Prevalence of diagnosed type 2 diabetes mellitus in the French general population: The INSTANT study

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Abstract

Aims. – To estimate the prevalence of diagnosed type 2 diabetes mellitus in the French general population. Secondary objectives were to evaluate treatments and diabetic complications.

Methods. – In this cross-sectional epidemiological survey, a representative sample of the French adult population was selected using a stratified quota method: 10,038 individuals were evaluated by a standardized face-to-face interview. The diagnosis of type 2 diabetes was determined on the basis of replies to six questions using a specific algorithm. Data were collected on risk factors, diabetes history, familial antecedents and diabetic complications. These patients also identified their treatments from an exhaustive list.

Results. – The prevalence of type 2 diabetes was 5.08% in men and 4.11% in women, and rose progressively after the age of 50. Of these, 79 patients (13.4%) received no pharmacological treatment, 477 (80.9%) were taking an oral antidiabetic drug and 134 (22.7%) were taking insulin. Renal and ocular complications were reported by 6.8% and 21.0%, respectively, of the patients. Also, 10.4% had been hospitalized at some time of that year for a diabetes-related problem. The most frequently reported treatments were metformin and sulphonylureas, used by more than 50% of the patients. In addition, 380 patients (65.9%) claimed to be following a diet and 228 (39.2%) were consulting a dietitian.

Conclusion. – The prevalence of treated and untreated type 2 diabetes mellitus in France was 4.57%.

Résumé

Prévalence du diabète de type 2 diagnostiqué dans la population générale française : étude INSTANT.

Objectifs. – Estimer la prévalence du diabète de type 2 en population générale française. Les objectifs secondaires étaient d’évaluer les traitements et les complications diabétiques.

Méthodes. – Dans cette étude épidémiologique transversale, un échantillon représentatif de la population adulte française a été constitué à l’aide de la méthode stratifiée des quotas. Dix mille trente-huit personnes ont été interrogées lors d’une interview standardisée en face à face. Un diagnostic de diabète de type 2 était posé à partir des réponses données à six questions selon un algorithme spécifique. Des données ont été recueillies concernant les facteurs de risque, l’histoire du diabète, les antécédents familiaux et les complications diabétiques. Les patients ont identifié les traitements à partir d’une liste exhaustive.

Résultats. – La prévalence du diabète de type 2 était de 5,08 % chez les hommes et de 4,11 % chez les femmes, et augmentait progressivement avec l’âge à partir de 50 ans. Soixante-dix-neuf patients (13,4 %) ne recevaient pas de traitement médicamenteux ; un traitement antidiabétique oral était prescrit à 477 patients (80,9 %) et de l’insuline à 134 (22,7 %). Des complications rénales ont été rapportées par 6,8 % des sujets et des complications oculaires par 21,0 % d’entre eux. Dans 10,4 % des cas, on relevait une hospitalisation à l’occasion d’un problème lié au diabète. Les traitements les plus fréquemment rapportés étaient la metformine et les sulfonylurées utilisées par plus de 50 % des patients. Trois cent quatre-vingt patients (65,9 %) ont déclaré avoir suivi un régime et 228 (39,2 %) avoir consulté un diététicien.

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1. Introduction

The prevalence of diabetes is rising rapidly across the globe [1,2], due in part to ageing of the population as well as changes in dietary habits and a sedentary lifestyle that have led to an increasing prevalence of obesity. The World Health Organization (WHO) has estimated that type 2 diabetes will affect over 366 million people by 2030 [2]. Given the high mortality associated with the disease, primarily due to macrovascular complications, type 2 diabetes is a major public-health concern. Moreover, diabetes is the principal cause of terminal renal insufficiency, adult-onset blindness and lower-limb amputation in Western Europe.

In France, three successive pharmacoepidemiological studies have derived prevalence rates for treated diabetes from medication reimbursement claims to the French National Health Service. These rose from 2.78% in 1998 to 2.96% in 2000 [3] and 3.80% in 2005 [4], a rate increase of over 30%. The authors of the latter paper estimated that the prevalence of treated diabetes rises by an average of 5.7% each year, that if maintained, predicted a prevalence rate of 4.2% in 2007 [4]. A national postal survey of the prevalence of obesity (ObEpi) conducted in 2006 reported that 4.2% of nearly 25,000 responders to the survey were prescribed a treatment for diabetes, compared with 3.1% of an identical survey performed in 2000 [5]. While it is likely that some of this increase may be explained by the currently more proactive treatment approach, these findings are nevertheless indicative of a rapidly rising prevalence of the disease.

