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Profile of adults with type 2 diabetes and uptake of clinical care best practices: Results from the 2011 Survey on Living with Chronic Diseases in Canada – Diabetes component

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ABSTRACT

Aims: This study aimed to (1) describe the profile of adults with type 2 diabetes (T2D) in Canada and (2) assess the uptake of clinical care best practices, as defined by the Canadian Diabetes Association (CDA) Clinical Practice Guidelines (CPGs).

Methods: We used data from the 2011 Survey on Living with Chronic Diseases in Canada – Diabetes component. Participants were aged 20 years and older, living in the 10 Canadian provinces, with self-reported T2D. Descriptive analyses present the prevalence of complications and comorbidities, as well as the level of clinical monitoring and self-monitoring/lifestyle management recommendations participants received.

Results: We included 2335 participants with T2D, a mean age of 62.9 years, and high prevalence of complications/comorbidities and prescription medication use. Most participants reported being monitored as recommended for eye disease (73.9%), weight (81.0%), blood pressure (89.0%) and blood cholesterol levels (94.3%), but only 65.5% reported having at least two HbA1c tests during the last year and 46.5% reported an annual foot examination by a health professional. About two-thirds of the participants reported having received recommendations on weight management (59.9%) and physical activity (64.7%) from a health professional in the previous year; only 47.8% of the participants reported having received diet counseling to improve diabetes control.

Conclusion: Although the uptake of CDA CPGs for clinical and self-monitoring was high, with the majority of the participants reporting meeting most indicators, it was lower for HbA1c measurement and foot examination. Uptake of lifestyle management recommendations provided by health professionals was also significantly lower.

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1. Introduction

Diabetes is reaching epidemic levels worldwide [1], and Canada is no exception. In 2008/2009, the prevalence rate of diagnosed diabetes was 8.7% among Canadian adults, and its overall prevalence increased by 70% over the last decade [2]. Diabetes may cause many long term complications, such as cardiovascular disease, nephropathy, neuropathy or retinopathy, and is associated with shorter life expectancy and health adjusted life expectancy [3]. Considerable resources are dedicated to diabetes treatment and care at the national level, and needs are expected to increase, in part due to the projected rise in diabetes rates in Canada [1].

Studies have shown an improvement in diabetes control and a reduction in complications after appropriate cost-effective interventions, including clinical treatment of associated risk factors and complications, and lifestyle management [4–14]. This type of evidence was foundational for the development of the Canadian Diabetes Association (CDA) Clinical Practice Guidelines (CPGs) for the prevention and management of diabetes in Canada [15], a compilation of evidence-based clinical recommendations that helps health professionals provide optimal treatment and care. However, population-based studies have reported gaps in the adherence of health professionals to recommended care for Canadian diabetic adults [16–21]. Information about the uptake of diabetes clinical care best practices, and ultimately the quality of clinical care delivered, can inform the development of better health policies, programs and services aimed at improving the health of Canadians living with this disease. Since about 90% of Canadian diabetic adults have type 2 diabetes (T2D) [22], and as clinical monitoring and management differ by type, this study focuses on the latter only.

Using data from the 2011 Survey on Living with Chronic Diseases in Canada – Diabetes component (SLCDC-D) and CDA CPGs as indicators of optimal care, the purpose of this study was to (1) describe the profile of adults with T2D in Canada and (2) assess the uptake of clinical care best practices looking specifically at clinical monitoring, as well as recommendations on self-monitoring and lifestyle management provided by health professionals.

2. Materials and methods

2.1. Data source and study population

The 2011 SLCDC-D is a cross-sectional survey developed by the Public Health Agency of Canada (PHAC) and administered by Statistics Canada that collected diabetes management and outcome information. Computer-assisted telephone interviews were conducted in 2010 and 2011. Respondents selected the language of their choice for the interview, including English, French, or any other preferred language. Respondents' personal information and confidentiality were protected by the Statistics Act [23], and PHAC was granted access under the terms of data sharing agreements.

SLCDC-D respondents were adults aged 20 years and older, living in private dwellings in the 10 Canadian provinces, and reporting diabetes in the 2010 Canadian Community Health Survey (CCHS). Residents of the three territories, certain remote areas, Indian Reserves, Crown lands, and individuals living in institutions or full-time members of the Canadian Forces were excluded. In total, 2933 adults responded to the survey (response rate: 81.7% of modeled in-scope units) [24]. The present study was restricted to respondents who self-reported having T2D, excluding those stating that "*Diabetes was never diagnosed by a health professional*" ($n = 3$) or not answering in the affirmative when asked "*Other than during pregnancy, has a health professional ever told you that you have diabetes?*" ($n = 7$).

