables and their definitions are:
- PERNCOMM % population resident in households headed by a person born in the New Commonwealth or Pakistan
  - OWNOCC % households owner occupied
  - COUNCL % households council rented
  - PRRENT % households privately rented (furnished and unfurnished)
  - NOCAR % households with no car
  - UNEMAC % male population economically active yet unemployed
  - BATHWC % households lacking a bath and inside toilet
  - HHLARG % households with six and more than six persons resident
  - OVRCRWD % households with more than 1.5 persons per room.

**Results**

The total number of cases of tuberculosis for the years 1980–2 is 444, but during these three years the

incidence has not followed the general decline since 1955. The total number of cases fluctuates (table 1) from 155 (1980) to 137 (1981) and then rises again to 152 (1982). The reason for this increase is a higher incidence of tuberculosis among the non-Asian population in 1982. There was a specific outbreak of the disease in late 1982, which affected particularly the British population.<sup>2</sup> The incidence of tuberculosis among the Asian population shows a continuing decline from 1980 to 1982.

Table 1 *Number of cases of tuberculosis 1980–2*

	Asian	Non-Asian	Total
1980	113	42	155
1981	96	41	137
1982	91	61	152
1980–1982	300	144	444

Asian = all persons born in countries in the Asian subcontinent or derived from there, eg. East African Asians.  
 Non-Asian = all persons born elsewhere.

**SPATIAL DISTRIBUTION OF TUBERCULOSIS**

The spatial distribution of individual cases within the Health Authority shows a definite clustering of tuberculosis cases in four main areas (Fig. 2). These all occur around the city centre and are

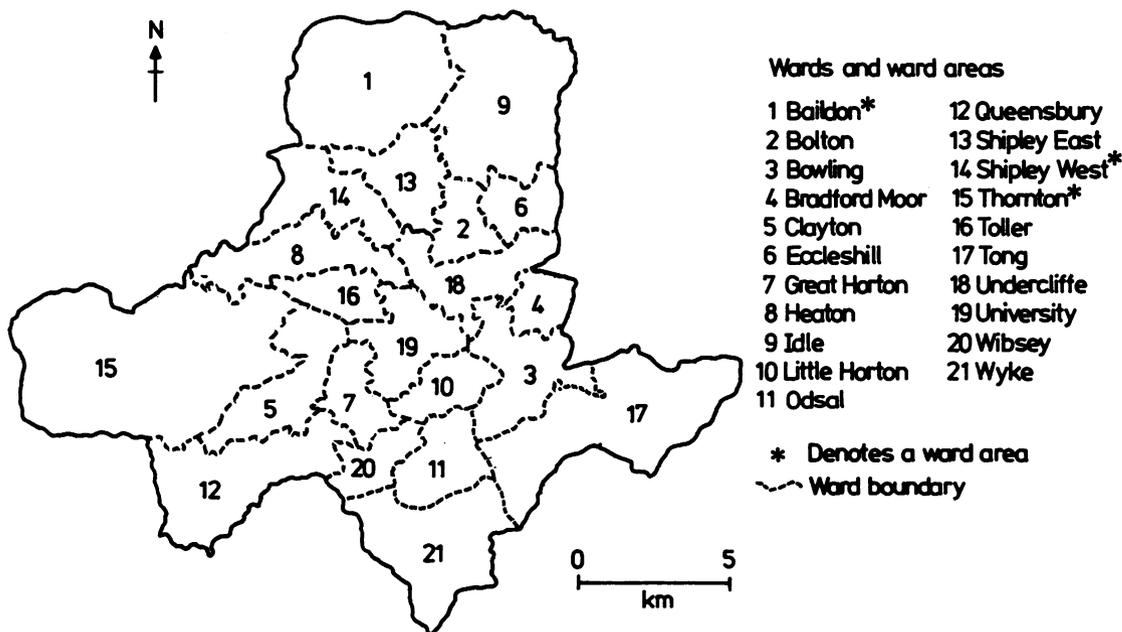


Fig 1 *Bradford Health Authority, its wards and ward areas.*

Girlington/Manningham, Shearbridge, West Bowling, and Thornbury. The outer wards on the periphery of the Health Authority have the fewest cases in 1980–2, for example, Baildon (4) and Wibsey (1). The largest number of cases are to be found in University ward (119) and then less in the central band of wards: Little Horton (40), Bradford Moor (39), Toller (35), Heaton (31), Undercliffe (24), Bowling (23), and Odsal (23).

