Prevalence and treatment of diabetes in France:
Trends between 2000 and 2005

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Abstract

Aims. – To estimate the prevalence of diabetes mellitus in France from 2000 to 2005, to monitor changes in its medical management and to determine the resultant costs to the French national healthcare system.

Methods. – Using patients’ data from the permanent sample of healthcare affiliates, we defined a treated diabetic patient as anyone who had been reimbursed for insulin or oral hypoglycaemic drugs at least twice within one calendar year.

Results. – The prevalence of treated diabetic patients in 2005 in the French population covered by the general healthcare scheme was 3.6% (±0.1). The average annual increase between 2000 and 2005 was 5.7%, of which 0.7% can be attributed to population ageing. In 2005, the maximum prevalence of treated diabetic patients among those aged 70–79 years was 17.7% for men and 11.5% for women. Cardiovascular risk factors associated with diabetes were treated more often with drug therapy in 2005 than in 2000. In 2005, 73.8% of diabetic patients were given antihypertensive drugs and 54.9% received cholesterol-lowering agents. In 2005, the annual cost of treatment with antidiabetic drugs and treatment of cardiovascular risk factors was 760 euros per diabetic patient.

Conclusion. – The number of treated diabetic patients greatly increased between 2000 and 2005. At the same time, their associated cardiovascular risk factors were more frequently managed by drug therapy. As a result, the total expenditures for the healthcare system for treating diabetes and its associated cardiovascular risk factors doubled in five years, amounting to 1.8 billion euros in 2005.

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Résumé

Prévalence du diabète et traitement des diabétiques en France : quelles évolutions entre 2000 et 2005 ?


Méthodes. – Étude réalisée à partir de l’échantillon permanent des assurés sociaux. Les personnes diabétiques traitées sont définies par le remboursement d’insuline ou d’antidiabétiques oraux à au moins deux reprises au cours d’une année calendrier.

Résultats. – En 2005, le taux de prévalence du diabète traité, en France métropolitaine, sur la population protégée par le régime général, était de 3.6 % (± 0.1). L’augmentation annuelle moyenne, entre 2000 et 2005, était de 5.7 %, dont 0.7 points dus au vieillissement de la population. En 2005, le taux de prévalence maximum était constaté dans la classe d’âge 70 à 79 ans, avec 17.7 % chez les hommes et 11.5 % chez les femmes. Les facteurs de risque cardiovasculaire associés au diabète étaient plus fréquemment traités par médicament en 2005 qu’ils ne l’étaient en 2000. En 2005, 73.8 % des diabétiques étaient traités par des antihypertenseurs et 54.9 % par des hypolipémiants. En 2005, le coût annuel du traitement médicamenteux antidiabétique et celui des facteurs de risque cardiovasculaire était de 760 euros par patient diabétique.


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Keywords: Diabetes; Prevalence; Cost; Cardiovascular risk factor; France

Mots clés : Diabète ; Prévalence ; Coût ; Facteurs de risque cardiovasculaire ; France

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1. Introduction

Diabetes mellitus, a chronic disease with significant social and economic consequences, is a major health problem in France. In November 2001, a national programme directed at its management was put in place [1]; in addition, two chapters concerning this problem were written into the public health laws of August 2004 [2]. In most countries, the prevalence of type 2 diabetes is rapidly increasing [3,4], and in the future, this will generate expenditures that national healthcare budgets will have difficulty to afford [5]. In France, the increase in obesity [6], the ageing of the population and more widespread diabetes screening [7] are all estimated to result in a diabetic population of 2.8 million individuals, or a prevalence of approximately 4.5% by 2016 [8]. This mathematical projection is partly based on data published by the Caisse nationale d’assurance maladie des travailleurs salariés (CNAMTS) for 1998 and 2000, which calculated that the prevalence of treated diabetes mellitus was 2.96% of the population covered by the general healthcare scheme in 2000, with an average annual increase of 3.2% between 1998 and 2000 [9,10].

