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Incidence of insulin dependent diabetes in England: a study in the Oxford region, 1985-6

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Abstract

***Objective*—To determine the incidence of insulin dependent diabetes mellitus up to the age of 21 in a geographically defined population in England with independent validation of completeness of case ascertainment.**

***Design*—Prospective registration of newly diagnosed cases supplemented by centralised hospital discharge records and death certificates. Validation of ascertainment from general practitioners.**

***Setting*—Oxford Regional Health Authority area (population 2·4 million).**

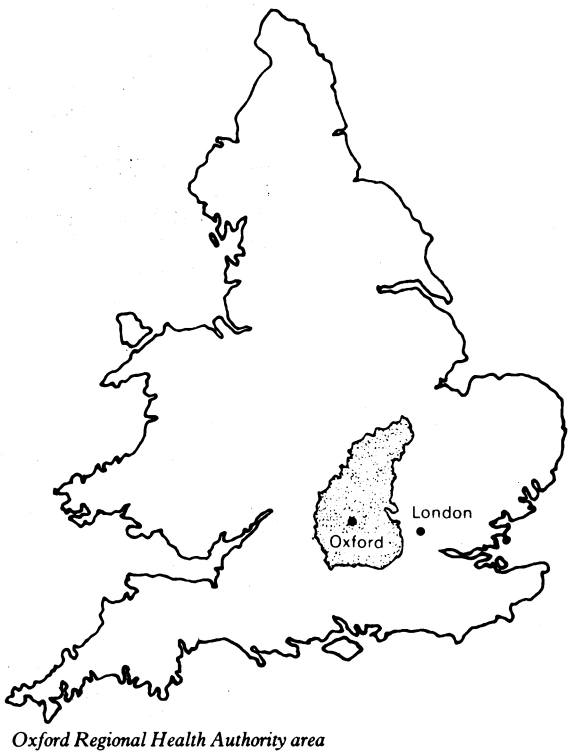
***Patients*—All patients with insulin dependent diabetes diagnosed below age 21 during 1985-6 and resident in the region at the time of diagnosis.**

***Interventions*—None.**

***End point*—Validation of a method of case ascertainment for assessing temporal variation in incidence of insulin dependent diabetes.**

***Measurements and main results*—The overall yearly incidence of newly diagnosed insulin dependent diabetes mellitus in people under 21 was 15·6 cases/100 000 (95% confidence interval 13·6 to 17·6). Among males the incidence was 16·8 cases (14·0 to 19·7)/100 000 and among females 14·3 cases (11·6 to 17·1)/100 000. The highest incidence, in the 10-14 year age group, was 26·4 (20·9 to 31·8) new cases/100 000 population yearly. Case ascertainment was greater than 95%.**

***Conclusions*—The incidence of insulin dependent diabetes in England is considerably higher than reported from large scale studies. It is consistent with described patterns of geographical variation. The figures provide a baseline for assessing temporal change.**



Oxford Regional Health Authority area

Introduction

Despite the fact that insulin dependent diabetes mellitus is one of the commonest chronic illnesses of childhood and still carries considerable morbidity and mortality, little epidemiological information is available on its occurrence in England. There are, for example, no large scale studies with case ascertainment complete enough to permit comparisons with other countries in respect of overall incidence or the characteristics of patients developing the disease. Similar comparisons have shown pronounced geographical variation—for example, a child in Finland is 17 times more likely to develop insulin dependent diabetes than one in Hokkaido, Japan[1]—and seem likely to contribute important insights into the aetiology of the disease. Our aim was to derive accurate incidence rates for insulin dependent diabetes in a geographically defined population in England, by using independent validation methods to assess the degree of case ascertainment.

Recent reports suggest that there has been a rapid increase in the incidence of insulin dependent diabetes over the past 20 to 30 years. This survey was therefore planned as a baseline for assessing the temporal variation in England. Such a study requires case ascertainment methods that will remain accurate and appropriate for the foreseeable future. We have therefore investigated the current management of new cases of insulin dependent diabetes, in particular the recent trend towards outpatient care, in assessing possible methods of ascertainment.

Patients and methods

The study formed part of the Barts-Oxford study of childhood diabetes, which covers the Oxford Regional Health Authority area (figure). This is divided into eight health districts, each containing one or more general hospitals. The area is 3130 square miles (8107 km^2) and has a population of 2·4 million, including 750 000 under the age of 21. Six per cent of the population under 15 is thought to be non-Europid, mainly originating from the Indian subcontinent. The Barts-Oxford study is being undertaken in col-

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laboration with paediatricians and physicians with a special interest in diabetes throughout the region.

