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DIABETES IN CANADA

National Statistics and Opportunities for Improved Surveillance, Prevention, and Control

Canada

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The Diabetes Division, Bureau of Cardio-Respiratory Diseases and Diabetes, Laboratory Centre for Disease Control, Health Canada, is solely responsible for any inaccuracies or omissions.

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INTRODUCTION

Diabetes is now being recognized as a public health problem of potentially enormous proportions. Over a million Canadians are currently living with diabetes, and age-standardized rates of diabetes among Aboriginal peoples are triple those found in the general population. Recent comparative national surveys show prevalence rates of diabetes to be on the increase; as the Canadian population ages and rates of obesity rise, this trend is expected to worsen. Diabetes is a major cause of heart disease, and a leading cause of blindness, kidney failure, and limb amputations. Diabetes is ranked as the seventh leading cause of death in Canada, and it accounted for approximately 25,000 potential years of life lost due to premature death in 1996. The actual number of deaths for which diabetes is a contributing cause is estimated to be five times as high as current figures indicate and will increase exponentially over the next 10 years if current trends continue. In economic terms, the burden of diabetes to the Canadian population due to health care costs, disability, work loss, and premature death is estimated to be up to $9 billion annually.

Effective prevention and control measures are urgently needed to

target modifiable risk factors for diabetes such as obesity and physical inactivity

improve the treatment and management of diabetes

delay or prevent debilitating complications.

The recently established Diabetes Division at the Laboratory Centre for Disease Control (LCDC), Health Canada, has compiled current national

statistics on diabetes and its complications in order to provide health professionals, policy makers and the public with a clearer picture of the burden of illness of diabetes and expected future trends. The Diabetes Council of Canada (DCC), through its member organizations, has assisted LCDC by reviewing this first Diabetes in Canada report.

This report is also intended to highlight the great gaps in our knowledge about diabetes. Although a few national surveys, such as the General Social Survey (1985, 1991), National Population Health Survey (1994/95, 1996/97), and the Aboriginal Peoples Survey (1991), do provide some basic data at the national level, there is no ongoing monitoring of the following: the incidence and prevalence of Type 1 and Type 2 diabetes; incidence and prevalence of diabetes complications and disabilities; prevalence of risk factors for diabetes and its complications; diabetes management practices by health professionals and patients; ambulatory health care utilization; quality of care; provision of diabetes education; direct and indirect costs of diabetes; or effectiveness of diabetes prevention and control strategies and activities. Furthermore, there are limited data from either basic or enhanced diabetes surveillance at provincial/territorial or regional/county levels, where diabetes prevention and intervention programs are planned and implemented. We continue to rely mainly on U.S. data for a comprehensive portrait of this chronic, costly, and preventable condition.

The Diabetes Division at LCDC is currently collaborating with provincial and territorial governments, non-governmental organizations and federal agencies on the development of the National Diabetes Surveillance System (NDSS), an initiative of the Diabetes Council of Canada. The ultimate goal of this system is to provide comprehensive, ongoing monitoring of the human and economic burden of diabetes and its complications in order to support urgently needed and effective health care policies and practices.

HIGHLIGHTS

Prevalence

Current national survey data indicate that 1.2 to 1.4 million Canadians aged 12 and over may have diabetes, although only about 800,000 of these are diagnosed cases.

The prevalence of diabetes increases with age: 3% of people aged 35 to 64 and 10% of those aged 65 and over have this diagnosis.

The age-standardized prevalence of diabetes among Aboriginal peoples is approximately triple the rate found in the general population. The age-standardized prevalence rate of diagnosed diabetes among Aboriginal peoples aged 15 and over is 10% and among those over 65 years of age it is 22.8%.

Incidence

Diabetes is diagnosed in an estimated 60,000 Canadians every year.

Disability and Work Loss

Diabetes is associated with more frequent disability days and increased loss of productivity. Among the working age population (35 to 64 years), 23% of people with diabetes had one or more disability days in a two-week period, compared with only 11% of those without diabetes. Note that disability days are not diabetes-specific.

Health Care Utilization

The current (1995) age-standardized rates (standardized to 1991 Canadian population) for diabetes are 112 hospital separations and 1,368 hospital days per 100,000 per year (crude rates for 1995: 115 hospital separations and 1,427 hospital days per 100,000 per year).

In the age group 65 and above, 24% of people with diabetes reported at least one overnight stay in a hospital, nursing home or convalescent home during the previous 12 months compared with 14% of those without diabetes.

Home care use in the previous one-year period is nearly twice as high among people aged 65 and older who have diabetes (16%) as among those without diabetes (9%).

Mortality

There were 5,447 deaths in 1996 for which diabetes was certified as the underlying cause. This ranks diabetes as the seventh leading cause of death in Canada. However, the actual number of deaths for which diabetes was a contributing factor is probably five times this number.

Age-standardized annual mortality rates (standardized to 1991 Canadian population) for diabetes have increased since the early 1980s, with the current (1996) rate at 16.8 per 100,000 population.

Approximately 25,000 Potential Years of Life Lost (PYLL) were lost as a result of diabetes prior to age 75 in 1996, representing an age-standardized rate of 85 per 100,000 population. Since 1983 there has been an increase in the age-standardized PYLL due to diabetes.

Projections in diabetes mortality trends into the year 2016 show an exponential increase in the number of deaths due to diabetes among males and a more linear increase among females.

Economic Burden

The economic burden of diabetes and its complications in Canada is estimated to be up to $9 billion (US) annually in direct health care costs and indirect costs, including lost productivity due to diabetes-related illness and premature death.

Obesity: A Modifiable Risk Factor for Diabetes

The majority of people (59%) with diabetes aged 35 to 64 are overweight.

Long-Term Complications

In the 35 to 64 age group, people with diabetes have six times the risk of heart disease or stroke as do people without diabetes; in the 65 and over age group they have twice the risk.

Among people over 65 years of age there is a significantly higher prevalence of permanent vision loss, cataracts, and glaucoma among those with diabetes than those without.

The percentage of new cases of kidney failure due to diabetes increased from 16% in 1981 to 28% in 1996; 3,340 people with diabetes were receiving treatment for kidney failure as of December, 1996.

Prevention Opportunities

Research is needed into the prevention and treatment of obesity and physical inactivity, the two most important modifiable risk factors for Type 2 diabetes.

Tight control of blood sugar levels can significantly decrease rates of microvascular complications (eye disease and kidney disease). Macrovascular complications (such as heart disease and stroke) can be significantly decreased in Type 2 diabetes through effective blood sugar and blood pressure control.

More funding support is needed into the causes of Type 1 diabetes (usually with onset in those under age 40) in search of a cure.

NATIONAL STATISTICS

Primary Data Source: National Population Health Survey

Description and Rationale

This section presents data from numerous sources, such as national survey data (e.g., National Population Health Survey 1996/97 and the Aboriginal Peoples Survey 1991) and Statistics Canada morbidity and mortality data. Because diabetes is under-represented in morbidity and mortality data, national survey data are particularly important for monitoring the health of Canadians with diabetes. The National Population Health Survey (NPHS) is the most up-to-date source for survey data on the general health of the Canadian population (with the exclusion of people living in the territories, on Indian reserves, on Canadian Forces bases, or in some remote areas of Quebec and Ontario). The NPHS was initiated in 1994/95 by Statistics Canada and will be repeated every two years. Because it is an ongoing survey with a consistent methodology, the NPHS provides comparable data over time. The NPHS provides (a) cross-sectional self-reported data on the health of Canadians every two years, and (b) longitudinal data on a representative sample of Canadians for the purpose of monitoring changes in their health since the start-up year in 1994. The NPHS has replaced the General Social Survey series of 1985 and 1991.

An earlier, important source of national data on the health of Canadians was the Canadian Heart Health Survey (CHHS) (1986-1992). The methodology of the CHHS was somewhat different from that of the NPHS (see Table 1). Therefore, comparisons between CHHS and NPHS data are inadvisable.

As noted in the introduction to this report, current data sources are insufficient for a comprehensive monitoring of the status of diabetes and its complications in the Canadian population. In the future, it is hoped that these data sources will be supplemented by ongoing accurate data from the provincial and territorial administrative databases linked with the National Diabetes Surveillance System (NDSS). The NDSS will have the added benefit of providing a means of validating NPHS self-report survey data with respect to diabetes.

PREVALENCE

Current Overall Prevalence Estimates 1996/97

Based on 1996/97 Canadian survey data and extrapolations from American sources, the number of Canadians aged 12 and over with diabetes is estimated at 1.2 to 1.4 million (4.9% to 5.8% of the population aged 12 and over), including undiagnosed cases of diabetes. Among Aboriginal peoples where age-standardized diabetes prevalence rates are triple those found in the general population, an estimated 60,000 people have diabetes, including undiagnosed cases.

According to the most recent national survey data from which we have prevalence estimates (NPHS 1996/97), 3.2% of the population aged 12 and over have a diagnosis of diabetes; this represents approximately 779,000 Canadians. In addition, diabetes has been diagnosed in an estimated 27,000 institutionalized Canadians (NPHS 1994/95). NPHS population coverage, however, excludes those living in the territories, on Indian reserves, on Canadian Forces bases and in some remote areas in Quebec and Ontario, which underestimates the true prevalence rate of diagnosed diabetes. Another potential source of underestimation of diabetes prevalence is the reliance on self-reported information that is subject to individual memory and willingness to report. For example, an analysis from the 1996 NPHS of new cases of diabetes since 1994 by reported year of diagnosis indicated that approximately 30% to 40% of these cases of diabetes were diagnosed in or before 1994 (NPHS 1996/97, longitudinal file).

Over-reporting of diabetes is also possible (for example, transient hyperglycemia as seen in gestational diabetes could be misinterpreted as diabetes), although NPHS longitudinal data indicate that a very small number of people reported in 1994/95 that they had diabetes but in 1996/97 reported that they either did not have diabetes or that it had disappeared.

Regarding undiagnosed cases of diabetes, American data from the Third National Health and Nutrition Examination Survey (NHANES III) indicate that approximately 35% to 44% of all diabetes cases may be undiagnosed, depending on the test used to diagnose diabetes[1] (see Box, this section). Note that rates of undiagnosed diabetes are gross estimates and the actual rate in Canada of undiagnosed diabetes could be outside the range given here.

Underestimation of Diabetes Prevalence: Undiagnosed Diabetes

The true prevalence of diabetes in Canada is substantially underestimated by our current self-reported estimates of diagnosed diabetes (at 3.2% of the population) mainly because of large numbers of undiagnosed cases of diabetes, assuming similar rates in Canada as exist in the USA. Note that these are gross estimates of undiagnosed diabetes because they are based on single blood samples, not repeat samples on two separate days as recommended.

According to the Third National Health and Nutrition Examination Survey, 1988-1994 (NHANES III), the prevalence of self-reported diagnosed diabetes is an estimated 5.1% for people aged 20 and over in the USA. In addition to the questionnaire, this American survey obtained fasting blood glucose and oral glucose tolerance test measures to detect diabetes in those people without a medical history of diabetes. Using the 1997 American Diabetes Association fasting plasma glucose diagnostic criteria, approximately one third (35%) of all diabetes cases are undiagnosed, representing an additional 2.7% of the US population aged 20 and over with undiagnosed diabetes. Using the World Health Organization (WHO) diagnostic criteria for the oral glucose tolerance test, which is a more sensitive test than the fasting plasma glucose test, undiagnosed diabetes constitutes approximately 44% of total diabetes cases.[1] US rates of undiagnosed diabetes may have decreased since the 1980s when NHANES II (1976-1980) data indicated 50% of all diabetes cases, using WHO oral glucose tolerance test criteria, were undiagnosed[2].

A similar study conducted in the UK from 1990-1992 found a prevalence of undiagnosed diabetes of 4.5% among those 40 to 65 years of age based on WHO criteria using the oral glucose tolerance test[3]. This finding of high numbers of undiagnosed cases of diabetes in a country with a publicly funded health care system suggests that the high prevalence of undiagnosed diabetes in the USA is generalizable to countries that do not have the American system of largely non-publicly funded health care.

Diabetes Prevalence Rates: Comparison of National Survey Estimates

Canadian Heart Health Survey (1986-1992) and National Population Health Survey 1996/97

Estimates of the prevalence of self-reported, diagnosed diabetes in the Canadian population vary widely. A frequently cited prevalence estimate is 5% of those between the ages of 18 and 74, according to the Canadian Heart Health Survey (CHHS) (1986-1992). For the same age group in the NPHS1996/97, the estimated prevalence of diagnosed diabetes is 2.9% of the Canadian population aged 18 to 74 years.

At first glance, it appears that diabetes prevalence among Canadians aged 18 to 74 years has decreased from 1986 to 1996. However, methodologic differences between the surveys make comparisons inadvisable. For example, the CHHS and NPHS differ in population coverage. The diabetes component of the CHHS was used in nine provinces (excluding Nova Scotia), and included people living on Indian reserves in one province (Manitoba). The NPHS collected data from 10 provinces, and did not include people living on Indian reserves. Another difference between the surveys was the length of time for data collection. The CHHS was carried out over a seven-year period whereas the NPHS 1996 data were collected over approximately a one-year period (June 1996 to March 1997). Also, the question used to identify people with diagnosed diabetes differed between these surveys. The CHHS asked people if they had *ever* had diabetes: Have you ever been told by a doctor that you have diabetes? By contrast, the NPHS asked people whether they *currently* had diabetes: Do you have diabetes that has been diagnosed by a health professional? It is not known whether one question is likely to lead to more accurate responses than the other, but it is known that comparing results of surveys with different interview questions is difficult.

Comparable National Surveys: Increasing Trends in Diabetes Prevalence

When surveys with consistent methodologies are compared, the prevalence of diabetes appears to be increasing over time.

General Social Survey (GSS). The GSS was conducted in 1985 and 1991. GSS results showed a significant increase in the prevalence of diagnosed diabetes over this six-year period, from 2.4% in 1985 to 3.5% in 1991 ($p < 0.001$). (GSS respondents were asked: Do you have diabetes?)

National Population Health Survey (NPHS). The NPHS was initiated in 1994/95 and repeated in 1996/97. Over this two-year period, NPHS results showed a nonsignificant trend toward an increasing prevalence of diagnosed diabetes, from 3% in 1994 to 3.2% in 1996.

Once again, differences between GSS and NPHS survey methodologies, such as in the question about diabetes, make comparisons of results between surveys inadvisable.

National Surveys of Diabetes Prevalence: 1978-1996/97

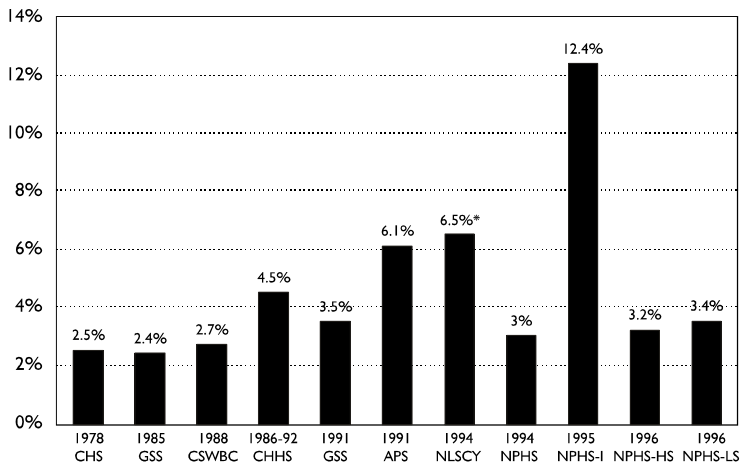
An in-house LCDC study of existing sources of Canadian national health survey data pertaining to diabetes identified eight surveys conducted from 1978 to 1996: Canada Health Survey, General Social Survey, Campbell s Survey on Well-Being in Canada, Canadian Heart Health Survey, Aboriginal Peoples Survey, National Longitudinal Survey of Children and Youth, National Population Health Survey, National Population Health Survey (institutional component) (Figure 1).

Although it is tempting to compare the prevalence rates of these surveys, the comparisons would not be accurate because of variation in the following methodologic factors (Table 1):

- geographic coverage;
- demographic coverage including age, institutional and Aboriginal subpopulations;

FIGURE 1

Prevalence of self-reported diabetes based on Canadian health surveys using different methodologies, 1978-1996/97



* gestational diabetes in most recent pregnancy.

Notes: CHS = Canada Health Survey, GSS = General Social Survey, CSWBC = Campbell's Survey on Well-Being in Canada, CHHS = Canadian Heart Health Survey, APS = Aboriginal Peoples Survey, NLSCY = National Longitudinal Survey of Children and Youth, NPHS = National Population Health Survey, NPHS-I = National Population Health Survey Institutional, NPHS-HS = National Population Health Survey 1996/97, Health Share File (cross-sectional), preliminary release. NPHS-LS = National Population Health Survey 1996/97, Health Share File (Longitudinal), preliminary release.

definitions of diabetes in terms of current versus ever, and who made the diagnosis;

method of contact in terms of a face-to-face interview, mailout or telephone survey; and

period of data collection.

