Estimated burden of diabetes mellitus in Manitoba according to health insurance claims: a pilot study

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Objective: To estimate the burden of diabetes mellitus in Manitoba from 1980 to 1984.
Design: Review of the Manitoba Health Services Commission (MHSC) database. The validity of the MHSC data was established through two substudies: one involved self-reports from a survey of elderly Manitobans, and the other involved people with confirmed diabetes enrolled in the provincial diabetes education program.
Subjects: Sample of 100 000 people stratified by age, sex and MHSC health region: 50 000 were aged 25 to 64 years, and 50 000 were aged 65 or more. All MHSC claims containing the ICD-9-CM code for diabetes mellitus or gestational diabetes were identified.
Main results: Of the sample 7627 people were found to have a diagnosis of diabetes, the annual prevalence being 0.8% among those 25 to 44 years of age, 3.5% among those 45 to 64 and 7.6% among those 65 or older. The annual incidence rate among those over 25 years of age was 7.8 per 1000. Of the 4556 pregnant women 25 to 44 years old 85 (1.9%) had diabetes; 23 were believed to have gestational diabetes.
Conclusions: The incidence and prevalence rates were similar to those determined on the basis of self-reports in Canadian and US national surveys. The use of an administrative database such as that of the MHSC will provide key information for planning health services for diabetic patients and will permit the monitoring of long-term trends in the incidence and prevalence of the disease.

Objectif : Évaluer le fardeau du diabète sucré au Manitoba de 1980 à 1984.
Conception : Examiner la base de données de la Commission des services de santé du Manitoba (CSSM). La validité de la base de données a été établie dans le cadre de deux études secondaires, dont l'une faisait appel à des rapports spontanés à partir d'un sondage auprès des aînés manitobains et l'autre, à des personnes à diagnostic de diabète, inscrites au programme provincial d'éducation des diabétiques.
Sujets : Échantillon de 100 000 personnes stratifié par l'âge, le sexe et la région administrative de la CSSM : 50 000 personnes de 25 à 64 ans, et 50 000 de 65 ans ou plus. Toutes les demandes du CSSM contenant le code ICD-9-CM de diabète sucré ou de diabète gestationnel ont été analysés.
Principaux résultats : Dans l'échantillon, nous avons constaté que 7 627 personnes avaient reçu un diagnostic de diabète, la prévalence annuelle étant de 0,8 % chez les 25 à 44 ans, de 3,5 % chez les 45 à 64 ans et de 7,6 % chez les 65 ans et plus. Le taux annuel d'incidence chez les plus de 25 ans était de 7,8 pour 1 000. Chez les 4 556 femmes enceintes de 25 à 44 ans, 85 (1,9 %) étaient atteintes de diabète; chez 23 cas, on croyait à un diabète gestationnel.
Conclusions : Les taux d'incidence et de prévalence étaient analogues à ceux établis d'après les rapports spontanés des sondages nationaux canadiens et américains. L'utilisation d'une base de données administrative comme celle de la CSSM permettra d'obtenir des renseignements clés de planification des services de santé à l'intention des personnes atteintes de diabète et d'effectuer un contrôle des tendances à long terme de l'incidence et de la prévalence de la maladie.

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Although diabetes mellitus is generally considered to be a significant health problem there is no accurate estimate of its extent and magnitude in Canada. This concern is well recognized by researchers and has been highlighted by the National Diabetes Task Force.[1] The dearth of population-based data has hampered efforts to improve the planning and evaluation of programs and services for people with diabetes.

Unlike the United States, which has a well-established system for collecting statistics on diabetes from various regular, periodic, nationwide surveys,[2] Canada has limited sources for epidemiologic data. The Canada Health Survey was conducted in 1978 and involved a probability sample of the population across Canada except for the Yukon and Northwest territories, Indian reserves and institutions. The survey included questions on diabetes and obtained blood samples for the random measurement of the glucose level.[3] In 1985 Statistics Canada conducted the General Social Survey,[4] which had a substantial health and disability component and included questions on diagnosed diabetes. However, there are limitations in estimating prevalence rates from these sources: both surveys depended on respondent recall and self-reporting and lacked validation of the medical records.

