Epidemiologic Survey of Juvenile-Onset Diabetes in Montreal

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SUMMARY

Active search of hospital records was used to survey insulin-dependent juvenile-onset diabetics younger than 17 years resident in General Montreal at the time of onset of symptoms during a seven-year period (1971–1977). A mean annual incidence of 8.8/100,000 was found with variation from year to year (5.8 to 10.3). Eighty percent were five years of age or more at time of diagnosis, and the increase with advancing age was similar to that seen in other studies including the somewhat earlier increase in incidence among females. Seasonal peaks were noted in some but not all years and were more marked in years of high incidence and among males. More cases occurred in areas of high socioeconomic level as measured by average family income. The estimated incidence among siblings of diabetics is 15 times the incidence in the general population. Ten percent of diabetics have a first degree relative who is insulin dependent. DIABETES *28*:690–693, July 1979.

Two main forms of diabetes mellitus have been delineated—a maturity-onset form and a juvenile-onset insulin-dependent form. Various subtypes were also described.[1] Although genetic susceptibilities to all types were suggested, the mode of inheritance is unclear, and a role for environmental factors is postulated.[1] The need for a clearer definition of the epidemiology of the juvenile form prompted the present survey of the disease in a large metropolitan area in Canada.

Studies from the United States,[2,3] Britain,[4,5] and Denmark[6] showed a mean annual incidence in Caucasians ranging from 6.0 to 13.2 per 100,000. Seasonality in the incidence of acute-onset diabetes was shown as early as 1926,[7] and seasonal and yearly variations have been shown since that time.[2–4,6] These studies support the hypothesis that viral infections play an etiologic role in the development of diabetes in the genetically predisposed individual, in a manner analogous to the virus-induced diabetic syndrome of mice.[8] It was further suggested that seasonality is not observed in children who are younger than five years of age at date of onset.[4] Data from Denmark indicate a possible, increased incidence in the lower socioeconomic group.[6]

This paper describes the epidemiologic and familial characteristics of insulin-dependent diabetes in the age group 0–16 years in a finite geographic area during the seven-year period.

METHODS

The survey was limited to children who required insulin. The small number of children presenting with abnormalities of glucose tolerance tests who could be managed with diet alone or diet plus oral hypoglycemic agents was not included in the study. The survey included all children who were less than 17 years of age and resident in the Metropolitan Montreal Area (as defined in the 1971 census by Statistics Canada) at the time of onset of symptoms.

Within this defined geographic area, there were two pediatric hospitals and ten general hospitals having pediatric wards. Records of these hospitals were surveyed for all admissions for diabetes mellitus in the stated age group for the years 1971–1977.

Date of birth, sex, residence at time of onset, current residence, date of onset of symptoms, date of diagnosis, and family history of insulin-dependent and noninsulin-dependent diabetes were recorded on a standard form.

The differences between age, sex, and year and month of onset were tested for significance using a multidimensional contingency table.[9]

The incidence by socioeconomic level was examined using the census tract of residence of the patients. Greater Montreal was subdivided into five quintiles by average household income (all sources) for each census tract. The significance of the number of patients in each quintile was

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tested using a chi-square of the observed and expected values.

The percentage of the base populations that belongs to the age groups 0–4, 5–9, 10–14, and 15–16 for ten census tracts from each group's quintile were calculated. The percentage of cases by age group for each quintile was also calculated.

RESULTS

The base population of children less than 17 years of age in the area was 433,890 males and 417,186 females. A total of 522 juvenile diabetics met our study's criteria. There were five blacks and two Orientals. There was a mean annual incidence of 8.8 and a variation from 5.8 per 100,000 in 1974 to 10.3 per 100,000 in 1975 (Table 1). No difference in numbers of patients was seen between the sexes (50% males and 50% females). However, these figures give a total annual incidence in females of 9.0 per 100,000 compared with 8.6 per 100,000 in males.

The general seasonal trend can be seen in Figure 1. Peaks in incidence can be seen in November and January with a trough in May through August. Figure 2 shows the seasonal trend by sex for the seven-year period and suggests a difference in pattern between males and females. Seasonality on onset of symptoms is more readily seen in years of highest incidence and in males more than females. In those less than five years of age the seasonal trend is evident only in November. However, the pooled data from all seven years does not achieve statistical significance.

The age of onset by sex is given in Figure 3. Most cases occur after five years of age (79.9%). There is a general increased incidence between the ages of 11 and 14 yr. However the increased incidence starts at an earlier age in females.

Table 2 shows the general incidence for Montreal by five socioeconomic subgroups. These figures were obtained by grouping the patients by the average household income (all sources) for the census tract of residence. A highly significant increase in the incidence is seen as the average household income increases ($P = 0.001$).

Examination of the census tract groups by age of the base childhood population within each group did not reveal any differences between groups. The age range of patients within each socioeconomic group was also similar.