Each of these differences influences the results to varying degrees, in terms of a tendency to either overestimate or underestimate. For exam-

TABLE 1

Study populations and methodology for national health surveys with diabetes content, 1978-1996/97

Survey	Year	Sample size (weighted pop. estimate)	Geographic/ population coverage	Age (years)	Definition of diabetes
Canada Health Survey	1978	31,668 (23,023,000)	10 provinces	15+	Ever had diabetes?
General Social Survey	1985	11,200 (19,669,000)	10 provinces	15+	Do you have diabetes?
General Social Survey	1991	11,924 (20,980,862)	10 provinces	15+	Do you have diabetes?
Campbell s Survey on Well-Being in Canada	1988	4,345 (22,075,319)	10 provinces	7+	Do you presently have diabetes - insulin dependent?; non-insulin dependent?
Canadian Heart Health Survey	1986-1992*	23,129 (18,829,203)	9 provinces (no diabetes content -Nova Scotia, 1986); Indian reserves in Manitoba only	18-74	Have you ever been told by a doctor that you have diabetes?
Aboriginal Peoples Survey	1991	36,635 (630,414)	Canada; Aboriginal	15+	Have you ever been told by a health care professional that you have diabetes?
National Longitudinal Survey of Children and Youth	1994/95	22,831 (4,673,390)	Provinces and territories; diabetes question asked of only women with children under 2 years of age	NA (mothers)	During pregnancy, did you suffer from pregnancy diabetes?
National Pop. Health Survey Institutional	1995	2,287 (227,842)	10 provinces; all long-term residents of selected health care institutions	12+	Do you have diabetes that has been diagnosed by a health professional?
National Pop. Health Survey-cross-sectional	1994/95	17,011 (23,948,603)	10 provinces; no Indian reserves	12+	Do you have diabetes that has been diagnosed by a health professional?
National Pop. Health Survey-cross-sectional	1996/97	77,403 (28,641,735)	10 provinces; no Indian reserves	12+	Do you have diabetes that has been diagnosed by a health professional?
National Pop. Health Survey-longitudinal**	1994/95-1996/97	14,860 (28,617,694)	10 provinces; no Indian reserves; selected respondents surveyed every two years	12+	Do you have diabetes that has been diagnosed by a health professional?

* The Canadian Heart Health Survey is the only listed cross-sectional survey that collected data over a multi-year period; data were standardized to the 1986 Canadian population.
** National Population Health Survey - longitudinal file was standardized to the 1994 Canadian population.
Note: Pop .= population. Non-proxy = respondents report on their own health status. Proxy = a selected respondent reports on the health status of all eligible household members.

ple, most surveys included adult populations but with age cutoffs that varied from 7 to 18 years of age and older. A higher age cutoff will tend to bias the result towards a higher prevalence estimate of diabetes because of the higher prevalence in older age groups. Even though the number of cases in institutional and Aboriginal populations is small, the exclusion of these groups will tend to underestimate the actual prevalence because of their higher diabetes rates.

Diabetes Prevalence by Race/Ethnic Group 1996/97

The distribution of diabetes prevalence by racial/ethnic group in the Canadian population aged 12 and over is as follows: 3.2% of whites, 3.8% of blacks, and 5.4% of Aboriginal peoples not living on reserves (the last two figures have high sampling variability because of small samples, i.e., n = 39 and 63 respectively). Samples are too small among those with diabetes in other racial/ethnic groups for population estimates to be made. (NPHS 1996)

Data from the 1991 Aboriginal Peoples Survey on diabetes among Aboriginal peoples are reported in a later section of this report.

Diabetes Prevalence by Age 1996/97

Prevalence rates of diabetes increase with age such that the rate in those aged 65 years and over is three times as high as the rate in those aged 35 to 64 (10.4% vs. 3.2%) (Table 2).

Diabetes Prevalence by Sex 1996/97

Diabetes prevalence is significantly higher among males than females (3.5% vs. 2.9%, $p < 0.001$). This difference is due to the higher prevalence in the 35 to 64 age group (3.7% among males vs. 2.7% among females) and the 65+ age group (12.1% vs. 9.1%) (Table 2). As noted in a later section on obesity, the higher level of obesity among males may explain this higher diabetes prevalence.

In terms of the distribution of diabetes cases by sex, 54% of those reporting diabetes are male and 46% female. This difference is due to a larger proportion of males with diabetes in the 35 to 64 age group (58.1% among males vs. 41.9% among females) (Table 3).

TABLE 2

Prevalence of diagnosed diabetes, by sex and age group Canada excluding Territories, 1996/97

Sex	% reporting diabetes (estimated number of cases)			
	Age group			
	Population (12+)	12 - 34	35 - 64	65+
Male	3.5 (420,000)	0.5* (25,000)	3.7 (217,000)	12.1 (178,000)
Female	2.9 (359,000)	0.5* (26,000)	2.7 (156,000)	9.1 (176,000)
Both	3.2 (779,000)	0.5 (51,000)	3.2 (373,000)	10.4 (355,000)**

* Estimate has high sampling variability.
** Sum total has rounding error.

Note: Diabetes refers to current diabetes that has been diagnosed by a health professional.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

TABLE 3

Proportion of males and females among those reporting diabetes, by age group Canada excluding Territories, 1996/97

Sex	% reporting diabetes			
	Age group			
	Population (12+)	12 - 34	35 - 64	65+
Male	54	49.6	58.1	50.3
Female	46	50.4	41.9	49.7
Both	100	100	100	100

Note: Diabetes refers to current diabetes that has been diagnosed by a health professional.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

Prevalence by Province 1996/97

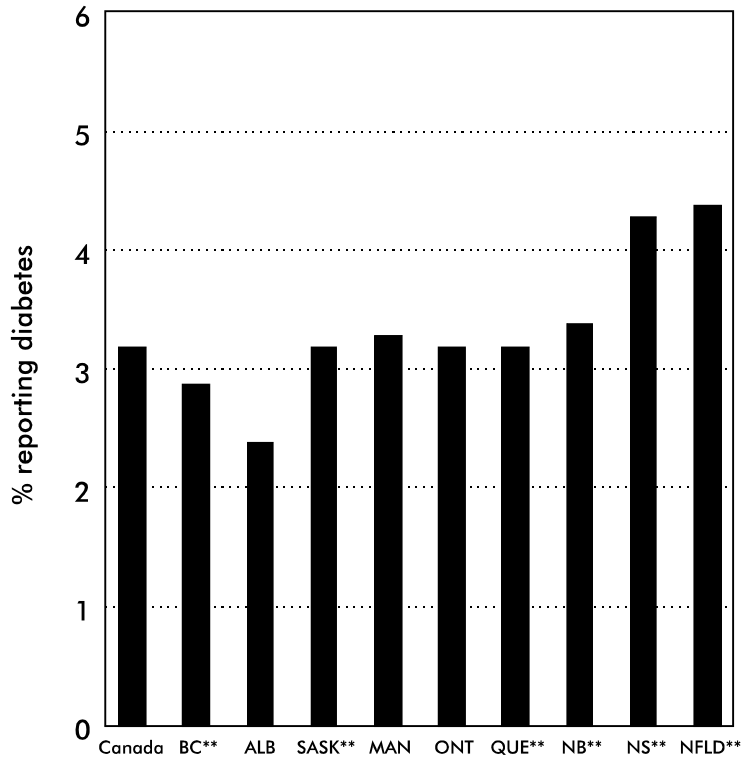
Prevalence rates of self-reported diabetes by province range from roughly 3% to 4% (Figure 2). Rates for diabetes vary among provinces when surveys are compared, but no consistent pattern is clear at this time.

Prevalence of Gestational Diabetes 1994-1995

Canadian data from the 1994-1995 National Longitudinal Survey of Children and Youth (NLSCY) indicate that 6.5% of women who had children under 2 years of age reported pregnancy diabetes in their most recent pregnancy.

FIGURE 2

**Prevalence of self-reported diabetes by province*
Canada excluding Territories, 1996/97**



* P.E.I. is not included here because the sample size is too small (<30) for reportable prevalence estimate.
** Prevalence estimate has high sampling variability.

Notes: Samples sizes (n) : BC n=45; ALB n=384; SASK n=37; MAN n=498; ONT n=1354; QUE n=77; NB n=30 ; NS n=40; NFLD n=38. Diabetes is self-reported. Respondents were aged 12 and over.

Source: LCDC 1998 using National Population Health Survey 1996/97, Health Share File, preliminary release.

INCIDENCE

There are an estimated 60,000 new cases of diagnosed diabetes every year in Canada. This is an incidence rate of 2.6 new cases per 1,000 people among those aged 12 and over each year (95% confidence interval [CI] 2.0-3.2 per 1,000/year) (NPHS 1996/97, longitudinal file). Type 1 and Type 2 diabetes are not differentiated in the NPHS results. The US Centers for Disease Control and Prevention report an annual incidence rate of approximately 2.9/1,000 new cases of diabetes per year in the general population[4].

Regarding provincial estimates, a 1996 Manitoba study reported a diabetes incidence rate of 5.6/1,000 among adults aged 25 and over for the period 1986-1991. This study used data from Manitoba Health s comprehensive insurance system to estimate diabetes incidence rates[5].

Type 1 Diabetes

The incidence of Type 1 diabetes is available from a few provincial studies and is compared in Table 4 with rates in Finland and Japan, which are at the extremes. Comparisons among countries facilitated by the WHO have found the highest rates of Type 1 diabetes in Scandinavia, intermediate rates in Canada and the United States, and low rates in Japan and Tanzania. Type 1 diabetes incidence appears to be increasing outside North America. Because of limited data it is unclear whether Type 1 diabetes is increasing in North America.

TABLE 4

Comparison of Type 1 diabetes incidence rates in Canada, Japan, and Finland

Year	Population	Age group	Annual incidence per 100,000
1971-1983	Montreal	0-14	9.6[6]
1975-1986	P.E.I.	0-14	15.5[7]
1976-1978	Toronto	0-14	9.0[8]
1985-1993	Manitoba	0-14	20.4[9]
1990-1995	Edmonton	0-14	25.7[10]
1985-1989	Japan	0-14	2.0[11]
1989-1990	Finland (2 regions)	0-14	42.9[12]

Note: All data sources are registries with the exception of the Manitoba study.

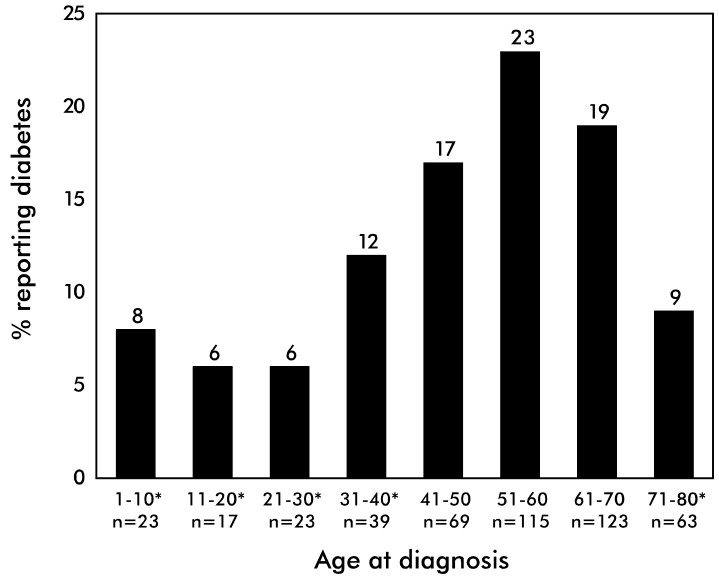
AGE OF ONSET OF DIABETES

The distribution of reported age at diagnosis of diabetes indicates that in a small proportion of people diabetes was diagnosed prior to age 40, and in the majority (68%) after age 40 (GSS 1991) (Figure 3). These results are consistent with the early onset of Type 1 diabetes in a minority and late onset of Type 2 diabetes in the majority of people with diabetes.

The mean age at diagnosis of self-reported diabetes was 47 years.

FIGURE 3

Self-reported age at diagnosis of diabetes, by 10-year intervals Canada excluding Territories, 1991



* Estimate has high sampling variability.

Notes: Respondents were aged 15 years and older. n = sample size in age group.

Source: LCDC 1997 using General Social Survey, 1991.

MORBIDITY

Disability

Diabetes is associated with more disability days and therefore increased loss of productivity as compared with the toll of disability among those without diabetes. Of those in the working age population (35 to 64 age group), 23% of people with diabetes reported one or more disability days (in bed or with restricted activities) in a two-week period compared with 11% of those without diabetes. In the 35 to 64 age group, 9.3% were disabled for the entire two-week period (i.e., they had had 14 disability days in the previous two weeks), compared with 2.9% of people without diabetes (Table 5).

TABLE 5

Distribution of self-reported number of disability days in a 2-week period, by age group and diabetes status Canada excluding Territories, 1996/97

# of disability days	% distribution by age group			
	35 - 64		65+	
	With diabetes	Without diabetes	With diabetes	Without diabetes
0	77.3	89.1	77.7	85.6
1-4	8.7	5.5	5.1	4.4
5-13	4.7*	2.6	3.8*	3.2
14	9.3	2.9	13.4	6.7

* Estimate has high sampling variability.

Notes: Disability day = a day in bed or with restricted activities. Cause of disability day is not diabetes-specific. Sample sizes in the 12-34 age group with diabetes were too small to be expressed as percentages.

Source: LCDC 1998 using National Population Health Survey, 1996/97, Health Share File, preliminary release.

Of people who reported at least one disability day in the previous two-week period, those with diabetes had had an average of nine disability days compared with an average of six among those without diabetes (Table 6).

TABLE 6

Mean number of disability days in a 2-week period among people reporting at least one disability day, by diabetes status and age group Canada excluding Territories, 1996/97

Mean number of disability days by age group							
12-34		35 - 64		65+		Population (12+yrs)	
With diabetes	Without diabetes	With diabetes	Without diabetes	With diabetes	Without diabetes	With diabetes	Without diabetes
4.37	4.61	8.13	6.51	10.27	8.93	8.88	6.10

Notes: Cause of disability day is not diabetes specific. Disability day = a day in bed or with restricted activities.

Source: LCDC 1998 using National Population Health Survey, 1996/97, Health Share File, preliminary release.

Please note that these disability days (in bed or with restricted activities) are not necessarily due to diabetes, since the specific cause of the disability was not obtained in the NPHS survey. However, NPHS respondents were asked to state the main cause of any long-term physical/mental condition or health problem leading to activity restriction (not equivalent

to disability day). In response to this question probing chronic conditions leading to activity restriction, disease was identified as the main cause of the activity restriction by 64% of people with diabetes aged 35 to 64, and 66% of people with diabetes aged 65 and over.

General Health Perception

Self-perceived health status has been found to correlate with mortality rate, indicating that people with poorer self-ratings of health tend to die sooner than those with higher personal health ratings[13].

Self-perceived health status was much worse among those with diabetes than those without (Table 7). Among the working age population (35 to 64 years), 34% of people with diabetes perceived their general health as fair or poor compared with only 9% of people without diabetes. Similarly, in the over 65 age group, 43% of people with diabetes as compared with 19% without rated their general health as fair or poor.

TABLE 7

Distribution of general health perception, by age group and diabetes status Canada excluding Territories, 1996/97

Perception of general health	% distribution by age group			
	35 - 64		65 and over	
	With diabetes	Without diabetes	With diabetes	Without diabetes
Poor	12.9	1.9	12.8	5.2
Fair	21.2	7.2	30.5	13.9
Good	33.7	27.3	34.6	37.8
Very good	28.4	39.0	18.1	29.8
Excellent	3.8*	24.6	4.1*	13.3

* Estimate has high sampling variability.

Notes: Diabetes was self-reported. The sample sizes in the 12-34 age group with diabetes were too small for the percentage to be expressed.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

Health Care Utilization

Outpatient Visits

On the basis of physician reports (IMS Canadian Disease and Therapeutic Index data), 79% of all visits to physicians for diabetes over a 12-month period are made by patients aged 50 years and older. This has been consistent from 1992 to 1996. According to the most recent data (Figure 4), the proportion of visits by age group increased with age, peaking at 60 to 69 years (30.3%) and then declined. Treatment (new or refill medication prescribed) and non-treatment visits followed the same pattern with increasing age. The proportion of treatment visits to total visits ranged from 58% in the youngest age group to 74% in the 60 to 69 year age group.

The number of visits per person in 1996 by age group (Figure 5) indicates that the largest percentage of single visits occurred in the youngest

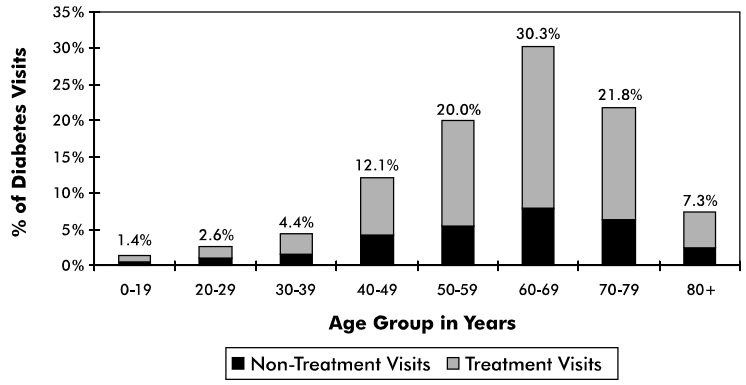
age group. The proportions with four or more visits and 11 or more visits increased with increasing age.

Self-Reported Consultations with Medical Doctor. People with diabetes in all age groups reported more frequent visits (not necessarily diabetes-specific) to medical doctors in the previous year than did those without diabetes (Table 8). The highest difference was in the 35 to 64 age group, in which people with diabetes reported an average of seven visits to a family doctor or general practitioner in the previous 12 months compared with an average of three visits by people without diabetes.

Diabetes Education. Diabetes is a condition that requires a great deal of self-management. Diabetes education is a key foundation of adequate diabetes control. The proportion of Canadians with diabetes who receive formal diabetes education is unknown.