The main aim of the present study was to update the overall prevalence of treated diabetes by age and gender for the period between 2000 and 2005 by using reimbursement data from the permanent sample of healthcare affiliates (EPAS). Treated diabetic patients were defined as anyone who had been prescribed, and received reimbursement for, insulin and/or any hypoglycaemic agent at least twice within the same calendar year. At the same time, we studied changes in the therapeutic options used (hypoglycaemic agents, antihypertensive drugs, cholesterol-lowering agents and antiplatelet agents) as well as the cost of their reimbursement by the healthcare system. Indeed, the accepted medical guidelines advise that type 2 diabetic patients be aggressively treated, including, when necessary, a combination of several hypoglycaemic agents to obtain normal blood sugar levels and to prophylactically treat associated cardiovascular risk factors [11–14].

2. Methods

2.1. Data collection

We used data from the permanent sample of healthcare affiliates, a representative sample set up by the CNAMTS each year from 1983. These data allowed us to study the nature of the healthcare reimbursed to 70,000 healthcare affiliates. The permanent sample of healthcare affiliates is an anonymous panel registered with the national committee on computer information and liberties (CNIL). Affiliates included in the panel are all enrolled in the general healthcare scheme, excluding sister healthcare schemes (such as students’ schemes and those insuring employees of the national educational system). The general healthcare scheme funded healthcare for 75% of the French population, or 47.1 million individuals, in 2005. Panel affiliates were selected through their national identification number (NIR), and the survey plan ensures that the sample remains representative of the general population [15]. All of the healthcare benefits received by individuals in the sample are tied to a specific individual identification number for reimbursed drugs. The database is updated each month by electronic data transmission or paper reimbursement forms, which beneficiaries or practitioners send to their local healthcare offices for reimbursement of the medicines purchased. Individuals are added to or removed from the permanent sample of healthcare affiliates according to changes in status such as births, deaths or when a new national identification number is allocated (as when a dependent reaches adulthood or a beneficiary becomes an affiliate). The sample is used for the biannual health and social protection survey [16], carried out by the institute on research and documentation in health economics (IRDES).

As there is a direct one-to-one relationship between diabetes treatment with drug therapy and reimbursement for oral hypoglycaemic agents and/or insulin, the permanent sample of healthcare affiliates is useful for identifying diabetic patients who are receiving diabetic medicines. For any given year, we can determine the population of treated diabetic patients: individuals covered by the general healthcare scheme, excluding sister healthcare schemes, who lived in metropolitan France and received reimbursements at least twice during one calendar year for oral hypoglycaemic agents and/or insulin. For each year from 2000 to 2005, we used the permanent sample of healthcare affiliates to obtain the list of the diabetic patients, with, for each patient, the detail of his healthcare consumption in the year. For the three overseas French populations, we calculated only the 2005 prevalence as the drug identification system was still incomplete up to 2003.

2.2. Statistical analyses

The prevalence of treated diabetes in a given year was defined as the number of individuals treated with oral hypoglycaemic agents or insulin during that year out of 100 people who were still alive on 31 December. Using the permanent sample of healthcare affiliates, the prevalence was calculated in affiliates covered by the general healthcare scheme. Finally, to correct for the effect of ageing in the population on changes in prevalence of treated diabetics between 2000 and 2005, we standardized the prevalence using the age pyramid of the 2000 reference population published by the national institute for statistics and economic studies (Insee).

In addition, we used reimbursement data gathered from the sample to calculate the average annual cost of oral hypoglycaemic agents or insulin per treated patient between 2000 and 2005, and the average cost of treating their associated cardiovascular risk factors. We then estimated the total annual cost of treatment for all diabetic patients in metropolitan France using the same method as for determining prevalence.