The 2010 CCHS, a large national cross-sectional survey from which the SLCDC-D sample was drawn ($n = 59{,}302$, response rate = 71.5%), collects information on health status, health care utilization and health determinants for the Canadian population aged 12 years and older, living in private dwellings in the 10 Canadian provinces and three territories. Similarly to the SLCDC-D, its target population excludes individuals who are full-time members of the Canadian Forces and those living on reserves and other Aboriginal settlements, in institutions, and in the Quebec health regions of Région du Nunavik and Région des Terres-Cries-de-la-Baie-James. In Nunavut, only the ten largest communities are included in the sampling frame. Overall, these exclusions represent less than 3% of the target population.

2.2. Measures

2.2.1. Descriptive variables

To describe the socio-demographic profile of the study sample, data were drawn from the SLCDC-D (sex, age group) and the 2010 CCHS linked dataset (ethnicity, total household income, highest level of education, geography), while only data from the SLDCD-D were used to describe the diabetes control, medication, and complications/comorbidities profile. Five categories of complications were defined: eye (diabetic eye disease, retinopathy, partial or complete blindness, cataracts and glaucoma), renal (protein in urine or kidney failure), neuropathy (nerve damage or neuropathy), cardiovascular (heart disease and stroke/mini-stroke), and feet/legs (poor circulation in feet or legs, foot or leg ulcers/infection, and gangrene/amputation).

2.2.2. Clinical monitoring indicators

Six clinical monitoring indicators were defined based on CDA CPGs [15], and uptake was assessed based on the proportion of participants meeting these indicators. Participants who reported at least two HbA1C tests during the last year were classified as meeting the HbA1C monitoring indicator, and those who reported at least one foot examination by a health professional as meeting the foot monitoring indicator. Even though CDA CPGs recommend eye screening at diagnosis, then every one to two years if the patient has no retinopathy and annually or more if the patient has retinopathy, participants who reported one eye examination less than two years ago were classified as meeting the eye monitoring indicator. To meet the weight and the blood pressure monitoring indicators, participants had to report that a health professional had measured their weight on a scale during the

last year and that their blood pressure had been "always" or "often" checked at diabetes-related appointments, respectively. Finally, CDA CPGs recommend assessing the lipid profile at the time of diagnosis of diabetes and then every one to three years. Therefore, participants who reported that their cholesterol was measured by a health professional less than three years ago were deemed to meet the blood cholesterol monitoring indicator.

2.2.3. *Self-monitoring and lifestyle management recommendations*

Based on CDA CPGs, two self-monitoring and three lifestyle management recommendations were defined. Uptake was assessed based on the proportion of participants meeting these indicators. Respectively, participants were classified as meeting the recommendation if they reported that a health professional recommended or discussed the following to help control their diabetes in the past year: monitoring blood glucose at home; taking prescription medication; controlling or losing weight; participating in physical activity or exercise; and changing the type or amount of food eaten.

2.3. *Statistical analysis*

Unweighted frequencies and weighted percentages are presented to describe socio-demographic, diabetes control, medication, complication and comorbidity characteristics. Statistics Canada's weighted records were applied to adjust point estimates to reflect the Canadian population aged 20 years and older living in private dwellings. To account for complex sampling design, bootstrap re-sampling method was used to estimate coefficients of variation and 95% confidence intervals (CI) [25]. Similarly, weighted percentages of participants meeting each of the clinical monitoring indicators and self-monitoring/lifestyle management recommendations were calculated for the whole sample, as well as by age and sex. Significant differences by age and sex were tested using the Z test for all cells with more than 30 observations. The same analysis was conducted for the number of clinical monitoring indicators and self-monitoring/lifestyle management recommendations met. SAS Enterprise Guide 4.1 (Cary, NC) was used to perform these analyses.

3. Results

3.1. *Profile of Canadians with type 2 diabetes*

Among SLCDC-D respondents who knew their diabetes type (89.0%, 95% CI: 87.1–90.8), 2335 (90.1%, 95% CI: 88.1–92.0) reported having T2D diagnosed by a health professional other than during pregnancy. Study participants' mean age was 62.9 years (95% CI: 62.1–63.7). The majority were male, white, with a post-secondary diploma, a total household income over 40,000 dollars, and living in an urban area (Table 1). The mean time since diagnosis was 10.6 years (95% CI: 10.1–11.2). Detailed information on time since diagnosis, diabetes control and medication among Canadian adults with T2D is presented in Table 2.

