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Patterns of childhood cancer by ethnic group in Bradford, UK 1974–1997

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Abstract

The highly urbanised northern English city of Bradford contains a diverse population from different ethnic backgrounds, including a high proportion of south Asians. We aimed to identify the effect of ethnic group on the incidence and temporal trends of childhood cancer in Bradford. Children (0–14 years) from the district of Bradford, who were diagnosed with a malignancy between 1974 and 1997, were selected from a population-based register. Each child was classified as south Asian (Indian, Pakistani and Bangladeshi), or not, based on their full name using 2 computer algorithms and individual inspection. Mid-year population estimates were used to calculate incidence rates and differences were assessed using Poisson regression. The study included 318 children, of whom 81 (25%) were south Asian. The incidence of all cancers in south Asian children (14.9 per 100,000 person years, 95% CI 11.6–18.2) was higher than non-south Asian children (12.0, 10.5–13.5) although not significantly so ($P=0.14$). Comparisons by diagnostic subgroup showed no major differences apart from significantly higher rates of acute myeloid leukaemia (AML) in south Asian children (1.9 versus 0.7, $P=0.02$). The age-specific incidence peaks of all childhood cancers and leukaemias were present in south Asian children aged 5–9 years compared with 0–4 years olds in the non-south Asian population. Non-significant increases of 1.4 and 1.5% in the average annual incidence of all cancers were seen for south Asians and non-south Asians respectively, with a significant rise for non-south Asians with leukaemia of 3.0% ($P=0.04$). Our timely study shows patterns of occurrence of childhood cancer that differ with respect to ethnic group. Differences are particularly apparent in the excess of AML and incidence peak in 5–9 year olds in south Asian children.

Keywords: Childhood cancer; Leukaemia; Ethnic group; Epidemiology

1. Introduction

The international incidence of paediatric malignancies varies across the world, both overall and by histological subtype [1]. Within the UK, childhood cancer incidence displays some variation by ethnic group with children of Asian ethnic origin revealing an excess of all cancers [2], lymphomas [2,3], Hodgkin's disease (HD) [2–5], neuroblastoma [2,4,5] and germ cell tumours [2] whereas deficits of central nervous system tumours (CNS) [2,4,5], Wilm's tumours [4] and rhabdomyosarcoma [2,4] have been observed.

In 1991, 5% of children aged 0–14 years in the UK were recorded as being of south Asian origin (Indian, Pakistani and Bangladeshi). In contrast, one quarter of all children in the metropolitan city of Bradford, UK are south Asian, the majority of whom will have been born in Britain. Bradford's Pakistani population, the largest of the south Asian group (78%), became established in the early 1960s following migration from a highly localised area in the northern Mirpur region. Bradford therefore provides an ideal opportunity to investigate disease occurrence in a settled south Asian population.

We aimed to investigate ethnic group and the incidence of childhood cancer, exploiting both the availability of population-based data on paediatric malignant disease [6] and year-by-year denominator

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populations by ethnic group. These descriptive analyses are not easily conducted in other areas where populations are only available at this level for the 1991 Census.

2. Patients and methods

The Yorkshire Specialist Register of Cancer in Children and Young People is a population-based register of childhood and young adult malignancies [6]. Since 1974, details have been collected for children aged 0–14 years diagnosed with a malignant disease whilst living within Yorkshire, which had a total population of approximately 3.5 million at the time of the 1991 census, of whom 0.7 million were under 15 years. Children living in the district of Bradford were selected using their validated residential address and postcode at diagnosis. Bradford is a highly urbanised district and in 1998 the total population was approximately 480,000 of whom 90,000 were south Asians.

Notifications of cases were received directly from the paediatric oncology tertiary referral centre in Leeds and cross-checks were undertaken with the National Registry of Childhood Tumours in Oxford [7] and the Northern and Yorkshire Cancer Registry and Information Service (http://www.nycris.org.uk). Over 80% of cases are histologically confirmed [6]. All diagnoses were categorised into groups according to the International Classification of Childhood Cancer (ICCC) [8].

Ethnicity was assigned to individual children who were classified as south Asian (Pakistani, Indian, Bangladeshi) using the South Asian Names Analysis program Nam Pehchan [9] and the South Asian Name and Group Recognition Algorithm (SANGRA) [10], alongside careful visual inspection of names by local experts. Nam Pehchan is used by the City of Bradford Metropolitan Council and Bradford Health Authority and therefore appropriate for the study population. Discrepancies in the assignment of ethnic group between the two programs were checked using local expert knowledge.