In the light of the increasing prevalence of type 2 diabetes, it is important – from a public-health perspective – to obtain accurate and up-to-date information on prevalence rates in the general population to both anticipate the need for healthcare resources and monitor the impact of public health policies aimed at improving diabetes prevention or control. However, these data are relatively difficult to obtain due to the limited public awareness of the distinction between type 1 and type 2 diabetes, and the limitations of the available methods of data collection. For example, surveys based on prescription data for oral antidiabetic drugs (OAD) and insulin underestimate prevalence rates because they do not identify untreated diabetic patients.

For these reasons, we have designed a general population survey of type 2 diabetes to overcome these obstacles as much as possible. The primary objective of the present study was to estimate the prevalence of diagnosed type 2 diabetes patients in the French general population. Secondary objectives were to estimate the prevalence of metabolic risk factors, treatments, diabetic complications and quality of life. Data on metabolic risk factors and quality of life will be presented in detail in subsequent reports.

2. Methods

This cross-sectional epidemiological survey of type 2 diabetes in the general population was conducted in France between September and November of 2006.

2.1. Study sample

A representative sample of the general population aged above 18 years was selected, using a stratified quota method, from a list of addresses generated by a random walk. Interviewers were expected to recruit a fixed quota of participants who fulfilled predetermined sociodemographic criteria for a given stratum. These strata were constructed from national population data based on the 1999 Institut national des statistiques et des études économiques (INSEE) report, updated in 2004, to ensure that it was representative in terms of gender (two categories), age (five categories), socioprofessional status (six categories), regional distribution (nine regions) by population size of place of residence (five categories) and employment status for women. Stratification by socioprofessional status and employment status in women was implemented to ensure that individuals who were at home all day were not overrepresented compared with individuals out at work. The target size for the entire sample was 10,000. The interviewers visited households in a predefined area in a random order to identify one member of the household matching the sociodemographic characteristics of the quota stratum. Interviewers were required to make at least four visits to the address to establish contact with an occupant, including in the evening and on Saturdays to maximize the chances of finding someone at home. When these attempts failed to generate a contact, interviewers moved on to the next address on their list. A face-to-face interview at a future date was proposed to each subject fulfilling the required sociodemographic criteria.

2.2. Data collection

Face-to-face interviews were conducted by 273 professional interviewers who had been specially trained by the Institut de sondages Lavialle (ISL®, Issy-les-Moulineaux, France), a polling organization. Data were collected using the computer-assisted personal interview (CAPI) method and Converso® software (developed by Converso®, France). The interview lasted approximately 20 minutes, with no gifts or incentives offered to participating subjects. As the first step, screening questions were asked during the face-to-face interview to collect sociodemographic data and identify those fulfilling the diagnostic criteria for diabetes in the INSTANT population.
Table 1
Questions used to identify subjects with type 1 and 2 diabetes in our survey.

| Q1. | Do you have diabetes? |
| Q2. | If so, was the diagnosis made by a physician? |
| Q3. | Do you take insulin regularly? |
| Q4. | Do you use or take any of the following tablets? (exhaustive list of OAD is presented) |
| Q5. | Were you diagnosed with diabetes before the age of 45? |
| Q6. | Were you treated with insulin in the two years following the diagnosis? |

In the second step, all those meeting the diagnostic criteria for diabetes were questioned in greater detail regarding metabolic risk factors, diabetic history, familial antecedents, diabetic complications and treatments for diabetes. In particular, these patients were asked whether or not their physician had ever mentioned that their kidneys or eyesight had been affected by the diabetes, or that they had arterial hypertension, angina pectoris, myocardial infarction, lower-limb arterial disease or cerebrovascular disease, or whether they had ever presented, or been treated for, anomalies in blood lipids or cholesterol.

2.3. Assignment of a diagnosis of type 2 diabetes

The six questions used to assign a diagnosis of diabetes are presented in Table 1. Replies to these questions assigned such a diagnosis using an algorithm adapted from that developed for the ENTRED study [6,7], a previous survey of diabetes in France, and which had also been used in the ECODIA2 study [8]. Three groups of participants were considered to have type 2 diabetes:

- the first group included all those who answered in the affirmative to Q1, Q2 and Q4;
- the second included those replying in the affirmative to Q1, Q2 and Q3, and in the negative to Q5;
- the third comprised those replying in the affirmative to Q1, Q2, Q3 and Q5, and in the negative to Q6.

