Prevalence of diagnosed diabetes mellitus in general practice in England and Wales, 1994 to 1998

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This study describes the prevalence of diagnosed diabetes mellitus in England and Wales using data from the General Practice Research Database from 1994 to 1998. The age-standardised prevalence of diagnosed diabetes increased from 1.89 to 2.23 per 100 males and from 1.37 to 1.64 per 100 females. Overall, 29, 48 and 24 per cent of males with diabetes, and 26, 48 and 26 per cent of females respectively were diet controlled, treated with oral hypoglycaemic drugs only, or insulin. Prevalence generally increased with increasing deprivation in men and women aged 35 to 74 years. It is estimated that there were 1.15 million people with a diagnosis of diabetes mellitus in 1998. Even with a conservative increase in prevalence of 10 per cent, this is projected to rise by 44 per cent to 1.66 million by 2023.

Introduction

Diabetes mellitus is a common chronic disease associated with considerably increased morbidity and mortality (Box 1). The standardised mortality ratio of people with diabetes is significantly higher than for those without diabetes,[1] and diabetes accounts for around 9 per cent of annual hospital inpatient expenditure.[2] Smaller studies have shown that the overall prevalence of diabetes is around 1.9 per cent,[3] and that the crude and age-standardised prevalence of type 1 and type 2 diabetes have been increasing during the past few decades.[4] World-wide, it has been projected that the number of people with diabetes will increase by 78 per cent, from 124 million in 1997 to 221 million in 2010.[5]

The aim of this study was to describe trends in the prevalence of diagnosed diabetes in England and Wales from 1994 to 1998 using data from the General Practice Research Database (GPRD). We describe changes over time and by socio-economic status in its overall prevalence and in the prevalence of diet controlled, oral hypoglycaemic treated and insulin treated diabetes. We have also estimated the numbers of people that may have this diagnosis in the future. The aim of the new National Service Framework for Diabetes is to improve the health of people with diabetes by raising the quality of the services they receive and by reducing inappropriate variations in care.[6] This study provides baseline data for those who will be responsible for implementing the National Service Framework.

Box one

Diabetes mellitus

People with diabetes mellitus have an abnormally high blood glucose level due to a lack of, or insensitivity to, the hormone insulin which metabolises glucose. There are two main types of diabetes. Type 1 is more common in children and is caused by destruction of the cells in the pancreas that make insulin by the body's own immune system. Type 2 diabetes is more common in older adults and in adults of Asian and African-Caribbean origin and is usually caused by insensitivity to insulin. Diabetes also occurs more rarely when insulin production is disrupted by certain drugs or other diseases. Diabetes can occur only in pregnancy, known as gestational diabetes.

The symptoms of diabetes include excessive thirst and urination. If left untreated, the metabolic disturbances caused by a high blood glucose level can be life threatening. In the long term, nerves and small blood vessels can be damaged leading to ulcers, visual and renal complications and other problems. Damage to larger blood vessels can lead to heart disease, strokes, disruption of the blood supply to the legs and other problems. As a result, people with diabetes have higher death rates than people of the same age and sex without diabetes.

People with type 1 diabetes usually need regular insulin injections. Although type 2 diabetes can sometimes be controlled by restricting the dietary intake of glucose, drugs that stimulate production of, or increase sensitivity to insulin and insulin injections are also often used. Recent evidence suggests that the outcomes for people with type 1 and type 2 diabetes are improved by tightly controlling the glucose level. People with diabetes also need regular check-ups to look for signs of complications so that they can be detected and treated early.

Methods

Data source

The GPRD was set up in 1987 and operated by the Office for National Statistics from 1994 to 1999. Participating practices followed guidelines for recording all significant morbidity events, prescriptions and reasons for prescribing and referrals. Contacts were coded using the Read and OXMIS systems. The age and sex of all registered people were collected and the practices regularly submitted anonymised, patient-based electronic records.[7] Data from each practice were reviewed every six weeks to ensure that quality criteria were being met, and practices were advised about problem areas. The comprehensiveness and accuracy of the data recorded has been previously documented.[8]

The data for this study are from 210 general practices with a combined list size of around 1.2 million people. These practices contributed data to the GPRD from 1994 to 1998 that passed quality checks. Although they were voluntarily recruited, their age and sex distribution was similar to the population of England and Wales in 1998.[7] Based on the Townsend score of the practice ward, 1.7 per cent of the national population in the least deprived quintile and 3.0 per cent in the most deprived quintile were represented in 1998.

Pilot study

We reviewed the Read and OXMIS codes used in the GPRD that contained the words 'diabetic' or 'diabetes'. We included codes that denoted type 1, type 2 or otherwise unspecified diabetes mellitus and excluded those for diabetes insipidus, gestational or drug induced diabetes and diabetes due to haemochromatosis, in line with the World Health Organisation classification.[9]

To improve the case selection criteria, we reviewed the full GPRD records of a sample of people assigned one of these codes during 1996 or in a previous year. We also wanted to assess the proportion of people that we initially classified as having diabetes who did not actually have type 1 or type 2 diabetes. This is the false positive rate. Samples were selected so that all age groups and both sexes were represented. As women may have gestational diabetes and because diabetes in the young is usually insulin treated rather than diet controlled, women of childbearing age and young people without an antidiabetic prescription might be more likely to be false positives. Hence, we selected greater proportions of people from these groups. We defined a person as false positive if there was a code or comment at any point in their record for diabetes other than type 1 or type 2 diabetes. We also defined a person as false positive if there was a comment after the last relevant code querying the diagnosis or stating that the code or diagnosis referred to screening only, to someone else, or to a risk of diabetes.