The incidence of cancer was calculated using Bradford Metropolitan District Council's mid-year population estimates by age, sex and ethnic group from 1981–1997 and estimates were derived back to 1974 using linear extrapolation. The estimates by ethnic group were derived using 1981 and 1991 census data in conjunction with locally recorded information on births, mortality and migration. Each birth in Bradford was categorised by ethnic group by birthing midwives. Mortality rates were adjusted to take account of higher infant death rates in Pakistani and Bangladeshi populations. Migration rates were adjusted to take account of the fact that Asian populations tend to be less mobile. Temporal incidence trends are displayed graphically using smoothed (3-year moving average) rates to accentuate patterns in the data more clearly.

Poisson regression was used to calculate rates and derive 95% confidence intervals by ethnic group (south Asian and non-south Asian), sex and age group (0–4, 5–9 and 10–14 years). A binary variable representing ethnic group was added to the Poisson model for each diagnostic group to determine differences in incidence rates for south Asian and non-south Asian children, whilst adjusting for the calendar year of diagnosis.

3. Results

Between 1974 and 1997, 318 children were diagnosed with cancer whilst living in Bradford and of these 81 (25%) were designated as south Asian with 237 (75%) remaining. Table 1 describes the incidence of all cancers by age, sex and ethnic group and shows the overall incidence rate for south Asian children is slightly higher than

Table 1
Numbers of cases and age- and sex-specific incidence rates of childhood cancer in Bradford and the Yorkshire Region between 1974–1997 by age, sex and ethnic group

	South Asians in Bradford				Non-south Asians in Bradford				Bradford children overall				Yorkshire Region (excluding Bradford)			
			95% CI				95% CI				95% CI				95% CI	
	n	Rate[a]	LCI	UCI	*n*	Rate[a]	LCI	UCI	*n*	Rate[a]	LCI	UCI	*n*	Rate[a]	LCI	UCI
Age (years)																
0–4	29	14.0	8.9	19.0	120	18.9	15.5	22.3	149	17.7	14.9	20.5	*823*	*16.9*	*15.8*	*18.0*
5–9	34	20.1	13.3	26.9	55	8.5	6.3	10.8	89	10.9	8.6	13.2	*489*	*9.5*	*8.6*	*10.3*
10–14	18	11.0	5.9	16.1	62	8.6	6.5	10.7	80	9.0	7.1	11.0	*540*	*10.1*	*9.2*	*10.9*
Sex																
Male	43	15.3	10.7	19.9	132	12.8	10.7	15.0	175	13.4	11.4	15.4	*1026*	*13.0*	*12.2*	*13.8*
Female	38	14.6	10.0	19.3	105	10.8	8.7	12.8	143	11.6	9.7	13.5	*826*	*11.0*	*10.3*	*11.8*
Total	81	14.9	11.6	18.2	237	12.0	10.5	13.5	318	12.5	11.1	13.9	*1852*	*12.0*	*11.5*	*12.6*

[a] Incidence Rates per 100,000 person-years-age and sex-standardised, where appropriate. 95% CI: 95% Confidence Interval, LCI: Lower confidence limit, UCI: Upper confidence limit.

non-south Asians. Rates were consistently higher in males than females for both south Asian and non-south Asian children for all cancers combined (Table 1) and all other diagnostic groups (results not shown). In the Asian children, a different age distribution is observed (Fig. 1) with the highest rates in 5–9 year olds who comprised 42% of the cases, compared with 23% in the non-south Asian children. Across all of the main diagnostic groups, a higher proportion of Asian children were aged between 5 and 9 years than non-Asians, and the 5–9 year old age peak was evident for Asians with leukaemia, lymphoma and central nervous system (CNS) tumours.

Table 2 shows the relative frequency and incidence of cancer by diagnostic group in Asian and non-Asian children. Apart from CNS tumours, the incidence was slightly higher for south Asians, both overall and for the individual diagnostic groups. Rates of leukaemia were higher in Asians than non-south Asians, a divergence that was accounted for by a two-fold excess in the "other leukaemia" group [83% of which were acute myeloid leukaemia (AML)]. For south Asians, the relative proportions of cancers in each diagnostic group were similar for Bradford and Yorkshire (excluding Bradford), apart from a smaller proportion of "other leukaemias" in Yorkshire (5% versus 12%).

