Trends in diabetes treatment in Canadians, 1994–2004

C. I. Neutel, PhD (1); N. R. Campbell, MD (2); H. I. Morrison, PhD (1,3)

Abstract

Objective: To examine trends in the treatment of diabetes using the biannual interviews of the longitudinal National Population Health Survey (NPHS), 1994–2004 as they relate to changes in Clinical Practice Guidelines (CPGs).

Methods: A sample of 17 276 Canadians 18 years and older was selected for repeated interviews at two-year intervals from 1994 to 2004 for the NPHS. The population used for this study includes all respondents aged 40 to 79 for any of the cycles.

Results: CPGs issued by the Canadian Diabetes Association in 1998 and 2004 recommend a stepwise introduction of lifestyle changes, to be followed by single then multiple oral antidiabetic agents (OA), and finally insulin until adequate control is achieved. While the use of OA increased, only a small proportion indicated diet or physical exercise as part of their treatment; those with no drug treatment reported less diet modification and physical exercise. Antihypertensives and statin use in Canadians with diabetes increased to double that of Canadians overall, but remained underutilized.

Conclusion: This study provides an update on the treatment of diabetes in Canada between 1994 and 2004. While some changes in diabetes treatment were compatible with CPGs, there is room for improvement, especially in lifestyle modifications.

Introduction

People with diabetes have a greatly increased risk of many adverse health outcomes, including heart disease, stroke, blindness and renal disease.[1] Up to 80% of people with diabetes die of vascular diseases. Primary cardiovascular disease prevention with lipid-lowering medication, such as statins and antihypertensive therapies, markedly reduces cardiovascular events and risk of death in people with diabetes;[2,3] however, improved patient outcome as a result of glucose lowering is assumed but has not yet been convincingly demonstrated.[4] A program that comprehensively addressed lifestyle and pharmacotherapy for multiple risk factors resulted in a 40% reduction in total mortality, highlighting the importance of an inclusive approach.[5]

Over the last decade, several sets of clinical practice guidelines (CPGs) have been produced by the Canadian Diabetes Association in order to help health care professionals develop efficient treatment plans for their patients. Of these, two will be relevant to this study.[6,7]

The objectives of this study are to examine trends in the treatment of glycemia, dyslipidemia and hypertension in Canadians with diabetes. Of interest will be whether changes in these trends over the years are generally compatible with CPG recommendations.

Methods

The study population was derived from the longitudinal National Population Health Survey (NPHS) which began in 1994 with a random sample of the Canadian population. The sampling frame for this sample originated with the Labour Force Survey for all provinces except Quebec, for which a provincial sampling frame was used. The sample design was a stratified multistage design. In the first stage, samples of clusters were drawn from pre-specified strata, and in the second stage, households were selected from lists of members of the chosen clusters. One person was randomly chosen from each household as the longitudinal respondent. A sample of 17 276 Canadians 18 years and older was selected for repeated interviews at two-year intervals from 1994 to 2004 for the NPHS. The study population used includes all respondents aged 40 to 79 for any of the cycles. To keep the age composition constant for each successive cycle of interviews, younger respondents were added to the study population as they reached age 40, while older respondents were dropped as they reached age 80.

Author References

1. Department of Epidemiology and Community Medicine, Faculty of Medicine, University of Ottawa
2. Departments of Medicine, Community Health Sciences, and Physiology and Pharmacology, Faculty of Medicine, University of Calgary
3. Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada

Correspondence: C. Ineke Neutel, Department of Epidemiology and Community Medicine, Faculty of Medicine, University of Ottawa, Ottawa, Canada; Tel.: (613) 731-7141; E-mail: cneutel@uottawa.ca

Information available for analysis included background, lifestyle, health and treatment variables. Respondents were asked to rate their health status on a five-point Likert scale. The top two categories were combined as "good health" and the bottom three as "poor health." Respondents were also asked whether they had taken any medications in the previous two days. If the answer was yes, the person was then asked to spell the name of the medication on the label of the container. The drug name was then coded using the Anatomical Therapeutic Chemical (ATC) classification system.

Self-reported diabetes was elicited by the question "Do you have diabetes?" Further questions were about insulin use and other treatment. Questions on diet and exercise started with the question "Do you take medication or treatment for your diabetes other than insulin?" Those who answered "yes" were asked separate questions about medication use, diet and exercise as part of their treatment of diabetes.

Body mass index (BMI; kg/m^2) was based on self-reported height and weight, and grouped into optimal weight (BMI less than 25), overweight (25–29.9) and obese (30 and over).