The data of a few studies on regional populations in Canada were from registries of physician-diagnosed cases in Prince Edward Island,[5] Montreal[6,7] and Toronto;[8] the last two involved insulin-dependent diabetic patients only. In the native population, where the prevalence of diabetes is high, studies have involved various tribes in northern Ontario and Manitoba,[9] southwestern Ontario[10] and the Northwest Territories.[11]

We report on the feasibility of studying the burden and impact of diabetes mellitus in the total population of Manitoba using data from the provincial health insurance plan. Although the utility of administrative databases in health services research has been well established[12,13] it has been limited in descriptive and analytic epidemiologic studies, such as the study of the adverse effects of medication use[14] and of the incidence of myocardial infarction.[15] To our knowledge this is the first time such a database has been used to study the prevalence of diabetes. Because universal health insurance plans exist in all Canadian provinces our study could be replicated in other provinces.

Methods

Manitoba Health Services Commission (MHSC) database

The MHSC enters on computer virtually all health care use by individuals, including physician visits, admissions to hospital, nonhospital laboratory tests and use of personal-care homes. Most physicians in Manitoba practise on a fee-for-service basis within the provincial plan. To receive payment they submit a claim to the MHSC for each patient visit or procedure performed. Institutions employing salaried physicians also submit claims for government record-keeping purposes. For each service (tariff) the physician records the tariff number, the diagnosis and the fee. Such claims constitute the "medical" file. A separate datafile exists for hospital admissions of provincial residents ("hospital" file). For each admission a discharge summary is sent to the MHSC; the summary includes information on the patient, the attending physician(s), the diagnosis, the procedure(s) performed and the dates of admission and discharge.

Since there are no premiums for health insurance in Manitoba, virtually all of the residents are registered with the MHSC. In addition, the MHSC maintains and updates a population registry that contains dates of coverage organized by family members. Under universal coverage the enrolled beneficiary population closely matches the actual provincial population, as determined by Canada census data.

Over the past 15 years a considerable effort has been made to establish the validity and reliability of claims data for research purposes. A comparison of MHSC data with physicians' medical records showed few differences in the number of visits and episodes.[12] Procedures associated with billable tariffs were recorded with a high degree of accuracy. Measures of physicians' interreliability and intrareliability in assessing diagnoses recorded in the hospital medical records and those in the hospital claims were found to correspond closely.[12,16,17] The MHSC database has been used over the past 15 years to study common surgical procedures,[18-21] screening and preventive services[22] and physician practice patterns.[23,24]

Disease frequency

A population-based sample of 100 000 people registered with the MHSC as of July 1, 1983, was drawn. The sample was stratified by age, sex and MHSC health region. Half of the people were 25 to 64 years of age and the other half 65 years or older. All analyses were weighted to reflect the age–sex distribution of the Manitoba population. The hospital and physician claims during 1980–84 were abstracted and saved to separate tape files. Claims for status Indians and people under 25 years of age were excluded.

All physician and hospital records containing

the ICD-9-CM code (International Classification of Diseases, 9th revision, clinical modification[25]) for diabetes mellitus were identified. For each person with at least one claim a 5-year profile of all diabetes-related health care claims was created. In addition, we identified all claims containing pregnancy codes (ICD-9-CM codes V22, V23, V27 and 630 to 676) for women aged 25 to 44 years. Potential diabetes-related complications in the identified diabetes cases were flagged as occurring before or after the first appearance of a diabetes diagnosis.

We identified 7627 people with at least one claim containing a diabetes code within the study period. The MHSC medical file was considered to be more important than the hospital file as the source of diabetes cases (Table 1); 95% of the people we identified as possibly having diabetes used some medical service during the study period, whereas only 43% used some hospital service.