Table 1 Socio-demographic characteristics of Canadian adults with type 2 diabetes.

Characteristics	*n*	%[a] (95% CI)
Sex		
Male	1158	58.0 (55.0–60.9)
Female	1177	42.1 (39.1–45.0)
Age group (years)		
20–44	110	6.8 (5.0–8.60)
45–64	917	48.0 (44.6–51.4)
≥65	1308	45.2 (42.0–48.5)
Ethnicity		
White	2133	82.7 (79.3–86.0)
Non white	194	17.3 (14.0–20.7)
Missing n = 8		
Total household income (CAD)		
<20,000	391	12.6 (10.4–14.7)
20,000–39,999	674	27.1 (24.0–30.2)
40,000–59,999	403	18.6 (16.2–21.1)
≥60,000	631	41.7 (38.2–45.2)
Missing n = 236		
Highest level of education		
Less than secondary	468	13.1 (11.1–15.0)
Secondary/some post-secondary	480	19.1 (16.5–21.7)
Post-secondary	1334	67.9 (64.7–71.0)
Missing n = 53		
Geography		
Rural	712	22.7 (19.9–25.5)
Urban	1623	77.3 (74.5–80.1)

[a] Percentages are weighted to reflect the Canadian population aged 20 years and older, living in private dwellings.

Fig. 1 outlines the prevalence of eye, renal, neuropathy, cardiovascular, and feet/legs complications in this sample. Approximately a third of the participants reported having none of these complications (37.0%, 95% CI: 33.6–40.4), having one complication (32.9%, 95% CI: 29.6–36.2), and having two or three complications (two: 18.5%, 95% CI: 16.1–21.0; three: 11.2%, 95% CI: 9.1–13.3). Among those with diabetes complications, 77.3% (95% CI: 73.8–80.8) reported at least one microvascular complication (eye, renal or neuropathy) and 61.9% (95% CI: 57.8–66.0) at least one macrovascular complication (cardiovascular or feet/legs). Erectile dysfunction was reported by 27.8% (95% CI: 23.6–31.9) of male participants.

The prevalence of comorbidities was high with 75.6% (95% CI: 72.5–78.7) of participants taking prescription medication to control their blood cholesterol or reporting high blood cholesterol, 74.0% (95% CI: 70.8–77.2) taking prescription medication to control their blood pressure or having been diagnosed with high blood pressure, and 43.6% (95% CI: 40.0–47.2) being obese (BMI $> 30\ kg/m^2$) based on self-reported weight and height. Most participants (43.9%, 95% CI: 40.4–47.4) reported having two of these comorbidities, 27.5% (95% CI: 24.4–30.5) having three, 22.0% (95% CI: 19.4–24.7) having one, and only 6.6% (95% CI: 4.7–8.5) reported having none.

3.2. *Clinical monitoring indicators*

The percentage of participants meeting the eye, weight, blood pressure, and blood cholesterol monitoring indicators was high (Fig. 2a). However, less than two-thirds met the HbA1C monitoring indicator (up to 76.8%, 95% CI: 73.8–79.8 for at least one HbA1C test during the last year), and less than half met the

Table 2 Time since diagnosis of diabetes, blood glucose control and medication use among Canadian adults with type 2 diabetes.

Characteristics and medication use	*n*	%[a] (95% CI)
Time since diagnosis of diabetes (years)		
≤5	779	34.2 (30.8–37.6)
6–9	416	19.3 (16.7–21.9)
≥10	1121	46.5 (43.1–49.9)
Missing n = 19		
Blood glucose control (as per last HbA1C test)		
Well controlled	836	49.1 (45.1–53.1)
Borderline	410	28.2 (24.5–31.8)
High	386	22.7 (19.2–26.2)
Missing n = 703[b]		
Total number of prescription medications		
None	77	3.7[c] (2.4–5.0)
1–2	302	14.4 (12.0–16.9)
3–4	688	32.0 (28.8–35.2)
5–9	974	37.6 (34.4–40.9)
≥10	287	12.2 (9.9–14.6)
Missing n = 7		
Insulin to control diabetes		
Yes	486	20.3 (17.7–22.9)
No	1848	79.7 (77.1–82.3)
Missing n = 1		
Number of pills to control blood glucose		
None	473	17.5 (15.2–19.9)
1	1065	46.7 (43.0–50.4)
2	546	26.5 (23.4–29.6)
3	145	6.8 (5.0–8.6)
≥4	61	2.4[c] (1.4–3.5)
Missing n = 45		
Number of prescription medications to control hypertension		
None	651	31.8 (28.4–35.2)
1	1010	43.3 (39.9–46.6)
2	431	17.2 (14.6–19.9)
3	146	6.0 (4.5–7.6)
≥4	47	1.7[c] (0.7–2.7)
Missing n = 50		
Prescription medication to control cholesterol		
No	767	32.9 (29.5–36.2)
Yes	1534	67.2 (63.8–70.5)
Missing n = 34		
Aspirin or other ASA		
No	959	41.5 (38.1–44.9)
Yes	1374	58.5 (55.1–61.9)
Missing n = 2		