The results indicated that it was feasible to use this list of codes to identify people with diabetes if additional steps were taken to minimise the false positive rate, as described below. Furthermore, antidiabetic treatments are rarely used for conditions other than diabetes and over 99 per cent of people with an antidiabetic prescription in 1996 had been assigned one of the codes during 1996 or in a previous year. Therefore, the proportion of people that we classified as not having diabetes but who did actually have the disease, the false negative rate, was likely to be low.

Definition of cases and rates used in the full study

Patients were included in the analysis if they were alive and permanently registered at a practice for the last six months of the analysis year. Cases of diabetes in a given year were those who had been assigned a code for diabetes from the list at any time during that year or in a previous year. Women for whom the only instance of a relevant code was within a year of pregnancy were excluded. This was necessary as 15 per cent of women aged 25 to 44 years without an antidiabetic prescription in the pilot study had gestational diabetes. People who had a diagnostic code for cystic fibrosis at any time were also excluded, in line with the World Health Organisation classification.[9]

Because many people with diabetes did not have a code specific to type 1 or type 2 diabetes in their record, it was not possible to categorise them in this way. Instead, we categorised people by their treatment. For each analysis year, we defined: people with diet controlled diabetes as people with diabetes who had no antidiabetic prescriptions in that year; people with oral hypoglycaemic treated diabetes as people with diabetes who had prescriptions for oral hypoglycaemic drugs (British National Formulary section 6.1.2) but not insulin in that year; and people with insulin treated diabetes as people with diabetes who had a prescription for insulin (British National Formulary section 6.1.1

excluding 6.1.1.3, hypodermic equipment) in that year. The three categories are mutually exclusive.

As the false positive rate in the pilot study in children and young adults aged 0 to 24 years without an antidiabetic prescription was 38 per cent, we validated the diagnosis and the treatment category in this group by reviewing their full GPRD record. We excluded patients if there was a code or comment at any point in their record for diabetes other than type 1 or type 2 diabetes, or if there was a comment after the last relevant code querying the diagnosis or stating that the code or diagnosis referred to screening only, to someone else, or to a risk of diabetes. In a given analysis year, we recategorised the diabetes as insulin treated if the diagnosis was made at the end of that year and there was evidence of insulin use early in the next year. We also recategorised the diabetes as insulin treated if there was evidence of insulin use before the analysis year because we considered it more likely that a patient would be receiving treatment elsewhere, such as a hospital clinic, than that they had stopped needing insulin.

Using the combined populations of the general practices as the denominator, we calculated the crude and age-specific prevalence of all diabetes and each category of diabetes in men and women for each year of the study. To facilitate comparisons over time and externally with other European countries, age-standardised prevalences were calculated by applying the age-specific rates for each five-year age group to the European standard population.

Variation by socio-economic status

The Townsend Material Deprivation Score is calculated using information on unemployment, overcrowding, car availability and home ownership from the Census.[10] Using this score, wards in England and Wales were arranged in order and divided into five quintiles, each containing 20 per cent of the population. The wards in which patients' general practices were located were used to allocate them to a deprivation quintile. The data were then grouped by quintile.

Future numbers of patients with diabetes

We estimated the number of people that had diagnosed diabetes in England and Wales in 1998 by applying the prevalence in broad age groups of males and females (0 to 24 years, 25 to 49 years, 50 to 74 years, 75 years and over) to the estimated population in those age groups. By applying each prevalence to the population projected for England and Wales in 2023 in those age groups, we estimated the number of males and females that would have this diagnosis in that year if prevalence remained constant. We also calculated what each age-specific prevalence would be in 2023 if they increased by 10, 20 and 30 per cent. We applied these to the population projected for 2023 in each age group to estimate the number of males and females that would have diagnosed diabetes in that year if prevalence increased by 10, 20 or 30 per cent.

Results

From 1994 to 1998, the age-standardised prevalence of diagnosed diabetes increased by 18 per cent from 1.89 to 2.23 per 100 males, and by 20 per cent from 1.37 to 1.64 per 100 females (Table 1). The age-standardised prevalence was higher in males than females throughout the period. The age-specific prevalence was also consistently higher in men than women aged 25 years and over (Figure 1). Prevalence increased in males and females of most ages each year from 1994 to 1998, and peaked in those aged 75 to 84 years in each year. One in 11 men and one in 15 women in this age group had diagnosed diabetes in 1998.