To estimate the confidence intervals with a risk of 5%, we used estimations of variance in randomized surveys at the rate of $f = 1/600$, as well as the normal approximations valid for large-scale samples. Although the survey plan was based on a random-cluster design, we chose to use approximations for a simple randomized survey, as the cluster effect is weak for two reasons. First, a cluster represents one affiliate, and
Table 1
Changes in raw prevalence data, characteristics and management modalities in patients treated with oral hypoglycaemic agents and/or insulin between 2000 and 2005 in metropolitan France (general healthcare scheme)

<table>
<thead>
<tr>
<th>Year</th>
<th>Crude prevalence (%)</th>
<th>Men (%)</th>
<th>Average age (all therapeutic modalities) (years)</th>
<th>ALD 30 statusa (%)</th>
<th>Treated with OHA alone (%)</th>
<th>Treated with insulin alone (%)</th>
<th>Treated with insulin + OHA (%)</th>
<th>Treated with sulphonamidesb (%)</th>
<th>Treated with biguanidesb (%)</th>
<th>Treated with AGIb (%)</th>
<th>Treated with glitazonesb (%)</th>
<th>Treated with at least three classes of OHAc (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2.7 ± 0.1</td>
<td>52.7 ± 2.2</td>
<td>64.4 ± 0.6</td>
<td>75.2 ± 1.9</td>
<td>13.0 ± 1.5</td>
<td>8.0 ± 1.2</td>
<td>66.1 ± 2.1</td>
<td>50.1 ± 2.2</td>
<td>18.3 ± 1.7</td>
<td>2.1 ± 0.6</td>
<td>0.0</td>
<td>10.7 ± 1.5</td>
</tr>
<tr>
<td>2001</td>
<td>2.9 ± 0.1</td>
<td>52.4 ± 2.1</td>
<td>64.5 ± 0.6</td>
<td>73.5 ± 1.8</td>
<td>12.8 ± 1.4</td>
<td>8.0 ± 1.1</td>
<td>63.4 ± 2.0</td>
<td>50.3 ± 2.1</td>
<td>18.2 ± 1.6</td>
<td>6.0 ± 1.0</td>
<td>0.0</td>
<td>10.7 ± 1.5</td>
</tr>
<tr>
<td>2002</td>
<td>3.1 ± 0.1</td>
<td>53.6 ± 2.0</td>
<td>64.4 ± 0.6</td>
<td>75.4 ± 1.7</td>
<td>12.6 ± 1.3</td>
<td>8.5 ± 1.1</td>
<td>60.0 ± 2.0</td>
<td>53.9 ± 2.0</td>
<td>17.0 ± 1.5</td>
<td>7.4 ± 1.1</td>
<td>0.3 ± 0.2</td>
<td>10.5 ± 1.4</td>
</tr>
<tr>
<td>2003</td>
<td>3.3 ± 0.1</td>
<td>54.3 ± 1.9</td>
<td>64.5 ± 0.5</td>
<td>77.2 ± 1.6</td>
<td>12.7 ± 1.3</td>
<td>9.6 ± 1.2</td>
<td>58.9 ± 1.9</td>
<td>53.8 ± 2.0</td>
<td>15.3 ± 1.4</td>
<td>8.3 ± 1.1</td>
<td>1.5 ± 0.5</td>
<td>9.5 ± 1.3</td>
</tr>
<tr>
<td>2004</td>
<td>3.5 ± 0.1</td>
<td>53.6 ± 1.9</td>
<td>64.5 ± 0.5</td>
<td>77.6 ± 1.6</td>
<td>13.6 ± 1.3</td>
<td>10.3 ± 1.2</td>
<td>56.8 ± 1.9</td>
<td>55.5 ± 1.9</td>
<td>14.0 ± 1.3</td>
<td>8.6 ± 1.1</td>
<td>4.2 ± 0.8</td>
<td>10.3 ± 1.3</td>
</tr>
</tbody>
</table>
| 2005 | 3.6 ± 0.1            | 53.6 ± 1.9 | 64.7 ± 0.5                                    | 76.1 ± 1.6        | 13.5 ± 1.3               | 10.4 ± 1.1                  | 54.6 ± 1.9                  | 58.0 ± 1.8                 | 11.9 ± 1.2               | 8.1 ± 1.0        | 8.9 ± 1.1        | 12.4 ± 1.4 \n
AGI: alpha-glucuronidase inhibitors; OHA: oral hypoglycaemic agents.
Source: CNAMTS-direction for strategy, studies and statistics.