[a] Percentages are weighted to reflect the Canadian population aged 20 years and older, living in private dwellings.
[b] 417 participants reported that their health professional never gave them an HbA1C test and 110 did not know/refused to answer. An additional 138 participants reported that their health professional did not tell them about their result, and 38 had either a low A1C, did not know their results, or refused to answer.
[c] High sampling variability, estimate should be interpreted with caution.

foot monitoring indicator (Fig. 2a). No difference was found between sexes, but participants aged 65 years or older were significantly less likely to report receiving HbA1C tests at recommended frequency compared to the 20–64 years old participants (60.9% vs. 69.2%, $p = 0.011$) (supplemental Table 1). Overall, more than half of the participants met five clinical monitoring indicators or more (Fig. 2b). There was no significant difference by sex or age, except that participants aged 65 years or older were significantly more likely to report receiving only two clinical monitoring indicators out of six compared to younger participants (7.4% vs. 3.7%, $p = 0.014$) (supplemental Table 2).

3.3. *Self-monitoring and lifestyle management recommendations*

The percentages of participants meeting the two self-monitoring management recommendations were high compared to the percentages for the three lifestyle management recommendations (Fig. 3a). Moreover, 70.4% (95% CI: 61.8–79.0) of participants who smoked reported that a health professional had discussed with them quitting or cutting down smoking, and 56.4% (95% CI: 52.6–60.1) of hypertensive participants reported that a health professional had advised them about monitoring blood pressure at home. More than half of the participants reported having received four self-monitoring and lifestyle management recommendations or more (Fig. 3b). More women than men reported that their health professional had recommended blood glucose self-monitoring (94.4% vs. 90.0%, $p = 0.021$), (supplemental Table 3). However, compared to participants aged 20–64 years, those aged 65 years or older were significantly less likely to have discussed taking prescription medication with a health professional (89.0% vs. 91.3%, $p = 0.019$), weight management (70.5% vs. 47.1%, $p < 0.001$), participating in physical activity or exercise (74.3% vs. 53.1%, $p < 0.001$) and changing the type or amount of food eaten to help control their diabetes (60.0% vs. 33.1%, $p < 0.001$). Similarly, fewer participants aged 65 years or older reported having received five self-monitoring and lifestyle management recommendations by their health professionals compared to the younger age category (supplemental Table 4).

4. Discussion

These results highlight the high prevalence of self-reported complications/comorbidities and prescription medication use among Canadian adults with T2D. Although the majority of participants met five clinical monitoring indicators or more over the six selected, only about two-thirds met the HbA1C monitoring indicator, and less than half met the foot monitoring indicator. Lifestyle management recommendations provided by health professionals to Canadian T2D patients were also identified as an area for improvement of knowledge transfer to care providers and strengthened CDA CPGs implementation strategies. Indeed, about two-thirds of the participants reported having received weight management and physical activity counseling, while less than half reported the same for nutritional counseling. Nevertheless, more than half of the participants received four out of the five self-monitoring and lifestyle management recommendations selected.