From 1994 to 1998, the age-standardised prevalence of diet controlled diabetes increased by 8 per cent from 0.56 to 0.60 per 100 males, and by 18 per cent from 0.33 to 0.39 per 100 females (Table 1). The age-standardised prevalence of oral hypoglycaemic treated diabetes increased by 21 per cent from 0.88 to 1.07 per 100 males, and by 18 per cent from 0.64 to 0.76 per 100 females. The age-standardised prevalence of insulin treated diabetes increased by 23 per cent in males and females, from 0.46 to 0.57 per 100 males and from 0.40 to 0.49 per 100 females. The age-standardised prevalence of each category of diabetes was lower in females than males each year from 1994 to 1998.

About half of the males and females with diabetes in the period 1994 to 1998 were treated with oral hypoglycaemic drugs alone (Table 2). Around one quarter of the remaining males and females had diabetes that was diet controlled, and one quarter had insulin treated diabetes. The proportion of males and females with diet controlled diabetes increased with age to a maximum in those aged 85 years and over. The proportion of males and females with oral hypoglycaemic treated diabetes also increased with age to a maximum in men aged 65 to 74 years and women aged 75 to 84 years. In contrast, the proportion of people whose diabetes was insulin treated peaked in those aged 0 to 15 years and declined to 8 and 9 per cent respectively in men and women aged 85 years and over.

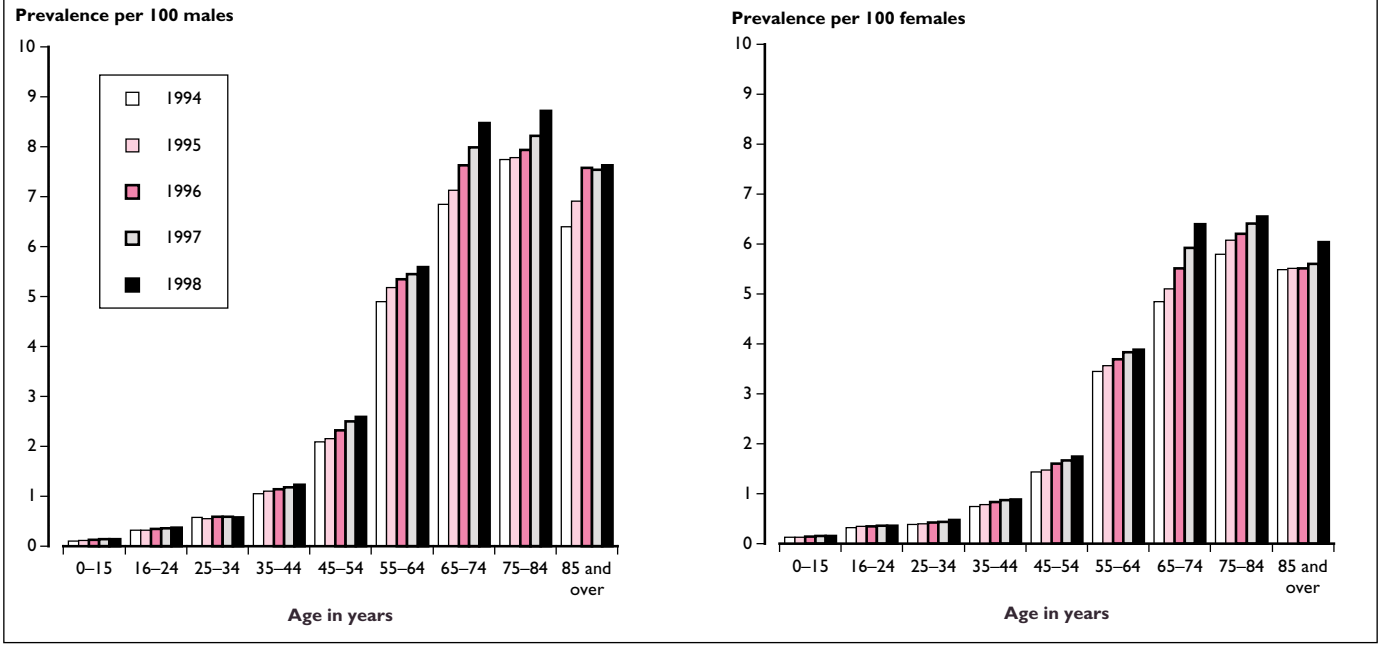
The prevalence of diet controlled and oral hypoglycaemic treated diabetes increased in most age groups from 1994 to 1998, and was consistently higher in men than women aged 35 years and over and 25 years and over respectively. This is similar to all diabetes and reflects the contribution made by these categories of diabetes to the overall estimates. Prevalence also increased with age, as with all diabetes. In each year, the prevalence of diet controlled diabetes was highest in men aged 75 years and over (2.93 per 100 men aged 75 to 84 years in 1998), and in women aged 85 years and over (2.27 per 100 women in 1998). In

Table 1 **Crude (CP) and age-standardised prevalence (ASP) with 95% confidence interval (CI) of diagnosed diabetes per 100 males and females, by calendar year, 1994 to 1998**

