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Incidence, Seasonal and Geographical Patterns of Juvenile-Onset Insulin-Dependent Diabetes Mellitus in Denmark

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Summary. The incidence, sex, seasonal and geographical patterns of juvenile-onset insulin-dependent diabetes mellitus (j. i. d. m.) were studied retrospectively on one third of the Danish population 1970–1974. The j. i. d. m. incidence remained fairly constant during the study period, the average being 13.2 per 100000 per year. The total number of boys exceeded the number of girls by 27 per cent. A marked peak of incidence was found at 12–14 years, earlier for females than for males. A seasonal variation in onset (diagnosis) of j. i. d. m. was observed with the lowest number of new cases in May-July. The j. i. d. m. incidence seemed to show socio-economic differences, being highest in those parts of the survey area with lower status.

Key words: Incidence, seasonal variation, geographical pattern, sex-difference, epidemiology, juvenile-onset, insulin-dependent, diabetes mellitus.

Solidly ascertained incidence data on juvenile-onset diabetes mellitus are sparse. Bloom and co-workers [1] reported an incidence of 7.67 per 100000 per year in the U. K. in 1975 and described the influence of age, sex and seasonal variation on the incidence.

The present study was undertaken in order to produce comparable data from Denmark.

Material and Methods

Denmark is well suited for epidemiological studies due to an ethnically uniform Caucasian, non-migrating cooperative population, a public health care system and an effective national register.

The study was based on two assumptions. First that every patient with newly diagnosed juvenile-onset insulin-dependent diabetes mellitus (j. i. d. m.) aged 0–29 years and diagnosed between January 1, 1970 and December 31, 1974 was referred to a hospital, and secondly that the referrals would be made to the in- or outpatient services of the paediatric and medical departments.

The survey area comprised the city of Copenhagen, the County of Copenhagen (suburban in character) and the County of Frederiksborg (partly rural and partly suburban in character). The area covers 1961 square kilometers (4.5 per cent of the Danish territory[1]) and contains a population of 1598754 (average of 1970–74) or 32 per cent of the total Danish population. The age group 0–29 years in the survey area comprised 716285 persons or 30.8 per cent of the total Danish population in this age group.

All hospital records of newly diagnosed insulin-dependent diabetics aged less than 30 at the time of diagnosis were collected. Name, date of birth, sex, date of diagnosis, and place of residence at diagnosis were noted for each patient. This sample of 474 patients comprised the analysed group of diabetics. The validity of the above-mentioned assumptions was checked by a questionnaire to the general practioners and the few specialists in private practice in the survey area. Official Danish statistical yearbooks were used as sources of data for calculations of the age-corrected incidences.

Results

The ascertainment was almost complete, since only five patients diagnosed in the survey period were

[1] Greenland and The Faroe Islands excluded

Table 1. The number of juvenile-onset insulin-dependent diabetics aged 0–29 years, diagnosed in the survey area 1970–74

YEAR	MALE	FEMALE	TOTAL
1970	46	51	97
1971	54	34	88
1972	62	36	98
1973	43	48	91
1974	60	40	100
1970–1974	265	209	474

Table 2. Age corrected incidence (annual number per 100000) of j. i. d. m. for age groups 0–29 years, 0–14 years and 15–29 years