During the course of the analysis, it became apparent that a small number of individuals who had replied in the negative, or that they did not know, to Q1 replied in the affirmative to Q4. These subjects were included retrospectively in the prevalence calculations.

2.4. Statistical analysis

Prevalence rates were determined with their 95% confidence intervals (CI). To generate overall population prevalence rates, the number of individuals aged less than 18 years was integrated into the prevalence calculation on a region-by-region basis. It was assumed that no one under that age would have type 2 diabetes. All tests were two-sided and a probability level of $P<0.05$ was considered significant. All data were controlled, validated and analyzed centrally using SAS software, version 8.2 (SAS Institute, Cary, NC, USA).

3. Results

3.1. Prevalence of type 2 diabetes mellitus

A total of 10,038 people were interviewed during the course of our INSTANT study, of whom 590 fulfilled the criteria for type 2 diabetes according to the diagnostic algorithm (Fig. 1). Of these:

- 464 (78.6%) reported a diagnosis of diabetes and use of an OAD;
- 79 (13.4%) had a confirmed diagnosis of diabetes, but were untreated;
- 26 (4.4%) had a diagnosis of diabetes after the age of 45, but were treated with insulin;
- 7 (1.2%) had a diagnosis before the age of 45, but no insulin treatment for at least two years.

In addition, 13 (2.2%) subjects did not report a diagnosis of diabetes, but were nevertheless being treated with an OAD.

Furthermore, 32 individuals had been diagnosed before the age of 45 and treated with insulin monotherapy within two years of the diagnosis. These individuals were considered to have type 1 diabetes.

Fig. 1. Flow diagram showing the identification of those with type 2 diabetes using the diagnostic algorithm. Subjects given the diagnosis are indicated by the grey boxes on the right. Those in the stippled box at the bottom were considered to have type 1 diabetes. The dotted lines indicate diagnoses assigned retrospectively. Questions Q1 to Q6 are listed in Table 1.
Prevalence rates were calculated on the basis of the 10,038 subjects interviewed, together with 2868 children under the age of 18, giving a total denominator for the sample population of 12,906 patients. The adjusted prevalence rate for type 2 diabetes was estimated to be 4.57% (95% CI: 4.16, 4.98).

Age- and gender-specific prevalence rates were also determined. The prevalence of type 2 diabetes was higher in men (5.08%) than in women (4.11%), and this gender-based difference in prevalence rose progressively with age, with a clear peak at around ages 50–80 years, after which age rates started to decline (Fig. 2).

3.2. Demographic and clinical features

These data are reported in Table 2 for the 577 subjects who were diagnosed with type 2 diabetes using the algorithm. Data are not available for the 13 subjects assigned a diagnosis retrospectively who did not fully reply to the study questionnaire. Men were slightly overrepresented (53.3%) in the study sample compared with women. The mean age was 64.6 ± 12.0 years for men and 62.8 ± 13.6 years for women; 21.3% were aged less than 55 years. The mean age at the time of diagnosis was 52.5 years. Nearly half the interviewees reported a first-degree relative who also had diabetes. Around two-thirds of the sample (n = 377; 65.3%) were aware of a recent fasting blood glucose, obtained by self-testing in around half these patients (n = 199; 57.7%). In contrast, the majority (n = 434; 75.2%) could not provide a value for their glycosylated haemoglobin either because they simply did not know it or because they had not been tested.

3.3. Diabetic complications and co-morbidities

Renal and ocular complications were reported by 6.8% and 21.0%, respectively, of the study sample (Table 3). Around one-tenth had been hospitalized at some time during the year for a diabetes-related problem. Cardiovascular disease – mostly arterial hypertension and coronary artery disease – was reported by 197 patients (34.1%).