The high proportion of participants who reported having received clinical weight, cholesterol, and blood pressure monitoring at optimal levels suggests that health professionals recognize the higher risk of developing cardiovascular

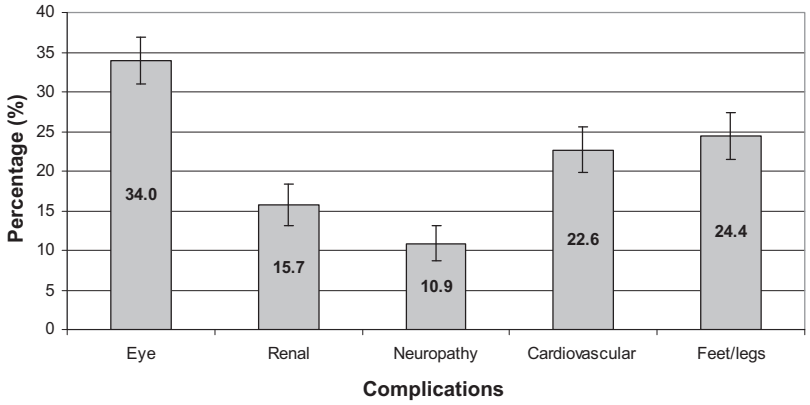

Fig. 1 – Percentage* of Canadian adults with type 2 diabetes reporting selected diabetes complications.**
*** Percentages are weighted to reflect the Canadian population aged 20 years and older, living in private dwellings.**
**** "Eye" includes diabetic eye disease, retinopathy, partial or complete blindness, cataracts and glaucoma. "Renal" includes protein in urine or kidney failure. "Neuropathy" includes nerve damage or neuropathy. "Cardiovascular" includes heart disease and stroke/mini-stroke. "Feet/legs" includes poor circulation in feet or legs, foot or leg ulcers/infection, and gangrene/amputation.**

complications among T2D patients. This finding is important given that almost one-quarter of study participants reported a least one cardiovascular complication. Previous smaller studies also reported that blood pressure was measured consistently [20,21], it thus appears to have been systematically incorporated into routine clinical care. However, these studies highlighted that cholesterol monitoring was performed less than high blood pressure screening, while no difference was found between these indicators in the present study. Differences in data collection methods (self-reported vs. audit), period of reference and geographic coverage may explain this divergence in findings.

In this study, the percentage of participants with T2D receiving at least one HbA1C test during the last year was high and comparable to results from other Canadian studies [16,17,26]. However, the percentage of those meeting the updated recommendation (at least two HbA1C tests per year) [15] was lower, which was also observed among people with diabetes (TD2 and type 1) in Ontario [26]. This finding suggests a lack of integration of this new recommendation by health professionals. On the other hand, a previous study conducted in 452 Canadian subjects with diabetes and in seven others countries ($n = 1090$) reported that more than 83% had received one HbA1C test in the last six months [27], which is higher than the proportion (66.5%) reported in the present study. Again, many factors may explain this difference between study results, including different sample size, question wording, period of reference and geographic coverage. Older participants were significantly more affected by a lower HbA1C test uptake, which was also observed in a previous Canadian study [16]. However in Ontario, they were more likely to receive a retinal eye examination than those aged 40–64 years [26], but this was not observed in the present study. In fact, the percentage of T2D adults who reported having had an eye examination in the past two years remained high and stable since 2007 [16,27], but a quarter of the population still did not receive the recommended eye monitoring in 2010.

The present study emphasizes an even greater gap in foot examination, which was noted in previous Canadian surveys in 2008, 2007 and 2005, as well as in several other countries (Australia, France, Germany, United States) [16,17,27]. Yet, early identification and treatment of problems identified through foot examination may reduce the number of amputations [6].

Although self-monitoring of blood glucose recommendation is subject to controversy in patients who are not using insulin (20.3% of study participants were using insulin) [28,29], the percentage of study participants who reported receiving health professionals' recommendations for self-monitoring of blood glucose or taking prescription medication was high. However, results on health professionals' lifestyle management recommendations revealed lower uptake, especially knowing the importance of these recommendations for diabetes treatment, and that engagement in self-management behavior change is more common in T2D patients receiving lifestyle behavior advice from their health professionals [30]. Older participants reported receiving fewer recommendations for lifestyle management, yet they could potentially benefit more from lifestyle counseling since their adherence is better compared to the younger age groups [14,31]. The discrepancies highlighted between the provision of health care and recommended guidelines may be explained by different internal and external barriers experienced by health professionals, such as the lack of knowledge and agreement with guidelines, self-efficacy, outcome expectancy, resources, patient's adherence and the inertia of previous practice [32].