	AGE GROUP	MALE	FEMALE	TOTAL
ANNUAL	0 – 14	15.0	13.2.	13.7
NUMBER	15 – 29	14.3	10.8	12.8
PER 100000	0 – 29	14.5	11.9	13.2

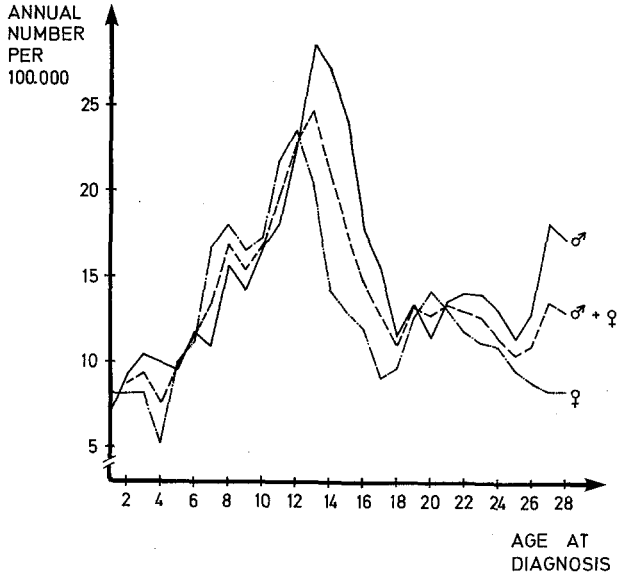

Fig. 1. Age variation in the incidence (annual number per 100000) of juvenile-onset insulin-dependent diabetes mellitus in Denmark. (N = 474)

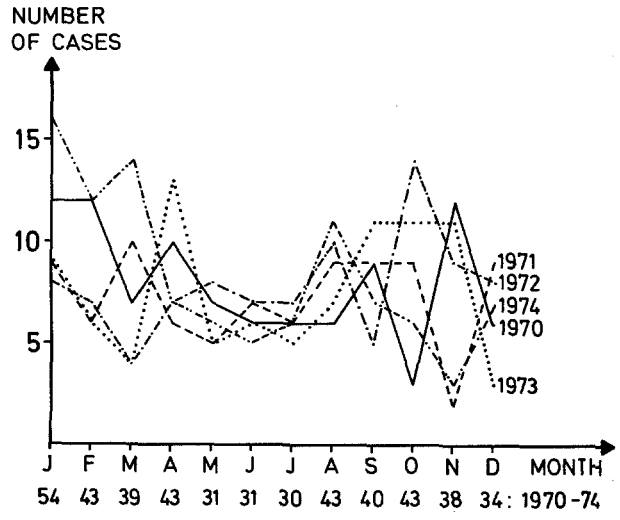

Fig. 2. Seasonal variation in the diagnosis of juvenile-onset insulin-dependent diabetes mellitus in Denmark in 1970–74

not included in the study by the method used. These five cases are omitted from the calculations.

A total of 474 cases of j. i. d. m. were registered during the five year period (Table 1). The total number of boys exceeded the number of girls by 27 per cent. The calculated age-corrected incidence of j. i. d. m. was found to be 13.2 per 100000 per year (for males 14.5 and 11.9 for females) (denominator in the equation was the total number across the whole age range involved). No major differences in age-corrected incidences between the age groups 0–14 and 15–29 years (Table 2) or between the three regions of the survey area were noted. Maximal year to year variation in incidence was 12.1 to 14.3.

When incidences for one year age groups were plotted in relation to age at diagnosis (Fig. 1), a marked peak incidence was demonstrated at ages 12 to 14. The female peak preceded the male peak by one to two years. During early childhood the j. i. d. m. incidence gradually increased, while it remained fairly stable after the age of 17–18. Smaller peaks were present at age 7–9 and in the late twenties.

A seasonal variation (Fig. 2) with a reduction of incidence during May, June and July was found. Geographical or familial clustering of outbreaks of j. i. d. m. was not observed in this study.

A detailed analysis of the incidence data from the county of Copenhagen, however, showed a difference between the northern and southern part of the county, with most cases in the southern part. This difference in incidence between the two areas was due to a marked difference in incidence in the age group 0–14 years (20.0 and 10.5 in southern and northern area respectively). Table 3 demon-

Table 3. Some socio-economic characteristics of the two areas of the Copenhagen county