In Bradford, trends in incidence of all cancers over time revealed an average yearly increase of 1.9% (95% CI−0.1%–4.0%, $P=0.06$) compared to 1.4% (−2.1%–5.1%, $P=0.42$) in south Asians and 1.5% (−0.8%–3.9%, $P=0.20$) in non-south Asians. This apparent paradox can be explained by the differential patterns of rising rates between south Asians and non-south Asians over the study period, resulting in a higher overall cumulative rate. Any changes in the relative sizes of the 2 populations were accounted for by having annual population denominators. For childhood leukaemia, Fig. 2 shows that for non-south Asians a statistically significant average annual increase of 3.0% (0.1%–6.1%, $P=0.04$) was present. There were 2 periods in the mid-1970s and mid-1980s where incidence was relatively low and we may subsequently have overestimated the true annual change. For south Asians, no significant changes over time were observed ($P=0.84$), but an incidence peak was seen during the late 1980s representing a small number of cases.

4. Discussion

Our study has shown that cancer incidence is slightly higher in south Asian children compared with other

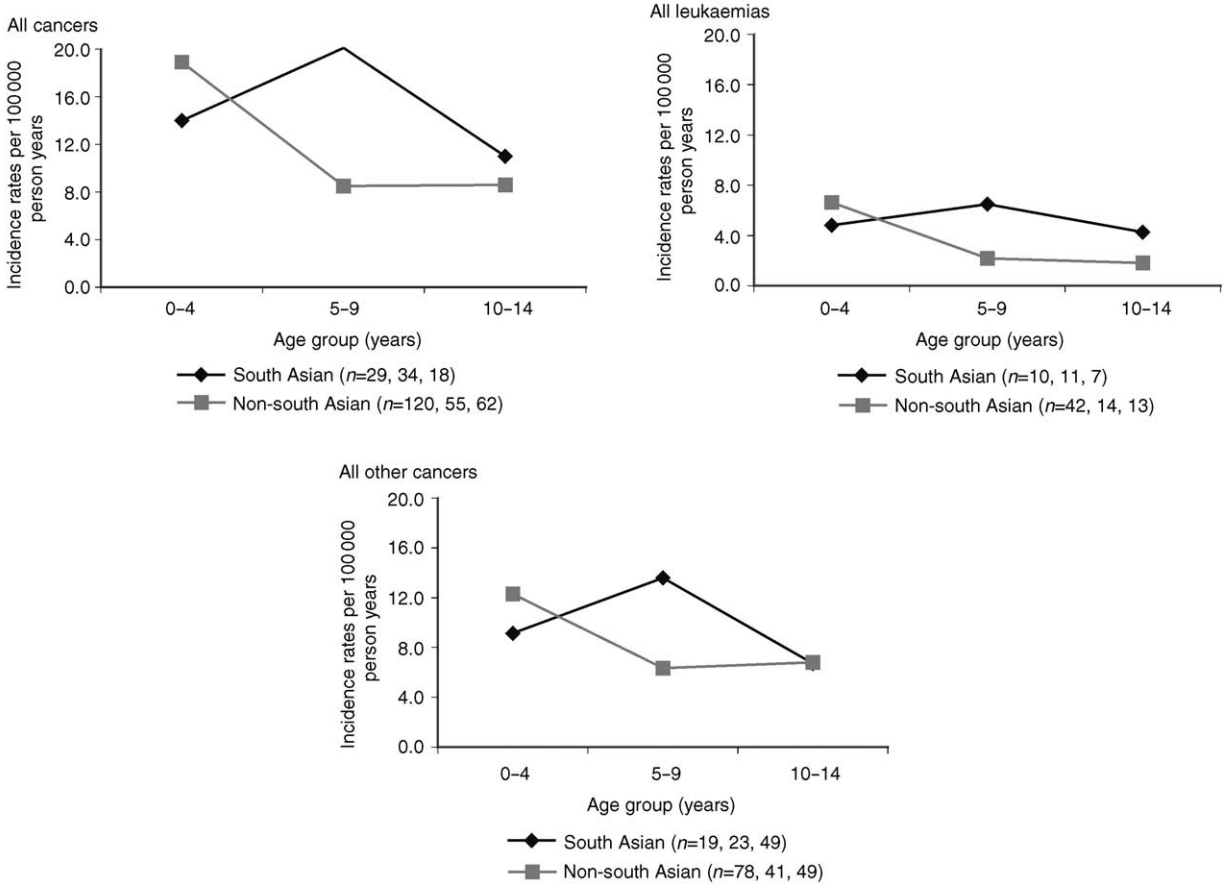

Fig. 1. Comparison of age-specific incidence rates by ethnic group in Bradford, 1974–1997.

