

Incidence and Prevalence of Diabetes in Manitoba, 1986-1991

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OBJECTIVE — To estimate the incidence and prevalence of diabetes among adults in Manitoba, Canada, from 1986 to 1991.

RESEARCH DESIGN AND METHODS — A population-based database of individuals diagnosed with diabetes (Manitoba Diabetes Database) was created using data from Manitoba Health's comprehensive insurance system. Using this database, estimates of the annual incidence and prevalence of diabetes among Manitoba adults aged ≥ 25 years were made for the years 1986-1991. Age-specific and age-adjusted rates were calculated separately for men and women.

RESULTS — The prevalence of diabetes in 1991 was 66.9/1,000 among adults ≥ 25 years. Between 1986 and 1991 the age-adjusted prevalence rose steadily among both men and women. In 1991, the incidence of diabetes was 5.6/1,000. After an observed decline prior to 1989, the annual incidence of diabetes appears to be relatively stable.

CONCLUSIONS — The prevalence of diabetes is increasing steadily despite relatively stable incidence rates. Population-based data are required for projecting future trends and are an important tool for planning the required health resources.

Diabetes is responsible for substantial morbidity and mortality and for economic costs in many populations (1,2). Planning and implementing effective community-based interventions requires accurate population-based data on the incidence and prevalence of diabetes and diabetic complications.

Manitoba is a province in Canada with a stable population of ~ 1.1 million that is geographically and ethnically diverse. The Manitoba Health insurance database provides us with an opportunity to obtain population-based estimates of the incidence and prevalence of diabetes in Manitoba. In a pilot study based on data from 1980-1984, Young et al. (3) dem-

onstrated the potential value of such databases in describing the epidemiology of diabetes. We have used the Manitoba Health insurance database to examine trends in the incidence and prevalence of diabetes among adults in Manitoba from 1986 through 1991.

RESEARCH DESIGN AND METHODS

Manitoba Health insurance database Manitoba Health provides universal health insurance for Manitoba residents, which includes coverage for physician and hospital services. Manitoba Health

also maintains computerized records that are based on the use of health care services by individuals in the province, including hospital admissions, physician visits, and the use of personal-care homes. For each physician service, the patient's identification, date of service, diagnosis (a three digit ICD-9-CM code, International Classification of Diseases, 9th revision), and service tariff code are entered into a "physician claims" database. Similarly, after each hospital separation, Manitoba hospitals submit an abstract to Manitoba Health that includes the patient's identification, dates of admission and discharge, attending physicians, and up to 16 ICD-9-CM diagnoses. These hospital separation records constitute the hospital file. The accuracy of these administrative health data has been demonstrated for a number of medical conditions (4,5). Manitoba Health also maintains a population registry that contains dates of insurance coverage, family information, and residence information for Manitoba residents. Death reports from Manitoba Vital Statistics are routinely reviewed and used to update the population registry. Since 1984, the Manitoba Health population registry has maintained a unique personal health identification number (PHIN) that is included with each physician claim record and each hospital separation record.

Diabetes Education Resource database

In 1985, Manitoba Health established the Diabetes Education Resource (DER) program, which provides education and support for individuals with diabetes and their families through 12 separate centers throughout the province. Clients are enrolled through voluntary referrals. Each contact with these clients has been maintained in a computerized database (DER database) that includes demographic, clinical, service-related, and other information, including the PHIN. From 1985 through 1992, there were 9,751 persons enrolled in the DER program from across the province.

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DER, Diabetes Education Resource; PHIN, personal health identification number.

Creation of the Manitoba diabetes database

To create the Manitoba diabetes database, all physician claims and hospital separation records from Manitoba Health insurance databases with the ICD-9-CM diagnostic code for diabetes (250) for fiscal year 1984 through fiscal year 1992 (1 April 1984 through 31 March 1993) were extracted into a separate database for analysis. The Manitoba diabetes database was then created by arranging the record, of each individual into a longitudinal record, using the PHIN to link all of the physician claims and hospital separation records.

Case definition

To develop a case definition for cases of clinically diagnosed diabetes and to assess the ascertainment rate of the diabetes database, the diabetes database was linked to the DER database using the PHIN. To determine appropriate criteria for assigning which members of the Manitoba diabetes database truly had clinically diagnosed diabetes and to assign a date of diagnosis, physician claims and hospital separation records for those who were DER clients (and therefore known to have diabetes) were analyzed. This analysis revealed that every DER client had at least two separate physician claims (i.e., on separate days) or one hospital separation record with a diagnosis of diabetes in the Manitoba diabetes database. Furthermore, life table analysis determined that the median time between health care contacts (including physician claims and hospitalizations) for diabetes was 30 days and that the probability of having a subsequent medical contact for diabetes within 2 years of any previous contact for diabetes was 0.96. Thus, individuals in the diabetes database were defined as having clinically diagnosed diabetes if they had at least two separate physician claims for diabetes within 2 years of each other or at least one hospital separation record with a diagnosis of diabetes. Of the 75,181 individuals in the initial diabetes database with at least one hospitalization or physician claim for diabetes, 17,640 (23.5%) individuals were excluded because they only had one isolated physician claim. An additional 690 (0.9%) were excluded who had more than one physician claim but not two claims within 2 years of each other.