a Long-term disorder included in a list of 30 severe and costly disorders.
b Reimbursed for at least one of these drugs during the year.
c Of those treated solely with oral hypoglycaemic agents.

all beneficiaries who are registered under his national healthcare identification number – usually children and, in certain cases, his unemployed spouse. These clusters are small and of comparable size. Second, the survey plan of the permanent sample of healthcare affiliates anticipated a large number of clusters. In addition, in the particular case of diabetes, most of the clusters only contain one individual so that a given cluster is usually equivalent to one person. This fact allowed us to use the same reasoning as for simple randomized clusters.

All statistical measures, from data extraction to analysis of the results, were performed with the software package statistical analysis system (SAS) for Windows, version 9.1.

3. Results

3.1. Epidemiology of diabetes

In 2005, the prevalence of treated diabetes in metropolitan France was 3.6% (±0.1) (Table 1) in the population covered by the general healthcare scheme. The average annual increase between 2000 and 2005 was 5.7%, of which 0.7% was due to population ageing. In 2005, the prevalence of treated diabetes in the three overseas French territories was estimated to be 7.7% (±1.0), derived from: 10.1% (±2.2) in Guadeloupe; 7.9% (±2.1) in Martinique; and 7.4% (±1.4) in Reunion Island.

Insulin is being prescribed more and more often to diabetic patients. Indeed, in 2005, 23.9% of diabetic patients were treated with insulin alone or in combination with hypoglycaemic agents compared with 21.0% in 2000. In 2005, 79.3% of the diabetic patients were exonerated from all co-payments and fully reimbursed for their medical care (ALD 30)\(^1\) by the healthcare fund compared with 75.2% in 2000.

In 2005, the average age of diabetic patients was 64.7 years (standard deviation: 14.0 years) and 53.6% of treated diabetic patients were male. Analysis of the prevalence in each age group showed significant differences according to patients’ age and gender. The prevalence of diabetes increased with age, up to 80 years. In 2005, the maximum prevalence was found in those aged 70–79 years, and was 17.7% men and 11.5% women. At any comparable age between ages 40 and 90 years, men had 1.5 times the risk of diabetes compared with that of women. Between 2000 and 2005, the prevalence of treated diabetes increased across all ages in both men and women, but was particularly notable in the older age groups (Table 2).

During the six-year study period, the annual death rate was 2.3% (±0.1), with an average age at death of 75.2 years.

3.2. Medical management and cost of diabetes medications

The therapeutic management of diabetes changed between 2000 and 2005: biguanides were more frequently prescribed and overtook sulphonylureas; glitazones were introduced and were prescribed to one in 10 diabetic patients; and several different hypoglycaemic agents were more frequently prescribed in combination.

\(^1\) The category of long-term disorders was put in place at the launch of the French national health insurance system to provide maximum reimbursement to patients with chronic illnesses requiring prolonged treatments and especially expensive care. Since 1987, the list (ALD 30) of 30 long-term disorders such as malignant tumours, diabetes, chronic psychiatric disorders and coronary artery disease exonerates affected patients from all co-payments.

Table 2
Prevalence in patients treated with oral hypoglycaemic agents and/or insulin in metropolitan France according to age group and gender between 2000 and 2005 (general healthcare scheme)