The individual 5-year profiles of the diabetes-related claims facilitated the identification of first-time occurrences; thus, it was possible to distinguish "incident" from "prevalent" cases of diabetes. Although the profiles encompassed only 5 years it is extremely unlikely that the first event would have occurred before then without subsequent contact with the health care system. We were able to determine through the population registry file whether no contact with the health care system meant that the person died or left the province. During the study period 2139 people with diabetes died, 160 left the province, and 69 had incomplete records (could not be located, status unknown or information deleted without reason).

Of the 4556 pregnant women 85 (1.9%) had a diagnosis of diabetes. To distinguish gestational diabetes from pre-existing diabetes we had to determine the time sequence of the diagnosis and the pregnancy. In Manitoba many obstetricians bill only once, at the end of pregnancy, for care provided during the entire period. We estimated the proportion of women with gestational diabetes by determining the first diagnosis of pregnancy and counting back 9 months from the time of delivery.

Validity checks

Two substudies were done to check the validity of the MHSC data in identifying people with diabetes.

In the first substudy we compared diagnoses from the MHSC database with self-reports of diabetes from people participating in the Manitoba Longitudinal Study on Aging.[26] In the longitudinal study a large representative sample of elderly Manitobans were interviewed in 1971; survivors were interviewed again in 1983. In both surveys the subjects were asked to indicate which of the common health problems listed (including diabetes) they had within the previous year or still had. Of the 1246 subjects interviewed in both 1971 and 1983, 26 reported having diabetes in 1971 and 1983, 61 in 1983 only and 19 in 1971 only. The last group was eliminated from the validity study since we were less certain of the diagnostic accuracy of these apparently "resolved" cases.

All diagnoses of diabetes associated with physician visits and hospital admissions during 1970–82 were examined. With self-reports serving as the "gold standard" the use of the MHSC database was found to have high sensitivity and specificity, regardless of whether the hospital file or the medical file was used (Table 2). In fact, 14 (16%) of the people who reported that they were diabetic in 1971 and 1983 had no diagnosis of diabetes recorded at a physician visit or hospital admission during that period. Conversely, 42 people who failed to mention their diabetes at the interview had it recorded at least once in their hospital record. These findings suggest that administrative databases are more appropriate as gold standards against which survey data can be compared and evaluated.

In the second substudy of validity the entire Manitoba population database (rather than the 100 000 sample) was used to examine claims records of those enrolled in the provincial diabetes education program. All enrollees were referred by a physician and thus constituted clinically confirmed "true" cases. An "event" file, consisting of 817 diabetic patients aged 25 years or more who enrolled in the education program during 1986, was created. All medical and hospital claims from January 1986 to April 1987 from these individuals were abstracted and written to tape files. Those with a diagnosis of diabetes were then matched with the event file. We were able to match 757 of the 817 people using just 16 months of claims data. Thus, 93% of the people with true diabetes who were enrolled in the provincial diabetes education program were identified as having diabetes by the MHSC database.

Table 1: Source of cases to determine the burden of diabetes mellitus in Manitoba according to health insurance claims from 1980 to 1984

Source*	No. (and %) of cases (n = 7627)
Hospital files only	385 (5.0)
Hospital and medical files	2895 (38.0)
Medical files only	4347 (57.0)

*Hospital files refer to the hospital admissions of provincial residents, claims for which are submitted to the Manitoba Health Services Commission (MHSC); medical files refer to the claims by the physician to the MHSC for payment.

Results

Prevalence and incidence of diabetes

Table 3 shows the estimated 5-year period prevalence of diabetes in Manitoba from 1980 to 1984 by age, sex and MHSC health region. All of the regions except Norman (in northern Manitoba) had similar prevalence rates. In Norman the rates were four times the provincial average, particularly among women aged 25 to 44 years; in addition, they were 1.5 and 1.9 times the provincial average among men and women aged 45 to 64 years respectively. This difference may have been because Norman has a high concentration of native Indians. Although status Indians were excluded from our sample many Indians who were not living on official reserves or had legally lost their Indian status were included.