FIGURE 4

Age distribution of treatment* and non-treatment diabetes visits to physicians Canada excluding Territories, 1996

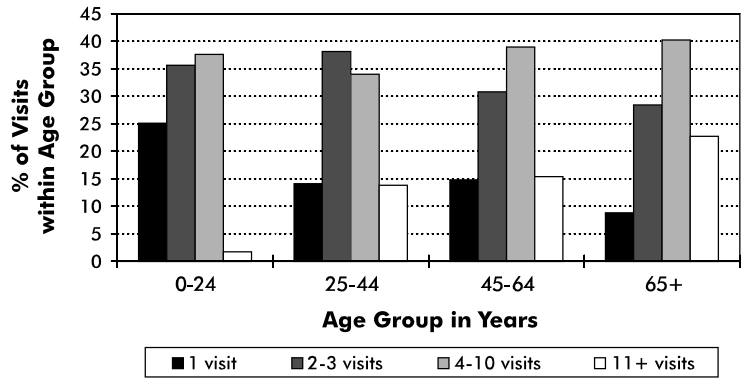


* Diabetes medication prescribed

Source: LCDC 1997 - using IMS Canadian Disease and Therapeutic Index year ending December, 1996.

FIGURE 5

Diabetes visits to physicians by age group Canada excluding Territories, 1996



Source: LCDC 1997 - using IMS Canadian Disease and Therapeutic Index year ending December, 1996.

Self-Reported Homecare Service Utilization. Home care use was nearly twice as high among people aged 65 and older with diabetes as among those without. In this

TABLE 8

Mean number of visits* to a family doctor or general practitioner in previous 12 months, by age group and diabetes status Canada excluding Territories, 1996/97

Mean number of visits by age group							
12-34		35 - 64		65+		Population (12+yrs)	
With diabetes	Without diabetes	With diabetes	Without diabetes	With diabetes	Without diabetes	With diabetes	Without diabetes
4.09	2.74	7.36	2.92	7.04	4.43	7.00	3.04

* Visits are not diabetes-specific

Note: Visit = see or talk on the telephone with a family doctor or general practitioner about personal physical, emotional or mental health.

Source: LCDC 1998 - using National Population Health Survey, 1996/97, Health Share File, preliminary release.

age group, 16% of people reported receiving home care in the previous year compared with 9% of those without diabetes (NPHS 1996/97).

Self-Reported Frequency of Eye Examinations. The Canadian Diabetes Association s 1998 clinical practice guidelines recommend annual screening for diabetes-related eye disease (retinopathy) for those with Type 1 diabetes, beginning five years after diagnosis, and at least every four years for those with Type 2 diabetes who have no or minimal retinopathy[14].

From NPHS 1996/97 data, it is clear that people with diabetes do have more frequent eye examinations than those without. Over 60% of people with diabetes reported having had an eye examination within the previous year compared with 40% of those without diabetes (Table 9).

TABLE 9

Period of time since last eye examination, by diabetes status and age group Canada excluding Territories, 1996/97

	Mean number of visits by age group							
	12-34		35 - 64		65+		Population (12+yrs)	
Time period since last exam	With diabetes	Without diabetes	With diabetes	Without diabetes	With diabetes	Without diabetes	With diabetes	Without diabetes
Less than 1yr ago	54.1	37.7	57.2	39.7	70.2	55.7	62.8	40.9
1-2 yrs ago	---	17.6	25.2	20.8	15.0	18.6	20.4	19.3
2-3 yrs ago	---	11.0	8.9	13.8	6.5*	11.4	7.6	12.4
3+ yrs ago	---	25.9	7.5	21.3	8.2	13.6	8.5	22.1
Never	---	7.8	---	4.4	---	0.8	---	5.3

* Estimate has high sampling variability.

Notes: --- = the sample size is too small to be expressed as a percentage.
Diabetes was self-reported. Data on eye examination frequency are derived from two NPHS variables.

Source: LCDC 1998 - using the National Population Health Survey 1996/97, Health Share File, preliminary release.

Of those with diabetes, 30% specified their condition as one of the reasons for an eye examination; other common reasons were to make sure all was well (40%), and prescription needs changing (31%).

Self-Reported Blood Pressure Assessment. High blood pressure (hypertension) contributes to the complications of diabetes, such as cardiovascular disease and kidney disease (nephropathy). Therefore, regular blood pressure checks are recommended for people with diabetes.

Based on self-report data that almost all people with diabetes (99%) have had their blood pressure checked, and over 90% in all age groups with diabetes have had their blood pressure checked in the previous year, it appears that the vast majority are being monitored for hypertension (Table 10).

TABLE 10

Percentage of people who reported having had their blood pressure taken within the previous year among those who had ever had their blood pressure taken*, by diabetes status and age group Canada excluding Territories, 1996/97

	% reporting blood pressure taken in previous year, by age group		
Diabetes status	**12 - 34**	**35- 64**	**65+**
With diabetes	94.9	94.4	97.2
Without diabetes	68.9	76.0	90.6

* 96% of NPHS respondents had had their blood pressure taken at least once (99% of people with diabetes and 95% of people without diabetes).

Note: Diabetes was self-reported.

Source: LCDC 1998 - using the National Population Health Survey 1996/97, Health Share File, preliminary release.

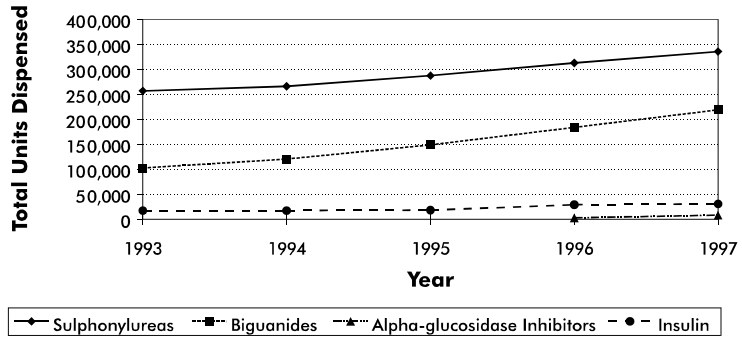
Medication Use

Data from Pharmacies. The total number of units of diabetes medications dispensed through pharmacies in Canada has increased for all medication types from 1993 to 1997. Sulphonylureas were the most common, followed by biguanides, insulin and alpha-glucosidase inhibitors (1996-1997 only) (Figure 6). For oral hypoglycemic medication, the number of tablets will vary with daily dosage routines. Given that sulfonylureas are usually indicated 1-2 times per day compared with the biguanides at 2-3 times per day, one could expect the actual difference between these two groups in terms of total number of people receiving the medications to be greater than that suggested by the graph.

Figure 7 compares the distribution within diabetes medications dispensed by medication type over time. In the same five-year period, the proportion of sulphonylureas dispensed, compared with the total, decreased from 68% to 57%, and for biguanides the proportion increased from 27% to 37%.

FIGURE 6

Total units* of diabetes medications dispensed by year Canada excluding Territories, 1993-1997

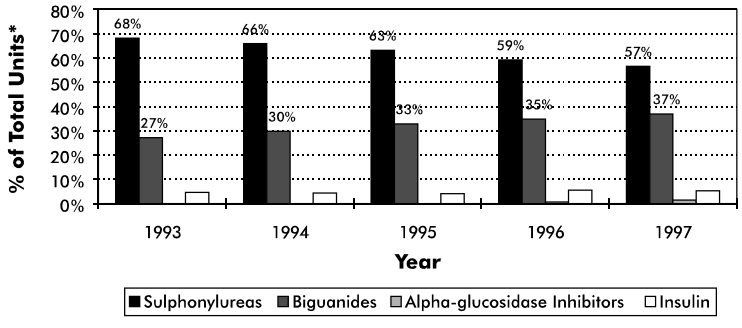


* Tablets, capsules and millilitres

Source: LCDC 1997 - using IMS Canada Compuscript- year ending December, 1993, 1994,1995, 1996, 1997.

FIGURE 7

Distribution of diabetes medications dispensed by year Canada excluding Territories, 1993-1997

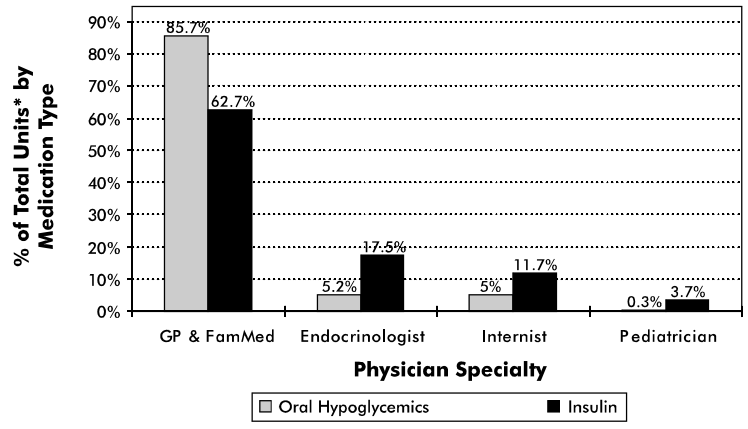


* Tablets, capsules and millilitres.

Source: LCDC 1997 - using IMS Canada Compuscript- year ending December, 1993, 1994,1995, 1996, 1997.

FIGURE 8

Distribution of diabetic medications dispensed by physician specialty Canada excluding Territories, 1997



* Tablets, capsules and millilitres.

Source: LCDC 1997 - using IMS Canada Compuscript- year ending December, 1997.

Insulin as a proportion of all diabetic medications has remained fairly constant.

Data from Physician Prescriptions. Prescriptions from general practitioners and family medicine specialists accounted for 86% of all oral hypoglycemic and 63% of all insulin medication units dispensed in 1997 (Figure 8).

Self-Reported Medication Use. An estimated 28% of Canadians with diagnosed diabetes were taking only insulin to control their diabetes, 54% were taking drugs (not insulin), 8% were taking both insulin and drugs, and 10% were using only diet to control their condition (Table 11).

Provincial government drug benefit plans could be an important source of data on the management of diabetes among those who are over 65 years of age. In the over-65 age group, an estimated 198,000 persons with self-reported diabetes were taking drugs (not insulin) to control their condition, 59,000 in the same age group were taking only insulin for their diabetes, and 27,000 people were taking both insulin and drugs (Table 11).

TABLE 11

Self-reported medication use for diabetes, by age group Canada excluding Territories, 1996/97

Age group	% distribution of self-reported medication use for diabetes (estimated number of cases)				
	Diet only	Drug/no insulin	Drug + insulin	Insulin only	Other
12 - 34	---	---	---	60.2* (21,000)	0
35 - 64	13.0 (39,000)	46.4 (141,000)	7.7* (23,000)	32.7 (99,000)	---
65+	6.5 (20,000)	65.1 (198,000)	9.0* (27,000)	19.3 (59,000)	---
All (12+)	9.8 (63,000)	53.8 (345,000)	8.4 (54,000)	27.8 (178,000)	---

* Estimate has high sampling variability.

Notes: Other = unspecified. - = the sample size was too small for the percentage to be expressed. Diabetes and medication use are self-reported. Drug = any drugs other than insulin

Source: LCDC 1998 - using the National Population Health Survey 1996/97, Health Share File, preliminary release.

Although the numbers are small, NPHS cohort-based data suggest a trend toward increased insulin use and decreased non-pharmacologic management of diabetes (Table 12).

TABLE 12

Cohort-based trends in self-reported medication use for diabetes Canada excluding Territories, 1994/95-1996/97

	% distribution by diabetes group			
	Diabetes in 94/95-96/97		New diabetes 96/97	
Medication use	1994/95	1996/97	1994/95	1996/97
No pills/no insulin	31.5	20.8*	100	56.3*
Pills/no insulin	47.4	47.5	0	37.4*
Pills + insulin	---	---	0	---
Insulin only	17.9*	25.5*	0	---

* Estimate has high sampling variability.

Notes: - = the sample was too small for the percentage to be expressed. New diabetes 96 = no diabetes in NPHS 1994 but reported diabetes in NPHS 1996 and reported year of diagnosis was after 1994. An extremely small percentage of respondents who reported no diabetes in 1994 and 1996 also reported taking insulin only (n = 4) or pills only (n = 7) in 1994; and insulin only (n = 7), pills only (n = 17), or pills and insulin (n = 3) in 1996.

Diabetes 94/96: n = 713,000 (approx. weighted count). New Diabetes 96: n = 114,000 (approx. weighted count).

Source: LCDC 1998 - using the National Population Health Survey 1994/95-1996/97, Longitudinal Share File, preliminary release.

Hospitalizations

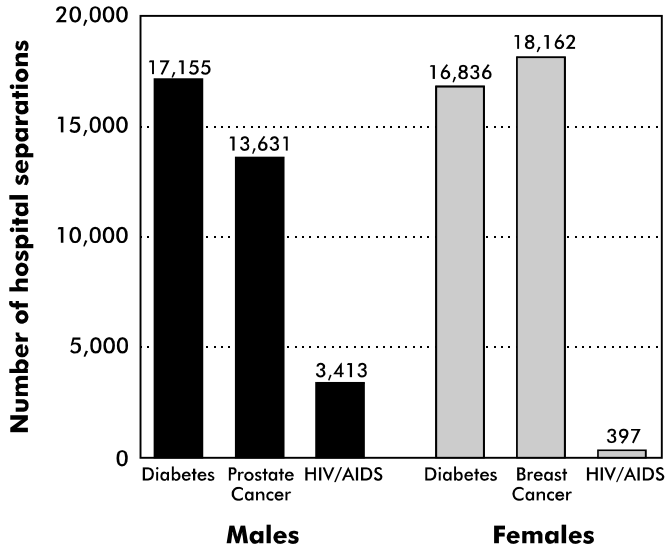
Diabetes is usually diagnosed and treated on an outpatient basis and hence tends to be poorly represented in hospital discharge records. Furthermore, people with diabetes are usually admitted to hospital because of the complications of diabetes, hence the presence of diabetes may not be recorded in the hospital discharge record. For example, Ontario data in the 1995/96 fiscal year indicated that for 12,046 hospital stays diabetes was given as the most significant cause for the hospitalization. However, there were another 28,586 hospitalizations for which diabetes probably affected the length of stay[15].

Current (1995) Rates. There were approximately 34,000 hospital separations (end of hospital stay due to discharge or death) attributable to diabetes in 1995. This figure represents over 400,000 hospital days for diabetes. The current (1995) age-standardized rates for diabetes (standardized to the 1991 Canadian population) are 112 hospital separations per 100,000 population (121/100,000 among males; 104/100,000 among females) and 1,368 hospital days per 100,000 population (1,511/100,000 among males; 1,240/100,000 among females).

The crude 1995 hospitalization rates for diabetes are 115 hospital separations and 1,427 hospital days per 100,000 per year.

FIGURE 9

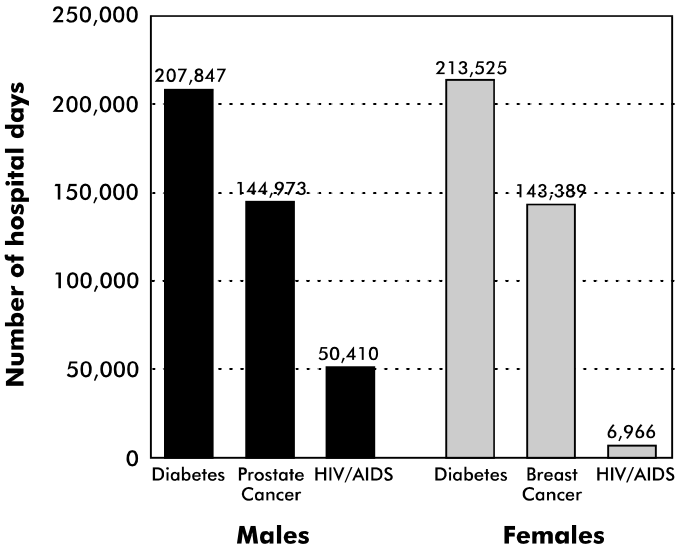
Total number of hospital separations* for diabetes, cancer (prostate, breast), and HIV/AIDS, by gender Canada excluding Territories, 1995



ICD-9 Codes: Diabetes (250), Prostate Cancer (185), Breast Cancer (174, 175), HIV/AIDS (042-044).
* Hospital separations are not person-specific.
Source: LCDC 1998 using Statistics Canada Morbidity Data

FIGURE 10

Total number of hospital days* for diabetes, cancer (prostate, breast), and HIV/AIDS, by gender Canada excluding Territories, 1995



ICD-9 Codes: Diabetes (250), Prostate Cancer (185), Breast Cancer (174, 175), HIV /AIDS (042-044).
* Hospital days are not person-specific.
Source: LCDC 1998 using Statistics Canada Morbidity Data

Comparison of Hospitalizations for Diabetes and Selected Diseases, by Sex, 1995. In order to help put the health care burden of diabetes into perspective, hospitalizations (calculated as total number of hospital separations and total number of hospital days) for diabetes are compared with those for other selected diseases, namely breast cancer, prostate cancer and HIV/AIDS, which have been recognized as important public health problems.

In terms of direct health care costs due to hospitalizations in 1995, males had more hospital separations for diabetes than for prostate cancer or HIV/AIDS (Figure 9), and also spent more days in hospital for diabetes-related events than for the other two diseases (Figure 10). Females had more hospital separations due to breast cancer than to diabetes or HIV/AIDS (Figure 9); however, they spent more days in hospital for diabetes than for breast cancer or HIV/AIDS (Figure 10).