	Males		Females	
	CP	ASP* (95% CI)	CP	ASP* (95% CI)
	All diabetes			
1994	1.99	1.89 (1.86-1.93)	1.69	1.37 (1.34-1.40)
1995	2.09	1.97 (1.93-2.00)	1.77	1.43 (1.40-1.46)
1996	2.22	2.07 (2.03-2.11)	1.86	1.50 (1.47-1.53)
1997	2.32	2.14 (2.11-2.18)	1.96	1.57 (1.54-1.60)
1998	2.43	2.23 (2.20-2.27)	2.04	1.64 (1.61-1.67)
	Diet controlled diabetes			
1994	0.59	0.56 (0.54-0.58)	0.44	0.33 (0.32-0.35)
1995	0.61	0.57 (0.55-0.59)	0.46	0.34 (0.33-0.36)
1996	0.64	0.59 (0.57-0.61)	0.49	0.37 (0.36-0.39)
1997	0.65	0.59 (0.57-0.61)	0.51	0.39 (0.38-0.41)
1998	0.66	0.60 (0.58-0.62)	0.52	0.39 (0.38-0.41)
	Oral hypoglycaemic treated diabetes			
1994	0.93	0.88 (0.85-0.90)	0.82	0.64 (0.62-0.66)
1995	0.98	0.92 (0.89-0.94)	0.86	0.67 (0.65-0.69)
1996	1.05	0.98 (0.95-1.00)	0.90	0.70 (0.68-0.72)
1997	1.11	1.02 (1.00-1.05)	0.93	0.72 (0.70-0.74)
1998	1.17	1.07 (1.04-1.09)	0.98	0.76 (0.74-0.78)
	Insulin treated diabetes			
1994	0.48	0.46 (0.44-0.48)	0.43	0.40 (0.38-0.42)
1995	0.50	0.48 (0.46-0.49)	0.45	0.42 (0.40-0.44)
1996	0.52	0.50 (0.48-0.52)	0.47	0.43 (0.42-0.45)
1997	0.56	0.53 (0.51-0.55)	0.51	0.46 (0.45-0.48)
1998	0.60	0.57 (0.55-0.58)	0.54	0.49 (0.47-0.51)

* Direct standardisation using the European standard population.

Figure 1 **Age-specific prevalence of diagnosed diabetes per 100 males and females, by calendar year, 1994 to 1998**



each year, the prevalence of oral hypoglycaemic treated diabetes was highest in men aged 65 to 84 years (4.70 per 100 men aged 65 to 74 years in 1998), and in women aged 75 to 84 years (3.63 per 100 women in 1998).

Similar to all diabetes and the other categories of diabetes, the prevalence of insulin treated diabetes increased in most age groups each year from 1994 to 1998, and was usually higher in men than women aged 25 years and over. However, the prevalence of insulin treated diabetes was higher than that of diet controlled and oral hypoglycaemic treated diabetes in males and females aged 0 to 44 years. Furthermore, the increase in prevalence with age thereafter was less marked than for the other categories of diabetes, although prevalence was still highest in older men and women aged 65 to 74 years (1.33 per 100 men and 1.21 per 100 women in 1998).

Socio-economic differences

The age-standardised prevalence of diagnosed diabetes was higher in males and females from the most deprived quintile than in those from the least deprived quintile (Table 3). This difference was greater in females, in whom the age-standardised prevalence was 50 per cent higher in those from the most deprived quintile (1.80 per 100 females) than in those from the least deprived quintile (1.20 per 100 females). Prevalence generally increased with increasing deprivation in men and women aged 35 to 74 years (Figure 2).

The age-standardised prevalence of diet controlled and oral hypoglycaemic treated diabetes were also higher in males and females from the most deprived quintile than in those from the least deprived quintile (Table 3). In contrast, there was no obvious association

Table 2 **Proportions of the age-specific prevalence of diagnosed diabetes that are accounted for by diet controlled, oral hypoglycaemic treated and insulin treated diabetes, males and females, 1994 to 1998**

	Males			Females		
	Diet controlled diabetes	Oral hypoglycaemic treated diabetes	Insulin treated diabetes	Diet controlled diabetes	Oral hypoglycaemic treated diabetes	Insulin treated diabetes
Age in years	%	%	%	%	%	%
0–15	2.9	0.0	97.1	2.9	0.5	96.5
16–24	3.7	1.6	94.7	5.2	2.4	92.5
25–34	9.5	9.2	81.3	11.3	10.0	78.8
35–44	22.0	27.6	50.4	19.6	25.7	54.7
45–54	27.5	45.3	27.2	24.8	43.8	31.4
55–64	29.4	53.8	16.9	24.3	53.1	22.6
65–74	31.0	54.9	14.1	27.1	55.0	17.9
75–84	34.1	53.7	12.2	30.3	55.6	14.1
85 and over	39.0	52.9	8.1	37.2	53.9	8.9
All ages	28.5	47.5	24.0	26.0	48.3	25.7

Figure 2 Age-specific prevalence of diagnosed diabetes per 100 males and females by deprivation quintile, 1994 to 1998