Table 2
Comparative frequency, proportion and incidence of childhood cancers in Asians and non-south Asians (1974–1997) in Bradford by diagnostic group

	Total number of cases	Number of cases, *n* (column%)				Incidence rate (95% CI)[a]		
		South Asian		Non-south Asian		South Asian	Non-south Asian	*P* value[b]
		n	(%)	n	(%)			
Leukaemia	97	28	(35)	69	(29)	5.1 (3.2–7.0)	3.5 (2.7–4.3)	0.12
Acute lymphoblastic leukaemia	74	18	(22)	56	(24)	3.3 (1.8–4.8)	2.9 (2.1–3.6)	0.63
Other leukaemia	23	10	(12)	13	(5)	1.9 (0.7–3.0)	0.7 (0.3–1.0)	0.02
Lymphoma	45	14	(17)	31	(13)	2.6 (1.2–4.0)	1.5 (1.0–2.1)	0.10
Hodgkin's Disease	22	6	(7)	16	(7)	1.2 (0.2–2.1)	0.8 (0.4–1.2)	0.44
Non-Hodgkin's lymphoma	23	8	(10)	15	(6)	1.5 (0.4–2.5)	0.8 (0.4–1.1)	0.12
Central nervous system tumours	68	12	(15)	56	(24)	2.3 (1.0–3.6)	2.8 (2.1–3.5)	0.37
Astrocytoma	29	3	(4)	26	(11)	0.6 (0.0–1.3)	1.3 (0.8–1.8)	0.17
Other solid tumours	108	27	(33)	81	(34)	4.9 (3.0–6.7)	4.1 (3.2–5.0)	0.51
Neuroblastoma	25	7	(9)	18	(8)	1.2 (0.3–2.1)	0.9 (0.5–1.4)	0.57
Total	318	81		237		14.9 (11.6–18.2)	12.0 (10.5–13.5)	0.14

[a] Age-sex standardised Incidence Rate per 100,000 person years; 95% CI: 95% Confidence Interval.
[b] Derived by adding a binary variable to the Poisson regression model.

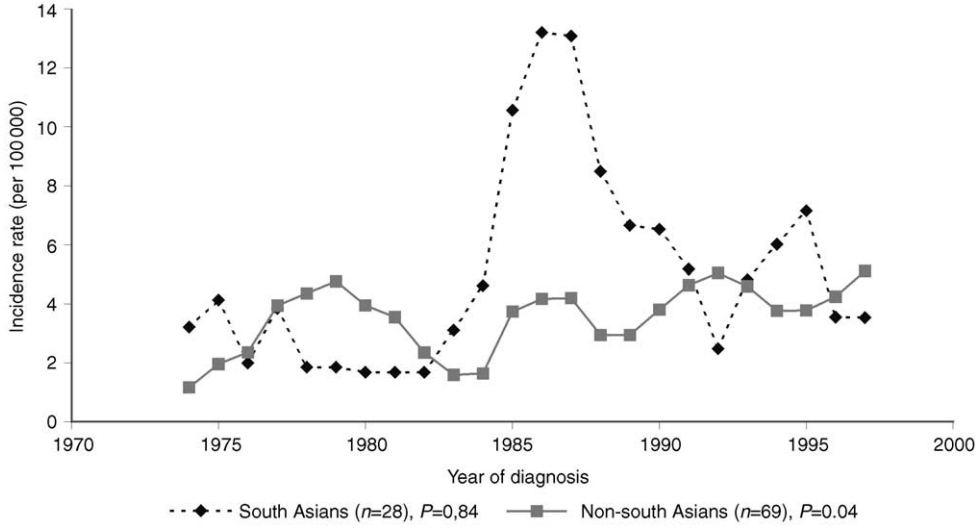

Fig. 2. Smoothed (3-year moving average) incidence rates for childhood leukaemia in Bradford 1974–1997.

children in Bradford, but the excess was not statistically significant. This finding is consistent with previous investigations in the UK [2,4,11], but our recent analysis had the advantage of using year-by-year population denominator data categorised by ethnic group, rather than relative frequencies [3,4] or estimates of populations essentially derived from the 1991 UK Census [2,11]. Our method permitted the calculation of incidence based on denominator populations that will have reflected the changing ethnic composition within a large northern UK city over the 24-year time period of the study.