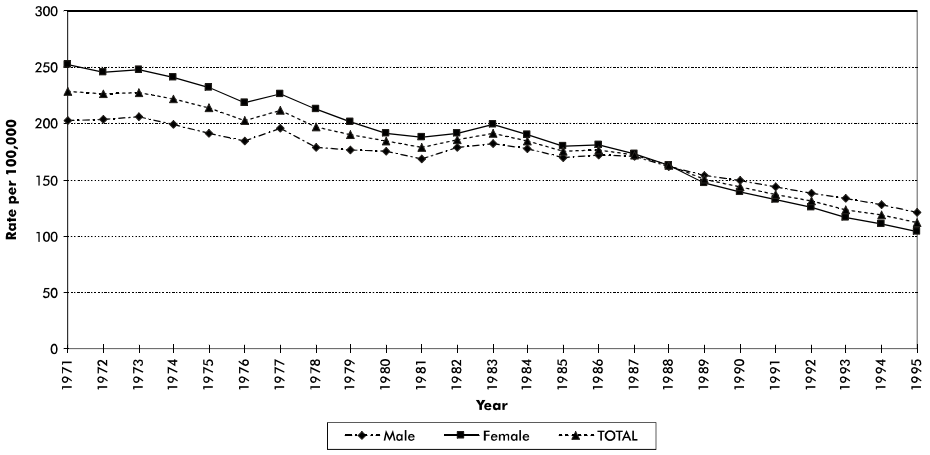
Trends in Hospitalization Rates: 1971-1995. Age-standardized hospital separation rates and rates of hospital days for diabetes have continued to decrease among both men and women and in all age groups since the 1970s (Figures 11 and 12). Since 1983, the number of hospital days has dropped by 42%, and the number of hospital separations has decreased by about 25%. This decrease in hospital utilization most likely reflects a general shift from inpatient (hospital) to outpatient care in Canada s health care system as well as the understanding that

people with diabetes need to learn how to control their blood sugar in their normal environment.

Before the late 1980s, the age-standardized hospital separation rates and corresponding rates for hospital days were higher among women than men, but since that time the gap has closed, and now males have slightly higher rates than females.

FIGURE 11

Age-standardized hospital separation rates (/100,000) for diabetes, by gender and year Canada excluding Territories, 1971-1995

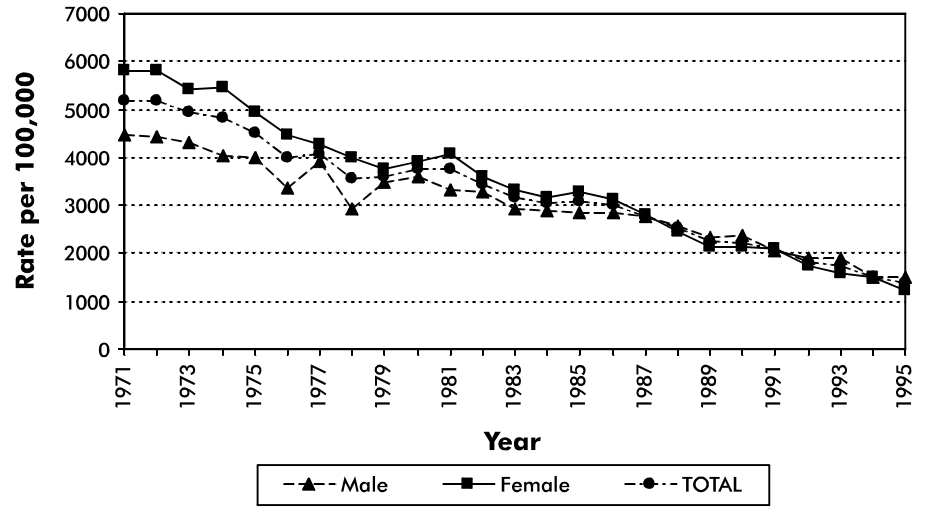


ICD-9 Code 250 Diabetes; Standardized to 1991 Canadian Population

Source: LCDC 1998 using Statistics Canada Morbidity Data

FIGURE 12

Age-standardized hospital days (/100,000) for diabetes, by gender and year Canada excluding Territories, 1971-1995

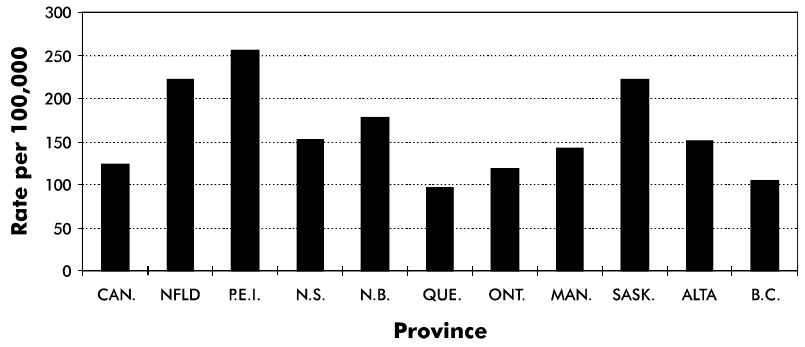


ICD-9 Code 250 Diabetes; Standardized to 1991 Canadian Population

Source: LCDC 1998 using Statistics Canada Morbidity Data

FIGURE 13

Age-standardized hospital separation rates (/100,000) for diabetes from 1991-1995 (5-year average) by province Canada

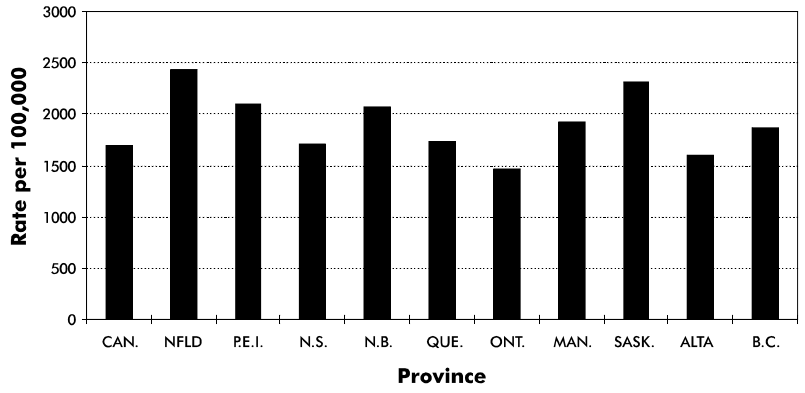


ICD-9 Code 250 Diabetes; Standardized to 1991 Canadian Population

Source: LCDC 1998 using Statistics Canada Morbidity Data

FIGURE 14

Age-standardized hospital days (/100,000) for diabetes from 1991-1995 (5-year average) by province Canada



ICD-9 Code 250 Diabetes; Standardized to 1991 Canadian Population

Source: LCDC 1998 using Statistics Canada Morbidity Data

Hospitalization by Province. Comparisons by province show that the three provinces with the highest five-year average (1991-1995) age-standardized hospital separation rates were Prince Edward Island (255/100,000), Newfoundland (223/100,000) and Saskatchewan (222/100,000). The lowest rate was found in Quebec (97/100,000) (Figure 13).

Some of the provincial variations in hospitalization rates may be explained by differences in the number of beds per 1,000 population per province, differing provincial health policy, and physician practices.

A comparison of age-standardized rates for hospital days shows that Newfoundland and Saskatchewan had the highest five-year average rates (1991-1995). Quebec rates were above the national average, suggesting a longer length of stay in Quebec (Figure 14). Hospital data are not available for Yukon and the Northwest Territories.

Self-Reported Institutional (hospital, nursing home, or convalescent home) Stays. NPHS 1996/97 data did not specify the cause for overnight institutional stays. However, people with diabetes reported more stays in a hospital, nursing home or convalescent home than did people without diabetes, indicating that diabetes is associated with higher rates of institutional stays. The largest differences in rates were in the age group 65 and above, in which 24% of people with diabetes reported at least one institutional overnight stay compared with 14% of those without diabetes (Table 13).

TABLE 13

Self-reported overnight stay in hospital, nursing home or convalescent home in previous 12 months, by age group and diabetes status Canada excluding Territories, 1996/97

	% reporting at least one overnight stay in hospital, nursing home or convalescent home in previous 12 months	
	Age group	
Diabetes status	35-64	65+
With diabetes	16.2	23.9
Without diabetes	7.5	13.9

Notes: Diabetes was self-reported. The sample in the 12-34 age group with diabetes was too small for the percentage to be expressed.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

TABLE 14

Cohort-based trends in percentage of people with at least one self-reported overnight stay in hospital, nursing home or convalescent home in previous 12-month period, by diabetes status Canada excluding Territories, 1994/95-1996/97

	% reporting at least one overnight stay in hospital, nursing home or convalescent home in previous 12 months	
	Year	
Diabetes status	1994	1996
With diabetes 94/96	15.0*	20.1*
Without diabetes 94/96	8.6	8.1

* Estimate has high sampling variability.

Notes: with diabetes 94/96" = respondents with self-reported diabetes in the 1994 & 1996 NPHS. without diabetes 94/96" = respondents without self-reported diabetes in the 1994 & 1996 NPHS.

Source: LCDC 1998 - using the National Population Health Survey 1996/97, Longitudinal Share File, preliminary release.

Longitudinal data indicate that people with diabetes in 1994 had been having more frequent overnight institutional stays by 1996, and that the gap between those with and without diabetes in terms of institutional stays was widening (Table 14).

MORTALITY

Number of Deaths

There were 5,447 deaths (2,701 males; 2,746 females) in 1996 for which diabetes was certified as the underlying cause of death (Statistics Canada Mortality Database). This ranks diabetes as the seventh leading cause of death in Canada.

However, the actual number of deaths for which diabetes was a contributing factor is probably five times this number according to recent Canadian studies (see Box). People with diabetes usually die from the late complications of the condition, such as ischemic heart disease, and it is

these complications that are, in most cases, coded as the underlying cause of death.

Diabetes Mortality Underestimation

A recent Statistics Canada study of all deaths from 1990 to 1993 found that diabetes was coded as underlying cause of death in only 28% of cases in which diabetes was mentioned on death certificates[16]. In the remaining 72% diabetes was mentioned as a contributing cause. Compared with all causes of death, diabetes had a very high ratio of mentions on the death certificate to selections as the underlying cause of death. Thus, using underlying cause of death alone will capture fewer than one third of all diabetes-related deaths. This study did not include deaths related to diabetes that were not coded on the death certificate.

A study in Prince Edward Island (1982-1984) identified people with diagnosed diabetes and matched these cases to death certificates[17]. It was found that for 41% of all people with diabetes who died in that time period, diabetes was not mentioned on the death certificate at all. Of these, 66% had an underlying cause of death coded as cardiovascular disease, gangrene or renal disease, and these can be considered uncertified diabetes-related deaths. The percentage of death certificates mentioning diabetes for which diabetes was identified as the underlying cause of death was similar to the above-mentioned Statistics Canada study, at 29%. When all diabetes-related deaths (certified and uncertified) are taken into account, the actual number of deaths for which diabetes is a contributing cause is probably over five times the number coded as underlying cause (LCDC estimate, 1998).

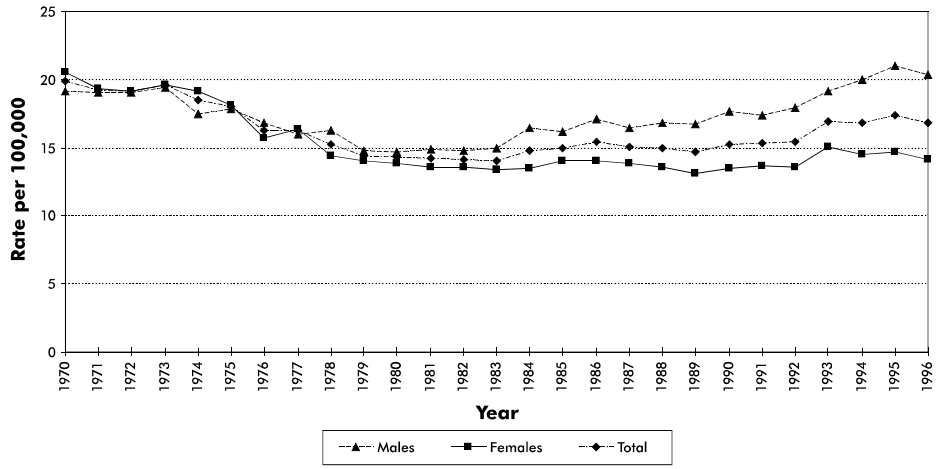
Age-Standardized Rates by Sex

The current (1996) age-standardized (to the 1991 population) mortality rate for diabetes in Canada is 16.8 per 100,000 population (Figure 15). Age-standardized mortality rates have increased since the early 1980s because of increased mortality rates for diabetes among males; in 1996 the rates were 20.4/100,000 and 14.1/100,000 for males and females respectively.

This increase in mortality rates could be related to an increase in the number of new cases of diabetes (incidence) or a decrease in the quality of care leading to earlier deaths after diagnosis. However, a higher incidence of diabetes is the most likely cause, given (i) the trend toward increasing prevalence of diabetes from 1994 to 1996 and (ii) the increased prevalence of obesity, which is the primary risk factor for Type

FIGURE 15

Age-standardized diabetes mortality rates (/100,000), by gender and year Canada, 1970-1996



ICD-9 Code 250 Diabetes; Standardized to 1991 Canadian Population

Source: LCDC 1998 using Statistics Canada Mortality Data

2 diabetes. There is no evidence that the quality of care for diabetes has decreased in recent years.

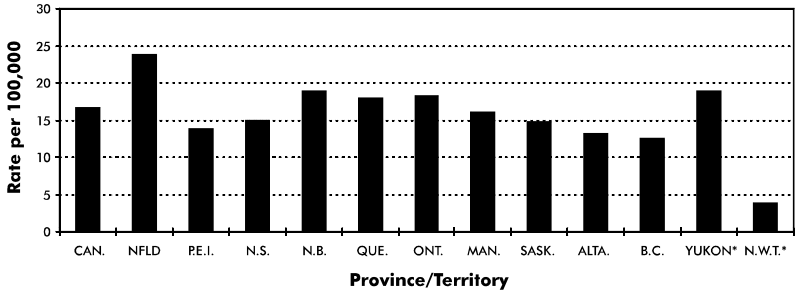
The increase in diabetes mortality rates is occurring over a period of time when the mortality rates for cardiovascular disease, the main cause of death for people with diabetes, are decreasing, likely because of better management of other risk factors for cardiovascular disease, such as smoking and hypertension, as well as improved treatment of cardiovascular disease in the general population.

Age-Standardized Rates by Province

The five-year (1992-1996) average age-standardized mortality rates for diabetes by province show Newfoundland with the highest diabetes mortality rate (Figure 16). The rates in Yukon and the Northwest Territories are based on a small number of cases (12 and 3 cases respectively). Death certificate coding procedures may vary by province and territory.

FIGURE 16

Age-standardized diabetes mortality rates (/100,000) from 1992-1996 (5-year average) by province and territory Canada



ICD-9 250 Diabetes; Standardized to 1991 Population.

* The actual number of deaths in the territories is 15.

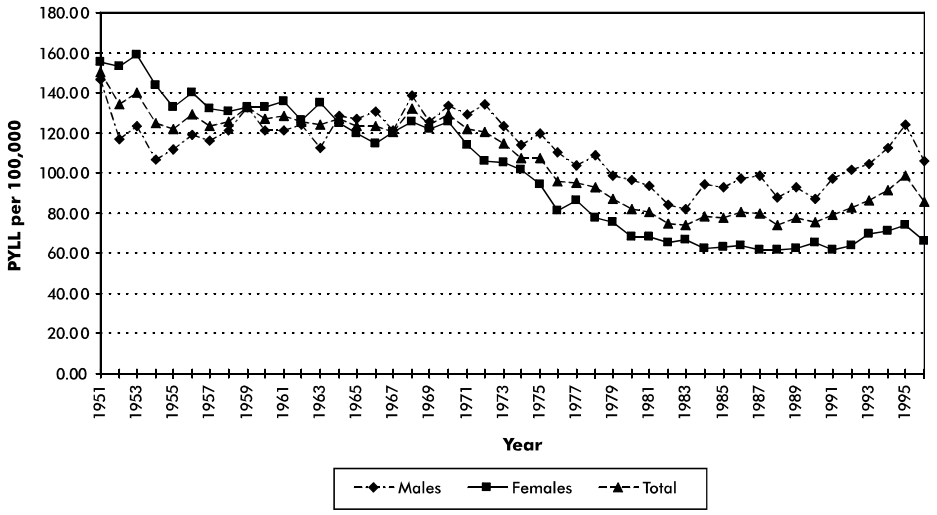
Source: LCDC 1998 using Statistics Canada Mortality Data

Age-Standardized Potential Years of Life Lost (PYLL)

Approximately 25,000 PYLL were lost because of diabetes prior to age 75 in 1996, representing an age-standardized rate (standardized to the 1991 Canadian population) of 85 per 100,000 population (Figure 17). The crude 1996 PYLL (prior to age 75) rate is 88 per 100,000. Since 1983 there has been an increase in the age-standardized PYLL that can be attributed primarily to increases in mortality rates among males aged 60 years and over.

FIGURE 17

Diabetes: Age-standardized potential years of life lost (PYLL) prior to age 75, by gender and year Canada, 1950-1996

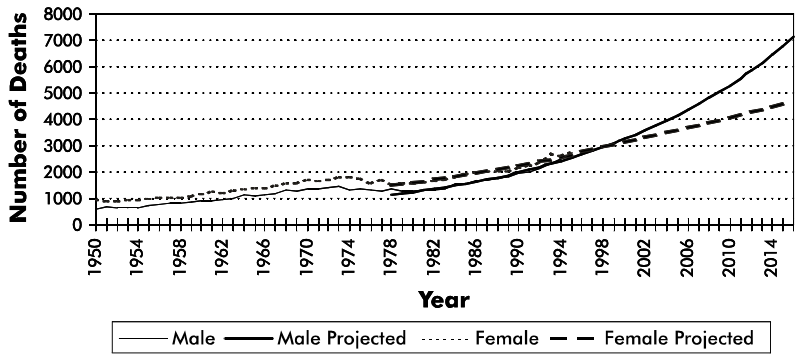


ICD-9 Code 250 Diabetes; Standardized to 1991 Canadian Population

Source: LCDC 1998 using Statistics Canada Mortality Data

FIGURE 18

Number of diabetes deaths (1950-1995) and projections to year 2016, by gender Canada



ICD-9 Code 250 Diabetes; projections based on deaths from 1978-1995.