<table>
<thead>
<tr>
<th></th>
<th>2000 (%)</th>
<th>2001 (%)</th>
<th>2002 (%)</th>
<th>2003 (%)</th>
<th>2004 (%)</th>
<th>2005 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0 to 9 years</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>10 to 19 years</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>20 to 29 years</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>30 to 39 years</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>40 to 49 years</td>
<td>2.3</td>
<td>2.2</td>
<td>2.4</td>
<td>2.5</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>50 to 59 years</td>
<td>5.9</td>
<td>6.3</td>
<td>6.7</td>
<td>7.0</td>
<td>7.2</td>
<td>7.5</td>
</tr>
<tr>
<td>60 to 69 years</td>
<td>11.6</td>
<td>12.4</td>
<td>12.6</td>
<td>13.7</td>
<td>14.0</td>
<td>14.2</td>
</tr>
<tr>
<td>70 to 79 years</td>
<td>13.8</td>
<td>14.6</td>
<td>16.2</td>
<td>17.1</td>
<td>17.7</td>
<td>17.7</td>
</tr>
<tr>
<td>80 to 89 years</td>
<td>9.4</td>
<td>10.9</td>
<td>12.0</td>
<td>11.9</td>
<td>13.5</td>
<td>14.7</td>
</tr>
<tr>
<td>90 years and older</td>
<td>3.6</td>
<td>3.5</td>
<td>7.1</td>
<td>6.1</td>
<td>4.8</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Women

<table>
<thead>
<tr>
<th></th>
<th>2000 (%)</th>
<th>2001 (%)</th>
<th>2002 (%)</th>
<th>2003 (%)</th>
<th>2004 (%)</th>
<th>2005 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 9 years</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<td>&lt;0.1</td>
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<td>&lt;0.1</td>
</tr>
<tr>
<td>10 to 19 years</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
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<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>20 to 29 years</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>30 to 39 years</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>40 to 49 years</td>
<td>1.3</td>
<td>1.5</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>50 to 59 years</td>
<td>4.1</td>
<td>4.2</td>
<td>4.5</td>
<td>4.6</td>
<td>4.6</td>
<td>5.1</td>
</tr>
<tr>
<td>60 to 69 years</td>
<td>6.2</td>
<td>6.5</td>
<td>6.9</td>
<td>7.1</td>
<td>8.2</td>
<td>8.3</td>
</tr>
<tr>
<td>70 to 79 years</td>
<td>9.8</td>
<td>10.8</td>
<td>10.6</td>
<td>10.9</td>
<td>11.5</td>
<td>11.5</td>
</tr>
<tr>
<td>80 to 89 years</td>
<td>7.3</td>
<td>7.8</td>
<td>8.6</td>
<td>9.7</td>
<td>10.7</td>
<td>10.8</td>
</tr>
<tr>
<td>90 years and older</td>
<td>7.1</td>
<td>7.5</td>
<td>7.6</td>
<td>6.7</td>
<td>6.6</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Source: CNAMTS-direction for strategy, studies and statistics.

Cardiovascular risk factors associated with diabetes were more frequently treated with drugs in 2005 than in 2000. In 2005, antihypertensive agents were prescribed to nearly three out of every four diabetic patients, antiplatelet agents to one out of three patients and cholesterol-lowering agents to 55% of all diabetic patients. The percentage of patients treated with statins grew from 23.9% in 2000 to 40.3% in 2005 (Table 3).

In 2005, the average cost of diabetes treatment for each patient was 312 euros (±11) whereas, in 2000, the average cost was 237 euros (±9). This corresponds to a 31.8% increase over five years, or an annual increase of 5.7%. If the cost of treating associated cardiovascular risk factors is included, the average additional cost was 448 euros per patient in 2005, making a total cost of 759 euros per patient, or a 41.1% increase over five years (Table 4). For the entire diabetic population covered by all healthcare schemes in metropolitan France, the cost of drug therapy for diabetes can be estimated to have increased from 0.9 billion euros in 2000 to 1.8 billion euros in 2005.

4. Discussion

4.1. Data from the general healthcare scheme for treated diabetic patients

From the start of 1999 to the beginning of 2001, the prevalence of antidiabetic treatments in the diabetic population covered by the general healthcare scheme in metropolitan France increased from 2.78 to 2.96%, irrespective of the therapeutic modality employed [10]. Between 2001 and 2005, the prevalence found in the permanent sample of healthcare affiliates

Table 3
Changes in treatment strategy for cardiovascular risk factors in patients treated with oral hypoglycaemic agents and/or insulin in metropolitan France between 2000 and 2005 (general healthcare scheme)