The annual prevalence rates of diabetes for 1983 only were compared with Canadian and US survey data (Table 4).

Five years of data documenting contact with the health care system were available for our sample. By determining the year during which the diagnosis first appeared in a patient's file we were able to estimate the incidence of the disease (Table 5). Because the study period began in 1980 many of the cases identified in that year were in fact prevalent cases diagnosed earlier. Thus, there was a large decrease in the number of incident cases from 1980 to 1981 and a smaller decrease in 1982. The number of incident cases from 1982 to 1984 was fairly stable. Assuming that it is unlikely for a person with diabetes not to receive any health care for more than 2 years we discarded the data from the first 3 years of the study period and computed the mean number of incident cases in the total Manitoba population from 1983 to 1984. This yielded an average annual incidence rate of 7.8 cases per 1000 population.

Table 2: Sensitivity and specificity of MHSC database, as compared with self-reports from Manitoba Longitudinal Study on Aging[26]

	Subject group; no. of self-reports		
MHSC data	Diabetic	Nondiabetic	Total
Diabetic cases			
(1) Hospital files only	9	31	40
(2) Hospital and medical files	58	11	69
(3) Medical files only	6	6	12
Nondiabetic cases	14	1092	1106
Total	87	1140	1227
	Sensitivity, %	Specificity, %	
1 + 2	82.7 (67/81)	96.3 (1092/1134)	
2 + 3	82.1 (64/78)	98.5 (1092/1109)	
1 + 2 + 3	83.9 (73/87)	95.8 (1092/1140)	

Table 3: Estimated 5-year period prevalence of diabetes in Manitoba from 1980 to 1984 by age, sex and MHSC health region

	Region; no. of cases (and prevalence, %)*							
Age, yr	Central	Eastman	Interlake	Norman	Parkland	Westman	Winnipeg	Total
Men	271 (5.0)	259 (5.4)	163 (4.8)	38 (4.8)	204 (6.1)	405 (5.9)	2538 (5.5)	3878 (5.4)
25–44	12 (1.1)	22 (1.9)	4 (0.6)	6 (1.8)	9 (1.6)	15 (1.3)	146 (1.5)	214 (1.5)
45–64	60 (5.4)	79 (7.2)	46 (6.1)	21 (10.3)	40 (5.5)	86 (5.9)	690 (7.3)	1022 (7.0)
≥ 65	199 (11.8)	158 (10.7)	113 (10.3)	11 (10.2)	155 (13.1)	304 (11.9)	1702 (13.0)	2642 (12.5)
Women	315 (6.0)	254 (5.8)	177 (6.1)	61 (10.4)	179 (6.8)	398 (6.4)	2365 (5.5)	3749 (5.8)
25–44	17 (1.5)	18 (1.9)	8 (1.2)	29 (9.3)	12 (2.4)	22 (1.9)	223 (2.3)	329 (2.2)
45–64	77 (6.3)	63 (6.1)	54 (7.2)	20 (11.7)	52 (7.6)	94 (6.4)	577 (5.9)	937 (6.1)
≥ 65	221 (13.0)	173 (13.9)	115 (12.4)	12 (15.4)	115 (11.3)	282 (11.4)	1565 (11.6)	2483 (11.8)
All	586 (5.5)	513 (5.6)	340 (5.4)	99 (7.4)	383 (6.5)	803 (6.2)	4903 (5.5)	7627 (5.6)
25–44	29 (1.3)	40 (1.9)	12 (0.9)	35 (5.3)	21 (2.0)	37 (1.6)	369 (1.9)	543 (1.9)
45–64	137 (5.9)	142 (6.6)	100 (6.7)	41 (11.0)	92 (6.5)	180 (6.2)	1267 (6.6)	1959 (6.5)
≥ 65	420 (12.5)	331 (12.3)	228 (11.4)	23 (12.4)	270 (12.2)	586 (11.7)	3267 (12.2)	5125 (12.1)

*Actual number of cases in sample of 100 000 Manitobans; the prevalence rates have been adjusted for age and sex.