3.4. Treatments

In the study sample (n = 590), 79 (13.4%) received no pharmacological treatment, 477 (80.9%) were taking an OAD and 134 (22.7%), some kind of insulin. Women were more likely than men (15.9% versus 11.9%, respectively) to use no pharmacological treatment. Recourse to drug treatment rose from 77.6% in the 34–54 age group to 91.4% in the over 75 years group. In particular, the use of insulin monotherapy rose progressively with age and included 10.2% of those aged above 75 years. Individual OAD treatments are listed in Table 4. The most frequently reported were metformin and sulphonylureas, used by more than 50% of those taking an OAD. Patients taking metformin tended to be somewhat younger than those taking sulphonylureas (data not shown). Patients who were overweight (BMI > 27 kg/m²) were more frequently taking metformin compared with non-overweight patients (60.9% versus 48.3%, respectively). No other drug class was used by more than 10%
Table 3
Diabetic complications and co-morbidities.

<table>
<thead>
<tr>
<th>Microvascular diabetic complications</th>
<th>Subjects (n = 577)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nephropathy</td>
<td>39 (6.8%)</td>
</tr>
<tr>
<td>Retinopathy</td>
<td>121 (21.0%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Macrovascular diabetic complications</th>
<th>Subjects (n = 577)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina pectoris</td>
<td>39 (6.8%)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>34 (5.9%)</td>
</tr>
<tr>
<td>Lower-limb arterial disease</td>
<td>34 (5.9%)</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>10 (1.7%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Co-morbidities</th>
<th>Subjects (n = 577)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial hypertension</td>
<td>103 (17.9%)</td>
</tr>
<tr>
<td>Hyperlipidaemiaª</td>
<td>149 (25.8%)</td>
</tr>
<tr>
<td>Hospitalization due to diabetes</td>
<td>60 (10.4%)</td>
</tr>
</tbody>
</table>

Note: subjects were considered to have nephropathy or retinopathy if they replied in the affirmative to the following questions: “Has your doctor ever told you that your diabetes has affected your kidneys?”; “Has your doctor ever told you that your eyesight is affected by your diabetes?” For other complications, patients were asked directly if they had these disorders.

ª Subjects were considered to have hyperlipidaemia if they replied in the affirmative to either of the following questions: “Do you have elevated blood levels of lipids or cholesterol?”; “Are you taking a treatment for blood lipid abnormalities?”.

of patients. Multiple OAD were being taken by 106 (17.9%) patients, and 100 (16.9%) patients were taking both an OAD and insulin.

As for diet and exercise, 380 subjects (65.9%) claimed to be following a diet and 228 (39.2%) were consulting a dietitian. However, 89 (15.4%) claimed to have gained significant weight over the previous year, with a mean weight gain of 6.3 ± 5.4 kg. The mean time spent walking or cycling per day was 64.1 ± 86.6 minutes. Overall, 8.7% of subjects (10.4% of men and 6.7% of women) reported regular physical activity of sufficient intensity to increase heart or respiratory rate significantly for at least 10 minutes and, on average, three times a week.

4. Discussion

This survey identified a peak prevalence rate of type 2 diabetes of 4.57% in France. Extrapolated to the whole of the French population, this would correspond to around 2.7 million individuals, an estimate that is higher than those previously provided by analyses of prescription-reimbursement claims. This difference may be explained mainly by the fact that previous studies could not include data on untreated patients. Indeed, if only those treated with OAD or insulin are considered in our study, the prevalence rate would drop to 3.98%, which is closer to the 3.8% reported in the most recent prescription-database study [4] and the 4.2% reported in the latest ObEpi postal survey [5]. On applying the annual prevalence growth rates determined from prescription surveys, the predicted prevalence of treated diabetes in 2007 would also be 4.2%.

