Epidemiological Studies of Diabetes Mellitus in Denmark

II. A Prevalence Study Based on Insulin Prescriptions

A. Green, M. Hauge, N. V. Holm, and L. L. Rasch

The University Institute of Clinical Genetics, Medical Department B and The Funen County Medical Computing Department, Odense University Hospital, Odense, Denmark

Summary. The study aimed at tracing the population of insulin-treated diabetics living in the Funen County, Denmark (approximately 450 000 inhabitants) on 1 July 1973. It was based on a recording of insulin prescriptions among all prescriptions handled by the pharmacies in Funen County during a five-month period. Through information from medical records and public registries the verification of the diagnosis and the identity of the insulin prescription holders were checked, and it is estimated that the completeness of the study material was above 98%. Age- and sex-specific prevalence rates of insulin-treated diabetes mellitus were calculated. The overall prevalence rate for males was 3.6 per 1,000 and that for females 3.3 per 1,000.

Key words: Prevalence, insulin-treated diabetes mellitus, prescriptions.

The need for epidemiological data on diabetes mellitus is obvious for several reasons. However, when traditional case finding methods are used in epidemiological studies of diabetes, bias and incomplete case finding may occur.

An alternative case finding method based on the Danish National Service Consript Registry has been presented previously [1]. In this report we present a study of prevalence based on insulin-treated diabetics identified through a perusal of prescriptions. Age- and sex-specific prevalence rates are presented.

Materials and Methods

The Administration of Prescriptions in Denmark

In Denmark insulin must be prescribed by a doctor; the costs are partly (in some cases totally) carried by the public health insurance, and the pharmacies are reimbursed when submitting the

prescriptions. As the public health insurance by law covers the total population, and as the pharmacies must submit the prescriptions in order to have their outlay reimbursed, all prescriptions of, for example, insulin in a given region are filed in the regional public health insurance office.

The Study Population

The study was carried out in the Funen County in Denmark; this region comprises approximately 450,000 inhabitants and forms a geographically well-defined administrative unit as well as a demographically representative 9% sample of the total Danish population (Green, unpublished data).

All pharmacies in the county submit the prescriptions to the regional public health insurance office, located in Odense.

The Study Material

All prescriptions handled by the pharmacies in the Funen County within the period 1 April 1973 – 31 August 1973 were perused in order to find the insulin prescriptions. For every insulin prescription, the name, address and identification number (including date of birth) of the holder were recorded.

All the insulin prescription holders were searched for in the files of all hospitals (11) in the county. For those not admitted to hospital, the general practitioner was contacted after confirming the name and address of the holder via the public registries. These procedures revealed a number of persons who were not diabetics; if so, we tried to obtain information as to insulin-treated diabetics in the households (spouses and/or children). Such cases were included, if they fulfilled particular criteria (see below).

In every case identified, we obtained the following clinical data: 1) date of onset of diabetes mellitus (i.e. the first time the physician established the diagnosis); 2) if stated, date when insulin treatment was initiated; 3) the daily dosage of insulin; and, when relevant, any additional antidiabetic drugs taken as of 1 July 1973; 4) data on body weight and ophthalmological examinations by specialists.

Whenever possible, we traced and perused the hospital records from the first admission with diabetes mellitus given as a discharge diagnosis.

If the records contained information about other household members with diabetes, the records for these additional persons were sought and were included in the study.

For the hospital records, if necessary supplemented by information from the public registries, we obtained the addresses for all cases at the time of diagnosis and at 1 July 1973, and, for those deceased within the registration period, the exact date of death.

Table 1. The basic study population and the final population

	Number of prescriptions	Number of persons
Basic study population	4,106	1,585
Excluded persons:		
Identification impossible	7	6
Clinical data unavailable	20	14
Address outside the Funen County on 1 July 1973	40	34
Not diabetes mellitus ^a	10	6
Deaths before 1 July 1973	9	7
Insulin treatment discontinued before 1 July 1973 or initiated after this date	25	19
Final population	3,995	1,499

^a Including 3 persons temporarily taking part in a clinical trial and 3 institutionalised persons for whom the general practitioner certified that they did not suffer from diabetes

Thus we define the final study material to be comprised of persons who

1) were alive on 1 July 1973 with insulin-treated diabetes mellitus, certified by a physician;

2) on this day had their permanent address in the Funen county;

3) at least once within the period 1 April 1973 – 31 August 1973 had received insulin from a pharmacy in the county by a prescription issued to themselves and/or a member of their household.