#### DEMOGRAPHIC INCIDENCE OF TUBERCULOSIS

The total number of cases, 1980–2, when examined by age group (Fig. 3), shows a peak at 15–24 years and then, as age increases, so the number of cases decreases. The male:female ratio generally shows the same trend, though overall there were more male cases, especially over the age of 25 years. The two

groups, Asian and non-Asian, show different characteristics with respect to age.

Asians show the highest incidence in the 15–24 and 25–34 year age groups; after this there is a steep decline in the number of cases with age. There are more cases of tuberculosis among Asian females than males (table 2), especially among the Pakistanis. The largest number of female cases is in the 15–24 and 25–34 age groups, the number of cases then decreasing with age. It is particularly in the 35–44 age group that female incidence exceeds male incidence. Otherwise the incidence is comparable, with a higher incidence of tuberculosis among males than females in the 15–24 and 25–34 age groups.

Non-Asians show an overall peak of cases at 15–24 years. The incidence then oscillates with a secondary peak at over 64 years. There are more than twice as

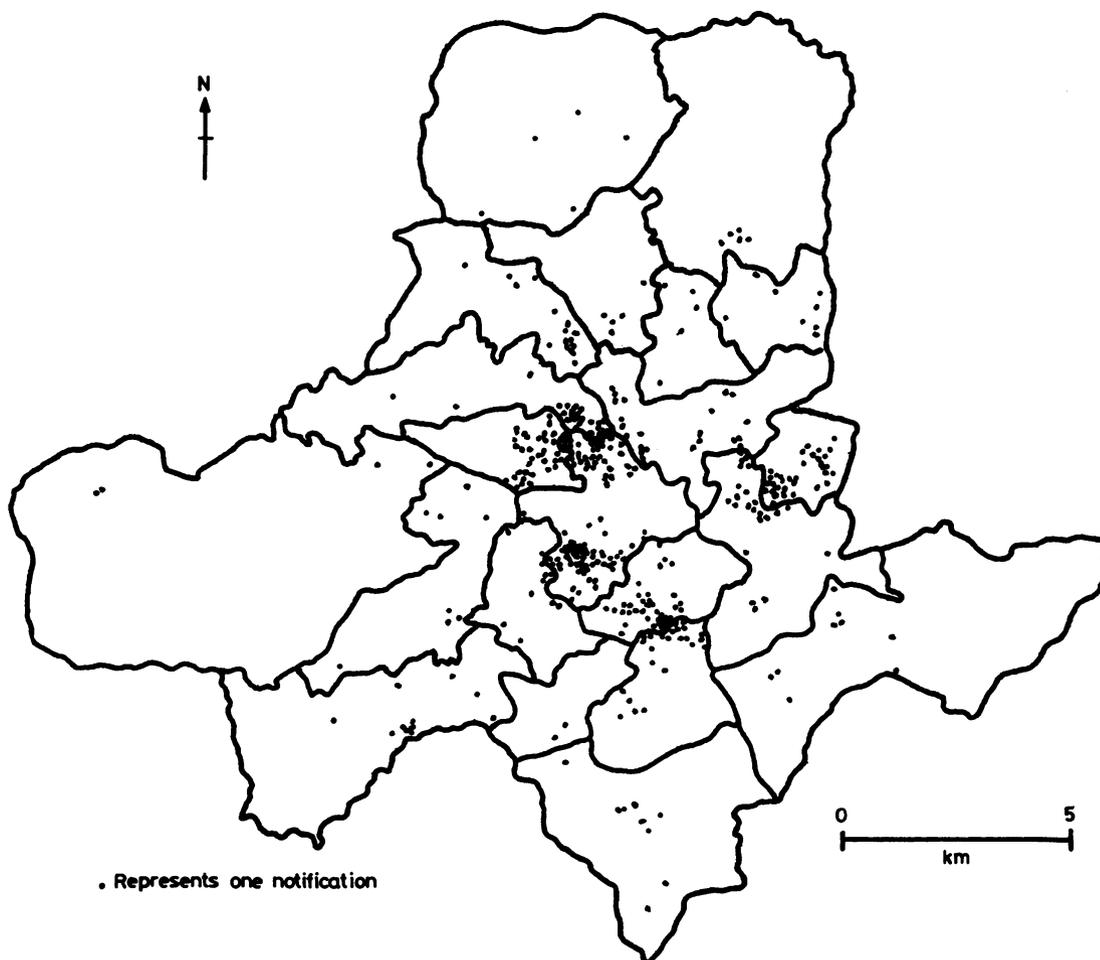


Fig 2 Distribution of tuberculosis notifications in Bradford Health Authority, 1980–2.