Estimating incidence and prevalence

Estimates of the annual incidence and prevalence rates were made for Manitoba residents aged ≥ 25 years. The date of initial diagnosis of clinical diabetes was defined by the first physician claim for diabetes that was then followed within 2 years by a subsequent diabetes claim or by the first hospitalization record with a diabetes diagnosis, whichever came first. Because the records were searched from 1984 onward, individuals who had medical contacts for diabetes beginning in 1984 or 1985 could not be assigned a definitive year of diagnosis, since a 2-year hiatus in diabetes contacts could not be confirmed. Therefore, the analysis of incidence and prevalence was restricted to the fiscal years 1986 through 1991.

The annual incidence rate was calculated using the mid-year population based on the Manitoba Health population registry. The annual period prevalence was estimated by adding all new incident cases within a year to all the incident cases from previous years who had neither died nor left the province prior to the beginning of the year (according to the population registry). All age-adjusted rates were computed by the direct method, using the 1990 Manitoba population as the standard.

Ascertainment-corrected prevalence

Two-source capture-recapture methods were used to assess the ascertainment rates for the diabetes database and to compute an ascertainment-corrected prevalence for men and women in 1986 and 1991 (6,7). For these analyses, records of individuals who had contacts recorded in the DER database that spanned any part of 1986 or 1991 were compared with records of prevalent cases of diabetes identified in the diabetes database during those years.

RESULTS

Diabetes prevalence

By 1991 there were 47,890 Manitoba residents ≥ 25 years of age who had diabetes, which yields a crude prevalence of 66.9/1,000 (Table 1). Between 1986 and 1991, the annual age-adjusted period prevalence increased for both men and women (Fig. 1). Among men, the age-adjusted prevalence increased by 48% from 47.1/1,000 in 1986 to 69.7/1,000 in 1991. Among women, the prevalence increased by 51% from 42.5/1,000 in 1986 to 64.1/

1,000 in 1991. During each year, the age-adjusted prevalence was slightly higher among men than among women. The age-adjusted prevalence rose substantially in all age-groups among both men and women (Table 1).

Ascertainment-corrected prevalence

The ascertainment rate for diabetes was very high and was similar for both men and women (Table 2). Consequently, the ascertainment-corrected prevalence estimates were very close to those obtained directly from the diabetes database. The overall ascertainment rate was slightly higher in 1991 (98%) than in 1986 (96%) (Table 2). The assessment of ascertainment rates for incidence rates was not performed because an accurate diagnosis date was not consistently available in the DER database.

Diabetes Incidence

In 1991, there were 4,038 individuals aged ≥ 25 years who were diagnosed with diabetes for the first time, which yields a crude incidence rate of 5.6/1,000. Between 1986 and 1991, the annual age-adjusted incidence rate decreased for both men and women (Fig. 1). Among men, the incidence rate decreased from 7.5/1,000 in 1986 to 6.0/1,000 in 1991. Among women, the incidence rate decreased from 6.8/1,000 in 1986 to 5.3/1,000 in 1991 (Table 3). The decline in the annual incidence occurred primarily between 1986 and 1989, after which there was no substantial decline in incidence rates for either sex (Fig. 1).

CONCLUSIONS

Various approaches have been used to obtain population-based estimates of the incidence and prevalence of diabetes, including sample surveys, clinical records, and treatment registries (8–12). We have used comprehensive administrative health data to create a population-based database of cases of clinically diagnosed diabetes. There are a number of potential problems with this approach. These data rely on the reports of many different physicians, and clinical precision cannot be assured. The use of different diagnostic criteria almost certainly occurs. Similarly, changes in the screening practices of physicians influence these estimates, particularly in the short term. Our estimates of incidence may be prone to overestimation for the early years of the study because

Table 1—Age-specific and age-adjusted prevalence (per 1,000 adults) of diagnosed diabetes in Manitoba, 1986 and 1991