Results

The number of respondents in the study population increased from 3970 in 1994 to 5400 in 2004 (Table 1). This net increase of 1430 was as a result of adding participants who reached age 40 and dropping those who reached age 80 in the previous interval. The number of people with diabetes increased from 156 to 431.

Table 2 shows the attributes of the overall study population and of people with diabetes. Differences between the two populations were apparent for age, education, BMI and self-reported health. While the overall population showed an increasing prevalence for obesity (BMI ≥ 30) between 1994 and 2004, obesity among people with diabetes remained at about double that of the overall population. Changes in medication use over the years include small decreases in insulin use and

an approximate 30% increase in the use of oral antidiabetic agents (OA), with the greatest increase occurring between 1998 and 2000 (Table 2). Similar patterns are reflected by the odds ratios (OR) adjusted for age and sex presented in Table 3. Since OA and insulin were not used by people without diabetes, no meaningful OR could be derived for these medications. The use of antihypertensives and statins increased markedly over this time and the increase in their use in the diabetic population was greater than in the overall population (Tables 2 and 3).

The proportion of people with diabetes who did not use any medication decreased, as did the proportion treated with insulin only (Table 4). The proportion of the diabetic population treated with any OA increased over the years, especially after the 1998 cycle. In terms of specific OA, biguanide (metformin) use increased from about 20% in the first two cycles (1994 and 1996) to about 46% in the last two cycles (2002 and 2004), while sulfonylurea use fluctuated around 40% in the first four cycles (1994, 1996, 1998, 2000) but decreased over the last two cycles (2002 and 2004). The proportions of individuals taking more than one OA started to increase in 1998.

The proportion of people with diabetes using diet as part of their treatment stayed at around 20% over the years of the study but peaked at 24% in 1998 and showed the start of another peak in 2004. These peaks were higher, and the troughs lower, for people with diabetes who were not using any antidiabetic medication. Exercise as part of the treatment for diabetes showed a slight decrease over time and was lower for those with no anti-diabetic drug treatment.

Discussion

This study provides an update on the treatment of diabetes in Canada between 1994 and 2004, during which many changes took place. Obesity increased from 16% to 21% in the overall population and from 38% to 44% in people with diabetes. The diabetic population showed increased use not only of OA, but also of statins and antihypertensive agents. Only a remarkably

small proportion of the diabetic population reported lifestyle changes as part of their treatment for diabetes.

Two sets of CPGs were produced by the Canadian Diabetes Association within the period covered by this study, in 1998 and in 2003.[6,7] The 1998 CPG published a chart illustrating a stepwise approach to the management of type 2 diabetes.[6] The first line of action should be lifestyle modification, including diet, exercise, and smoking cessation, and education about diabetes self-care. If the goals for glucose control have not been achieved after a few months, the next step is OA monotherapy using biguanides, alpha-glucosidase inhibitors or sulfonylureas, depending on the needs of the individual. If glucose control is still not achieved, or is no longer achieved, oral combination therapy can be started, most commonly with a combination of the OA classes mentioned above. The next step would be the addition of insulin, with or without OA. The 2003 CPGs include more stringent recommendations regarding the control of blood pressure and lipids than those for the rest of the population.[7]

Only about 20% of respondents with diabetes said that they used diet as part of their treatment for diabetes, and only about 10% exercised as part of their treatment. Neither of these percentages changed much over the years of the study. Although the survey question leading to diet and exercise is obscure (not everyone sees exercise as a treatment for diabetes), it confirms our previous study where we reported little change in lifestyle after diagnosis of hypertension in Canadians.[8] While the slight increase in the percentage of the study population who become more physically active is encouraging, the increasing prevalence of obesity is worrisome, both directly as a risk factor for diabetes, and indirectly, as obesity decreases the motivation for exercise. Of special interest are the short-term changes in dieting, corresponding to the publications of the 1998 and 2003 CPG.[6,7] These changes are compatible with a short-term enthusiasm when the new CPG recommendations were still fresh in the minds of physicians and patients; new guidelines in hypertension therapy also caused similar short-lived

TABLE 1
Study population, age 40–79 years, Canada, 1994–2004

Population		1994	1996	1998	2000	2002	2004
All	N =	3970	4263	4579	4901	5184	5400
With diabetes	n =	156	201	236	309	387	431
	%, unweighted	3.9	4.7	5.2	6.3	7.5	8.0
	%, age-adjusted and weighted	3.7	4.8	5.0	5.9	6.9	7.5

Abbreviations: N, overall sample size; n, sub-sample size.