Results

The total number of prescriptions collected from the pharmacies during the five-month registration period was approximately 550,000; of these, 4,106 (0.8%) were insulin prescriptions, corresponding to 1,585 persons. However, 86 were excluded for different reasons so that the final population comprised 1,499 persons (Table 1).

The distribution of the final insulin-taking population in age and sex groups is shown in Table 2 together with the corresponding prevalence rates. As shown, the overall prevalence rate of insulin-treated diabetes was 3.6 per 1,000 for males and 3.3 per 1,000 for females.

Discussion

The use of insulin prescriptions as a means of identifying the prevalence of insulin-treated diabetics seems ideal, provided that there is access to all prescriptions from a well-defined population and to clinical data on each insulin prescription holder. In con-

Table 2. Age- and sex-specific prevalence rates of insulin-treated diabetes mellitus in the Funen County, Denmark, 1 July 1973

Age class (years)	Number of persons ^a (1 January 1973)	Number of insulin-treated diabetics (in parentheses rates per 1,000)		
		Onset before age 30 years	Onset after age 30 years	Total
<i>Males</i>				
0-4	16,345	3 (0.2)	—	3 (0.2)
5-9	18,381	15 (0.8)	—	15 (0.8)
10-14	16,758	31 (1.8)	—	31 (1.8)
15-19	17,183	40 (2.3)	—	40 (2.3)
20-24	16,565	57 (3.4)	—	57 (3.4)
25-29	17,763	63 (3.5)	—	63 (3.5)
30-34	13,754	50 (3.6)	4 (0.3)	54 (3.9)
35-39	12,400	45 (3.6)	14 (1.1)	59 (4.8)
40-44	12,209	33 (2.7)	31 (2.5)	64 (5.2)
45-49	12,642	28 (2.2)	33 (2.6)	61 (4.8)
50-54	12,917	22 (1.7)	50 (3.9)	72 (5.6)
55-59	12,478	13 (1.0)	37 (3.0)	50 (4.0)
60-64	12,306	6 (0.5)	60 (4.9)	66 (5.4)
65-69	10,147	4 (0.4)	55 (5.4)	59 (5.8)
70-74	7,695	3 (0.4)	49 (6.4)	52 (6.8)
75-79	5,119	2 (0.4)	21 (4.1)	23 (4.5)
80+	4,804	—	14 (2.9)	14 (2.9)
Total	219,466	415 (1.9)	368 (1.7)	783 (3.6)
<i>Females</i>				
0-4	15,312	2 (0.1)	—	2 (0.1)
5-9	17,400	11 (0.6)	—	11 (0.6)
10-14	15,915	21 (1.3)	—	21 (1.3)
15-19	16,128	39 (2.4)	—	39 (2.4)
20-24	15,318	37 (2.4)	—	37 (2.4)
25-29	16,818	37 (2.2)	—	37 (2.2)
30-34	13,306	29 (2.2)	4 (0.3)	33 (2.5)
35-39	12,449	48 (3.9)	8 (0.6)	56 (4.5)
40-44	12,295	22 (1.8)	13 (1.1)	35 (2.8)
45-49	13,108	24 (1.8)	25 (1.9)	49 (3.7)
50-54	13,187	16 (1.2)	38 (2.9)	54 (4.1)
55-59	12,892	14 (1.1)	38 (2.9)	52 (4.0)
60-64	12,766	12 (0.9)	68 (5.3)	80 (6.3)
65-69	11,052	2 (0.2)	60 (5.4)	62 (5.6)
70-74	9,124	—	74 (8.1)	74 (8.1)
75-79	6,755	—	38 (5.6)	38 (5.6)
80+	6,398	—	36 (5.6)	36 (5.6)
Total	220,223	314 (1.4)	402 (1.8)	716 (3.3)