Sex and age group (years)	1986		1991		% change in prevalence
	Cases	Prevalence per 1,000	Cases	Prevalence per 1,000	
Men					
25–29	286	5.6	358	7.3	+30.3
30–39	887	10.1	1,336	14.2	+40.6
40–49	1,634	28.1	2,704	38.3	+36.3
50–59	2,745	55.8	4,025	82.6	+48.0
60–69	3,924	90.9	5,629	130.6	+43.7
70–79	3,453	126.3	5,199	178.4	+41.3
≥80	1,593	150.2	3,284	272.6	+81.5
Total (crude)	14,522	44.3	22,535	65.0	+46.7
Age-adjusted	—	47.1	—	69.7	+48.0
Women					
25–29	376	7.5	609	12.6	+68.0
30–39	1,052	12.1	1,793	19.4	+60.3
40–49	1,495	26.1	2,618	37.5	+43.7
50–59	2,502	50.0	3,462	70.7	+41.4
60–69	3,876	77.9	5,421	110.9	+42.4
70–79	3,792	107.3	5,994	155.1	+44.5
≥80	2,489	133.5	5,458	248.0	+85.8
Total (crude)	15,582	44.8	25,355	68.7	+53.3
Age-adjusted	—	42.5	—	64.1	+50.8
Total					
Crude	30,104	44.6	47,890	66.9	+50.0
Age-adjusted	—	44.5	—	66.5	+49.4

Data are n or %.

prevalent cases may have been misclassified as incident cases for individuals who had a hiatus in medical contacts for several years leading up to 1986. Despite these shortcomings, there is some evidence to suggest that these data are quite accurate. Our comparison with the DER program database indicated that the ascertainment rate of these data was >95%. Young et al. (3) compared the data to self-reports from the Manitoba Longitudinal Study on Aging and found that the specificity was >95% in that elderly population.

We report an overall crude prevalence of diabetes of 66.9 per 1,000 Manitoba adults for 1991. This is congruent with other estimates reported for populations in North America and Europe (1). Our results are also consistent with those of others who have found that the prevalence of diabetes is increasing in many populations worldwide (1, 12).

We observed that the prevalence of diabetes is rising quickly despite declining or constant incidence rates. This

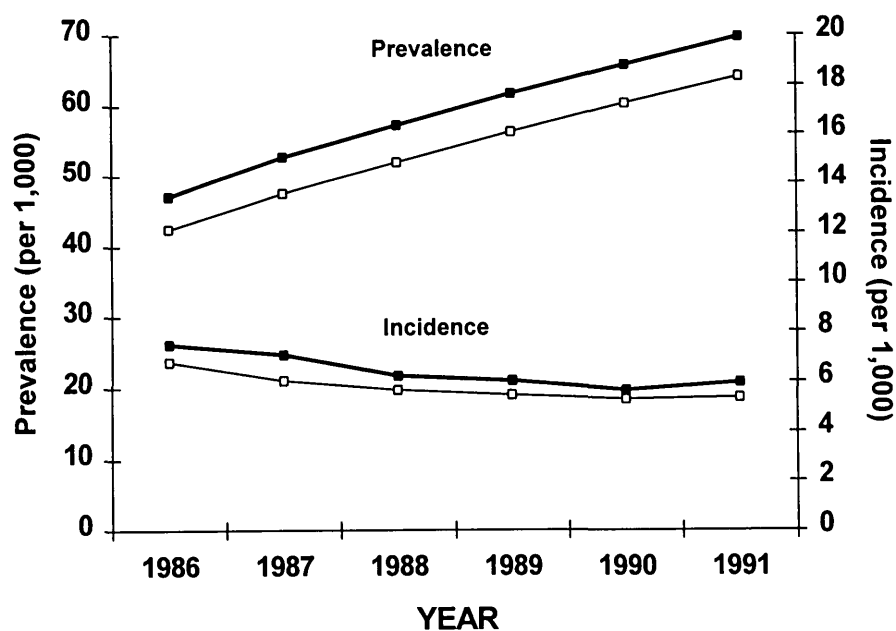


Figure 1—Annual age-adjusted period prevalence and incidence rate per 1,000 of diabetes among Manitoba men and women aged ≥25 years for fiscal years 1986–1991.

Table 2—Number of diabetes cases identified by Manitoba Health (MH) diabetes database and DER database, ascertainment rate for MH diabetes database, and ascertainment-adjusted prevalence, by sex and year

	MH diabetes database	DER database	Both databases	Ascertainment rate (%)	Ascertainment-adjusted prevalence per 1,000
Men					
1986	14,522	553	530	96	46.2
1991	22,535	1,119	1,091	98	66.6
Women					
1986	15,582	714	690	97	46.4
1991	25,355	1,476	1,448	98	70.0
Both					
1986	30,104	1,267	1,220	96	46.3
1991	47,890	2,595	2,539	98	68.3

Data are n or %.

indicates that the annual incidence rate is still substantially higher than the mortality rate, resulting in the rapid accumulation of prevalent cases. This is unlikely to change in the near future because many of the cases prevalent in 1991 were recently diagnosed. Between 1986 and 1991, there were over 25,000 newly diagnosed cases. With the increasing availability of

life-prolonging therapeutic options, it can be anticipated that the prevalence of diabetes in Manitoba will continue to rise unless there is a dramatic decline in the incidence rate.