<table>
<thead>
<tr>
<th></th>
<th>2000 (%)</th>
<th>2001 (%)</th>
<th>2002 (%)</th>
<th>2003 (%)</th>
<th>2004 (%)</th>
<th>2005 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated with antihypertensive medicationsab (%)</td>
<td>68.7 ± 2.0</td>
<td>69.3 ± 1.9</td>
<td>70.1 ± 1.8</td>
<td>71.7 ± 1.8</td>
<td>71.4 ± 1.7</td>
<td>73.8 ± 1.6</td>
</tr>
<tr>
<td>Including ACE inhibitors/sartans (%)</td>
<td>45.0 ± 2.2</td>
<td>46.9 ± 2.1</td>
<td>49.2 ± 2.0</td>
<td>52.9 ± 2.0</td>
<td>54.4 ± 1.9</td>
<td>57.0 ± 1.8</td>
</tr>
<tr>
<td>Treated with cholesterol-lowering agents (%)</td>
<td>42.7 ± 2.2</td>
<td>44.7 ± 2.1</td>
<td>45.9 ± 2.0</td>
<td>49.3 ± 2.0</td>
<td>52.1 ± 1.9</td>
<td>54.9 ± 1.9</td>
</tr>
<tr>
<td>Including statins (%)</td>
<td>23.9 ± 1.9</td>
<td>26.2 ± 1.8</td>
<td>28.0 ± 1.8</td>
<td>32.1 ± 1.8</td>
<td>37.1 ± 1.8</td>
<td>40.3 ± 1.8</td>
</tr>
<tr>
<td>Treated with PAA (%)</td>
<td>25.8 ± 1.9</td>
<td>26.7 ± 1.9</td>
<td>28.0 ± 1.8</td>
<td>29.7 ± 1.8</td>
<td>31.5 ± 1.8</td>
<td>32.2 ± 1.7</td>
</tr>
<tr>
<td>Including low-dose aspirin (%)</td>
<td>22.4 ± 1.8</td>
<td>23.0 ± 1.8</td>
<td>23.6 ± 1.7</td>
<td>24.4 ± 1.7</td>
<td>25.4 ± 1.7</td>
<td>25.6 ± 1.6</td>
</tr>
</tbody>
</table>

ACE: inhibitors, angiotensin-converting enzyme inhibitors; PAA: antiplatelet aggregation agents.

Source: CNAMTS-direction for strategy, studies and statistics.

a Reimbursed at least once for a medication in this therapeutic class during the year.
b Medications approved for this indication.
increased from 2.9% (±0.1) to 3.6 (±0.1), which suggests that the prevalence of diabetes in 2016 will probably be higher than expected [8]. Indeed, the prevalence calculated with the permanent sample of healthcare affiliates data for 2005 (3.8%) already exceeds the highest projections formulated by Bonaldi et al. for 2006 (3.6%) [8]. This suggests that France will not escape the worldwide diabetes epidemic predicted over the past few years and which, according to the experts, may translate to a prevalence superior to 9% in Europe and approaching 10% in North America by 2025 [4]. Moreover, the prevalence of diabetes in the adult populations of Canada and the United States was already 4.8% [17] and 4.3% [18], respectively, in 1998.

In the French overseas populations, the raw prevalence data for treated diabetes in 2005 was much greater than in metropolitan France: 10.1% (±2.2) in Guadeloupe; 7.9% (±2.1) in Martinique; and 7.4% (±1.4) in Reunion Island. These high prevalences are in agreement with the previously published data. In fact, in Reunion Island, the declared prevalence of diabetes in the adult population was 9.4% [19]. In Martinique, a 2004 study of the population aged superior than 15 years [20] found a prevalence of treated diabetes of 6.5%. These high percentages overseas are probably related to a higher rate of genetic risk factors, precarious socioeconomic living conditions and rapid changes in lifestyle.