We believe that the diagnostic algorithm used in our study identified virtually all patients with type 2 diabetes in our sample population [6]. In particular, untreated patients and those treated only with insulin were also identified. The algorithm excluded insulin-treated patients with type 1 diabetes by age at onset (45 years), and by a delay between diagnosis and start of insulin therapy of more than two years in younger subjects. Patients with type 2 diabetes less than 18 years of age would not have been identified in our survey, but such cases are unlikely to have been sufficiently common as to have significantly influenced our overall prevalence estimate. Another potentially untapped patient group are undiagnosed subjects. However, in a French survey conducted in primary care, involving 5950 individuals presenting with risk factors for diabetes who were systematically screened for dysglycaemia, the proportion of those with previously undiagnosed diabetes was less than 1% [9]. Another primary-care survey of above 50,000 individuals in Australia found that 2% of those with elevated fasting blood glucose were undiagnosed [10]. It is possible that there is a pocket of patients with undiagnosed diabetes who do not consult a general practitioner, but these individuals are, by definition, outside of the healthcare system and, thus, not relevant for public health initiatives for diabetes care. Finally, institutionalized individuals were not targeted by our survey, and such individuals are likely to have type 2 diabetes, given their age and morbidity. However, only 4% of elderly people in France live in institutions, and the lack of such cases in our survey is, thus, unlikely to introduce major error into our prevalence estimate. On the other hand, patients with diabetes are frequently hospitalized, and this may represent a pool of cases that were untapped by our survey and may, therefore, contribute to an underestimation in our prevalence rates. We identified 13 subjects who claimed to be taking OAD, yet did not report a diagnosis of diabetes. It is possible that these individuals were taking a drug such as metformin for another reason, such as polycystic ovary syndrome. However, in the absence of further information, these patients were considered diabetic for the purposes of our analysis. In any case, such patients do not contribute significantly to our prevalence estimate.
In contrast, this survey did not address the prevalence of type 1 diabetes with any accuracy, as children under 18 were not eligible for the survey. Although, it is reasonable to suppose that cases of type 2 diabetes are extremely rare in this age group, this is evidently not the case for type 1 diabetes, which is generally diagnosed during childhood or adolescence.

The proportion of patients reporting diabetic complications in our study appears to be low compared with previous reports [11] such as the CODIAB study in France [12]. This discrepancy could be explained by the fact that data were collected by patients’ self-reports rather than by having co-morbidities assessed systematically by a physician. A high proportion of patients were not able to provide a value for glycosylated haemoglobin, a situation that has not improved since the ENTRED study in 2001, in which only four patients out of 10 knew their HbA1c level [6]. This highlights an important challenge for patient education in diabetes.

As regards to treatments, we found that 16.9% of patients were taking insulin in combination with an OAD and 5.8% were using insulin alone. This proportion of patients is relatively high and probably reflects the impact of practice guidelines that recommend a more aggressive approach to insulin therapy to reduce the risk of diabetic complications, and the introduction of safer and more user-friendly insulin preparations. The increase in the proportion of patients with type 2 diabetes in France treated with insulin — from 5.1% in 1999 to 14.5% in 2005 — was revealed by two sequential primary-care surveys (ECODIA) [8,13]. In contrast to the 2005 ECODIA study, in which only 2.7% of patients followed in primary care managed their diabetes by diet and exercise alone, we found that 13.4% of our study population was taking no drug treatments. This surprisingly high rate may refer to a pool of individuals who have received a diagnosis of diabetes, but are not actively followed-up by their GP. This possibility needs to be evaluated in future studies and, if so, could be targeted by educational or awareness programmes directed at primary-care physicians as well as the general public.

The findings of the present survey are comparable to those of prevalence studies in other countries. Our prevalence rate is similar to the 4.7% reported for all types of diabetes in the general population of England in 2005 [14], although it was estimated that 28% of the sample were undiagnosed at the time, a much higher proportion than the undiagnosed patients in France (around 1%) [9]. Similarly, the Italian National Health Survey of 1999–2000, which used a methodology similar to the present study, reported prevalence rates of 4.3% for men and 4.8% for women [15]. Although this estimate is close to our own, the gender dominance is reversed. The SHIELD study in the US was a wide-ranging questionnaire-based general-population survey of 200,000 households carried out in 2004 [16]. This identified a prevalence rate for self-reported diabetes (types 1 and 2) of 8.2% in adults, nearly twice as high as the French, English and Italian rates. A prevalence rate of 8.2% was also reported in a general population survey in Greece [17], and an intermediate rate of 6.2% in Finland [18]. Evidence of marked variations in the prevalence of diagnosed type 2 diabetes in European countries has also come from European sentinel practice-surveillance networks, although these are likely to underestimate absolute prevalence rates due to the sampling method used. Comparisons of data obtained in 1999–2000 from eight European countries (Belgium, Croatia, England, France, Netherlands, Portugal, Slovenia and Spain) revealed a twofold difference in prevalence — from 1.7% in Slovenia to 3.1% in Belgium [19].

In conclusion, the present study has estimated the prevalence of treated and untreated type 2 diabetes to be 4.57% in France. This is consistent with other studies using different methodologies which, taken together, indicate that the prevalence of this form of diabetes in France is rising.

References