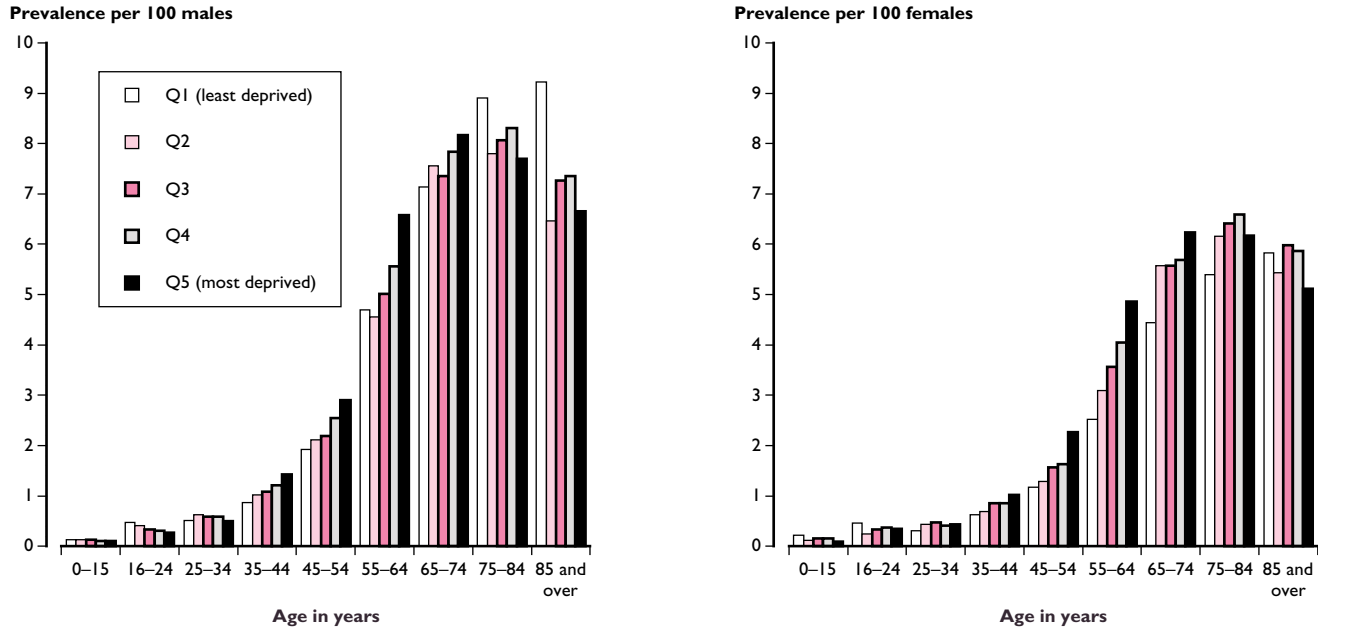


Table 3 Crude (CP) and age-standardised prevalence (ASP) with 95% confidence interval (CI) of diagnosed diabetes per 100 males and females by deprivation quintile, 1994 to 1998

	Males		Females	
Quintile	CP	ASP* (95% CI)	CP	ASP* (95% CI)
	All diabetes			
Q1 (least deprived)	2.22	1.92 (1.88-1.97)	1.57	1.20 (1.17-1.24)
Q2	2.20	1.93 (1.90-1.97)	1.83	1.36 (1.33-1.39)
Q3	2.12	1.99 (1.96-2.03)	1.87	1.51 (1.49-1.54)
Q4	2.35	2.15 (2.11-2.18)	2.01	1.58 (1.55-1.61)
Q5 (most deprived)	2.21	2.33 (2.29-2.37)	1.93	1.80 (1.77-1.83)
	Diet controlled diabetes			
Q1 (least deprived)	0.67	0.57 (0.55-0.59)	0.40	0.28 (0.26-0.30)
Q2	0.63	0.54 (0.53-0.56)	0.47	0.33 (0.32-0.35)
Q3	0.59	0.55 (0.53-0.57)	0.48	0.37 (0.35-0.38)
Q4	0.65	0.58 (0.56-0.60)	0.53	0.39 (0.37-0.40)
Q5 (most deprived)	0.64	0.68 (0.66-0.70)	0.50	0.45 (0.43-0.47)
	Oral hypoglycaemic treated diabetes			
Q1 (least deprived)	1.02	0.86 (0.83-0.89)	0.71	0.49 (0.47-0.52)
Q2	1.04	0.89 (0.86-0.91)	0.92	0.64 (0.62-0.66)
Q3	1.00	0.94 (0.92-0.97)	0.89	0.69 (0.67-0.71)
Q4	1.12	1.01 (0.99-1.04)	0.96	0.72 (0.70-0.74)
Q5 (most deprived)	1.08	1.15 (1.12-1.18)	0.96	0.89 (0.86-0.91)
	Insulin treated diabetes			
Q1 (least deprived)	0.53	0.49 (0.47-0.52)	0.47	0.43 (0.41-0.45)
Q2	0.53	0.50 (0.48-0.52)	0.44	0.39 (0.37-0.40)
Q3	0.52	0.50 (0.48-0.52)	0.50	0.46 (0.44-0.47)
Q4	0.58	0.55 (0.53-0.57)	0.52	0.47 (0.46-0.49)
Q5 (most deprived)	0.49	0.50 (0.49-0.52)	0.47	0.46 (0.44-0.48)

* Direct standardisation using the European standard population.

between the age-standardised prevalence of insulin treated diabetes and deprivation.