TABLE 2
Comparing people with diabetes to the overall population (shaded), age 40–79 years, weighted for the Canadian population, 1994–2004

	Percentage of the study population											
Categories	1994		1996		1998		2000		2002		2004	
	Diabetes %	Overall %	Diabetes %	Overall %	Diabetes %	Overall %	Diabetes %	Overall %	Diabetes %	Overall %	Diabetes %	Overall %
Sex												
Male	51.8	46.1	51.8	46.7	50.2	46.9	52.1	46.9	50.2	47.4	50.7	47.7
Female	48.2	53.9	48.2	53.3	49.8	53.1	47.9	53.1	49.8	52.6	49.3	52.3
Age												
40–59	48.2	70.4	43.6	69.2	43.7	68.2	41.5	67.6	43.5	67.3	41.8	66.3
60–79	51.8	29.6	56.4	30.8	56.3	31.8	58.5	32.4	56.5	32.7	58.2	33.7
Education												
< High school	54.9	36.5	49.4	34.8	48.8	32.7	44.9	30.7	42.1	29.0	40.2	27.7
≥ High school	45.1	63.5	50.6	65.2	51.2	67.3	55.1	69.3	57.9	71.0	59.8	72.3
Smoking												
Yes	17.8	21.2	14.5	22.5	15.9	21.8	14.7	21.3	16.4	19.5	17.7	18.8
No	82.2	78.8	85.5	77.5	84.1	78.2	85.3	78.7	83.6	80.5	82.3	81.2
BMI												
< 25	26.2	42.3	18.3	42.5	20.5	42.1	15.4	39.9	18.5	38.2	21.9	38.5
25–29.9	36.2	41.3	48.4	41.1	42.6	39.7	46.3	40.0	41.9	40.6	34.6	40.1
≥ 30	37.6	16.4	33.4	16.5	36.9	18.2	38.3	20.2	39.5	21.2	43.5	21.4
Physical activity												
More active	33.7	39.4	33.3	41.3	40.6	46.4	40.4	41.8	43.3	50.1	41.3	47.6
Less active	66.3	60.6	66.7	58.7	59.4	53.6	59.6	58.2	56.7	49.9	58.7	52.4
Health												
Better	23.2	60.8	29.2	60.5	38.1	60.9	29.3	58.0	25.5	54.7	23.5	55.1
Worse	76.8	39.2	70.8	39.5	61.9	39.1	70.7	42.0	74.5	45.3	76.5	44.9
MD visits per year												
< 5 visits	38.4	92.0	46.3	74.3	45.1	71.5	45.9	71.5	47.4	70.7	47.8	70.6
≥ 5	61.6	8.0	53.7	25.7	54.9	28.5	54.1	28.5	52.6	29.3	52.2	29.4
Medications used in past two days												
OA	47.7	1.8	44.3	2.0	49.4	2.6	60.0	3.6	60.1	4.3	59.0	4.5
Insulin	13.9	.5	11.8	.5	12.0	.6	9.9	.6	7.6	.5	9.8	.7
Statins	3.4	2.4	8.3	3.8	12.3	5.3	23.2	7.4	31.0	10.6	35.8	11.9
Antihypertensives	29.0	12.7	42.9	16.1	49.5	17.8	55.1	19.8	61.0	22.4	58.0	24.4

Abbreviations: BMI, body mass index; MD, doctor of medicine; OA, oral antidiabetic agents.

TABLE 3
Age-sex-adjusted odds ratio, comparing people with diabetes to the overall population, age 40–79 years, weighted for the Canadian population, 1994–2004

		1994	1996	1998	2000	2002	2004
Sex	Female/Male	.7	.7	.8	.9	.8	.8
Age	Per 10 years	1.7*	1.7*	1.7*	1.8*	1.8*	1.7*
Education	Less than HS/HS completed	.6	.7	.7	.8	.8	.9
Current smoker	Yes/No	.9	.7	.8	.8	1.0	1.2
BMI	25–29.9 / < 25	1.3	2.7*	2.1*	3.0*	2.1*	1.5
	≥ 30 / < 25	4.2*	5.3*	4.6*	5.8*	4.5*	4.3*
Physical activity	No/Yes	1.4	1.5	1.3	1.1	1.3	1.3
Health	Worse/Better	4.8*	3.4*	2.5*	3.0*	3.3*	3.7*
MD visits per year	≥ 5 / < 5	4.2*	3.4*	3.0*	2.8*	2.6*	2.5*
Drug use categories in last 2 days							
Statins	Yes/No	.9	1.8	1.8	3.2*	3.3*	3.9*
Antihypertensives	Yes/No	2.1*	3.2*	3.9*	4.1*	4.9*	3.6*

Abbreviations: BMI, body mass index; HS, high school; MD, doctor of medicine.