	AREA I	AREA II
INCIDENCES OF JUVENILE DIABETES MELLITUS (ANNUAL NUMBER PER 100000) IN THE AGE GROUPS 0–14 YEARS	10.5	20.0
THE AGE GROUP 0–14 YEARS IN PER CENT OF THE TOTAL POPULATION	23.9	27.9
FIVE YEARS GROWTH RATE OF THE TOTAL POPULATION (IN PER CENT)	−2.27	+8.24
THE AVERAGE NUMBER OF PERSONS PER ROOM	0.84	0.92
NUMBER OF UNSKILLED WORKERS IN PER CENT OF THE TOTAL POPULATION	9.7	13.6
NUMBER OF THE POPULATION WITH SCHOOL ATTENDANCE ≥ 11 YEARS (IN PER CENT)	7.6	3.6
NUMBER AF WOMEN WORKING AWAY FROM HOME (IN PER CENT)	38.4	42.1
PROPERTY ACCORDING TO ASSESSMENT PER FAMILY (IN DANISH CROWNS)	145.000	62.500

strates some socio-economic differences between the two areas of the Copenhagen county collected from official statistical sources.

Discussion

Adams [2] described as early as 1926 a seasonal variation of "acute diabetes" with most cases occurring in fall, winter and early spring. Later Gamble and Taylor [3] renewed the interest in the seasonal pattern of the onset of juvenile-onset diabetes mellitus by demonstrating a seasonal variation in the age group 0–19 years similar to that described by Adams.

The data from the prospective study conducted under the auspices of the British Diabetic Association [1] showed a similar seasonal pattern among 2000 0–15 year old newly diagnosed diabetics. In that material the 5–15 year subgroup accounted for the seasonal variations in onset.

A similar seasonal variation in the onset (diagnosis) of j. i. d. m. was demonstrated in the present study comprising ages 0–29 years. No differences could be demonstrated between subgroups. It was suggested by Gamble et al. [4] that the seasonal variation reflected a seasonal variation in certain infections, but unequivocal data to support this hypothesis have not been reported so far, and the seasonal pattern found in Great Britain and in Denmark might perhaps be explained in other ways (e. g. dietary changes and increased physical activity in the summer period. Low frequency of patient-doctor contacts at this time of the year).

The j. i. d. m. incidence found in the present study was higher than that of the British study [1]. Obviously this might reflect true incidence differences (13.2 and 7.67 respectively), but differences in degrees of ascertainment are more likely.

The number of males with j. i. d. m. found in this study was 27 per cent higher than the number of females. The male excess (in numbers) in the British study can be calculated to 12 per cent. Thus sex seems to influence in some way the development of j. i. d. m. In this context it is of interest that sex may affect the incidence of a viral infection [5] and its manifestations [6]. Also experimental diabetes can be more readily produced in male than in female animals [7] (Kromann et al. in preparation).

The incidence of j. i. d. m. varies with age. A small peak is perhaps present at 7–9 years and a main peak at 12–14 years, earlier for females than for males (12 and 13–14 years respectively).

It was claimed [8] that the incidence peaks were associated with puberty and growth spurts, but this was disputed by Bloom and co-workers [1] and neither does this hypothesis fit Danish conditions [9, 10]. However, it cannot be ruled out that hormonal changes in prepubertal years are of importance in relation to diabetes onset.

No geographical or familial clustering of cases was found in the present study. It was however of interest to observe that the incidence of j. i. d. m. was higher in the southern part of the Copenhagen

county than in the northern part. This pattern was constantly present during the sampling period and was also observed in a one year prospective study in the same survey area (in preparation). This difference in incidence could be demonstrated for the age group 0–14 years only. It was reported from the United States that the prevalence of diabetes mellitus is associated in some way with income and educational level [11]. The mechanisms involved in the socio-economic associations are unknown so far.

The rather low concordance rate of juvenile-onset diabetes mellitus in identical twins [12], the detailed data on j. i. d. m., HLA association [13, 14] and the surprisingly low empirical risk of juvenile diabetes in first degree relatives of juvenile diabetics [15] suggest that environmental factors are of importance in the development of j. i. d. m. The seasonal variation demonstrated in both the British study [1] and this report, the influence of age on the incidence of j. i. d. m. and the possible socio-economic impact on the outbreak of the disease, further support the importance of non-genetic environmental factors in the aetiology and pathogenesis of j. i. d. m.

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