The prevalence of diet controlled diabetes generally increased with increasing deprivation in females aged up to 74 years. However, there was no clear relationship between deprivation and age-specific prevalence for diet controlled diabetes in males, although prevalence was markedly higher in those aged 85 years and over from the least deprived quintile. The prevalence of oral hypoglycaemic treated diabetes usually increased with increasing deprivation in men and women aged 35 to 64 years, and was highest in men aged 75 years and over and women aged 85 years and over from the least deprived quintile. This is similar to all diabetes and reflects the contribution made by this category of diabetes to the overall estimates. The prevalence of insulin treated diabetes was highest in males and females aged 0 to 24 years from the least deprived quintile, but was generally lower in older men and women from the less deprived quintiles, except for men aged 75 years and over.

National estimates and future projections

We estimate that there were 0.61 million males and 0.54 million females with diagnosed diabetes in England and Wales in 1998 and over half (60 and 53 per cent respectively) were aged 50 to 74 years (Table 4). Because the population is ageing, the number of males and females with diagnosed diabetes is projected to rise to 0.84 million (37 per cent increase) and 0.67 million (24 per cent increase) respectively in 2023, even if there is no further increase in age-specific prevalence.

From 1994 to 1998, the increase in prevalence was 24 per cent in 0- to 24-year-old males, 18 per cent in 25- to 49-year-old men, 15 per cent in 50- to 74-year-old men and 14 per cent in men aged 75 years and over. In females, the increases were 17, 20, 18 and 12 per cent respectively. If

Table 4 **Projected numbers of males and females with diagnosed diabetes in England and Wales in 2023, from the baseline of 1998, given different percentage increases in age-specific prevalence**

		Age in years				
		0–24	25–49	50–74	75 and over	Total
Prevalence per 100 males in 1998		0.21	1.13	5.74	8.52	
Thousands of males with diabetes in 1998*		18	110	365	118	610
Thousands of males with diabetes in 2023†	– if prevalence has remained constant	17	107	512	202	838
	– if prevalence has increased by 10%	19	118	563	222	921
	– if prevalence has increased by 20%	21	129	614	242	1,005
	– if prevalence has increased by 30%	22	139	665	262	1,089
Prevalence per 100 females in 1998		0.22	0.82	4.24	6.41	
Thousands of females with diabetes in 1998*		18	77	286	160	541
Thousands of females with diabetes in 2023†	– if prevalence has remained constant	17	75	379	199	669
	– if prevalence has increased by 10%	19	82	417	218	736
	– if prevalence has increased by 20%	21	90	455	238	803
	– if prevalence has increased by 30%	22	97	493	258	870

* Estimated numbers calculated using the estimated resident population of England and Wales at mid-1998 from the Office for National Statistics.
† Projected numbers calculated using population projections from the Government Actuary's Department.

prevalence increases by 10 per cent from 1998 to 2023, the number of males with the diagnosis is projected to rise by 51 per cent to 0.92 million in 2023, and the number of females with the diagnosis is projected to rise by 36 per cent to 0.74 million (Table 4). Given a 20 per cent increase in prevalence, the number of males is projected to rise to 1.01 million (65 per cent increase) in 2023, and the number of females is projected to rise to 0.80 million (48 per cent increase). If prevalence increases by 30 per cent from 1998 to 2023, the number of males and females is projected to rise to 1.09 million (78 per cent increase) and 0.87 million (61 per cent increase) respectively in 2023.

Discussion

Main findings

We estimated the prevalence of diagnosed diabetes in England and Wales from 1994 to 1998 using data from the GPRD. The age-standardised prevalence increased each year in males and females. Prevalence increased in most age groups, was higher in males than females in most age groups and peaked in those aged 75 to 84 years in each year. It usually increased with increasing deprivation in men and women aged 35 to 74 years. The number of people with diagnosed diabetes is projected to rise even if there is no further increase in age-specific prevalence because the population is ageing. With a conservative increase in prevalence of 10 per cent from 1998 to 2023, the number of people with diagnosed diabetes is projected to rise from 1.15 to 1.66 million.

Strengths and weaknesses of study

The practices included in this study had a combined list size of 1.2 million in 1998. We were able to describe trends over time and variation in prevalence by socio-economic status by mapping practices to a deprivation quintile, although it would have been more precise to map patients to quintiles. Although practices contributing to the database are self-selected, their age and sex distribution is comparable to the general population.[7] The prevalence of diabetes is higher in certain ethnic groups.[11] However, as general practices do not routinely collect information relating to ethnicity, we were unable to examine its association with diabetes. As with many other studies, we were only able to identify people whose diabetes was diagnosed. Several studies have suggested that this will be an underestimate of the true prevalence of diabetes.[11, 12]

We categorised diabetes by treatment modality rather than as type 1 or type 2 diabetes. Although this is not ideal, it does give some idea of the resource implications of changes in the prevalence of diabetes treated with oral hypoglycaemic drugs or insulin. A previous study defined type 1 diabetes as treatment with insulin within one month of diagnosis.[13] However, this type of definition may now be unreliable, as more patients with type 2 diabetes are likely to be treated with insulin, following publication of evidence that tighter glycaemic control in these patients improves outcomes.[14, 15]