Source: LCDC 1998 using Statistics Canada Mortality Data

Trends and Projections

Projections of diabetes mortality trends into the year 2016 show an exponential increase in the number of diabetes deaths among males and a more linear increase among females (Figure 18). Projections were modelled on the basis of diabetes deaths (counts and age-specific rates) from 1978-1995.

ECONOMIC BURDEN

The economic burden of diabetes alone was estimated at $1.1 billion annually in 1993[18]. This is an underestimate of the true figure, because the economic costs of the complications of diabetes, such as cardiovascular disease and renal failure, were not included in these calculations.

A brief review of US studies is useful for comparison purposes[19]. Four studies during the 1980s in the United States estimated the costs of diabetes at between $17 and $23 billion annually (1990 US dollars). However, a 1992 US study published by the American Diabetes Association estimated costs at $91.8 billion annually when costs of illnesses associated with diabetes were included in the calculations[20]. For example, diabetes is a risk factor for heart disease, therefore the costs for a proportion of people with heart disease were attributed to diabetes. Given that the Canadian population is approximately one tenth the size of the US population and has roughly similar prevalence rates of diabetes, the real economic costs of diabetes in Canada may be as high as (US) $9 billion annually (i.e., 10% of $91.8 billion).

With regard to the cost-effectiveness of prevention and control measures for diabetes, the Conference Board of Canada calculated that a 1% increase in the number of people in the Canadian population who were physically active would result in an expected annual saving of $877,000 (in 1993 constant dollars) in the direct costs of treating Type 2 diabetes[21].

MODIFIABLE RISK FACTORS FOR DIABETES

The NPHS 1996/97 provides the most recent, although limited, information on the main modifiable risk factors for Type 2 diabetes: obesity and physical inactivity. Trend data on these factors derive from the NPHS 1994/95 and 1996/97 and the General Social Surveys 1985 and 1991. Income inadequacy, smoking, and hypertension (high blood pressure) are additional modifiable risk factors for diabetes and its complications for which we have data.

Obesity

The association between obesity and diabetes is supported in the literature, as cohort studies have indicated that obesity is an independent risk factor for diabetes[19]. Diabetes can also exacerbate obesity over time, in

that the complications of diabetes can limit physical activity, and intensive treatment for diabetes often results in weight gain.

Obesity in the General Population

A greater proportion of males than females in the population aged 20-64 are above the acceptable weight range (Body Mass Index 25) (59% vs. 37% respectively). According to the NPHS definition of overweight (Body Mass Index 27), 35% of males and 23% of females are overweight (Table 15). Note that this definition differs from that of the U.S. National Institutes of Health, which defines overweight as a Body Mass Index of 25. (People under 20 years of age, those who were pregnant, and those over 65 were not assessed for weight status in the NPHS.)

TABLE 15

Percentage distribution of weight status among those aged 20-64, by sex Canada excluding Territories, 1996/97

Weight status	% distribution by sex		Total
	Males	Females	
Insufficient	---	---	8.2
Acceptable	38.1	48.9	43.3
Some excess	24.6	13.8*	19.3
Overweight	34.6	23.4	29.2

*Estimate has high sampling variability.

Notes: --- = sample size is too small to be expressed as a percentage. Insufficient = BMI < 20. Acceptable = BMI 20-24.9. Some excess weight = BMI 25-27. Overweight = BMI > 27. BMI= Body Mass Index. Weight and height were self reported. People under 20 yrs of age, pregnant, or over 65 were not assessed for weight status.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

This finding of higher levels of obesity among males may partially explain the higher prevalence of diabetes among males than females (see Table 2).

There is some evidence that obesity has been increasing since 1991, although comparisons among surveys with differing methodologies must be interpreted with caution (Figure 19).The cause of the apparent increase in obesity is unknown, as there have been no longitudinal national surveys of caloric intake in Canada.

Obesity by Diabetes Status

A substantially greater proportion of people with, than without, diabetes in the 35 to 64 age group are overweight (Body Mass Index 27) (59% vs. 32%, Table 16).

TABLE 16

Weight status among people aged 35-64 years, by diabetes status Canada excluding Territories, 1996/97

Diabetes status	Not overweight %	Overweight %
With diabetes	41.3	58.7
Without diabetes	67.7	32.3
Total	66.9	33.2

Notes: Not Overweight = Body Mass Index (BMI) ≤ 27 which includes the range of NPHS categories from insufficient , acceptable , to some excess weight. Overweight = BMI > 27.
BMI = weight (kg)/squared height (m^2). Diabetes, height and weight were self-reported.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

The trend for increasing obesity is also evident in the longitudinal data from the NPHS 1996/97. Both those with, and without, diabetes showed a trend to increasing obesity (Table 17).

TABLE 17

Cohort-based trends in percentage distribution of weight status, by diabetes status and age group Canada excluding Territories, 1994/95-1996/97

Age group in 1994	Diabetes status	Weight status			
		1994/95		1996/97	
		Not overweight %	Overweight %	Not overweight %	Overweight %
35-64	With diabetes '94/96	43.3*	56.7*	40.6*	59.4
	Without diabetes '94/96	67.3	32.7	65.7	34.3

*Estimate has high sampling variability.

Notes: Not Overweight = Body Mass Index [weight (kg)/squared height (m^2)] ≤ 27; includes categories some excess weight, acceptable weight, and insufficient weight . Diabetes, height and weight are self-reported.
Overweight = Body Mass Index [weight (kg)/squared height (m^2)] > 27.
With diabetes 94/96 = respondents with self-reported diabetes in the 1994 & 1996 NPHS.
Without diabetes 94/96 = respondents without self-reported diabetes in the 1994 & 1996 NPHS

Source: LCDC 1998 - using the National Population Health Survey, Longitudinal Share File, preliminary release.

Physical Inactivity

Physical Inactivity in the General Population

Over 50% of both males and females in the general population are physically inactive, females more so than males (60% vs. 54% respectively) (Table 18).

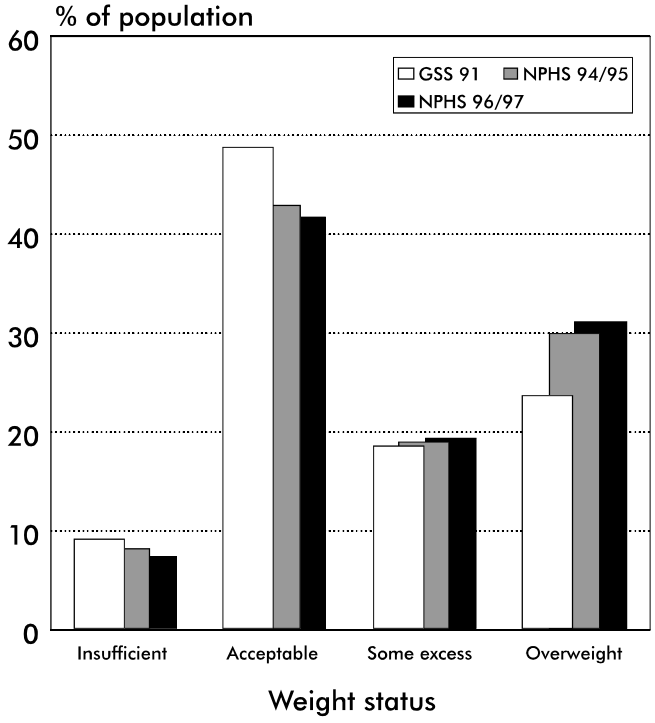
Canadians in general appear to have become somewhat less sedentary from 1985 to 1996; however, differing methodologies among surveys in terms of how physical activity level is measured make any conclusions tentative at best (Figure 20).

Physical Inactivity by Diabetes Status

Levels of physical inactivity are similar for those with and without diabetes in the 35 to 64 age group (63% and 61% respectively), but higher in those with diabetes in the over-65 age group (76% vs. 64%) (Table 19).

FIGURE 19

Risk factor for diabetes: Trends in weight status among the population aged 20-64 years Canada excluding Territories, 1991-1996/97*



* Comparisons between surveys with differing methodologies should be interpreted with caution

Notes: Standard weight was calculated from Body Mass Index (BMI) scores. BMI = weight (kg)/squared height (meters squared). BMI< 20 = "Insufficient" weight in NPHS (equivalent to GSS 91 category "possibly underweight"). BMI= 20-24.9 was "acceptable". BMI= 25-27 was "some excess weight" in NPHS (equivalent to "possibly overweight" in GSS 91). BMI > 27 was "overweight". Measurement of BMI for GSS 85 was not comparable to GSS 91 and NPHS 94/96. Height and weight were self-reported.

Source: LCDC 1998 using General Social Survey (GSS) 1991, National Population Health Survey (NPHS) 1994/95 Health file, and National Population Health Survey 1996/97, Health Share file, preliminary release.

TABLE 18

Percentage distribution of physical activity status in the population aged 12 and over, by sex Canada excluding Territories, 1996/97

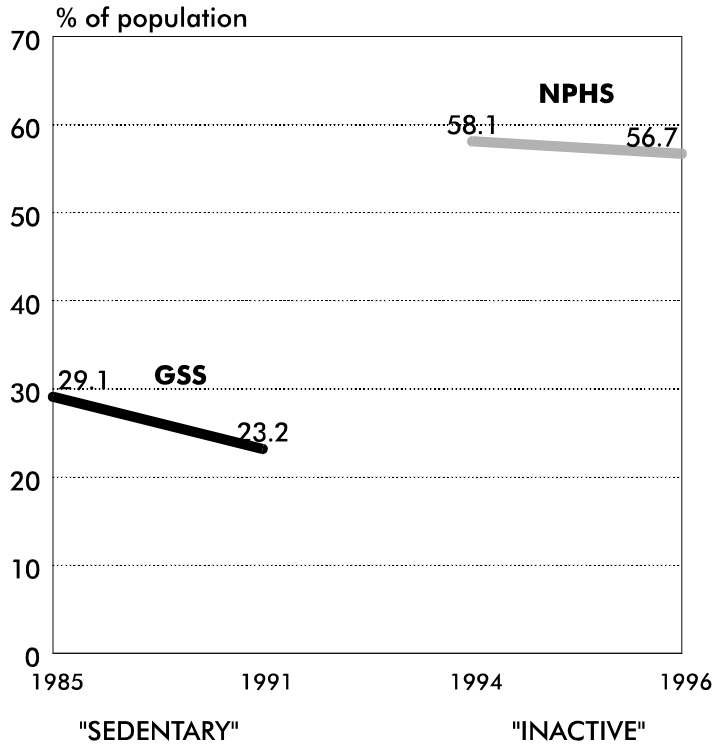
Physical activity status	% distribution		
	Males	Females	Total
Active	23.85	17.53	20.61
Moderate	22.32	22.98	22.65
Inactive	53.83	59.49	56.73

Notes: Measurements of energy expenditures: Active = average 3^{+} kcal/kg per day. Moderate = average 1.5-2.9/kcal/kg per day. Inactive = 1.5 kcal/kg per day.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

FIGURE 20

Risk factor for diabetes: Trends in physical inactivity across surveys* Canada excluding Territories, 1985-1996/97



* physical inactivity measurement differs across surveys but is consistent within surveys across years.

Notes: GSS defined "sedentary" as = < 500 kcal/wk of energy expenditure. NPHS defined "inactive" as < 1.5 kcal/kg/week of energy expenditure (or < 735 kcal/wk for an average (70Kg) man). Note that according to NPHS criteria some respondents who were not classified as sedentary in the GSS would have been classified as physically inactive in the NPHS. GSS respondents were aged 15+ years, and NPHS respondents were aged 12+ years.

Source: LCDC 1998 using General Social Survey (GSS) 1985 and 1991, National Population Health Surveys, Health File (1994/95), Health Share File (1996/97), preliminary release.

Although physical inactivity is a risk factor for diabetes, it is also a risk factor for complications such as cardiovascular disease. Therefore, the high proportion of people with diabetes who are physically inactive is a matter of great concern.

Income Inadequacy

For people aged over 35 years, those with diabetes are more likely than those without diabetes to have lower levels of income adequacy (calculated as a relation between household size and total income before deductions) (Table 20). The biggest difference is in the 35 to 64 age group, in which 48% of people with diabetes compared with 38% without diabetes are in the lower two quartiles of income adequacy. This association is an important factor in the prevention and control of diabetes. The cost of diabetes treatment supplies is covered by provincial/territorial programs to a variable extent across Canada.

TABLE 19

Physical activity level, by age group and diabetes status Canada excluding Territories, 1996/97

Age group	Diabetes status	Physical activity level	
		%	
		Active	Inactive
35 - 64	With diabetes	36.7	63.3
	Without diabetes	38.9	61.1
	All	38.8	61.2
65+	With diabetes	24.4	75.6
	Without diabetes	35.8	64.2
	All	34.6	65.4

Notes: Sample sizes in the 12-34 age group with diabetes are too small to be expressed as percentages. Respondents classified by the NPHS 96 physical activity index (measurement of energy expenditure) as active (average 3+ kcal/kg/day) or moderate (average 1.5- 2.9 kcal/kg/day) were counted in the Active category. Respondents classified as inactive (< 1.5 kcal/kg per day) were counted in the Inactive category. Diabetes is self-reported.

Source: *LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.*

TABLE 20

Income adequacy, by diabetes status and age group Canada excluding Territories, 1996/97

Age group	Diabetes status	Income adequacy group			
		%			
		Lowest	Lower middle	Upper middle	Highest
12 - 34	With diabetes	---	35.7*	26.7*	---
	Without diabetes	16.5	30.2	29.3	14.0
35 - 64	With diabetes	20.8	27.0	40.2	12.1
	Without diabetes	12.2	26.0	42.9	19.0
65+	With diabetes	23.0	48.2	21.2	7.7
	Without diabetes	24.5	42.1	28.4	5.0
Population (12+yrs)	With diabetes	22.3	37.1	30.8	9.9
	Without diabetes	15.4	29.7	39.7	15.3

Notes: *Estimate should be interpreted with caution because of high sampling variability. --- = sample size is too small to be expressed. Diabetes was self-reported. Income refers to total income from all sources before taxes or deductions. Income adequacy was assessed as follows:
Lowest = 1-4 persons and less than $10,000; 5+ persons and less than $15,000.
Lower middle = 1-2 persons and $10,000-14,999; 3-4 persons and $10,000-$19,999; 5 or more persons and $15,000-$29,000.
Middle = 1-2 persons and $15,000-$29,999; 3-4 persons and $20,000-$39,000; 5 or more persons and $30,000-$59,999.
Upper middle = 1-2 persons and $30,000 - $59,999; 3-4 persons and $40,000-$79,999; 5 or more persons and $60,000-$79,999.
Highest = 1-2 persons and $60,000 or more; 3 persons or more and $80,000 or more.

Source: LCDC 1998 - using National Population Health Survey 1996/97, Health Share File, preliminary release.

RISK FACTORS FOR DIABETES COMPLICATIONS

Smoking

Smoking predisposes people with diabetes to heart disease, peripheral vascular disease, and lower extremity amputations. In the age group 35 to 64, 27% of people with diabetes reported being daily smokers. This does not differ from the prevalence of daily smokers among people without diabetes in the same age group. In the over 65 age group the per-

centage of daily smokers is much lower among both those with, and without, diabetes (9% and 13% respectively).

High Blood Pressure

The prevalence of high blood pressure in people aged 35 to 64 years is four times higher among those with diabetes than those without (40% vs. 10%) (Table 21).

TABLE 21

Prevalence of self-reported hypertension (high blood pressure), by diabetes status and age group Canada excluding Territories, 1996/97

	% with high blood pressure		
	Age group		
Diabetes status	**35 - 64**	**65+**	**Population (12+ yrs)**
With diabetes	40.0	44.4	39.7
Without diabetes	10.0	30.7	9.0

Notes: The sample sizes of those with diabetes in the 12-34 age group were too small for the percentage to be expressed. Diabetes and high blood pressure were self-reported.

Source: LCDC 1998 - using the National Population Health Survey 1996/97, Health Share File, preliminary release.

LONG-TERM COMPLICATIONS OF DIABETES

Canadian data on the complications of diabetes are limited. These complications include

- microvascular complications: retinopathy (eye disease) and nephropathy (kidney disease);
- macrovascular complications: cardiovascular disease, stroke, and peripheral vascular disease;
- neuropathy (nervous system disease); and
- foot problems, which can lead to amputation.

The proportion of people with diabetes in whom these complications develop is not known. However, current data sources provide estimates of the proportion of people who have diabetes and who also have (i) heart disease, (ii) vision problems (not specifically retinopathy), and (iii) kidney failure, for which diabetes is likely to be a contributing cause.