TABLE 1
Annual incidence, by sex, of juvenile diabetes in Montreal per 100,000 population less than 17 years of age

	Number of Cases			Rate per 100,000		
	Male	Female	Total	Male	Female	Total
1971	44	42	86	10.1	10.1	10.1
1972	42	36	78	9.7	8.6	9.2
1973	46	39	85	10.6	9.3	10.0
1974	22	28	50	5.1	6.7	5.8
1975	42	46	88	9.7	11.0	10.3
1976	34	33	67	7.8	7.9	7.9
1977	30	38	68	6.9	9.1	8.0
				Average Annual		
Total	260	262	522	8.6	9.0	8.8

Population <17 years of age in Montreal metropolitan region according to 1971 census: male—433,890; female—417,186; total—851,076.

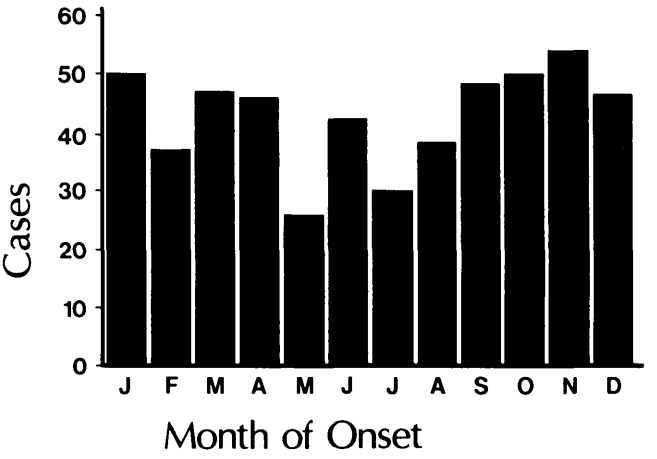


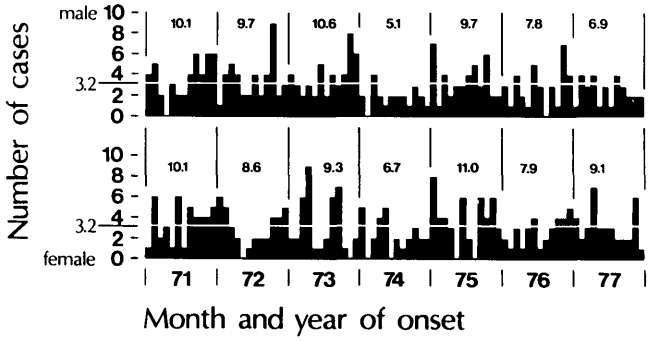
FIGURE 1. General seasonal trend, 1971–1977, of onset of juvenile diabetes in Montreal.

Family histories with regard to diabetes were obtained on 518 children. Thirty-two of these have one or more siblings who are also diabetic, a total of 44 diabetic siblings among 1080 siblings at risk, giving a prevalence of 4074 per 100,000. Assuming a stable incidence of juvenile diabetes and an age range of siblings of from 0 to 30 years, this would give a calculated crude annual incidence of 135.8 per 100,000 (i.e. 4074 ÷ 30). This is 15 times higher than the general population. In the 33 families in which both a parent and a child were insulin-dependent diabetics, 12 of the 98 siblings are diabetic, giving a crude annual incidence among siblings of 408.1 per 100,000. In 10.4% of our cases (54 families) a first degree relative of the index is a diabetic receiving insulin.

DISCUSSION

Our method of ascertainment of cases—by active searching of hospital records—is based on the assumption that newly diagnosed juvenile diabetics in our area are usually admitted to hospital. This method of ascertainment was used in two other population-based studies and was effective. Sultz et al.[10] used the method in their Erie County study and Christau et al.[6] in Copenhagen. Both later showed, through questionnaires to private physicians, that the search of hospital records revealed more than 98% of all new cases. Recently, prevalence studies were reported from two areas of the United States based on questionnaires sent to district

FIGURE 2. Seasonal incidence, by sex, of all new cases, 1971–1977. Each bar represents the number of cases in each month. The white line represents the mean number of cases for all months, and the figure within each year is the sex-specific incidence per 100,000 population.



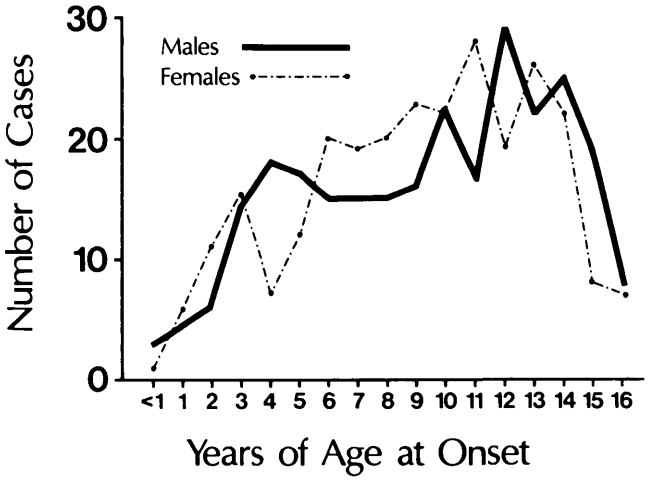


FIGURE 3. Age of onset, by sex, of 522 new cases of juvenile-onset diabetes in Montreal, 1971–1977.

school directors.[11,12] These studies omit patients who are less than school age and are dependent on the response to the questionnaire. Also the amount of case history available on the patients is limited.

