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A prevalence study of known diabetes mellitus in Tuscany assessed from pharmaceutical prescriptions and other independent sources

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Abstract. This study evaluates the prevalence of diabetes mellitus (DM) in Pisa (Tuscany, Italy) using four independent data sources. The main source, represented by computerized prescriptions for anti-diabetic agents collected over a 4-month period, was validated using three secondary sources: (a) the list of diabetic patients who receive material of self-care from the National Health Service; (b) the clinical records of diabetic patients obtained from a random sample of family doctors; (c) the clinical records of diabetic patients attending our outpatient clinic. The main source provided 3806 patients, and 697 patients were added from the secondary sources, thus identifying a total number of 4503. The prevalence of known DM in the "Pisa area" exclusively reckoned by the main source, was 2.01%, and the prevalence corrected by the addition of the various sources resulted in 2.4%. The capture-recapture method showed a completeness of ascertainment of the survey of 90.1%, and thus an estimated prevalence of known diabetes of 2.64%. Of these, 141 patients had insulin-dependent diabetes mellitus (IDDM) corresponding to 3.2% of identified diabetic subjects (prevalence 0.07% inhabitants); 4362 patients had non-insulin-dependent diabetes mellitus (NIDDM), 96.8% of identified diabetic subjects (prevalence 2.36%). Of patients with NIDDM 10.5% was treated by diet, 65% with oral hypoglycaemic agents (OHA), 23% with insulin and 1.5% with insulin plus OHA. This study shows that the method used in this survey is suitable for epidemiological studies because it does not demand the cooperation of the diabetic patients, is addressed to the entire diabetic population without age discrimination and singles out the diabetic population in a very reliable way.

Key words: Diabetes mellitus – Epidemiology – Pharmaceutical prescriptions

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Introduction

In Italy, diabetes mellitus (DM) is considered one of the most widespread chronic-degenerative diseases. Nevertheless, there are conflicting data concerning its prevalence in the Italian population [1–10]. In fact, studies in the 1970s and 1980s revealed remarkable variations in prevalence, ranging from a minimum of 1.5% in Ferrara [1] to about 12% on the island of Pantelleria (southern Italy) [2]. This large variability was probably due, at least in part, to differences in the methods used for collecting the data, low response rates, non-random selection of subjects and the different diagnostic criteria adopted [3]. Recently, several studies in Italy [4–8] and other countries [11] have shown the reliability of pharmaceutical prescriptions of insulin and/or oral anti-diabetic agents as a source for epidemiological studies. The Italian studies based on this epidemiological approach referred to a total of about 500 000 inhabitants, a value which is about 0.8% of the Italian population. Two of these studies were conducted in northern and one in southern Italy. Thus, the number of patients studied was too low to provide reliable results which could be extended to the entire Italian population. Moreover, currently no data are available for the population living in central Italy. Accordingly, we have undertaken this study in order to establish the prevalence of known DM in the Pisa area, in Tuscany, central Italy, with a population of 189 085 inhabitants. In order to obtain data comparable with the above-mentioned studies, we used pharmaceutical prescriptions as the main source of information and three other independent secondary sources.

Materials and methods

In order to obtain insulin and oral hypoglycaemic drugs through licensed pharmacies without charge, diabetic patients must have them prescribed via the regional prescription form by general practitioners of the National Health System (NHS). The form contains the number of the health district, the name and NHS code of the patient and of the prescribing physician, plus the registered name of