Cardiovascular Disease and Stroke

Approximately 21% of people with diabetes compared with 4% without have heart disease or are suffering the effects of stroke (Figure 21). The greatest difference is in the 35 to 64 age group, in which the overall

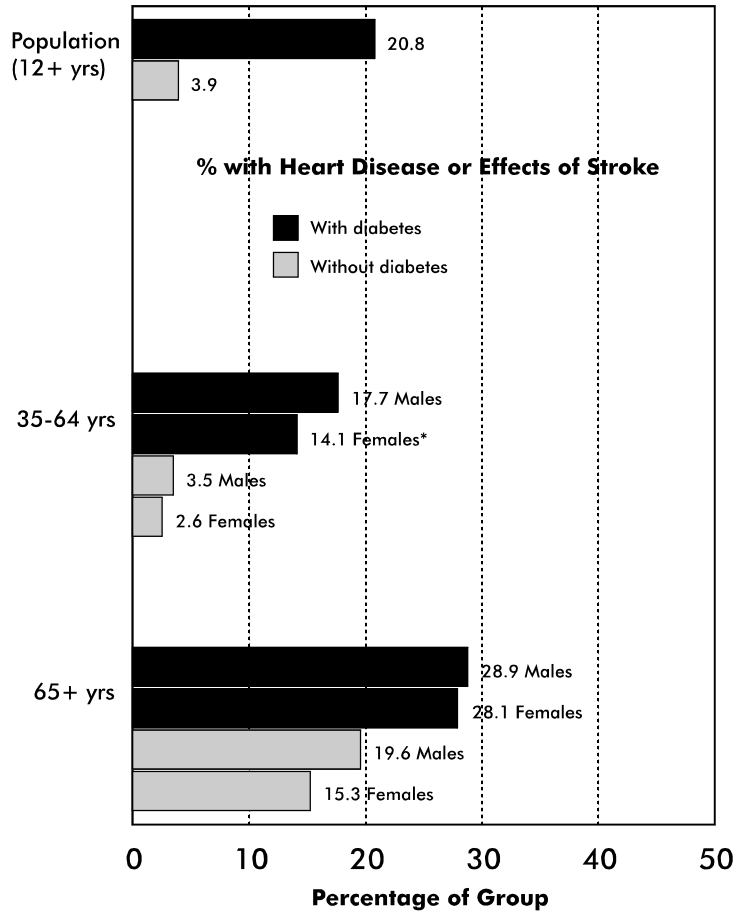
prevalence is 16.2% among those with diabetes and 3% among those without diabetes.

In the 35 to 64 age group, people with diabetes are six times more likely to have heart disease or stroke as those without diabetes (95% CI 4.7-7.4 among males, 4.6-8.3 among females); in the over 65 age group they are twice as likely to have these complications (95% CI 1.3-2.1 among males; 1.8-2.7 among females).

In general a greater proportion of men with diabetes have heart disease or the effects of stroke than women, except in the over 65 age group, in which the prevalence rates are almost the same (28.1% vs 28.9% among women and men respectively) (Figure 21).

FIGURE 21

Prevalence of heart disease or the effects of stroke, by diabetes status, gender, and age group Canada excluding Territories, 1996/97



* Estimate has high sampling variability.

Notes: The sample sizes in the 12-34 age group with diabetes were too small for percentages to be expressed. Diabetes, heart disease, and the effects of stroke refer to current, self-reported conditions that have been diagnosed by a health professional.

Source: LCDC 1998 - using the National Population Health Survey 1996/97, Health Share File, preliminary release.

The prevalence of diabetes is much higher in the population with heart disease or stroke than the population without these two conditions (15% vs. 3%). In the older age group (65 years and above) this finding still holds, although the difference is no longer as great because of the higher overall prevalence of diabetes in this age group (Figure 22).

Vision Problems

People with diabetes in the over 65 age group report significantly higher rates of vision problems than do people without diabetes in this age group**.** These include significantly higher rates of

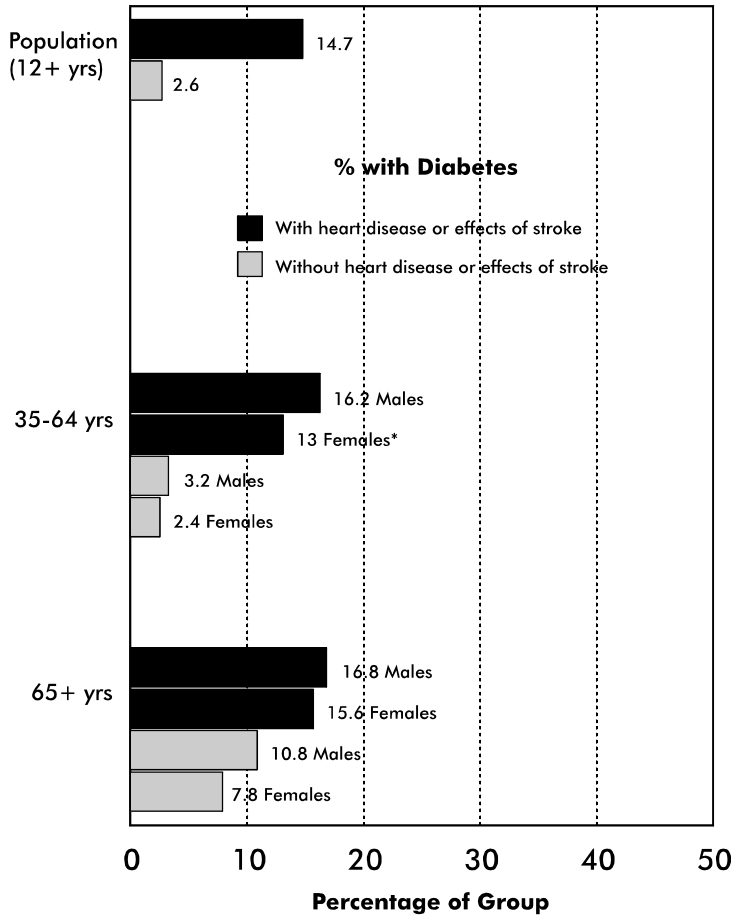
cataracts (21.9% vs. 14.1%, $p < 0.001$),

vision problems that cannot be corrected (problems seeing near or far objects, or total vision loss) (9% vs. 5%, $p < 0.001$), and

glaucoma (7% vs. 5%, $p < 0.05$).

FIGURE 22

Prevalence of diabetes among people with and without heart disease or the effects of stroke, by gender and age group Canada excluding Territories, 1996/97



* Estimate should be interpreted with caution due to high sampling variability.

Notes: The sample sizes in the 12-34 age group with diabetes were too small a percentages to be expressed. Diabetes, heart disease, and the effects of stroke refer to current, self-reported chronic conditions that have been diagnosed by a health professional.

Source: LCDC 1998 - using the National Population Health Survey 1996/97, Health Share File, preliminary release.

Kidney Failure

Statistics from the Canadian Organ Replacement Register (CORR) Annual Report 1998[22] indicate an increase in the proportion of patients with newly diagnosed kidney failure who also have diabetes, from 16% in 1981 to 28% in 1996. According to CORR data, there were 3,340 people with diabetes as of December, 1996 who were receiving treatment for end-stage renal disease, also known as kidney failure.

DIABETES AND ABORIGINAL PEOPLES

*(taken from the **Background Paper for the Development of an Aboriginal Diabetes Strategy: Report of the Working Group**, draft, June 17, 1998, with permission of the Health Programs Analysis Division, First Nations and Inuit Health Programs, Medical Services Branch, Health Canada.)*

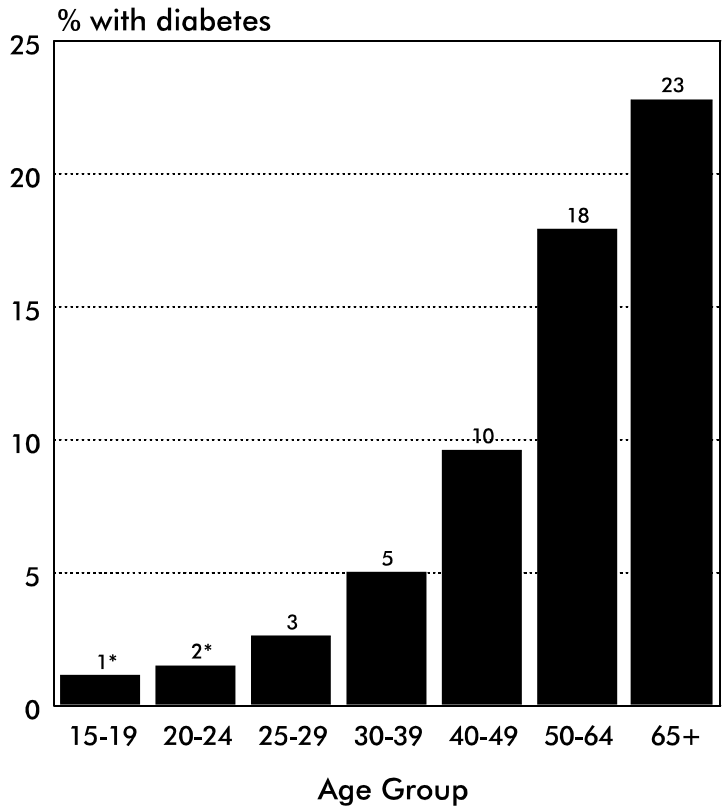
Prevalence of Diabetes

Diabetes Rates Are Very High Among Aboriginal Peoples

The age-standardized prevalence of diabetes among Aboriginals is at least three times that of the general population[23,24]. A series of studies have documented high rates in First Nations communities, and although much less is known about diabetes among Métis people, results from the Aboriginal Peoples Survey suggest that rates are well above the non-Aboriginal average. Inuit people are the only exception to the pattern: at present, their rates are below the national average; however, there are indications that they are rising, and it is feared that over time they will be as high as those of the other Aboriginal groups. Further, since not everyone with diabetes knows about it or has been given the diagnosis, existing figures probably understate the true prevalence of diabetes, possibly by as much as one half[25].

FIGURE 23

Diabetes by age group: First Nations, 1991



* Caution: high sampling variability for this figure.

Data from 1991 Aboriginal Peoples Survey, for people who self-identify as North American Indian.
Source: Bobet, 1997, Medical Services Branch.

According to a 1991 Statistics Canada report, the prevalence of diabetes among native groups in Canada is as follows: 8.5% of North American Indian peoples on Indian reserves and settlements; 5.3% of North American Indian peoples off reserves; 5.5% of Métis people; 1.9% of Inuit people[26].

Most Aboriginal Peoples with Diabetes Are Women

Approximately two-thirds of the First Nations people with a diagnosis of diabetes are women[24].

Diabetes Rates Vary Substantially Across the Country

Diabetes rates vary from province to province, and from community to community. This means that in some areas rates are far more than triple the national average, whereas in others they are lower. According to the 1991 Aboriginal Peoples Survey, the provincial rates were lowest in

British Columbia and the northern territories and highest in the Ontario-Manitoba-Saskatchewan areas[24].

The Prevalence of Diabetes Is Increasing

Until the 1940s, diabetes was virtually unknown among Aboriginal peoples[26,27]. Statistical data are lacking, since few groups have been continuously monitored longitudinally for any length of time. However, a 1983 study in the Sioux Lookout Zone showed a prevalence rate of 2.8%. By 1994, this had risen to 3.8%, with nearly 45% of the cases having been diagnosed in the preceding five years[28,29]. For chronic illnesses of long duration, such as diabetes, the prevalence can be expected to increase over time as a function of incidence, survival of people with diabetes, and aging of the population. In Manitoba, it has been estimated that the number of Aboriginal diabetes cases can be expected to increase threefold over the next 20 years[30].

Complications of Diabetes

Given that many complications take 10-20 years to develop, and that diabetes is a relatively new condition for Aboriginal peoples, it is not surprising that there are gaps in the literature about the types, onset and severity of complications faced by Aboriginal peoples in Canada. The existing literature suggests the following description.

Increased Risk of Cardiovascular Disease (heart disease)

People with diabetes have a substantially increased risk of developing cardiovascular disease[24,31]. Among Status Aboriginals in Manitoba, almost 60% of hospitalizations for heart disease and approximately half of the hospitalizations for stroke occurred among people with diabetes[32]. In Kahnawake, half of those with diabetes had significant heart disease leading to heart attacks and coronary bypass surgery[33].

Higher Prevalence of Hypertension (high blood pressure)

The prevalence of hypertension is far higher among First Nations adults with diabetes: 43% compared with just 10% of those without diabetes. Untreated hypertension has been identified as an additional risk factor for cardiovascular disease such as heart attacks and strokes, and for kidney disease and retinopathy.

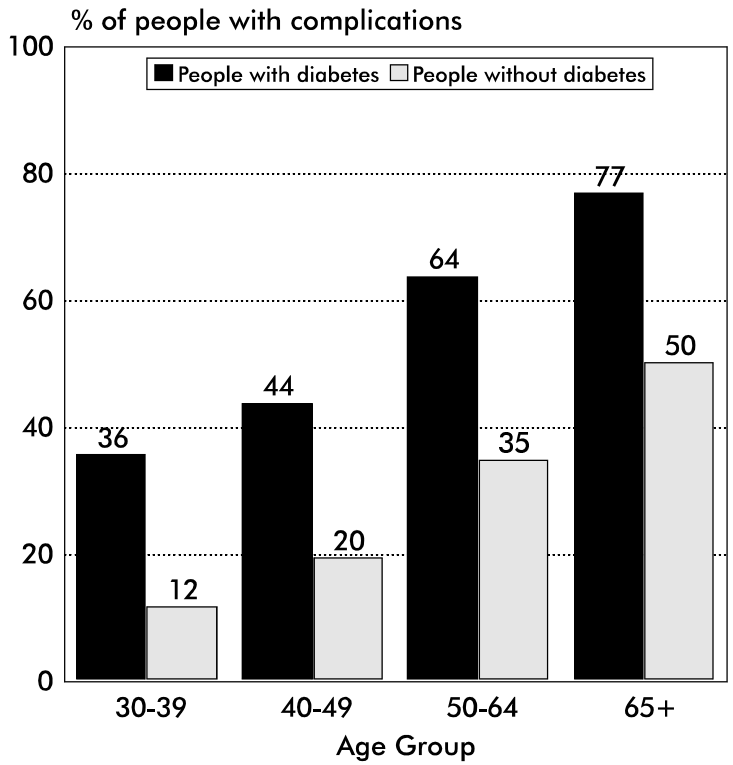
Increased Risk of Stroke

Studies have established that people with diabetes are at increased risk of having strokes, possibly because many people with diabetes also suffer from hypertension[31]. A study at Kahnawake (Quebec) found that 13% of people with diabetes had had strokes, versus just 3% of a comparable

group of people without diabetes. This gave an odds ratio of 4.5[33]. The same study found that the risk of having macrovascular disease was six times higher among people with diabetes. These ratios are comparable to those observed in the non-Aboriginal population.

FIGURE 24

Presence of one or more complications*: First Nations, 1991, by age group and presence of diabetes



* People reporting that they have one or more of : high blood pressure, heart disease, vision problems.

Data from 1991 Aboriginal Peoples Survey. Refers to people who identify as "North American Indian".
Source: Bobet, 1997, Medical Services Branch.

More Lower Limb Amputations

People with diabetes have a 15 times greater risk of requiring lower extremity amputation than those without diabetes. Those more than 40 years of age whose diabetes was diagnosed at least 10 years earlier are at the highest risk[34]. A study of Native Americans in Oklahoma showed that the mean interval to first amputation was 6.6 years after the diagnosis[35]. Yet if individuals at risk are aggressively sought out and treated, up to 50% of amputations can be prevented[34].

In general, morbidity and mortality rates are elevated among individuals with diabetes who have undergone an amputation. For the Native Americans in Oklahoma, the 5-year survival rate after first amputation was only 40%[35].

Higher Rates of Kidney Disease and Dialysis Especially for Aboriginal Peoples with Diabetes

Whiteside[36] documents that the prevalence of diabetic nephropathy is much higher among Aboriginal Canadians than the general population with diabetes. The rates range from 25 to 60% after 15 to 20 years with diabetes. In Manitoba, it is estimated that an Aboriginal person is 12 times more likely to have diabetic nephropathy than a non-Aboriginal. The risk of end-stage renal disease (ESRD) is approximately four times that of other Manitobans, and more than half of this ESRD is caused by diabetes.

Among Aboriginal peoples with ESRD, the relative risk of undergoing dialysis is 6.5 times that of a non-Aboriginal patient (Dr. K.N. Bernstein, Central Dialysis Unit, Manitoba: personal communication, 1998). Among First Nations people living in Manitoba, there has been an increase in dialysis starts of more than 400% since 1987[32].

■ Higher Rates of Eye Disease

Diabetes causes diabetic retinopathy, which is the leading cause of adult-onset blindness in North American adults. People with diabetes also have higher rates of cataracts. The National Institutes of Health in the United States indicates that approximately half those with diabetes have some form of eye disease, and just over 10% report serious retinal disease. In the Pima of Arizona, however, serious retinopathy has a frequency rate of 18%[27], and at Kahnawake (Quebec) 50% of patients had retinopathy after 10 to 15 years of the disease[33].

■ Frequent Instances of Peripheral Neuropathy

Diabetes can affect the nervous system. This manifests as an absence of reflexes and impaired nerve conduction, and usually involves pain and decreased sensation in the lower limbs. Estimates of how common this is among people with diabetes vary enormously, and none are specific to Aboriginal peoples.

Groups Needing Special Focus in Diabetes Initiatives

In addition to the general trends described, the impact of diabetes on specific subpopulations warrants attention.

■ Children Instances of Aboriginal Children with a Diagnosis of Type 2 Diabetes

Although Type 2 diabetes is referred to as adult-onset , in recent years it has been diagnosed in Aboriginal children as young as 5 to 8 years of age in both northern Ontario[37] and Manitoba[38]. Furthermore, the incidence appears to be increasing at a rapid rate[39]. In Manitoba, the number of Aboriginal children with a diagnosis of diabetes rose from 20 in 1990 to 51 in 1995. There was a similar pattern in the Sioux Lookout Zone: in 1994, diabetes was diagnosed in 18 children (under age 16), and in 1997 in 52 children (under age 18). In both these areas, girls outnumbered boys by more than five to one among the children with this condition.