Although every indication is that ascertainment in the present study is relatively complete, some cases may have been lost because children in the upper age range at the time of diagnosis may have been admitted to a general hospital with no pediatric ward and, thus, not surveyed. Also it is possible that, in the young age group, deaths are occurring before diagnosis.

Annual incidence. The mean annual incidence of juvenile diabetes in Montreal children is 8.8 per 100,000; this is similar to that in other studies[2,4,6] (Table 3). Variability in annual incidence during the seven years under study is apparent. The lowest incidence was found in 1974; a low incidence was also found in Britain during that year.[4] However, a longer study period will be necessary to demonstrate any periodicity in annual incidence as described in Erie County.[2]

Age and sex. Bloom[4] reported an initial slight peak in those who were five years of age; this was not apparent in our data. The British study also reported a main peak at 11 years of age, whereas in Montreal an increased incidence is seen between the ages of 11 and 14 years. The increases in incidence are earlier in females than in males. A similar finding was reported from Denmark.[6]

One is tempted to link the earlier onset of the main peak in girls with the earlier appearance of pubertal changes and maximum velocity of pubertal growth. However, objective assessment of pubertal status at onset of symptoms is lacking in all studies including this one. Prospective studies should include a rating of puberty by standard nomenclature.[13]

The breakdown by age and sex confirms the British findings of an excess of males in the age group 0–4 years of age and over 10 years of age.

Seasonality. There are two large surveys indicating seasonality in the onset of disease.[4,6] In both studies the month of diagnosis rather than the month of onset of symptoms was examined. The data in the present study plot month of onset of symptoms. In certain years, peaks are seen in the fall and winter. However, variation in the seasonality is seen from year to year.

Family history. The prevalence of juvenile-onset diabetes among siblings of diabetics is high. In families that have both a diabetic parent and a diabetic child, the risk of the sibling is even higher. At the present time, considerable controversy remains concerning the genetics of juvenile-onset diabetes, but these figures conform with those reported in other studies. Six percent of diabetic children have a sibling who has juvenile-onset diabetes. Between 10 and 11% of patients had a first degree relative receiving insulin treatment. This is comparable with other studies.[4,14]

Socioeconomic data. The significant finding that incidence of diabetes increases with family income was not previously reported. Sultz et al.[9] reported little difference between three socioeconomic levels. In the Danish study, in which the geographic area of Copenhagen was crudely split into two parts, the authors reported that the part with the lower socioeconomic indicators had the higher incidence.[6] In our study all patients were tabulated by individual census tracts, which were grouped by average household income. We considered the possibility that the age distribution of children in the socioeconomic groups might be skewed such that children in the ages most at risk (9–14 years) would more likely be found in the higher socioeconomic areas. However, examination of the base population in each group as well as the distribution of the ages of the diabetics themselves failed to confirm this as an explanation for the differing incidences. This raises the possibility of etiologically related environmental factors such as nutrition in the

TABLE 2
Juvenile-onset diabetics by average household income

Sub-group	Population <17 yr of age	No. of census tracts	Income range (1971 census) Average income per household	Expected number of cases	Observed	
					Number of cases	7-yr Rate per 100,000
1	170,585	175	$3,265–$7,965	105	77	45.14
2	170,795	110	$7,975–$8,970	105	71	41.57
3	170,535	95	$8,970–$9,930	104	110	64.50
4	165,965	85	$9,950–$11,535	103	120	72.30
5	172,265	105	$11,555–$44,485	105	144	83.59
	850,145*	570	—	522	522	61.40

P = 0.001.

* This figure differs from the total population given in Table 1 since the population numbers were rounded in each of the 570 census tracts.

TABLE 3
Comparison of findings in recent studies on juvenile diabetics

	Montreal	New York	Britain	Denmark
Author	—	Sultz et al.[2]	Bloom et al.[4]	Christau et al.[6]
Population Studied	Montreal	Erie County	Great Britain and Ireland	Copenhagen
Method of Ascertainment	Hospital records	Hospital records	Physician reports	Hospital records
Age Range of Cases	<17 yr	<16 yr	<16 yr	<30 yr
Years of Study	1971–1977	1948–1972	1972–1974	1970–1974
Mean Annual Incidence	8.8	6.10–11.0 Approx.	7.67	13.2
Seasonal Peaks	November January	Not recorded	December to March October	October January
Peak Age of Incidence				
Male	12 yr	9–12 yr	11–12 yr	14 yr
Female	11 yr		10 yr	12 yr

juvenile as well as in the maturity-onset diabetic. Cohen[15] suggests that the difference in prevalence seen in Israel between children born in Europe/America and Asia/Africa may be due to environmental as well as to genetic factors.

Our survey was undertaken to initiate a registry and to provide a data base for prospective studies of juvenile diabetics. The close similarity of our incidence data to those of other surveys indicates that our study population is probably representative of this group. The marked variation from year to year highlights the necessity for a prolonged longitudinal study on large populations.

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