Diabetes during pregnancy

Eighteen (21%) of the 85 pregnant women with diabetes had a file in which a diabetes claim had been made before the pregnancy, and 67 (79%) had one in which the claim was during the pregnancy. Of the 67 women 44 had further claims after delivery; the remaining 23 had no other claims up to 2 years after delivery and thus constituted those with gestational diabetes.

Discussion

The use of an administrative database to estimate the burden of diabetes has several advantages: the data cover the entire population and are based on physicians' diagnoses instead of subjects' recall, information on diabetes and pregnancy is available, the database can be linked to other databases, such as vital statistics, and no invasive clinical procedures or personal interviews are necessary. The disadvantages include nonstandardized diagnostic criteria, the inability to distinguish between insulin-dependent and non-insulin-dependent diabetes, the inability to estimate the prevalence of undiagnosed diabetes and impaired glucose tolerance, and the paucity of information on risk factors regarding lifestyle and behaviour.

The strengths and weaknesses of using administrative databases in epidemiologic studies of adverse drug reactions have recently been reviewed.[14] The lack of clinical precision is considered by some epidemiologists (of the "clinical" persuasion) to be a fatal flaw.[27] Our study demonstrates the validity of the method; although better diagnostic accuracy is desirable, this should not pose a major impediment for program planning. Patients with diabetes diagnosed with nonstandard or even idiosyncratic criteria are being treated by the physicians who made the diagnosis. This may be more important in understanding and planning the use of health care resources than knowing the number of people in a population with diabetes diagnosed according to internationally recognized criteria.

Administrative databases have been shown to be useful for constructing composite health status (i.e., morbidity) measures.[28] In a cohort study involving the elderly[29] such illness scales were found to have predictive power in terms of death and future admissions to hospitals and nursing homes.

Although we did not review the actual medical records to assess the validity of the MHSC claims we did compare the claims with survey data in a cohort

Table 5: Estimated incidence of diabetes in study sample and in Manitoba by year in which diabetes was first diagnosed

	No. of cases	
Year	In sample	In Manitoba
1980	3 185	13 569
1981	1 214	5 617
1982	1 044	5 020
1983	1 000	4 683
1984	978	4 970

Table 4: Annual prevalence rates of known cases of diabetes by source of data

	Source; prevalence rate, %			
Age, yr	Canada Health Survey, 1978[3]	General Social Survey, 1985[4]	NHANES II,* 1976–80[37]	MHSC database, 1983
Male				
15–24	1.4	0.5	–	–
25–44		0.5	0.6	0.6
45–54		3.3	4.3	3.6
55–64			5.6	
≥ 65	5.1	8.7	9.7	7.3
Female				
15–24	1.7	0.7	–	–
25–44		1.3	1.5	0.9
45–54		3.1	4.3	3.2
55–64			7.4	
≥ 65	8.0	8.6	8.9	6.9
All				
15–24	1.5	0.6	–	–
25–44		0.9	1.1	0.8
45–54		3.2	4.3	3.5
55–64			6.6	
≥65	6.7	8.7	9.3	7.0

*NHANES II = National Health and Nutrition Examination Survey; investigators used age group 20–44 instead of 25–44 and excluded newly screened cases.

of elderly Manitobans. A recent study among elderly people in Florida found a high degree of agreement (98%, $\kappa = 0.93$) between self-reports and medical record reports for diabetes.[30] We realize that the elderly population is not representative of the general adult population; however, as yet no health survey data that can be linked to MHSC claims involve younger groups. The just-completed Manitoba Heart Health Survey, which examined self-reports of diabetes and actual measurements of fasting plasma glucose and glycosylated hemoglobin levels in a representative sample of Manitobans aged 18 to 74 years, could serve as another source of validation of the MHSC database.