many male cases of tuberculosis as female cases (101 and 43 respectively). The peak for female cases is in the 15–24 years age group (20 cases) and then falls rapidly to less than seven cases in all other age groups. Male incidence is highest in young adults (15–24 years), moderately high in the middle aged (35–44 years), and slightly higher in the elderly (over 64 years).

Table 2 Tuberculosis cases, by sex and ethnic group, 1980–2

Ethnic group	Sex		
	Male	Female	Total
Pakistani	98	122	220
British	80	39	119
Indian	28	30	58
European except British	14	1	15
Asians from Africa	9	4	13
Bangladeshi	3	3	6
Other	9	4	13
Asian	140	160	300
Non-Asian	101	43	144
Total	241	203	444

The incidence (table 3) shows great variation between the main ethnic groups as well as between the sexes. All parts of the population have a higher incidence than the annual notification rate for the United Kingdom, 1978–9, which was 0.164/1000.<sup>4</sup> The British population, which comprises 28% of all cases, 1980–2, has the lowest incidence, 0.4/1000/1980–2, with a slightly higher incidence among males compared with females. The Pakistani population has the highest incidence

Table 3 Tuberculosis incidence, by ethnic groups and sex

Ethnic group	Incidence (Cases/1000 Persons/1980–2)		
	Overall	Male	Female
British	0.4	0.6	0.3
Pakistani	13.9	10.7	18.3
Indian	9.6	8.9	10.2
Asians from Africa	7.9	10.5	18.3
Bangladeshi	6.7	4.9	10.5
New Commonwealth/Pakistani	11.0	9.2	13.3
Rest of population	0.6	0.7	0.5