* statistically significant at $p < .05$

TABLE 4
Percentage of persons aged 40–79 with diabetes receiving treatment, weighted for the Canadian population, 1994–2004

		1994 N = 156 %	1996 N = 201 %	1998 N = 236 %	2000 N = 309 %	2002 N = 387 %	2004 N = 431 %
Diabetes treatment							
No insulin/OA		40.0	44.3	40.7	32.7	34.8	35.9
Insulin		13.9	11.8	12.0	9.9	7.6	9.8
Any OA		47.7	44.3	49.4	60.0	60.1	59.0
Both insulin / OA		1.1	.4	2.1	2.6	2.4	4.6
Specific OA							
Biguanides		21.2	17.9	28.6	36.0	45.7	46.7
Sulfonylureas		40.3	39.0	37.2	41.4	35.2	29.7
Alpha-glucosidase inhibitors		–	–	2.8	2.0	.5	.8
Thiazolidinediones		–	–	–	2.5	7.3	12.9
One OA		33.8	31.6	31.5	39.5	32.9	31.3
More than one OA		13.9	12.6	17.9	20.1	26.5	26.7
Lifestyle changes							
Diet	All diabetics	–	19.9	23.9	18.6	21.1	23.6
	Diabetics without OA / insulin	–	14.7	26.0	14.1	17.9	25.0
Exercise	All diabetics	–	–	11.9	9.7	9.8	9.1
	Diabetics without OA / insulin	–	–	9.1	4.4	8.5	6.7
Other medications							
Antihypertensives		29.0	42.9	49.5	55.1	61.0	58.0
Statins		3.4	8.3	12.3	23.2	31.0	35.8

Abbreviations: N, sample size; OA, oral antidiabetic agents.

changes.[9] Even those not taking medication for their diabetes did not seem to pay any greater attention to their diet. Of interest are the even higher peaks of dieting among those not taking any medication for their diabetes at the time of release of the CPG. Although we cannot be sure of any causal association, these peaks are consistent with an even higher level of short-term good intentions by the diabetic population not taking any OA.

After lifestyle changes fail to have the desired effects, the next step in the stepwise approach would be to start pharmacological treatment. Single OA was used in about one-third of people with diabetes, but the use of multiple OA almost doubled over the study period. The two main classes of OA are sulfonylureas, which stimulate insulin production, and biguanides, i.e. metformin, which reduce hepatic glucose production.[10] Biguanide use shows a steadily increasing trend from an average of 20% in the first two cycles to 46% in the last two. Sulfonylurea use did not show this increase and, in fact, showed a decrease after 2000. This is consistent with physicians following the 1998 CPG for a more aggressive pharmacological treatment and the 2003 guidelines recommending starting biguanides before sulfonylureas. Biguanides are especially effective in overweight and obese diabetic patients.[10] The thiazolidinedione, including rosiglitazone, showed increasing trends in this data; however, there is some concern about increased risk of heart disease with rosiglitazone use.[11]

The 2003 CPGs also acknowledged that people with diabetes need to be treated more aggressively with antihypertensive medications and statins than the general population.[7] In fact, there was a considerable increase in the use of antihypertensives and statins over the years of the study. In 1994, statin use was similar for the diabetic and non-diabetic populations, but by 2004 people with diabetes were three times as likely to be taking statins. However, this still only amounts to one-third of the diabetic population in the last cycle, and there remain important gaps in the use of lipid-lowering and antihypertensive therapy in Canadians with diabetes.[12] While the emphasis in diabetes CPG has been on glucose lowering, there is even stronger evidence from clinical trials that large reduction in mortality came from approaches that include both lipid-lowering and antihypertensive therapy.[5]

There have been marked changes in the management of people with diabetes in Canada between 1994 and 2005. Some of the changes in the treatment data presented are compatible with the recommendations of the 1998 and 2003 Canadian Diabetes Association guidelines. For example, signs of more aggressive treatment of diabetes are evident from the increased OA use, especially of multiple OA. Using biguanides rather than sulfonylureas might also be a response to the CPG, as might be the increased use of antihypertensives and statins. Although encouraging changes were noted, there is still plenty of room for improvement. In particular, a large proportion of respondents with diabetes still do not report getting any treatment. Lifestyle changes such as diet and exercise need to be instituted and sustained since the short-term increases in dieting which coincide with CPG publication are clearly insufficient.

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