The rapid increase in diabetes prevalence in metropolitan France is due to a combination of various factors, the foremost being the increase in obesity, affecting 12.4% of the adult population in 2006 [21]. This factor is expected to account for 47% of the foreseeable increase in the number of diabetic patients by 2016 [8]. Moreover, three other factors also contribute to the increase in the prevalence of treated diabetes. In addition to demographic considerations such as an ageing population and the massive arrival of age groups with a high risk for diabetes, represented by the “baby boom” generation born between 1945 and 1950, the steady increase in the life expectancy of people with diabetes will also boost its prevalence. Furthermore, changes in the medical management of diabetes – in particular, better screening and greater recognition of the need to treat all anomalies of glucose metabolism – will inevitably influence the number of patients treated. The gradual lowering of the diagnostic threshold from 1.4 g/L (7.8 mmol/l) to 1.26 g/l (7.0 mmol/l) between 1998 and 2000 may also have contributed to an increase in treated patients. It is also possible that patients are being treated for, for example, so-called “impaired fasting glucose” (IFG), in the absence of a firm diagnosis of diabetes. However, our study design excluded patients diagnosed with diabetes, but not receiving any diabetic medication, as indicated by their not appearing on the reimbursement database of the general healthcare scheme. Undiagnosed diabetic patients, albeit relatively infrequent in France, are even more likely to escape detection; the prevalence is estimated to be 1.4% in the population superior than 65 years [22] and 0.67% in those inferior than 65 years who have at least two risk factors for diabetes [23].

A comparison of patients’ age and gender distribution gave similar results in the populations treated with antidiabetic medications between the beginning of 1999 and 2005. The male predominance noted in 2005 (53.6% of treated diabetic patients were men) was already evident both in 1999 [9] and in a cohort of diabetic patients in the ENTRED study [24]. The average age of diabetics in 2005 (64.7 years) was only slightly higher than in 1999 (64.3 years). The male predominance according to age was 14.2% at age 60–69 years and 17.7% at age 70–79 years. These results are similar to those published earlier in the DECODE study, involving 13 European countries [25]. That study was also designed to analyze the causes of death and to estimate the excess mortality attributable to diabetes, and found that the annual death rate from all causes in diabetic patients was 2.0%. In the patient sample from the EPAS, the annual death rate in diabetics during 2000–2005 was 2.3%, with death occurring several years earlier in diabetics compared with the general population (age 75.2 versus 79.6 years) [26].

The management of diabetes is based on appropriate long-term lifestyle measures, including getting enough exercise, correcting major dietary errors, taking prescribed medicines regularly and treating all associated cardiovascular risk factors. Between 2000 and 2005, the drug management of diabetes evolved considerably. The percentage of patients treated with biguanides increased from 50.1 to 58.0%, which is in agreement with the accepted medical guidelines which state that metformin should be preferentially prescribed, especially in overweight diabetic patients [11–13]. The accepted guidelines also encourage the concomitant use of several oral hypoglycaemic agents rather than monotherapy as part of the early intensification in treatment. In addition, the management guidelines recommend that insulin be introduced as soon as it becomes evident that maximum doses of two or three different oral hypoglycaemic agents do not satisfactorily reduce blood-sugar levels. This is especially
important as the percentage of patients considered poorly controlled (HbA1c > 8%) was estimated to be 25.1% in ENTRED [27] and 45.6% according to the MEDIAB study [28]. The proportion of patients treated with both insulin and oral hypoglycaemic agents increased from 8.0% in 2000 to 10.4% in 2005, suggesting that physicians are more aggressive in addressing the issue of blood-sugar control, an approach that should eventually result in better overall sugar control in the diabetic population. The same is true for the glitazones, which only became available to the public in 2002. Initially, they were deemed second-line drugs, only to be used when an oral hypoglycaemic agent failed when used on its own; however, since 2004, glitazones can now be used as a stand-alone treatment.