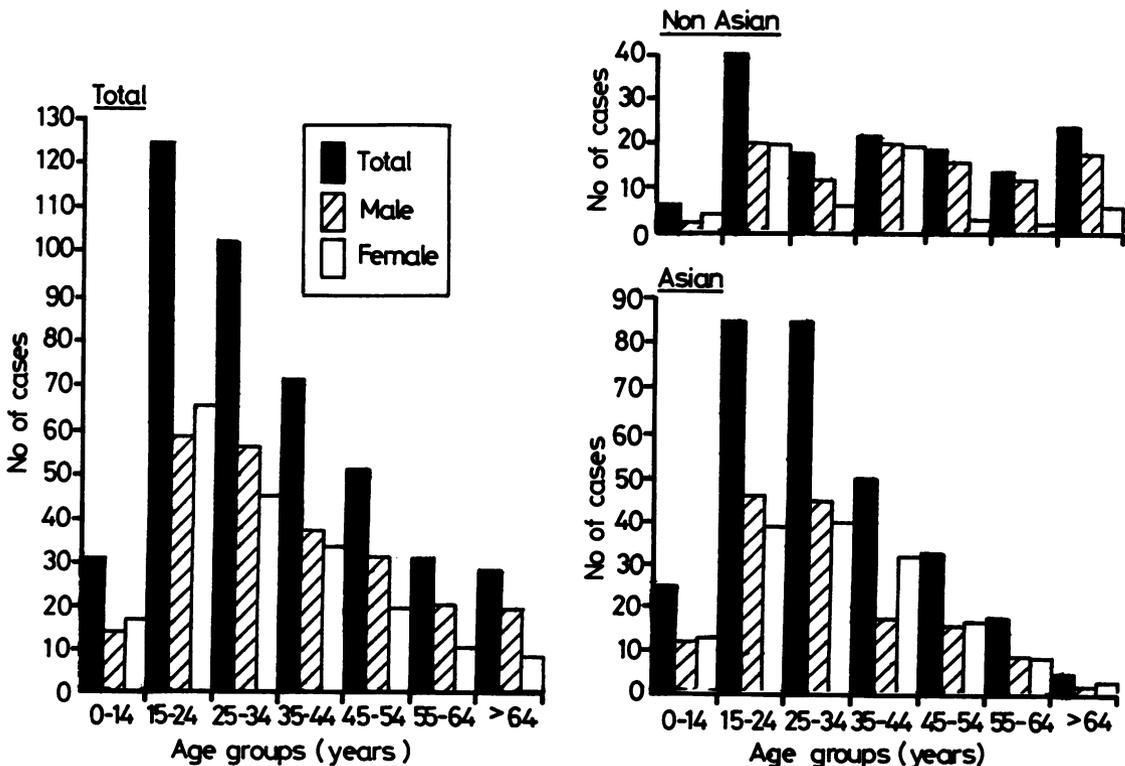


Fig 3 Tuberculosis notifications, 1980–2, Asian and non-Asian by age group and sex.

(14/1000/1980–2) and comprises 50% of the tuberculosis cases that occur. Unlike the British population, Pakistani females have a higher incidence than males, almost twice as high. The Indian, East African, Asian, and Bangladeshi populations also have a high incidence (all greater than 8/1000/1980–2), the incidence being higher for females than males.

It is not possible to determine the incidence for the Asian or non-Asian population as defined previously (table 1), but figures for the New Commonwealth/Pakistani population and the “rest” can be obtained. The incidence in the New Commonwealth/Pakistani population is 18 times higher than in the “rest” of the population: 13 times higher in males and 26 times higher in females.

**BRADFORD’S DEMOGRAPHIC CHARACTERISTICS**

The age structure of Bradford’s population is particularly youthful, so that in Bradford Health Authority 25% of the population is under 15 years of age. This attribute is particularly true of the immigrant population, nearly half the New Commonwealth or Pakistani born population in Bradford Metropolitan District being under 16 years of age.<sup>9</sup> Conversely, there are relatively few pensioners originating from the New Commonwealth or Pakistan, less than 1000 in the Bradford Metropolitan District.

The most obvious demographic factor exhibited in Bradford’s population is that of ethnicity. Bradford is very definitely a multicultural city; one in every 10 Bradfordians was born outside the United Kingdom, and a similar number may have been born in this country but to parents with origins abroad. Reasons for this cultural diversity lie in the successive immigrations of people during the last 150 years. The ethnic groups with the greatest social impact are those that have originated from Pakistan, Bangladesh, and India. The variable PERNCOMM gives a measure of this ethnicity.

The central wards have the highest proportions of New Commonwealth and Pakistani populations: University (68%), Bradford Moor (38%), Toller (31%), Little Horton (28%), Bowling (20%), and Heaton (20%). The wards with the smallest proportions lie on the outskirts of the Health Authority: Tong (3%), Wibsey (2%), Eccleshill (2%), Clayton (2%), Idle (1%), Shipley East (1%), Thornton (1%), Baildon (1%), and Wyke (1%).

**BRADFORD’S HOUSING AND SOCIOECONOMIC CHARACTERISTICS**

The three main types of housing, owner occupied council rented, and private rented, show different patterns of spatial distribution. The highest

proportion of owner occupied housing is to be found in Shipley West (81%), Bolton (83%), and Great Horton (81%). The smallest proportion is in Tong (36%) and Little Horton (39%). This is almost the reverse of the distribution of council housing. High values for COUNCL are to be found in Tong (59%), Shipley East (46%), Little Horton (46%), and Eccleshill (40%). The distribution of PARENT shows a completely different pattern. The highest values are in the inner wards of University (19%), Heaton (17%), Queensbury (16%), and Undercliffe (16%). Wards with values of less than 5% for PARENT are the outer areas, Baildon, Tong, Wibsey, Eccleshill, Shipley East, Bolton, Odsal, and Wyke.