Antidiabetic treatments are rarely used for other conditions. As almost all patients who were prescribed oral hypoglycaemic drugs or insulin in 1996 had also been assigned one of the codes used to identify patients with diabetes, it seems likely that most people with drug treated diabetes were identified in this study. The false negative rate in patients with diet controlled diabetes would have also been low if there had been no systematic difference in the way that diet controlled and drug treated diabetes were recorded by primary care professionals. This seems likely as the proportion of patients who were diet controlled in this study is similar to estimates from other studies.[13, 16] For chronic conditions, such as diabetes, GPRD age-specific consulting rates were found to be 10 to 20 per cent lower than rates from the Fourth National Study of Morbidity Statistics from General Practice.[8] However, this was based on face to face consultations during the analysis year only and ignored referrals, letters and hospitalisations. This is in contrast to the present study which has a more complete method of capturing people with diabetes.

The pilot study suggested that false positive rates for diet controlled and medication treated diabetes were low in older people. The higher false positive rate in patients aged 0 to 24 years with no antidiabetic prescription was minimised by reviewing their records, as detailed in the methods section. Even so, three per cent of males and females aged 0 to 15 years with diabetes were categorised as having diet controlled diabetes. These children may not have diabetes but we could find no evidence to exclude them. Alternatively, we may have miscategorised their diabetes and they may actually be treated with insulin. Although patients with diabetes would be known to their primary care team, they

Table 5 **Estimates of the crude prevalence per 100 people of diagnosed diabetes in the United Kingdom from 1994 to 1998**

Place	Date	Data source	Denominator	Prevalence		
				Males	Females	Both
England and Wales[16]	1993–1995	Primary care audit groups	1,474,512	-	-	1.46
South Tees[21]	1994	Community based register	287,157	1.75	1.39	1.50
Poole[13]	1996	Primary and secondary care registers	184,801	2.17	1.77	1.96
Tayside[3]	1996	Primary and secondary based sources	391,274	-	-	1.94
South Glamorgan[20]	1996	Primary care audit database and other sources	434,398	-	-	2.30
Manchester[22]	1997	Evaluation of primary care based audit project	418,000	-	-	1.46

may be treated at a hospital clinic, or have moved but not have been removed from the practice list. In such cases, the patient would have a relevant code but prescriptions would not be recorded.

Another alternative explanation is that these patients do actually have this category of diabetes. Over the period of this study, the prevalence of diet controlled and oral hypoglycaemic treated diabetes in children aged 0 to 15 years was 0.041 per 1000 children and this is similar to an estimate of 0.038 in under 18 year olds cared for in Birmingham in 2000.[17] In America, type 2 diabetes represents eight to 45 per cent of diabetic diagnoses in large paediatric centres.[18]

Around 12 per cent of people with diabetes are cared for in hospital clinics only,[19] and hence it may be necessary to use data from primary and secondary care to get an accurate estimate of the number of patients known to have diabetes.[20] However, although there may be some potential for treatment miscategorisation in this study, all cases of diabetes known to secondary care should also be known to their primary care team. Furthermore, specific information related to hospital care should be present in patients' GPRD record, increasing the chances of ascertainment.

Comparisons with previous studies

Several studies have estimated the crude prevalence of diagnosed diabetes in the United Kingdom during our study period (Table 5).[3, 13, 16, 20, 21, 22] Although our estimate for 1996 (2.04 per 100 people) was similar to estimates from other studies for this year, our estimates for 1994 and 1997 (1.84 and 2.13 per 100 people respectively) were higher than those from other studies for these years. However, sex and age-standardised estimates were often absent from other studies and the discrepancies could be due to the different age and sex structures of the populations.

Age- and sex-specific prevalence estimates were available for the study in Poole,[13] and applying these to the European standard population gives age-standardised prevalences of 1.72 per 100 males and 1.22 per 100 females. These were lower than those calculated using our data and the same age groups (2.07 per 100 males and 1.51 per 100 females), although the ratios of the age-standardised prevalence in males to that in females were both 1.4:1. Excluding children where the numbers are smaller, the greatest differences in age-specific prevalence were in older adults. The estimates from our study for adults in 10 year age groups from 40 to 80 years were 17 to 42 per cent greater than those from Poole. Although we may have overestimated prevalence, it is also possible that other studies have underestimated prevalence or that the populations sampled may not be directly comparable with the population from the GPRD for reasons other than a different age and sex structure.

The Health Survey for England is a population-based survey of people living in private households.[23] We age-standardised the prevalence of self-reported diabetes in the 16,000 men and women aged 16 years and over who were surveyed in 1998. Although the resulting prevalences (2.9 per 100 men and 2.1 per 100 women) were very similar to those calculated using our data for men and women over 16 years of age (2.9 per 100 men and 2.1 per 100 women), the age-specific prevalences varied widely. The prevalence estimates from the Health Survey in men and women aged over 24 years in 10 year age groups ranged from 21 per cent lower to 40 per cent greater than those from our study. Any comparison is also limited by the fact that the Health Survey is based on self-reported information. Although only diagnoses that are reported as having been confirmed by a doctor are recorded, it is possible that this method may overestimate the prevalence of a condition when compared with prevalence based on a documented diagnosis.