Patients with diabetes diagnosed and treated with insulin before their 21st birthday between 1 January 1985 and 31 December 1986 and resident in the region at the time of diagnosis were eligible for inclusion, and we sought to ascertain all such patients. Case records were later examined to exclude secondary diabetes and, so far as possible, maturity onset diabetes of the young.

Primary case ascertainment was from two sources—namely, prospective registration of new cases by collaborating paediatricians and physicians and examination of regional Hospital Activity Analysis records; these provide a record of all hospital admissions but do not distinguish between the first and subsequent admissions with the diagnosis of diabetes. Centralised records of admissions dating back to 1964 were therefore examined to exclude patients admitted with this diagnosis before the study period. Newly diagnosed cases among the remainder were identified by examination of the hospital records of the relevant admission either by the admitting consultant or by one of us (PJB). The Oxford Record Linkage system was used to identify patients who died at the time of diagnosis.[2]

It is increasingly common for patients to start insulin as outpatients,[3] which means that they cannot be ascertained from hospital admission records. So far as we know, this approach in our region has been applied only by teams including a diabetes nurse specialist, and these patients should therefore have been identified by the registration procedure. To validate these methods questionnaires were sent to 1276 general practitioners in the region. They were asked to report any cases of insulin dependent diabetes on their lists fulfilling the inclusion criteria. They were also asked whether they would normally refer newly diagnosed cases of insulin dependent diabetes mellitus in this age group to hospital, at least for initial assessment, as either an inpatient or an outpatient and if so to which hospital.

Incidence rates were calculated by using the Registrar General's mid-year estimates of population (Office of Population Censuses and Surveys, unpublished); 95% confidence intervals were calculated as described by Armitage and Berry.[4]

TABLE I—*Ascertainment of cases of insulin treated diabetes*

Source	No of cases
Prospective registration	208
Hospital Activity Analysis only	23
General practitioners only	5
Death certificate only	1
Total	237

TABLE II—*Overall yearly incidence of insulin dependent diabetes (cases/100 000)*

	Male population		Female population		Total	
Year	Incidence	95% Confidence interval	Incidence	95% Confidence interval	Incidence	95% Confidence interval
1985	15·2	11·3 to 19·1	14·8	10·8 to 18·8	14·9	12·1 to 17·6
1986	18·5	14·2 to 22·7	13·9	10·0 to 17·7	16·4	13·5 to 19·3

TABLE III—*Yearly incidence of insulin dependent diabetes mellitus during 1985-6 stratified by age and sex (cases/100 000)*

	Male population			Female population			Total		
Age group (years)	No of cases	Incidence	95% Confidence interval	No of cases	Incidence	95% Confidence interval	No of cases	Incidence	95% Confidence interval
0-4	11	6·5	2·7 to 10·3	9	5·6	2·0 to 9·3	20	6·1	3·4 to 8·7
5-9	31	19·0	12·3 to 25·7	15	9·8	4·8 to 14·8	46	14·6	10·3 to 18·8
10-14	46	26·5	18·8 to 34·1	43	26·3	18·4 to 34·1	89	26·4	20·9 to 31·8
15-19	36	16·0	10·8 to 21·2	33	16·5	10·9 to 22·2	69	16·2	12·4 to 20·1

TABLE IV—*Seasonal variation in diagnosis of insulin dependent diabetes*

	Month of diagnosis												
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
No of cases	28	12	22	13	16	17	12	17	22	29	22	24	234*

*Table excludes two cases of secondary diabetes and one case of maturity onset diabetes of the young.

Results

Two hundred and thirty seven cases of insulin treated diabetes were identified (table I). Two cases of secondary diabetes (one patient with cystic fibrosis, one receiving steroids) and one case of maturity onset diabetes of the young (positive family history, absence of islet cell antibodies, 17 month delay between diagnosis and insulin treatment) were identified and excluded from further analysis. One child died at the time of diagnosis, having presented in ketoacidotic coma.

The overall incidence during the two years was 15·6 cases/100 000 population a year (95% confidence interval 13·6 to 17·6). Rates were 16·8 (95% confidence interval 14·0 to 19·7) among the male population and 14·3 (11·6 to 17·1) among the female population. There were no significant differences between the rates or between the sexes for the two years (table II). Table III shows the age specific incidence rates.

Variation in incidence according to month of diagnosis was confirmed ($\chi^2=25·48$, df=11; $p<0·01$) (table IV). More cases were diagnosed in the autumn and winter than in summer (103 cases during October to January as compared with 62 cases during May to August), but the difference was not significant.

VALIDATION

There was a 78% (990/1276) response from general practitioners to the questionnaire. They reported 117 cases, 112 of which were already known to us from prospective registration or Hospital Activity Analysis records, giving a degree of case ascertainment from primary sources in excess of 95%.