Although our analyses only included a relatively small number of south Asian children ($n = 81$) the numbers are comparable to other incidence studies of south Asians [2,3,5] although ascertained over a longer and more recent time period. The limited size of the study does, however, place restrictions on the depth of our investigation, making it impossible to examine differences across age groups for example, and our findings must be interpreted with caution.

The overall incidence of paediatric malignancies in Bradford was similar to the remainder of Yorkshire and to the rest of England and Wales [7]. A steady (non-

significant) rising incidence of all cancers in Bradford is in line with other UK studies [12–15].

4.1. Leukaemia

Overall, the rates of leukaemia and acute lymphoblatic leukaemia (ALL) in south Asian children were higher, but not significantly so, compared with the remaining population thus supporting earlier observations in the UK [2–5]. However, a novel finding was the significant excess of Asian children diagnosed with 'other leukaemias', 83% of which were AML. This difference by ethnic group reached statistical significance despite the paucity of cases and has not been observed elsewhere. The relative risk of childhood AML associated with Down's syndrome is high [16] and amongst the 23 'other leukaemias' (19 of which were AML) 2/10 Asian and 1/13 non-south Asian children had Down's Syndrome.

The rising incidence of childhood leukaemia seen in the UK [12,13] is reflected in the non-south Asian population of Bradford, and neither data collection procedures nor differing referral patterns are likely explanations of the changes over time. Small numbers preclude interpretation of the trend and 1980s peak for non-south Asians.

Typically, the age incidence peak for childhood leukaemia, which is accounted for by ALL, occurs between the ages of 2–5 years [17]. Our study showed a different age specific incidence pattern for south Asian children with the highest rates of leukaemia seen in 5–9 year olds. This later childhood leukaemia peak has been observed in other ethnic populations such as US blacks [18], Japanese children [19] and in Jews and non-Jews from Israel [20] and increasing levels of affluence seem to be associated with the lowering of the age at which the peak appears [21]. The link with a late age peak and higher levels of deprivation could explain our finding as there is a strong correlation between south Asian ethnicity and living in deprived circumstances [22]. In the future, it will be interesting to observe whether the childhood peak begins to occur in younger south Asian children.

4.2. Lymphomas

Along with other studies, our findings have shown that south Asian children in the UK have an increased risk of lymphomas, both Hodgkin's Disease (HD) [2–5] and Non-Hodgkin's Lymphoma [2,3]. HD seems to be one of the tumour types which displays considerable international variation, with Hispanic children from different countries showing some of the highest rates seen in the world [1] contrasting with the low rates that are seen in Japanese [23] and US Black children [1].

4.3. Central nervous system tumours

Lower rates of CNS tumours are seen in south Asian children in our study, elsewhere in the UK [2,4,5] and in southern Asia [1]. A lower incidence of CNS tumours has also been seen among US blacks [24] and Hispanics living in Los Angeles [1] and New Mexico [25].

4.4. Study design

Methods of ascribing ethnicity that are not self-reported are inevitably prone to error and our study, although designating ethnicity to an individual child rather than a small geographical area, may not have avoided misclassification. In order to compensate for the recognised inadequacies of a single strategy for identifying Asian names [26], we used two independent computer algorithms, which function slightly differently. Taken together with the expert inspection, we considered a high level of accuracy was achieved. Although this study was specifically interested in south Asians, we recognise that the 'non-south Asian' group will include children from mixed and other ethnic backgrounds, although 96% of the non-south Asians in this age group were white Caucasian in 1991.

The designation of 'south Asian' fails to identify a homogeneous cultural group, and differing lifestyles exist in the Indian, Pakistani and Bangladeshi populations. The proportional representation of these three groups has varied slightly over the study period with the Indian population remaining fairly stable, the Pakistani population increasing and the Bangladeshi population remaining small throughout [27].

Socio-economic status (SES) is known to differ noticeably by ethnic group [22] and rates of childhood cancer may also differ according to levels of deprivation [28]. Despite being able to allocate a measure of SES to individual children in the study based on where they lived, the denominator data related to the whole of the Bradford area and thus stratification by SES was not possible.

In conclusion, this study has used high quality data to describe patterns of cancers by ethnic group in an area where this is relevant to the population. The high rates of AML in south Asian children may merit future monitoring. Both the later age peak in south Asians and the increasing rates of all cancers in the entire population, specifically leukaemia in non-south Asians are important not only to underpin appropriate planning and delivery of comprehensive paediatric oncology services, but for studies of aetiology.

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