Dyslipidaemia and diabetes are frequently associated with, and lead to, a cumulative risk of cardiovascular complications [29,30]. Depending on the country, between 38 and 60% of all diabetic patients have dyslipidaemia [13]. Most experts consider that statins should be prescribed to these patients, although fibrates can be considered when the patient’s LDL cholesterol is normal, when elevated triglycerides are associated with low levels of HDL cholesterol or when triglycerides are extremely elevated [31]. In this context, the considerable increase in the number of patients treated with statins, from 23.9 to 40.3% between 2000 and 2005, has probably resulted in a reduction of cardiovascular risk in the diabetic population. This is all the more true considering that simvastatin (since 2003) and atorvastatin (since January 2006) are now indicated for primary cardiovascular prevention in high-risk diabetic patients with or without associated hyperlipidaemia. At the same time, the number of diabetic patients treated with antihypertensive medications has notably increased since 2000, reaching 73.8% in 2005. This is not surprising, as most experts consider that between 50% and 74% of patients with type 2 diabetes already had high blood pressure when their diabetes was diagnosed [13]. High blood pressure can also be caused by progressive kidney impairment. Finally, the risk of a cerebrovascular accident, myocardial infarct or sudden cardiovascular death is two to four times higher in diabetic patients than in the general population [12]. As a result, most experts recommend that, for primary prevention, diabetic patients should take low-dose aspirin when other cardiovascular risk factors are present, in particular, hypertension [12,13]; antiplatelet agents, notably clopidogrel, should be reserved for secondary prevention. In 2005, only 32.2% of all diabetic patients took antiplatelet agents, and eight out of 10 of those that did took low-dose aspirin.

In 2005, 79.3% of all treated diabetic patients were exonerated from co-payments as diabetes is one of the 30 long-term disorders (ALD 30) listed in the statutes of the general healthcare scheme; in comparison, in 1998 [32], only 69.7% were similarly exonerated from co-payments under the same statutes. The increase in diabetic patient requests for exoneration may have been linked to the increase in treatment costs. Indeed, the annual amount reimbursed to patients taking antidiabetic medications increased from 538 euros in 2000 to 759 euros in 2005, an average annual increase of 7.1%. Of this significant increase in the total costs of treatment for these patients, 66% is down to the more frequent and more costly treatment of associated cardiovascular risk factors.

5. Limitations and validity of the results

To determine the prevalence of treated diabetes in France, we selected individuals who had a prescription filled for an oral hypoglycaemic agent or insulin on at least two different dates during the year. Thus, our study was based on the identification of medications that were reimbursed to healthcare affiliates using a specific drug-coding system. In 2000, 89.0% of all medications were coded and, in 2005, this figure reached 98.1%. Since all reimbursement data are electronically transmitted by pharmacies to the healthcare scheme, the risk of error in the identification of a barcode for a given medication is virtually zero. In addition, because we selected patients over a 12-month period during which they had a prescription filled, theoretically corresponding to 12 different prescriptions, we feel confident that we were able to identify virtually all diabetic patients prescribed antidiabetic medications. Furthermore, we selected at least two filled prescriptions during the study year to be certain that the selected individual was the treated patient, and to ensure that no mistake was made in terms of a beneficiary in the same family using the same healthcare identification card (carte vitale) as the affiliate.

6. Conclusion

One of the most remarkable findings of the present study was the vast improvement in the medical management of cardiovascular risk factors in patients treated for diabetes (hypertension, hyperlipidaemia and even prophylaxis for cardiovascular diseases).

Given the increased number of treated diabetic patients (2.3 million in 2005), the more frequent prescription of drugs to prevent cardiovascular risk factors resulted in a doubling of the cost of medications to treat diabetes over five years, accounting for 1.8 million euros in 2005. This highlights the enormous economic stakes of prophylactic measures such as the fight against obesity and, in general, all cardiovascular risk factors. If the steady increase in the number of diabetic patients continues, the costs involved in their drug treatment may soon put a severe strain on public resources. While patient management needs to be optimized, an open debate on the economic aspects becomes necessary when public funding is limited. French guidelines in the future should take a more systematic approach towards cost-effectiveness with the use of multidisciplinary teams. The equitable sharing of healthcare costs urgently requires a genuine debate [33] among all of those concerned, and should not be limited solely to clinical experts.

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