Only 170 (72%) of the 237 patients were admitted to hospital at the time of diagnosis, the remainder beginning insulin as outpatients. Six general practitioners reported that they would not necessarily refer all young patients with newly diagnosed insulin dependent diabetes to hospital, though they would refer any presenting in ketoacidosis. None had treated new cases during the study period. Doctors from four group practices, all of whose patients were resident within the region, would refer some patients to hospitals outside the region. Two further practices whose catchment areas traversed the regional boundary and with a minority of their patients resident in the region would refer all such patients to hospitals out of the region. No eligible patients had been referred out of the region during the study period.

Discussion

The most commonly cited source of information concerning the frequency of childhood diabetes in England is the British Diabetic Association register. This ran from 1972 to 1985 and was based on voluntary notification by physicians and paediatricians of all new cases in children aged up to 15.[5] An incidence of 7·7 cases/100 000 a year was reported for England and Wales in 1973-4, but case ascertainment was clearly incomplete. A recent small study in Leicester found an incidence of 14/100 000 a year.[6] The prevalence of insulin dependent diabetes mellitus has been studied in three British cohorts born in 1946, 1958, and 1970. The prevalences at age 10 were respectively 0·1, 0·6, and 1·3 cases/1000.[7] The numbers of cases were small and the confidence intervals correspondingly wide. The prevalence at age 21 has recently been reported as 3·3/1000 for the first cohort and 2·8/1000 for the second.[8]

The overall incidence that we report was considerably

TABLE V—*Variation in incidence of insulin dependent diabetes in Europe*

Country	Time period	Age range (years)	Yearly incidence/100 000		
			Male population	Female population	Total
Finland[12]	1970-9	0-14	29·7	27·3	28·6
Sweden[16]	1977-83	0-14			23·6
Norway[17]	1973-7	0-14	18·8	16·4	17·6
The Netherlands[10]	1978-80	0-19	11·6	10·4	
Mid-western Poland[13]	1982-4	0-16	6·7	6·6	6·6
Scotland[9]	1977-83	0-19	21·7	20·2	
France[18]	1970-9	0-15	5·1	4·8	5·0
Italy[19]	1981-2	0-19			11·6

higher than that found previously. The apparent difference may be due to inadequate ascertainment in earlier studies. Our own ascertainment, in excess of 95%, was validated by a questionnaire to general practitioners. This also allowed us to establish that cases managed independently by general practitioners or referred outside the region are not likely to be an important source of error. Case referral was by paediatricians and physicians with an interest in diabetes throughout the region, and Hospital Activity Analysis data were used to identify patients admitted under the care of doctors whose primary interest was not in diabetes. The study was carried out in a geographically defined area for which denominator statistics are available. These may be subject to minor errors, due, for example, to the time lapse since the 1981 census, but this is likely to result in only minimal error.

A study from Scotland based on routine hospital discharge data recently reported a considerably higher incidence of 21·7 cases/100 000 a year (95% confidence interval 20·5 to 22·9) in the male population and 20·2/100 000 a year (19·0 to 21·4) in the female population up to age 18 between 1977 and 1983.[9] This difference is consistent with the north-south gradient of incidence that has repeatedly been recorded in concurrent studies throughout Europe. A corresponding south-north variation with latitude has also been shown in the southern hemisphere.[1] Table V shows the most recent available results from other European studies.

During the period covered by the Scottish study a rapid increase in the incidence of insulin dependent diabetes mellitus was found. This increase has also been shown in other European countries[10-13] and in some North American studies.[14 15] The rate of this increase, equivalent to a doubling within 20 years in some countries, has suggested that environmental influences are concerned, though it might also mean that the disease is presenting earlier in susceptible people.[8]

Wide variation in incidence within countries has been detected in several studies.[5 9 16] This study looked at only a sample of the population of England and the results cannot necessarily be extrapolated throughout the country. It does, however, provide accurate results for part of a country in which validation of nationwide studies has not proved feasible.

The case ascertainment methods used in this study reflect the important changes that have taken place in recent years in the management of insulin dependent diabetes.[3] These have implications for future epidemiological studies in England and elsewhere, as almost 30% of cases were managed entirely on an outpatient basis. This means that studies relying on hospital discharge records alone can no longer provide accurate information on the incidence of the disease.

Information on the incidence of insulin dependent diabetes is available for only about 5% of the world's population but the wide differences that have already emerged suggest that the epidemiological approach may in time provide important clues to its aetiology. For example, comparison of 15 well validated population studies has suggested an inverse association between the incidence of diabetes and average yearly temperature.[1] Efforts are currently under way to establish a network of population studies throughout Europe which will allow detailed comparisons between low and high incidence populations with respect to genetic markers and environmental conditions. This will allow hypotheses to be generated and tested before more complex and expensive case-control or prospective cohort studies are undertaken.

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