Because duration of high blood sugars is correlated with complications, there is a real concern that this early onset of diabetes will lead to an increased risk of early onset of complications.

■ Women Higher Prevalence, Risk of Complications of Pregnancy, and Future Risk for the Child

Existing data on gestational diabetes (GDM) in Aboriginal peoples in Canada give cause for concern. A study by Harris et al in Sioux Lookout Zone found GDM rates of 8.4% the highest rate reported so far in a Canadian population[39]. In another study based in Sioux Lookout Zone, 70% of women with GDM went on to develop overt diabetes within three years[40]. In the general population the typical conversion rate ranges between 25% and 60% over a decade or more[41].

MAIN DATA SOURCES

National Population Health Survey (NPHS), 1994-95

■ Health File

The NPHS was initiated in 1994 by Statistics Canada and will be repeated every two years. Data were collected quarterly, in June, August, and November 1994 and March 1995, from a representative sample of household residents in all provinces, excluding Indian reserves, Canadian Forces bases and some remote areas in Quebec and Ontario. Respondents were aged 12 and over. One person aged 12 and over was selected randomly in each household for an in-depth interview. The sample count for the Health file is 17,626 people in total (weighted estimate of the population = 23,948,603 people), and 615 people in this sample (weighted estimate = 722,490 people) answered Yes to the question: Do . . . have any of the following long-term conditions that have been diagnosed by a health professional: .. Diabetes ? Diabetes was the tenth item on the list of chronic conditions read out to respondents.

■ Institution File

Data were collected between January and March 1995 from any long-term residents of selected health care institutions from all provinces, excluding the territories. The sample count for this file was 2,287 people in total (weighted estimate of the institutional population = 227,842 people), and 274 people in this sample (weighted estimate = 27,770)

reported that they had been given a diagnosis of diabetes by a health professional.

National Population Health Survey (NPHS), 1996-1997

This survey is the continuation of the NPHS 1994-95 and collects cross-sectional as well as longitudinal data. Data were collected in June, August, and November 1996 and March 1997. Selected household respondents from the previous survey were approached once again for an interview; the response rate was 96%. Individuals were contacted in the same quarter for each survey. For cross-sectional purposes, data were also collected from new respondents. The two files used for the analyses in this report are limited to household residents who agreed to share their data with Health Canada and the provinces.

■ Health Share File

Although the core sample consisted of 14,549 respondents, three provinces (Alberta, Manitoba, Ontario) bought additional sample size, creating a total sample of 77,403. This weighted up to a population of 28,641,734. There were 2,529 people who answered Yes to the diabetes identification question noted in the NPHS 1994-95 description earlier. Of these people, 2,236 (over 88%) lived in the three provinces with additional sample size.

■ Longitudinal Share File

The total sample in this file consisted of 14,860 respondents, 509 of whom identified themselves as having diabetes. The accuracy of longitudinal compared with cross-sectional surveys is unclear at this time. A survey itself is an intervention and may have an effect on both health behaviour and survey responsiveness.

Aboriginal Peoples Survey (APS), 1991 (Adults)

The APS 1991 was conducted by Statistics Canada in the fall of 1991. The APS population covered people aged 15 and over who reported at least one Aboriginal origin (i.e., North American Indian, Métis, Inuit or other Aboriginal group) on question 15 of the long census questionnaire, or who reported being registered under the Indian Act on their 1991 Census long questionnaire. It included individuals who had indicated either a single Aboriginal origin; multiple ethnic origins, that is, Aboriginal in combination with at least one other non-Aboriginal origin (e.g., English, Irish, etc.); or multiple Aboriginal origins. The APS was, however, excluded from some reserves with the result that approximately 18% of those listed on the Indian register were not covered by the

survey. The final sample of the APS included 36,635 people. The total weighted count was 630,414, of whom 388,610 identified themselves as Aboriginal. In all, 1,608 people (weighted count: 22,897) reported Yes to the question Have you been told by a health professional that you have diabetes?

General Social Survey (GSS), 1985, 1991 (Health Cycle)

The GSS-Health cycle was an interviewer-administered survey conducted by Statistics Canada in 1985 and updated in 1991. Health-related data were collected in September/October 1985 and from January to December 1991 from household residents in all provinces (excluding residents of institutions) aged 15 years and older. Within each household contacted, one person aged 15 or over was randomly selected for the interview. The sample count for the GSS-Health 1985 was 11,200 people in total (weighted estimate of the population = 19,680,000), and 403 people in this sample (weighted estimate = 722,490) answered Yes to the question Do you have diabetes? . The 1991 total sample count was 11,924 (weighted estimate of the population = 20,980,862 people), and the 1991 subsample with self-reported diabetes was 546 persons (weighted estimate = 739,886).

National Longitudinal Survey of Children and Youth (NLSCY), 1994-1995

The NLSCY is an ongoing interviewer-administered survey conducted by Statistics Canada. Data collection was initiated from November 1994 to June 1995 from a representative sample of households with children 0 to 11 years of age, excluding individuals living in Yukon or the Northwest Territories, residents of institutions, and people living on Indian reserves. The intention of the NLSCY is to select a representative sample of children newborn to 11 years of age in Canada and to follow and monitor these children over time every two years into adulthood. Data on the prevalence of gestational diabetes was obtained by asking mothers: During the pregnancy did you suffer from any of the following: Pregnancy diabetes? This question covered children 0 to 23 months of age. The total sample count was 22,831 (weighted estimate = 4,673,390), of which there were 270 (weighted estimate = 43,172) positive responses to the question about pregnancy diabetes.

Statistics Canada Mortality Data

These data provide a count of all deaths in Canada from the provinces and territories for a given year. The reported cause of death is based on the ICD-9 (International Classification of Diseases, 9th Revision) code of 250 (diabetes mellitus) for the underlying cause of death as stated on the death certificate.

Statistics Canada Morbidity Data

Morbidity data provide a count of cases separated (through discharge or death) from a hospital, by most responsible diagnosis using ICD-9 coding. This event-based information is derived from hospital discharge abstracts (administrative data) and does not include outpatient or day surgery activity. Event-based data do not distinguish between a single person with multiple discharges from hospital and many people with single hospital discharges. Since the Northwest Territories and Yukon have been included only since 1994, information in this report refers to the provinces alone.

IMS (Intercontinental Medical Statistics) Canada

This company operates a commercial database with a market survey approach. IMS describes itself as a leader and an essential partner in the advancement of health, providing critical data, global intelligence and knowledge-based solutions to the health care community . All results are projected or weighted up to represent the total universe, i.e., all physicians and pharmacies in Canada.

■ IMS Canadian Disease and Therapeutic Index

This is a continuing compilation of statistical information about the therapeutic use of prescription and nonprescription medications by office-based physicians, as well as medical visits that do not involve drug therapy, such as routine checkups and consultations. The data are collected from a sample of over 650 physicians stratified by region and representing all major specialties. Each doctor reports each quarter on all patient contact for a period of two consecutive days.

■ IMS Canada Compuscript

This measures the number of new and refill prescriptions dispensed by Canadian retail pharmacies to consumers through formal prescriptions. Data are collected from over 2,500 pharmacies (40% of all pharmacies in Canada) stratified by province, type (chain/independent) and size (large/small). IMS matches approximately 70% of the reported prescrip-

tion records to the doctors who generated them and therefore can identify their specialty.

LIMITATIONS OF CURRENT NATIONAL DATA SOURCES

Our current information on diabetes and its risk factors is limited by a number of factors, summarized below.

Limitations on Diabetes Information

■ Incomplete Data Sources

Diabetes is generally diagnosed and treated in physicians offices, from which data collection is difficult. Data from hospitalization records capture only people with more severe diabetes. Therefore, the prevalence of diabetes in the Canadian population is underestimated by current data sources. Most national data sources are also geographically incomplete in that they exclude the territories.

■ Survey Data Are Unsubstantiated

There are limitations to survey data because the presence of diabetes is based on self-report. Some people with diabetes do not report having diabetes when questioned; conversely, some report diabetes when they do not have the condition.

■ Inability to Capture Undiagnosed Diabetes

Survey data do not detect people with undiagnosed diabetes unless a blood sample is taken. Administrative databases (such as physician billing databases) do not identify these people either.

■ Inaccurate Mortality Data

Mortality data are limited, in that diabetes is often not cited as the underlying cause of death in cases of death due to the complications of diabetes.

■ Type 1 and 2 Diabetes Undifferentiated

Most data sources do not differentiate between Type 1 and Type 2 diabetes.

■ Small Samples in National Surveys

Population surveys have not had an adequate sample size nationally to allow comparison on a subprovincial or sometimes even provincial level.

Lack of Aboriginal Data

Aboriginal status has not been included as a variable in most national surveys. Some reserves were not included in the Aboriginal Peoples Survey 1991, with the result that roughly 58,000 potential respondents had no opportunity to be included in the sample.

Different Methodologies in National Surveys

National health surveys that have been conducted over the past 20 years differ in their methodologies such that comparison of diabetes prevalence over time is limited.

Limitations on Risk Factor Information

Lack of National Risk Factor Surveillance System

Canada does not have an established national risk factor surveillance system comparable to the Behavioural Risk Factor Surveillance System (BRFSS) in the United States. However, a similar risk factor surveillance system is currently in development at the Laboratory Centre for Disease Control, Health Canada.

Physical Measures in Few National Surveys

Few national surveys in Canada incorporate physical measures, such as blood pressure or weight, and none on the scale of the National Health and Nutrition Examination Survey (NHANES) in the United States. Thus, our data on known or potential risk factors, such as hypertension and central deposition of fat, are limited.

Social Desirability Bias in Self-Reports

Reliance on self-report for data on risk factors such as obesity and physical inactivity introduces the possibility of a social desirability bias in the results (i.e., respondents claim to be thinner and more physically active than they actually are), with the result that survey data on these risk factors are probably inaccurate.

PREVENTION OF DIABETES AND LONG-TERM COMPLICATIONS

Primary Prevention: Preventing Diabetes

The prevention of Type 1 and Type 2 diabetes requires different strategies, as they have quite different causes. Primary prevention efforts are focused on the reduction of obesity and physical inactivity, which are the known modifiable risk factors for Type 2 diabetes only. Further evaluation of the effectiveness of such programs is required. At this time there are no known modifiable risk factors for Type 1 diabetes. Additional basic research is needed as the etiology of this condition remains unclear.

Secondary Prevention: Early Detection of Diabetes Through Screening

Secondary prevention involves early identification of diabetes through screening to prevent or delay the progression of the disease. In 1994, the Canadian Task Force on the Periodic Health Examination[42] recommended against screening for asymptomatic people with Type 2 diabetes. There were two reasons why the Task Force was not in favour of screening for diabetes: (i) the lack of a screening test that combined accuracy with practicality and (ii) the absence of adequate evidence that early detection and treatment improved outcome in asymptomatic people.

In terms of the lack of an appropriate screening test, new studies have been published since the Task Force finalized its report in January, 1994. The report of the American Diabetes Association Expert Committee on the Diagnosis and Classification of Diabetes Mellitus lists three critical sources of information supporting the creation of a new cutpoint for fasting blood sugar for diagnosis[43]; none of these was available in January, 1994. The sources are McCance's study in Pima Indians[44], Engelgau's study in Egyptians[45], and finally the National Health and Nutrition Examination Survey III, which was unpublished in 1994.

With regard to the lack of evidence for improved outcomes in asymptomatic people as a result of early detection and treatment of diabetes, the United Kingdom Prospective Diabetes Study (UKPDS) shows clear evidence that tight glycemic control improves outcome[46]. In conjunction with the previous evidence from UKPDS that those with previously undiagnosed diabetes (30% of subjects in the study) showed no significant difference in the progression rates for any of the complications or conditions compared with those who presented initially with symptoms of diabetes[47] this is more evidence that people with asymptomatic Type 2 diabetes would benefit from screening and treatment. The Canadian Diabetes Association has endorsed screening in select groups (including everyone over the age of 45) in its 1998 clinical practice guidelines[14]. It is hoped that the Task Force, now renamed the Canadian Task Force on Preventive Health Care, will revisit this question in the near future.

The positive benefits of screening for Type 1 diabetes have not been established and with the potential for negative psychosocial effects, it is not recommended for this group.

Tertiary Prevention: Preventing or Delaying the Complications of Diabetes

Tertiary prevention is aimed at delaying or preventing the development of complications in people who already have diabetes. A landmark trial investigating people with Type 1 diabetes showed that good glycemic control can reduce the likelihood of microvascular complications leading to blindness or kidney disease, but the trend toward a decrease in macrovascular disease was not statistically significant[48]. The UKPDS[49] has shown that tight control of blood sugar and blood pressure reduces the rate of microvascular disease and macrovascular disease (heart disease or stroke) in people with Type 2 diabetes. The treatment of hyperlipidemia also prevents the development of macrovascular disease in people with diabetes. For all people with diabetes, regular foot and

eye examinations with proper preventive treatment can prevent amputations and progression of retinopathy.

Education: Key Role in Tertiary Prevention

Diabetes education of health care professionals and those affected by diabetes plays a key role in the tertiary prevention of the disease. Canadian data are lacking on how many people with diabetes receive education on self-management of their condition. A US National Health Interview Survey found that only 35% of people with diabetes had attended a class or program about diabetes[50].

OPPORTUNITIES FOR IMPROVED DIABETES SURVEILLANCE, PREVENTION, AND CONTROL

Diabetes Today - A Summary of the Evidence

Diabetes is a significant public health problem in Canada today. Over a million Canadians are estimated to have diabetes, although many are unaware of their condition. It is the seventh leading cause of death based on mortality data that underestimate the true problem. Diabetes is the most common cause of end-stage renal disease, of new onset blindness in the working age population, and of lower limb amputations, and a noted risk factor for cardiovascular disease[18]. The increased morbidity seen with diabetes is clearly shown in this report. People with diabetes have poorer general health perception and more days of disability than people without diabetes. They have a much higher need for health care services.

There appears to be a trend toward increased diabetes prevalence from the analysis of the two NPHS surveys done to date, although this change is not statistically significant. Other indicators of increased prevalence, however, are the increasing rates of mortality from diabetes and the increase in the amount of diabetes medication dispensed in Canada. The number of Canadians with diabetes can be expected to increase on the basis of demographic factors, as the most common age of onset for Type 2 diabetes appears to be between 51 and 60 years of age. The

oldest baby boomers are entering this decade of life now. It is expected, however, that the prevalence of diabetes will increase for two additional reasons: the incidence of Type 2 diabetes will probably rise as the major risk factor for diabetes, obesity, is increasing at this time; the second reason is that improvement in diabetes care should increase the survival of people with the condition after diagnosis.

A clear conclusion from this report is that information about diabetes in Canada is quite limited. There are limited data in Canada on the incidence and prevalence rates for diabetes at the provincial and subprovincial levels. In fact, the proportion of complications due to diabetes, such as loss of vision, is not known at the national level. It is at the subprovincial level that this information about diabetes is urgently needed, because decisions concerning diabetes prevention and control programs are made locally as a result of regionalization in almost all jurisdictions. As the evidence has mounted during the 1990s that the complications of diabetes and possibly diabetes itself are preventable, it is discouraging to note that information to assess baseline status and monitor progress is not available for this disease.

Addressing the Problem

Since diabetes is not a unique problem to Canada, it is perhaps best to learn from international experience. The Declaration of the Americas on Diabetes (DOTA) was endorsed by the Pan American Health Organization (PAHO) in 1996. This declaration proposed four Minimum Essential National Targets to improve the prevention and control of diabetes:

1. Create a national focal point for diabetes program development.
2. Establish national surveillance.
3. Create a national strategic plan for prevention and control.
4. Set national and local targets.

The first national target has been achieved in the creation of the Diabetes Council of Canada (DCC). This coalition of diabetes-related non-governmental organizations and federal government agencies can act as the focal point for diabetes program development. The Adult Health Division of Health Promotion and Programs Branch of Health Canada provides logistic and financial support to the DCC.

The second national target, to establish national surveillance, is an initiative of the DCC. The National Diabetes Surveillance System (NDSS) is being developed by the Laboratory Centre for Disease Control of Health Canada along with provincial and territorial governments, non-governmental organizations, academic clinicians, and other federal agencies. This proposed system will use existing administrative data-

bases and record linkage to provide information such as the following: incidence and prevalence of Type 1 and Type 2 diabetes, incidence and prevalence of diabetes complications, diabetes management practices by health professionals and patients, ambulatory health care utilization, provision of diabetes education, quality of diabetes care, economic costs of diabetes, and the effectiveness of diabetes prevention and control programs.

The third national target is to create a national diabetes strategy for the prevention and control of diabetes. This has been discussed by the DCC, and a background document reviewing the relevant issues has been funded by Health Canada and will be completed early in 1999. This discussion paper is only the first step in a multi-sectoral consultation process. This strategy will need to address primary, secondary, and tertiary prevention of diabetes. The Aboriginal Diabetes Strategy at present being developed by Medical Services Branch and Aboriginal groups will be an integral part of a national diabetes strategy.

The final goal through DOTA is to set national and local targets based on epidemiologic and resource estimates. It is becoming no longer acceptable to fund disease prevention and control programs without knowing the present status of the disease and the planned outcome of the intervention. Clearly, this final step requires a functional national surveillance system and a well-coordinated prevention and control strategy.

Conclusion

Diabetes is a significant problem in Canada today. Although limited surveillance makes the picture of this disease incomplete, it is clear that diabetes will exact an increasing burden on Canadians in the near future. The complications of diabetes can be prevented, however, and there is some evidence that Type 2 diabetes can be prevented through lifestyle modification. A logical approach to this problem is provided through PAHO s Declaration of the Americas on Diabetes. Action has begun along the path to improved diabetes surveillance, prevention, and control. These goals can be achieved through the vision and persistance of all diabetes stakeholders in Canada.