We plan to continue to use the Manitoba diabetes database to continue to track the incidence and prevalence of diabetes in Manitoba in a variety of popula-

tions, including children and the Native American population. In addition, we plan to use links to other clinical and administrative health data and vital statistics to study the epidemiology of diabetic complications. It is anticipated that these data will continue to yield valuable information for planning diabetes services in the future.

Table 3—Age-specific and age-adjusted incidence (per 1,000 adults) of diagnosed diabetes in Manitoba, 1986 and 1991

Sex and age-group (years)	1986		1991		% change in incidence
	Cases	Incidence per 1,000	Cases	Incidence per 1,000	
Men					
25–59	44	0.9	42	0.9	0.0
30–39	170	1.9	167	1.8	–5.3
40–49	335	5.8	363	5.1	–12.1
50–59	534	10.9	433	8.9	–18.3
60–69	667	15.5	497	11.5	–25.8
70–79	456	16.7	353	12.1	–27.5
≥80	158	14.9	139	11.5	–22.8
Total (crude)	2,364	7.2	1,994	5.7	–20.8
Age-adjusted	—	7.5	—	5.3	–20.0
Women					
25–29	90	1.8	91	1.9	+5.5
30–39	237	2.7	203	2.2	–18.5
40–49	303	5.3	297	4.3	–18.9
50–59	427	8.5	365	7.5	–11.8
60–69	604	12.1	432	8.8	–27.3
70–79	514	14.5	437	11.3	–22.1
≥80	273	14.6	219	10.0	–31.5
Total (crude)	2,448	7.0	2,044	5.5	–21.4
Age-adjusted	—	6.8	—	5.6	–17.6
All					
Crude	4,812	7.1	4,038	5.6	–21.1
Age-adjusted	—	7.1	—	5.6	–21.1

Data are n or %.

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References

1. King H, Rewers M: Global estimates for prevalence of diabetes mellitus and impaired glucose tolerance in adults. *Diabetes Care* 16:157–177, 1993
2. The Carter Center of Emory University: Closing the gap: the problem of diabetes mellitus in the United States. *Diabetes Care* 8:391–406, 1985
3. Young TK, Roos NP, Hammerstrand KM: Estimated burden of diabetes mellitus in Manitoba according to health insurance claims: a pilot study. *Can Med Assoc J* 144: 318–324, 1991
4. Roos LL, Mustard CA, Nicol JP: Registries and administrative data: organization and accuracy. *Med Care* 31:201–212, 1993
5. Roos LL, Roos NP, Cageorge SM, Nicol JP: How good are the data?: reliability of one health care data bank. *Med Care* 20:266–276, 1982
6. LaPorte RE, McCarty D, Bruno G, Tajima N, Baba S: Counting diabetes in the next millennium: application of capture-recapture technology. *Diabetes Care* 16:528–534, 1993
7. McCarty DJ, Tull ES, Moy CS, Kwok CK, LaPorte RE: Ascertainment corrected rates: applications of capture-recapture methods. *Int J Epidemiol* 22:559–565, 1993
8. Harris MI, Robbins DC: Prevalence of adult-onset IDDM in the U.S. population. *Diabetes Care* 17:1337–1340, 1994
9. Tuomilehto J, Lounamaa R, Tuomilehto-Wolf E, Reunanen A, Virtala E, Kaprio EA, Åkerblom HK, the Childhood Diabetes in Finland (DiMe) Study Group: Epidemiology of childhood diabetes mellitus in Finland: background of a nationwide study of type 1 (insulin-dependent) diabetes mellitus. *Diabetologia* 35:70–76, 1992
10. Harris MI, Hadden WC, Knowler WC, Bennett PH: Prevalence of diabetes and impaired glucose tolerance and plasma glucose levels in U.S. population aged 20–74 yr. *Diabetes* 36:523–534, 1987
11. Sasaki A, Okamoto N: Epidemiology of childhood diabetes in Osaka District, Japan, using the documents from the medical benefits system specific for childhood diabetes. *Diabetes Res Clin Pract* 18: 191–196, 1992
12. King H, Rewers M, the World Health Organization Ad Hoc Diabetes Reporting Group: Diabetes in adults is now a Third World problem. *Ethn Dis* 3 (Suppl.):S67–S74, 1993