Overall, we found that 48 per cent of patients with diabetes were treated with oral hypoglycaemic drugs, 25 per cent were treated with insulin and 27 per cent were diet controlled. This is broadly in keeping with results from other studies.[13, 16]

Socio-economic differences

The prevalence of diagnosed diabetes increased with increasing deprivation in men and women aged 35 to 74 years. Ascertainment or recording bias is unlikely to account for this relationship, as patients in affluent areas would probably be more likely to be diagnosed and have their diabetes recorded. Researchers from Middlesborough and East Cleveland used a community based diabetes register to identify known cases of diabetes in a population of 300,000 people in 1994.[21] They described the relationship with socio-economic status based on the ward of residence of the patient and found that there was a similar trend of increasing prevalence of diet controlled and oral hypoglycaemic treated diabetes with deprivation in men and women. In keeping with our study, they found that the steepest gradient was in those aged 40 to 69 years. Researchers in Tayside found that the prevalence of type 2, but not type 1, diabetes varied with deprivation category, and that there were more obese, diabetic patients in deprived areas.[24] They suggested that these patients require more targeted resources and primary prevention.

We also observed that the prevalence of oral hypoglycaemic treated diabetes was highest in the oldest adults from the least deprived quintile, and that the prevalence of diet controlled and insulin treated diabetes was highest in the oldest men from the least deprived quintile. Although there are potentially many reasons for this, this may reflect increased testing and diagnosis of diabetes in the oldest men in the less deprived quintiles. Additionally, mortality is higher in people with diabetes in the lower socio-economic groups than in those from the higher socio-economic groups,[25] indicating that differential survival of affluent people may also be important. This may be particularly relevant to this study because we excluded patients who died during the analysis year.

Key findings

- From 1994 to 1998, the age-standardised prevalence of diagnosed diabetes increased by 18 per cent from 1.89 to 2.23 per 100 males, and by 20 per cent from 1.37 to 1.64 per 100 females. Prevalence increased in most age groups, was higher in males than females in most age groups and peaked in those aged 75 to 84 years in each year.
- About half of the males and females with diabetes from 1994 to 1998 were treated with oral hypoglycaemic drugs alone. Around one quarter of the remaining males and females had diabetes that was diet controlled and one quarter had insulin treated diabetes.
- The prevalence of diagnosed diabetes usually increased with increasing deprivation in men and women aged 35 to 74 years.
- Because the population is ageing, the number of males and females with diagnosed diabetes is projected to rise even if there is no further increase in age-specific prevalence. Even with a conservative increase in prevalence of 10 per cent from 1998 to 2023, the number of people with diagnosed diabetes is projected to rise by 44 per cent, from 1.15 million in 1998 to 1.66 million in 2023.

Meaning of the study

The increase in the prevalence of diagnosed diabetes over time demonstrated in this study is unlikely to be due to increased recording. The GPRD was in place for several years before 1994 and there were no major changes in the way that data were recorded during the period of the study. Other studies have demonstrated increases in the prevalence of diabetes. Researchers in Poole used primary and secondary care data sources to describe the prevalence of diagnosed diabetes in 90,000 people.[4] From 1989/9 to 1996, the age-standardised prevalence increased by 53 per cent in men and 43 per cent in women. The age-specific prevalence of self-reported diabetes also increased in most 10 year age groups of adults aged 16 years and over who were surveyed from 1994 to 1998.[23] Therefore, it seems likely that the results from this study do support an increase in the overall prevalence of diagnosed diabetes. Improved survival and increased ascertainment may have contributed to the increase in prevalence due to increased awareness of diabetes and, towards the end of the study period, the benefits of tight glycaemic control in patients with type 2 diabetes.[14, 15]

Given the increasing prevalence of diabetes, it may be appropriate to target prevention activities at those at higher risk. Body mass index has been identified as a dominant risk factor for diabetes, and the risk of diabetes was reduced among men who took regular exercise.[26] In Finland, type 2 diabetes was prevented by lifestyle changes, including weight loss, in overweight middle aged patients.[27]

Future research

The age-standardised prevalence of diagnosed diabetes increased from 1994 to 1998, and this was probably due to increased survival, case ascertainment and incidence. Because the population is ageing, the number of people with diagnosed diabetes is projected to rise even if there is no further increase in age-specific prevalence. However, it is likely that the prevalence of diagnosed diabetes will continue to increase for several reasons. For example, better treatments should lead to longer survival in patients with type 1 and type 2 diabetes, and the National Service Framework for Diabetes recommends that strategies to identify people who do not know they have diabetes should be implemented.[6] Changes in the prevalence of diabetes in people from ethnic minorities and changes in the size and age structure of the ethnic minority population will also affect the future number of people with diabetes. To adequately plan future preventive, diagnostic and treatment services, it will be necessary to continue to describe the change in the prevalence of diabetes over time, and more fully explore inequalities in diabetes prevalence and the relationship with ethnicity.

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