the drug. Then the forms are processed by the Central Pharmaceutical Service to form a computerized database of insulin and oral hypoglycaemic drug prescriptions. This database allowed us to select all DM-related prescriptions given out over the last 4 months of 1989. Thus, from this list of patients (after excluding overlapping prescriptions and prescriptions occasionally issued to non-residents) a first assessment of the prevalence of DM in the study area was made. This case-finding source (main source) was validated by crosschecks with the following independent sources: (1) list of diabetic patients who obtained material for self-care (insulin syringes and strips to measure blood glucose) from the NHS; (2) clinical records of diabetic patients obtained from a random sample of 65 family doctors picked out from the list of general practitioners contracted with the NHS; (3) clinical records of diabetic patients attending our outpatient clinic. For all patients identified by the main and secondary sources, it was possible to obtain further clinical characteristics such as age and body weight at diagnosis, family history of DM, body mass index (BMI) and type of treatment (drug and dose). The age-specific prevalence rates of DM were calculated, taking into account the age distribution of the resident population in the study area on the cut-off date 31 December 1988. To estimate the completeness of ascertainment of the survey, the "capture-recapture" method was used [12].

In this paper we labelled patients who suffered from DM before the age of 30 years and were treated with insulin immediately as having IDDM and all others as having NIDDM. The use of these criteria instead of more specific classification criteria is a reasonable and internationally accepted approximation for epidemiological studies. In fact, new cases of IDDM are rare, relative to NIDDM, in adult populations. According to a study of the population of Rochester (Minnesota), among new patients with DM occurring after the age of 30 years, less than 10% was treated with insulin, and only half of these were diagnosed as IDDM [13].

Results are presented as percentages or means ± SD.

Results

From the pharmaceutical prescriptions issued in the third quarter of 1989 ("main source"), we identified 3806 patients. The three secondary sources (crossing each other) identified 2931 cases, 2234 of which (76.2%) had been included in the main source. The remaining 697 were added to make a total number of diabetic patients identified by the four sources of 4503.

The prevalence of known DM in the Pisa area exclusively reckoned by the main source was 2.01%, and the prevalence corrected by the addition of the various secondary sources resulted in 2.4%. Using the "capture-recapture" method, the estimated number of prevalent cases was 4995. Thus, the prevalence of known DM in the Pisa area using this figure was 2.64%. The estimated completeness of the primary data source was 84.7% (3806/4495), and the estimated completeness of the prevalence survey was 90.1% (4503/4495).

The mean age of identified patients was 65 ± 13.5 years (range 6–98 years). The prevalence of DM according to age and sex is given in Table 1. The prevalence rates increased with age both in men and women and were very high for people over 60 years old.

Prescriptions of insulin allowed the identification of 1010 insulin-treated diabetic patients; a further 134 patients were obtained from the secondary sources. Thus, the total number of insulin-treated patients was 1144 (25.4% of identified patients).

Table 1. Prevalence rates (% inhabitants) of known patients with diabetes mellitus according to age and gender

Age (years)	Males		Females	
	Cases (*n*)	Rate [%]	Cases (*n*)	Rate [%]
0–10	5	0.05	9	0.09
11–20	11	0.08	16	0.12
21–30	27	0.22	51	0.43
31–40	33	0.25	59	0.45
41–50	91	0.73	166	1.24
51–60	322	2.60	521	3.84
61–70	407	4.55	538	5.03
71–80	768	12.3	853	9.21
> 80	331	17.8	295	7.24
Total	1995	2.21	2508	2.54

Table 2. Number of patients and prevalence rates of insulin-dependent (IDDM) and non-insulin-dependent (NIDDM) diabetes mellitus. The classification criteria are reported in Materials and methods

Identified patients with IDDM	$n = 141$
Prevalence of IDDM	0.07%
Identified patients with NIDDM	$n = 4362$
Prevalence of NIDDM	2.3%

Table 3. Clinical characteristics of patients with insulin-dependent (IDDM) and non-insulin-dependent (NIDDM) diabetes mellitus

	IDDM	NIDDM
Identified patients	3.7%	96.3%
Mean age (years)	30 ± 13	66 ± 8
Age at diagnosis (years)	19 ± 7	54 ± 15
Female	50%	52.5%
Male	50%	47.5%
Body mass index (kg/m^2)	24 ± 4	27 ± 4
Family history of diabetes	12%	39.9%
Overweight at diagnosis	9%	64.6%