NOCAR and UNEMAC are essentially measures of economic status. The wards with the highest values of NOCAR (greater than 60%) and UNEMAC (greater than 10%) are in the south and east of the Health Authority—University, Little Horton, Bowling, Bradford Moor, Tong, and Undercliffe. Baildon has the lowest values for both variables.

BATHWC, OVRCRWD, and HHLARG are more reflective of the social conditions of the wards although they intrinsically reflect economic status as well. Table 4 shows the figures and percentages for these variables by wards. The wards with the largest number of unmodernised houses (ie, lack a bath and toilet) lie in and around the city centre—University, Bowling, Little Horton, and Great Horton, and also on the periphery, in Odsal and Tong. University also has the largest number of households that are overcrowded, then to a lesser extent Bradford Moor and Undercliffe. It is the rented furnished households

Table 4 BATHWC, OVRCRWD, and HHLARG by wards

Ward	BATHWC		OVRCRWD		HHLARG	
	No	%	No	%	No	%
Baildon	11	0	23	0	134	2
Bolton	29	1	16	0	153	3
Bowling	182	3	195	3	461	7
Bradford Moor	73	1	196	4	666	13
Clayton	34	1	22	0	238	5
Eccleshill	33	1	41	1	298	6
Great Horton	116	2	56	1	250	5
Heaton	74	1	124	2	406	7
Idle	64	1	14	0	132	3
Little Horton	128	2	176	3	573	9
Odsal	86	1	37	1	244	4
Queensbury	72	1	31	1	175	3
Shipley East	44	1	29	0	171	3
Shipley West	40	1	44	1	266	5
Thornton	109	2	47	1	205	3
Toller	75	1	179	3	569	11
Tong	46	1	53	1	362	7
Undercliffe	84	2	200	4	401	7
University	203	4	490	9	1175	22
Wibsey	28	1	32	1	222	4
Wyke	110	2	34	1	239	4

that have the highest percentage of serious overcrowding (6.6%).<sup>9</sup> University has the highest proportion of large households (HHLARG) (22%), and then the central wards of Bradford Moor and Toller (13% and 11% respectively).

## Discussion

As collection and analysis of the data continued, it became apparent that demographically and spatially there were clusterings of tuberculosis occurrence. The present day patterns are explained, at least in part, by the minority ethnic population, but other socioeconomic factors emerged as being important. There was the emergence of two distinct areas within the Health Authority. There is a clear dichotomy between the inner areas of Bradford centred around University ward and the outer wards, especially to the north, for example, Baildon and Idle.

The central and south eastern tract, particularly the wards of University, Little Horton, Bowling, Bradford Moor, and Tong, is an area of lower occupational and income status population.<sup>11</sup> This is demonstrated by the distribution of the variables NOCAR and UNEMAC. It is the inner wards that contain not only the higher proportions of terraced housing, back-to-backs, and private rented accommodation, but also the highest proportions of unmodernised, overcrowded, and large households. The outer wards, especially Baildon, Idle, Shipley West, and Shipley East, form the inner commuter territory of Bradford. These areas contain the highest proportions of owner occupied housing, the least private rented accommodation, and the least unmodernised, large, and overcrowded households. Council housing has its own distinctive pattern, in that it is found in a ring around Bradford, especially to the west and east in Thornton and Tong.

It is impossible to consider Bradford's social environment and demographic structure without considering ethnicity since 11% of its population is of foreign birth. The ethnic groups from the New Commonwealth and Pakistan are concentrated in the inner wards and found least in the outer wards. These groups show a higher male:female ratio and also have a more youthful age structure than the rest of the population. They also tend to live in the poorest housing conditions with respect to modernisation, overcrowding, and large household size. Within Bradford Metropolitan District 50% of households headed by a New Commonwealth or Pakistani born person are overcrowded, giving an average household size of 5.1 persons; the district average is only 2.15.<sup>10</sup>

In the light of these inner-outer socioeconomic differences, it was no surprise to find a similar trend concerning the spatial distribution of tuberculosis, most cases occurring within the inner wards of Bradford, although not exclusively. The wards with the smallest number of cases were to be found in the outer areas.