The prevalence of diabetes in Manitoba in 1983, estimated on the basis of the MHSC data, was comparable to the prevalence determined from self-reports in the Canadian and US surveys (Table 4). Little data on the incidence were available for comparison. Apart from small studies involving local populations, only the US Health Interview Survey (HIS), performed during 1979–81, provides one of the few large-scale estimates of the incidence of diabetes.[31] The estimated annual rate from the MHSC data among people aged 25 to 44 years was similar to the annual rate from the HIS (2.8 v. 2.0 per 1000). The rate among people aged 45 to 64 years was 10.3 in Manitoba, about twice that reported in the United States.

Although self-reports tend to underestimate the number of people with diabetes, as compared with the MHSC data (Table 2), the prevalence rate was slightly lower and the incidence rate was considerably higher in Manitoba than in the United States. If the difference is real and not the result of a methodologic artefact then one has to seek an explanation in terms of differences in the duration of disease and the relative survival rates among diabetic people in the two jurisdictions. Our study was not designed to address this issue. On the other hand, the discrepancy in incidence rates between the MHSC estimates and the HIS estimates may well be methodologic. In the HIS incidence was estimated from prevalence, a procedure that requires certain assumptions of disease irreversibility and stability of disease incidence and risk factors.[32] To determine which of the two approaches, ours or the HIS one, provides the most accurate estimate of incidence one must perform a longitudinal comparison with direct observation of an initially disease-free cohort. Future studies should use 20-year history files to explore the incidence question more thoroughly.

Estimates of the proportion of pregnant women with diabetes, from the few population-based US studies, have been from 0.51% to 1.16%,[33-35] as compared with 1.9% in our study. Large regional variations can be expected, particularly since the extent to which oral glucose tolerance screening among pregnant women is practised can affect the proportion of pregnant women with diabetes.

It is well recognized that the true prevalence of diabetes in a population can be determined only through oral glucose tolerance screening. Studies have shown that people with diabetes who seek care from physicians and hospitals constitute perhaps only 50% of all the people who would satisfy the biochemical criteria for diabetes had they undergone screening.[36,37] In Canada such population surveys, whether on a national or a provincial level, have not been done. The ability even to estimate the prevalence of previously diagnosed, known cases of diabetes with the use of administrative databases is a major step forward.

It is debatable whether diabetes prevention, particularly primary and secondary prevention, is possible.[38,39] However, diabetic people consume considerable health care resources. The potential exists for cost reduction and improvement in the quality of life through health education programs and the reduction of complications through modification of risk behaviour.[40] In Canada the available data on the cost of diabetes care are scanty.[41] Such information is necessary for the planning of health care services for diabetic people and will be obtainable in further studies using the MHSC database.

We are planning to repeat our study using the entire claims database for 1970–89 and including children and young adults under 25 years of age as well as status native Indians. This will allow us to monitor long-term trends in the incidence and prevalence of diabetes.

Other epidemiologic studies that can be performed on the total provincial population and various regional and socioeconomic subgroups include (a) linkage with vital statistics to compare the survival rates among diabetic and nondiabetic people, (b) prospective studies on the risk of diabetes and complications in cohorts of diabetic and nondiabetic people, (c) studies of physician practice patterns in relation to the health care of diabetic patients, (d) evaluation of interventions and education programs for such people and (e) studies on the economic impact of diabetes on the health care system.

Canada's unique universal health insurance system ensures its citizens accessibility to publicly financed and administered health services. The administrative databases in all provinces have been used in different areas of health services research. Our study demonstrates a new application and the potential capabilities of this approach in obtaining epidemiologic data for diabetes and other important health problems affecting Canadians.

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