The classification of diabetic patients into IDDM and NIDDM was accomplished by the combination of age at onset and insulin treatment as reported in Materials and methods. Using these criteria we found hat 141 patients had IDDM and 4362 NIDDM (Table 2). The clinical characteristics of the two groups are given in Table 3. Patients with IDDM represent 3.2% of the identified diabetic population (prevalence 0.07%). Their current mean age is 30 ± 13 years, while the mean age at onset of the disease was 19 ± 7 years. The age distribution at onset shows that most of the prevalent cases of IDDM (32.2%) occurred in the age group 21 to 25 years, while a lower rate (14.5%) was observed in the 11 to 15 years group (Fig. 1). A positive history of IDDM in first-degree relatives was reported from 12% of patients. Only 9% of patients was overweight (BMI > 25 kg/m^2) when diagnosed. The mean BMI found during this study was 24 ± 4 kg/m^2 (men 24 ± 3 kg/m^2; women 24 ± 6 kg/m^2).

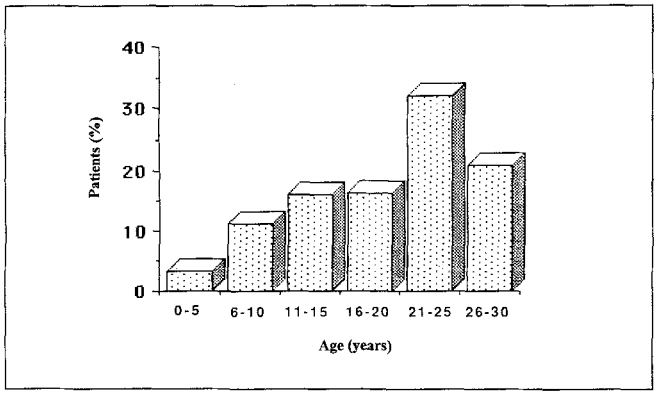

Fig. 1. Age distribution of insulin-dependent diabetes mellitus patients at onset

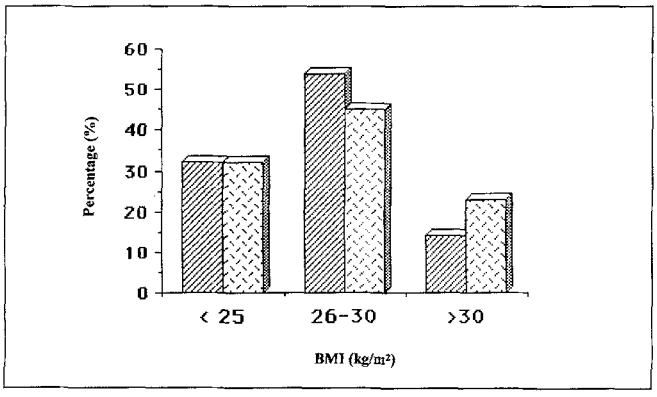

Fig. 2. Distribution of body mass index (BMI) in male (▨) and female (▧) patients with non-insulin-dependent diabetes mellitus

Table 4. Modes of therapy in patients with non-insulin-dependent diabetes mellitus (NIDDM)

Therapy	D	S	B	S+B	I	C
Patients:						
n	458	679	118	2040	1002	65
%	10.5	15.6	2.6	46.8	23.0	1.5

D, Diet; S, sulphonylureas; B, biguanides; I, insulin; C, insulin plus S or S/B

Finally, their mean insulin daily dose was 45 ± 18 IU with 2.5 ± 0.7 daily injections.