^a Danmarks Statistik: Statistisk Tabelværk 1973: XIII ("Befolkningen i de enkelte kommuner pr. 1. januar 1973 fordelt på køn, alder og ægteskabelig stilling"). Copenhagen 1974

trast to many other countries these conditions are fulfilled in Denmark. Nevertheless, the method seems largely neglected, maybe because it is very time-consuming. Larsen [2, 3] conducted a comparable study with similar results in another part of Denmark by collecting consecutively all insulin prescriptions from the pharmacies over a period of six months. He concluded [3] that the method is very

reliable, giving a case registration rate of almost 100%. However, no detailed evaluation of the validity of the method was presented.

In spite of the favourable conditions, possibilities of error in our study exist; these errors can be grouped as 1) simple omissions when recording insulin prescriptions from total prescriptions, 2) a registration period so short that not all diabetics have visited a pharmacy within the period, and 3) errors caused by incorrectly issued prescriptions. Based on various analyses (control recordings of insulin prescriptions in samples of the total material; calculations of the pharmacy visiting frequencies of diabetics related to the amount of insulin delivered and the mean daily insulin dosage; comparison with another study material, collected independently) we conclude that the actual registration period of five months is sufficiently long, and the completeness in our study material is above 98%. Further, we conclude that insulin-treated diabetics could not have been traced from hospitals and diabetes clinics alone.

To our knowledge, no previous studies have elucidated to which extent the population of insulin-treated diabetics is identical with that of insulin-dependent diabetics. Therefore, we have preliminarily divided our patients according to age at onset below or above 30 years of age, assuming that of all diabetics with onset below this age, only a very small proportion will not be insulin-dependent diabetics. In at least half of the insulin-treated diabetics onset occurred below age 30. The increasing prevalence rates with increasing age of diabetes with onset after age 30 suggest that even in older people, insulin-treated – and maybe insulin-dependent – diabetes may develop, because without these cases the excess mortality among diabetics should in fact tend to reduce the prevalence rates, as seen for the rates of early-onset diabetes after age 40 years. In these considerations it is assumed that no major fluctuations in the incidence of insulin-treated diabetes have occurred in the decades prior to the study.

Further analyses concerning the discrimination between subgroups in the population of insulin-treated diabetics must be based on detailed clinical data of each case, and such analyses will – together with prognosis evaluation – be presented subsequently.

Acknowledgements. The authors want to thank Mr. Bent Nielsen, head of the public health insurance office in the Funen region, for giving access to the prescriptions. Mr. Martin Pedersen, chief of the Funen County Medical Computing Department, Professor Bent Harvald, Odense, and Dr. Anders Frøland, Fredericia, have given valuable help and advice.

The heads of all medical departments in the region and of a large number of other departments in and outside the region gave access to hospital records, and in addition we want to thank the secretaries for their efforts to trace these records.

A large number of the public registries helped us very kindly with information on personal data.

Secretarial assistance was given by Mrs. Anette Rasmussen.

The study was supported financially by Landsforeningen for Sukkersyge (the Danish Diabetic Association) and "Dr. med. Erik Garde og Elizabeth Gardes Legat". During the initial part of the study A. G. received a fellowship from the Danish Medical Research Council (grant no. 512-7419).

References

1. Green A, Hauge M, Holm NV, Rasch LL (1980) Epidemiological studies of diabetes mellitus in Denmark. I. A case finding method based on the National Service Conscript Registry. *Diabetologia* 19: 355-358
2. Larsen DF (1978) Den insulinkrøevende diabetikers økonomiske problemer. *Ugeskr Laeger* 140: 2338-2340
3. Larsen DF (1979) An epidemiological study of an insulin-dependent diabetic population. MPH Thesis, Yale University

Received: June 16, 1980,
and in revised form: November 10, 1980

Dr. Anders Green
University Institute of Clinical Genetics
J. B. Winsløvsvej 17
DK-5000 Odense C
Denmark