Demographically the incidence of tuberculosis was highest in the 15–24 year olds but the more specific Asian:non-Asian trends reflect their particular population characteristics. Since the Asian population is more youthful so more cases of tuberculosis occur among young Asians. There is also an unequal division of tuberculosis cases between the sexes: the females have a higher incidence. Why this should be so is not clear, but it may be that many Asian women spend more time in the house, in conditions conducive to the spread of the tubercle bacillus. This is certainly more likely in women from the Indian subcontinent who are subject to the Muslim rule of Purdah.

In the non-Asians it was the middle-aged and elderly men who were particularly at risk, probably due to the reactivation of infection acquired in youth. The high incidence among non-Asian adolescents and young adults was due principally to an outbreak of tuberculosis in late 1982. This originated from a single patient who was a regular customer and part-time barman at a city centre public house. Of the 41 infected patients notified in 1982, 38 were white; the epidemic affected almost exclusively non-vaccinated adolescents and young adults.<sup>2</sup> The main reason for the spread of tuberculosis during this episode was that most of the infected patients had never received BCG. The cause of the increased incidence of tuberculosis among non-Asian males compared with females is not clear. Further study looking at occupation may yield an explanation.

The suggestion that the incidence of tuberculosis is higher in Asians merely because of their race is nonsensical and founded only on myth despite statements to the contrary in modern medical textbooks.<sup>12 13</sup> Race is a purely social concept with no biological meaning. "Race does not mark in any important way for genetic traits, rather it demonstrates beyond question the paramount role of the social causes".<sup>14</sup> Race can be understood properly only as a social factor since it is invariably a product of the class structure of society. It is because Asians tend to belong to a lower socioeconomic class and live in poorer, overcrowded conditions that the likelihood of their catching tuberculosis increases. It is not so much that housing conditions cause disease, but that poor housing makes individuals more susceptible to disease. Being an infectious disease, tuberculosis is spread more effectively under certain

environmental conditions that are found in the inner wards of Bradford.

It is necessary to consider possible origins of the tuberculosis occurring among immigrants; four exist:<sup>15</sup>

- 1 Arrival of an immigrant in the UK with the disease already active.
- 2 Arrival with the disease in a quiescent state which later breaks down to become active again.
- 3 Arrival with an infection, with no signs of the disease; later, by endogenous exacerbation but no further exposure to further infection, the disease may become active.
- 4 Acquisition of the infection and disease after arrival in this country.

It seems probable that all four origins of tuberculosis exist, but there is little agreement as to the relative importance of these four origins.

It is generally accepted that the incidence of tuberculosis is higher in India, Pakistan, and Bangladesh than in the United Kingdom, although statistics are not always accurate or comparable.<sup>16 17</sup>

The issue of immigrants and the origin of their tuberculosis is a confused one. Retrospective studies have been carried out<sup>18</sup> to see whether immigrants acquire their tuberculosis after entry to the United Kingdom. Unfortunately, sample sizes are small, and it is difficult to draw any hard conclusions from the work. In the light of the socioeconomic evidence, endogenous exacerbation seems to play an important role with respect to incidence of tuberculosis in Bradford.

Further work needs to be carried out in this area of tuberculosis and its environmental influences on a smaller scale, that is, at the intraward level. Other factors may also be considered, such as occupation and nutrition, which could shed light on the differential tuberculosis rates among different parts of the population. They could, for example, be affecting the immunological status of people.

The incidence of tuberculosis within Bradford Health Authority reflects to an extent the nature of Bradford's past and present social environment. For the decline in tuberculosis to continue the present health care system needs to be maintained and certain aspects, for example, BCG vaccination, re-emphasised. The decline could also be speeded up by the input of resources into areas of high risk, principally areas of poor, badly maintained, and unmodernised housing.

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