There were 4362 patients with NIDDM (96.8% of identified patients; 52.5% female) with a prevalence rate of 2.30%. Their mean age was 66 ± 8 years (men 65 ± 9 years; women 67 ± 9 years). The diagnosis of diabetes was first noted, on average, at the age of 54 ± 15 years. Some 39.9% had a positive family history of DM; 64.6% of these patients was overweight (BMI > 25 kg/m^2) when diagnosed. The current mean BMI is 27 ± 4 kg/m^2 (men 26.6 ± 4 kg/m^2; women 27.3 ± 3 kg/m^2). Some 32.5% of men had a normal weight (BMI < 25 kg/m^2), 54% was overweight (BMI 26–30 kg/m^2) and 14% obese (BMI > 30 kg/m^2). In women these figures are 32%, 45% and 23%, respectively (Fig. 2).

The pattern of treatment can be extrapolated from our data (Table 4): 10.5% of patients was treated only with diet, 23% with insulin, 65% with OHA and 1.5% with insulin and OHA combined. As for the use of hypoglycaemic drugs, the most widely prescribed therapy was biguanides and sulphonylureas combined (65.5%), while sulphonylureas and biguanides alone accounted for 15% and 3% of the total oral agents prescribed, respectively.

Discussion

The epidemiological studies concerning the prevalence of DM carried out so far have not supplied unequivocal data, probably because of the use of different methods and methodological defects [14, 15]. Pharmaceutical prescriptions of hypoglycaemic agents are undoubtedly an easily accessible source which reflects the diabetic population in a reliable way. The method does not require the cooperation of diabetic patients and is addressed to the entire diabetic population without age discrimination, a condition which is difficult to obtain in screening studies. On the other hand, with this survey method, all diabetic patients who are treated only with diet or are not known to have DM are missed. In order to overcome this problem, patients being treated only by diet were singled out, although probably not all of them, through the secondary sources. Nevertheless, the prevalence of DM we registered should be considered an underestimate as we do not really know the exact prevalence of DM patients treated only with diet, and we have no data for undiagnosed subjects.

It is of interest to compare our data with those obtained in other countries. Harris et al. [16] reported in an American population aged 20–74 years a specific prevalence of known DM of 3.4%, and Barret-Connor [17] in the Rancho-Bernardo study reported a specific prevalence of 6.01% in men and 3.27% in women in a 30–95 year group. In our study the specific prevalence in the 20–74 year group was 2.34%, and that for patients over 30 years old was 2.89% in men and 3.76% in women, respectively.

Compared with the prevalence of known DM in different European countries, the prevalence observed in this study is higher than that reported in British elderly people [18], lower than that for people living in north-east Scotland [19] and the same as that reported in Spain [14]. In Italy, this epidemiological method has been employed to evaluate the prevalence of known DM in other areas. The prevalence reported in the study performed in Casale Monferrato (Turin) was 2.2% [7], in Cremona 3.2% [3], in Foligno (Perugia) 3.3% [20] and in Pozzuoli (Naples) 2.4% [4]. Moreover, in Vicenza [5], a survey based on prescriptions and hospital discharge records, without referring to the family doctors, found a DM prevalence of 2.07%. These results, taken together, show that the overall Italian prevalence of known DM appears to be about 2%–3%.

The age-related prevalence of DM is rather low in the first four decades of life; afterwards, it increases rapidly. Thus, for patients aged > 75 years it reaches 13.5% in

men and 6.19% in women. This trend is similar to that reported in other studies [21].

In this study the classification of diabetic patients into either IDDM or NIDDM was accomplished according to the age at onset of diabetes and the presence of insulin therapy; patients diagnosed after 30 years of age were thought to have NIDDM. The prevalence of IDDM found in this survey (0.07%) matched that observed in Turin (0.08%) [7] and Vicenza (0.068%) [5].

As for the therapeutic pattern this study shows that patients with NIDDM are mainly treated with OHA, while only one patient out of five uses insulin. This relatively low use of insulin to treat NIDDM is clearly in sharp contrast to the use of insulin reported elsewhere [24].

In conclusion, drug prescriptions monitoring and validation represent a quick, inexpensive, non-invasive method to estimate the prevalence of known DM and to identify a population-based cohort of diabetic patients suitable for further clinical and epidemiological studies.

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