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GLOSSARY

Age-specific Rate

The number of cases or deaths per 100,000 persons per year for a specified age group. Five-year age groups are commonly used.

Age-standardized Rate

An adjusted rate that represents what the crude rate would have been in the study population (such as a province or a census division) if that population had the same age distribution as the standard population, which in this report is the 1991 Canadian population. However, because standardization produces a summary measure, it may obscure important differences in the age-specific patterns. Also, standardized rates can be compared with each other only when the same standard population has been used to obtain the rate.

Body Mass Index (BMI)

A measure of human body size and proportion. It is defined as the weight in kilograms divided by the square of height in metres (see Obesity).

ICD-9

International Classification of Disease, 9th edition.

Incidence

The number of new instances of illness commencing, or of persons falling ill, during a given period in a specified population.

Leading Causes of Death

The leading causes of death are those diseases that account for a high proportion of the total number of deaths (taking the number of deaths reported for a given disease chapter based on the ICD-9 classification and dividing by the total number of deaths for a given period).

Life Expectancy

Life expectancy is a summary measure of the health status of a population. It is defined as the average number of years an individual of a given age is expected to live if current mortality rates continue to apply.

Mortality

Death from a particular cause.

Mortality Data

Mortality or death data are collected by the provincial registrar of vital statistics for persons resident in that province or territory at the time of death and sent to Statistics Canada for final editing. The death registration covers all deaths of Canadians occurring in Canada and to some extent in the United States. Deaths occurring in countries other than Canada and the United States are not covered.

Non-Proxy (NPHS)

See Proxy/Non-Proxy

Obesity

The National Population Health Survey 1996 (Statistics Canada) uses the following criteria for levels of obesity: (i) some excess weight = Body Mass Index 25-27, and (ii) overweight = Body Mass Index > 27. The U.S. National Institutes of Health uses the following criteria: (i) overweight = Body Mass Index 25-29.9 , (ii) obesity = Body Mass Index 30-39.9, and (iii) extreme obesity = Body Mass Index ≥ 40 (see Body Mass Index).

Physical Inactivity

A relative term that refers to a lack of exercise, the definition of which varies among researchers.

Potential Years of Life Lost (PYLL)

A measure of the relative impact of various diseases and lethal forces on society resulting in youthful or premature deaths. The PYLL due to a particular cause is calculated by a summing, over all persons dying from that cause, of the years that each individual

would have lived had they experienced normal life expectation (see Life Expectancy).

Prevalence

The number of existing instances of a given illness, at a given time, in a specified population.

Proxy/Non-Proxy (NPHS)

Proxy:
One knowledgeable person in every participating household provided general socio-demographic and health information about each household member.

Non-Proxy:
One randomly selected person in each participating household was chosen to provide in-depth information about his or her own health.

Rate

The proportion of a group affected over a period of time, such as a year. It is usually expressed as the number of new cases (deaths, separations etc.) per 1,000 or 100,000 people per year.

Standard Population

A population structure that is used to provide a constant age distribution, so that the rates of different study populations can be adjusted to it and can be properly compared (see Age-Standardized Rates).

Waist-Hip Ratio

The ratio of waist circumference (cm) to hip circumference (cm). It is used as a measurement of obesity (see Obesity).

APPENDIX A

DIABETES COUNCIL OF CANADA

Member Organizations (1998)

Canadian Diabetes Association
Juvenile Diabetes Foundation of Canada
L Association du diabète du Québec
National Aboriginal Diabetes Association
Assembly of First Nations
Heart and Stroke Foundation of Canada
Kidney Foundation of Canada
Canadian National Institute for the Blind
Canadian Pharmacists Association of Canada
Medical Research Council of Canada
Health Canada

APPENDIX B

GENERAL INFORMATION
DIABETES MELLITUS

This section summarizes current clinical information on diabetes mellitus for the general reader, as well as relevant epidemiologic information not available at the national level in Canada. Unless otherwise noted, the information source for this section is *Diabetes in America,* 2nd Ed., National Institutes of Health, 1995. Additional information sources include journal articles, and publications of the Canadian Diabetes Association (CDA) and the Centers for Disease Control and Prevention (CDC) in the United States.

DIABETES MELLITUS

Description

Diabetes mellitus is a condition resulting from an inability of the body to sufficiently produce and/or properly use insulin. Insulin, a hormone secreted from beta cells in the pancreas, assists with the conversion of glucose into energy. Without insulin, glucose cannot be sufficiently absorbed from the bloodstream into the cells of the body (primarily in muscle, fat and liver tissue). Chronic high levels of blood glucose due to diabetes are associated with long-term damage, dysfunction and failure of various organs, especially the kidneys, eyes, nerves, heart, and blood vessels.

There are three main types of diabetes: Type 1 diabetes, Type 2 diabetes, and gestational diabetes. Impaired fasting glucose and impaired glucose tolerance are conditions that can lead to diabetes. Most of our information on diabetes in terms of life expectancy, complication rates, and risk factors comes from US data sources.

■ Type 1 Diabetes

Type 1 diabetes, previously known as insulin-dependent diabetes, typically occurs in childhood or adolescence and requires multiple daily injections of insulin for survival. The most common form of Type 1 diabetes is caused by auto-immune destruction of beta-cells, resulting in an inability of the pancreas to produce insulin. Type 1 diabetes may account for 5% to 10% of all diagnosed cases of diabetes[51].

According to US data, the reduction in life expectancy seen in people with Type 1 diabetes is dependent on the age at diagnosis. At a minimum, life expectancy is shortened by 15 years. One study using life insurance records showed a reduction in life expectancy of 27 years in those diagnosed before age 15. A study of patients at the Joslin Clinic, a US clinic specializing in diabetes, found only a 16 to 17 year reduction in life expectancy for those diagnosed at ages 10 or 15. However, people who are treated at the Joslin Clinic would tend to be from wealthier families and would likely receive better medical care.

■ Type 2 Diabetes

Type 2 diabetes, previously known as non-insulin dependent diabetes, typically begins after age 40. Type 2 diabetes may account for 90% to 95% of all diagnosed cases of diabetes(51). The onset of Type 2 diabetes is a two-stage process: (1) resistance to insulin s action, often exacerbated by obesity, followed by (2) the pancreas failing to increase insulin

enough to compensate adequately. This form of diabetes has recently been detected in Aboriginal youth and is known as Paediatric Type 2 diabetes or Type 2Y diabetes (Y referring to youth).

Life expectancy is reduced by 5 to 10 years in middle-aged people with Type 2 diabetes. Life expectancy varies with age of onset, the reduction being greater the younger the age at diagnosis.

Gestational Diabetes Mellitus

Gestational diabetes mellitus (GDM) is defined as glucose intolerance first recognized during pregnancy. Usually this form of diabetes is a transient condition that disappears by six weeks postpartum. Gestational diabetes is associated with an excess incidence of fetal macrosomia (big babies), pre-eclampsia, and Cesarean section. Women who have had gestational diabetes are at increased risk for later development of Type 2 diabetes. There is some evidence that Type 2 diabetes develops in approximately one third of women who have ever had gestational diabetes[52].

Associated Conditions

People with blood glucose levels greater than those considered normal but less than the level that is diagnostic of diabetes on standard tests are classified as having impaired fasting glucose (IFG) (if given a fasting glucose test), or impaired glucose tolerance (IGT) (if given an oral glucose tolerance test). People in these groups are considered to be at high risk for diabetes and/or its complications. IFG or IGT prevalence rates are not available at the national level in Canada. In the United States, an estimated 7% of the population have IFG[51]. A study conducted in the UK from 1990-1992 found the prevalence of IGT, based on World Health Organization criteria, to be 16.8% among those 40 to 65 years of age[3] Researchers are investigating how to predict which of those people with IFG or IGT will go on to have diabetes and how to prevent such progression.

Symptoms and Diagnostic Testing

Symptoms

The classic symptoms of diabetes mellitus are fatigue, polyuria (frequent urination), polydipsia (unusual thirst), and unexplained weight loss. In Type 1 diabetes, the symptoms usually progress quickly and are often dramatic. In Type 2 diabetes, since symptoms are slower to progress, it is possible to have no apparent symptoms and be diagnosed on a non-related medical examination.

These symptoms are also compatible with diabetic ketoacidosis (DKA), a condition resulting from absolute insulin deficiency and excess contra-insulin hormones, which can lead to coma and death. DKA is much more common among those with Type 1 diabetes. Before the discovery of insulin, people with Type 1 diabetes usually died of DKA[34].

Diagnostic Testing

The Canadian Diabetes Association (CDA) released new criteria for the diagnosis of diabetes in 1998 in its revision of the Clinical Practice Guidelines for the Management of Diabetes in Canada[14]. The new diagnostic criteria are based upon a number of recent studies demonstrating that the previous diagnostic criteria using the fasting plasma glucose test (FPG) lacked sensitivity (proportion of diabetes cases accurately detected) compared with the sensitivity of the oral glucose tolerance test (OGTT). However, the OGTT has problems of less specificity (proportion of non-diabetes cases accurately identified) compared with the FPG, as well as a lack of test-retest reliability. Also, because the OGTT is a more difficult and expensive test to perform, it has not received wide clinical acceptance.

The new FPG diagnostic criteria increase the sensitivity of that test by lowering the cutpoint for a diagnosis of diabetes, from 7.8 to 7.0 mmol/L. The use of the new FPG criteria for a diagnosis of diabetes should increase the number of people with diagnosed diabetes as well as decrease the proportion of undiagnosed cases.

Treatment/Management of Diabetes

The primary goal of therapy for diabetes is the maintenance of the patient s health in terms of his or her quality of life and overall sense of well-being, as well as the avoidance of acute and chronic complications. Since virtually every aspect of daily life may be affected by treatment, the person with diabetes is the key member of the diabetes health care team. For most people with diabetes, improving metabolic control (such that blood glucose is near normal levels at all times) will achieve the primary goal of preventing long-term complications. Depending upon the type of diabetes and the therapy required to achieve near normal levels of blood glucose, this objective may be more or less difficult to achieve without causing acute side effects. The metabolic goals of treatment/management must therefore be individualized. Education of health care providers and of the people affected with diabetes and their families is a cornerstone of effective treatment and self-management of this condition.

Type 1 Diabetes

Lack of insulin production by the pancreas makes Type 1 diabetes particularly difficult to control. Treatment requires a strict regimen that typically includes a carefully calculated diet, planned physical activity, home blood glucose testing up to several times a day, and multiple daily insulin injections[51].

Type 2 Diabetes

Treatment typically includes diet control, exercise, home blood glucose testing, and in most cases, oral medication and/or insulin. Approximately 40% of people with Type 2 diabetes require insulin injections[51].

Gestational Diabetes Mellitus

Treatment for women with gestational diabetes includes dietary counseling, regular and moderate exercise, glucose monitoring, and insulin therapy if diet alone does not achieve target blood glucose. The value of treatment for gestational diabetes remains controversial.

Risk Factors for Diabetes

Type 1 Diabetes - Risk Factors

Race and Ethnic Background. Race and ethnic background are accepted risk factors for Type 1 diabetes. Rates are higher among non-Hispanic whites than blacks or Hispanics in the United States.

Age. Incidence increases with age through childhood and adolescence but decreases during adulthood.

Geographic Variability. Comparisons among countries facilitated by the World Health Organization (WHO) have found the highest rates of Type 1 diabetes in Scandinavia, intermediate rates in Canada and the United States, and low rates in Japan and Tanzania.

Seasonal Variability. Most studies show some seasonal variation, with incidence rates lowest in the warm summer months.

Genetic Susceptibility/Family History. Genetic susceptibility is a factor in Type 1 diabetes but is not as strong a factor as in Type 2 diabetes.

Possible Links to Diet and Exposure to Viruses. There is some evidence of a protective effect of breast-feeding against Type 1 diabetes.

Note. Type 1 diabetes affects males and females equally.

■ Type 2 Diabetes - Risk Factors

Age. The prevalence of Type 2 diabetes increases rapidly with age. The usual onset of diabetes is after age 40.

Genetic Susceptibility/Family History. Increased risk of diabetes with a positive family history of diabetes is probably due to genetic and environmental factors. Evidence for genetic factors comes from twin studies where the probability of finding diabetes in both twins is twice as high among identical twins as fraternal twins.

Obesity. Obesity is a well-recognized risk factor for diabetes. Diabetes has been positively associated with each of the following: (a) the level of obesity, (b) the duration of obesity, and (c) body fat distribution (i.e., central deposition of fat).

Physical Inactivity. Physical inactivity is considered a risk factor on the basis of observational and ecologic studies.

Ethnic Background. Ethnic background has been accepted as an independent risk factor based on studies of high prevalence populations (Aboriginal, Black, Hispanic), which have found increased risk for diabetes among these populations compared with the white population after controlling for all other known risk factors.

Note. High blood pressure and dyslipidemia (disturbances in lipoprotein patterns, linked to coronary heart disease) are associated with diabetes, although it is not clear at this time whether these factors contribute to a person s risk of getting diabetes, or are caused by diabetes itself. Gender is not an independent risk factor for Type 2 diabetes in the general population. Smoking has been associated with diabetes in a few studies but it is unclear if smoking is a causal factor in the onset of diabetes. It is clear that smoking is a causal factor for cardiovascular disease, one of the major complications of diabetes.

■ Gestational Diabetes - Risk Factors

US studies have reported an increased risk of gestational diabetes among African Americans, Hispanic/Latino Americans, American Indians, and people with a family history of diabetes. Obesity is also associated with higher risk.

Long-Term Complications of Diabetes

The main long-term complications of diabetes are as follows: (i) microvascular disease, or small blood vessel damage, including retinopathy (eye disease) and nephropathy (kidney disease); (ii) macrovascular dis-

ease, or large blood vessel damage, including ischemic heart disease, stroke, and peripheral vascular disease; (iii) neuropathy (nervous system disease); and (iv) foot problems. Hypertension (high blood pressure) is a risk factor for most complications of diabetes. There is strong evidence that early diagnosis and tight control of blood sugar levels and blood pressure can prevent or delay these complications.

Cardiovascular Disease

The risk of heart disease is substantially increased for people with diabetes. According to 1996 national survey data (NPHS 1996/97), Canadians have 2 to 6 times (depending on age) the likelihood of having heart diseases or stroke if they have diabetes as those without diabetes. Heart disease is uncommon in those under 30 with Type 1 diabetes. Adults with diabetes are more likely than those without to have risk factors for heart disease, especially high blood pressure, low levels of HDL cholesterol, and high levels of triglycerides. However, some of the increased risk of heart disease associated with diabetes appears to be independent of these factors.

Kidney Disease (Nephropathy)

After 7 to 15 years, 25 to 40% of all patients with Type 1 diabetes develop microalbuminuria. Of these, over 90% progress to proteinuria over time. Kidney function declines at variable rates; it appears to be a slower decline in Type 2 diabetes. After 10 years of persistent proteinuria, the incidence of chronic kidney failure is 11% in those with Type 2 diabetes and 50% in those with Type 1 diabetes.

Blindness

Three complications of diabetes can lead to blindness: retinopathy, cataracts, and glaucoma. Of people who have had diabetes for at least 15 years, 97% of insulin-taking patients and 80% of those not taking insulin have retinopathy; the most severe manifestation, proliferative diabetic retinopathy, occurs in 40% of those taking insulin and 5% of those not taking insulin. Of people who have had insulin-dependent diabetes for 30 or more years, 12% are blind. Diabetic retinopathy is the leading cause of new cases of legal blindness among the working age population.

Nervous System Disease (Neuropathy)

Roughly 60% of people with diabetes have some degree of diabetic neuropathy, and in half of these it develops within nine years of diagnosis. Most have a mixed motor/sensory deficit resulting in decreased sensation, increased sensitivity, pain, weakness, and muscle wasting. Frequently, abnormal functioning of the autonomic (self-functioning)

nervous system leads to disorders of the heart and circulation, and gastrointestinal and genitourinary tracts.

Lower Extremity Amputations (LEA)

The risk of lower extremity (limb) amputations following diabetes diagnosis is 6% at 20 years and 11% at 30 years. Lower limb amputations are typically the result of a foot infection that does not heal and eventually becomes gangrenous. The initial wound is often the result of a lack of protective sensory function in the foot due to neuropathy. The inability of the wound to heal properly is due to decreased blood and nutrient flow to the lower limbs, the result of peripheral vascular disease in most cases.

High Blood Pressure (Hypertension)

An estimated 40% of people with diabetes in Canada have high blood pressure. High blood pressure is one of the main risk factors for cardiovascular disease.

Dental Disease

Periodontal disease (a type of disease that can lead to tooth loss) occurs with greater frequency and severity among people with diabetes. Periodontal disease has been reported to occur among 30% of people aged 19 years or older with Type 1 diabetes[51].

Complications of Pregnancy (for women with pre-existing diabetes)

The rate of major congenital malformations in babies born to women with pre-existing diabetes varies from 0% to 5% among women who receive preconception care to 10% among women who do not. Between 3% and 5% of pregnancies among women with diabetes result in the death of the newborn; the rate among women who do not have diabetes is 1.5%[51].

Other Complications

Diabetes can directly cause acute life-threatening events, such as diabetic ketoacidosis and hyperosmolar nonketotic coma, as a result of biochemical imbalance in uncontrolled diabetes. People with diabetes are more susceptible to many other illnesses. For example, they are more likely to die of pneumonia or influenza than people who do not have diabetes[51].

EVALUATION AND ORDER FORM

We hope that this report has provided you and your organization with useful information on the status of diabetes in Canada. Your feedback will enable us to improve and expand future reports.

Please let us know:

what you found useful in this report and would like to see updated in future reports

_____

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