A major strength of this study is its large sample and its good response rate, which limited the non-response and selection biases. Moreover, this study presents detailed results on clinical monitoring indicators, as well as self-monitoring

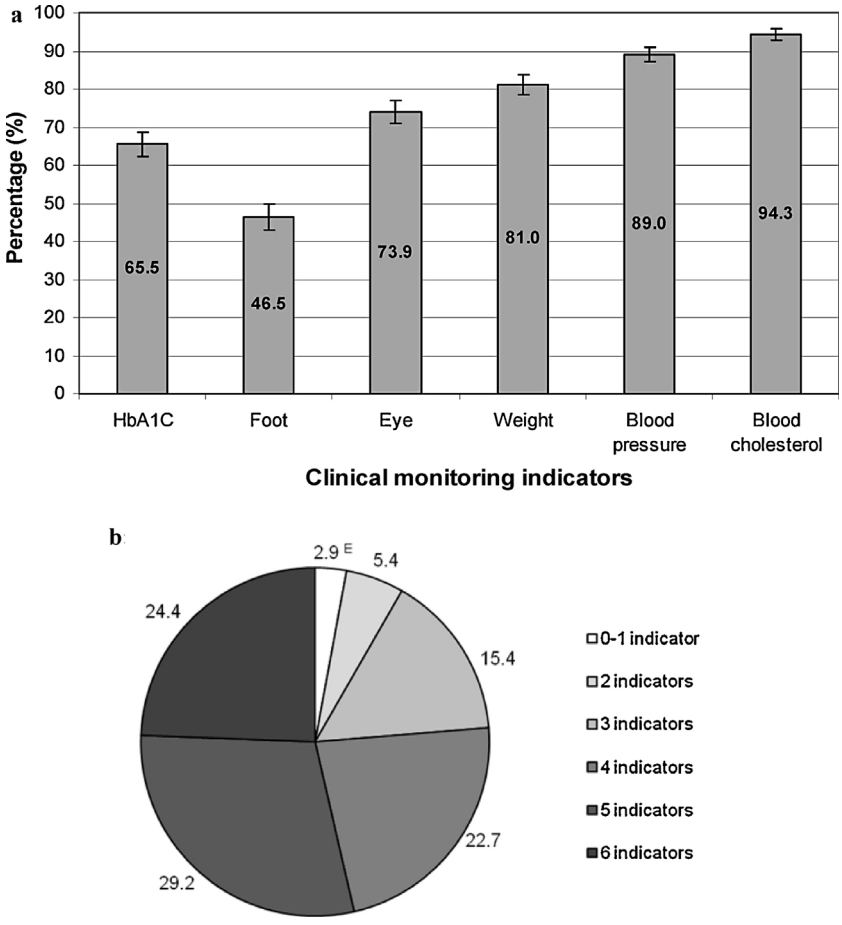

Fig. 2 – (a) Percentage * of Canadian adults with type 2 diabetes by type of clinical monitoring indicator received. (b) Percentage * of Canadian adults with type 2 diabetes by number of clinical monitoring indicators received**.**
*** Percentages are weighted to reflect the Canadian population aged 20 years and older, living in private dwellings.**
**** The 6 clinical monitoring indicators selected from the Canadian Diabetes Association Clinical Practice Guidelines are: HbA1c tested at least twice in the last year; foot examination by a health professional in the last year; monitoring of eyes less than 2 years ago, weight measured on a scale by a health professional during the last year; blood pressure always or often measured at diabetes related visit; blood cholesterol tested less than 3 years ago.**
[E]High sampling variability, estimate should be interpreted with caution.

and lifestyle management in a T2D population in Canada. Previous national studies had pooled type 1 and T2D together and focused only on clinical monitoring indicators [16,17].

However, some limitations regarding the representativeness of the SLCDC-D sample should be considered when interpreting results. Based on a sample drawn from the 2010 CCHS, the SLCDC-D followed an innovative approach designed to efficiently identify a large number of Canadians living with diabetes and to obtain in-depth information about their health outcomes and management practices. However, conducting the sampling in two waves (one for each volunteer survey) may have had an impact on the selection bias. This survey-design could partly explain the lower proportion of non-white respondents (17.3% [14.0–20.7] vs. 24.7% [21.6–27.9]), and the higher mean total household income (CAD 59,519 [56,232–62,806] vs. CAD 47,575 [44,020–51,129]) compared to adults with T2D from the 2010 CCHS. However, if the SLCDC-D collected information on a less vulnerable sample, this would in fact strengthen the study conclusions as the gaps identified may be even larger in a more at-risk sample. Except for the proportion of non-white respondents, none of the proportions for the other characteristics reported in Table 1 was significantly different compared to the source national survey (all confidence intervals were overlapping).

The territories, where the majority of Aboriginal Canadians reside, were not part of the target population, which led to an under-representation of this population known to be at higher risk for diabetes. However, the SLCDC-C sampling frame did include Aboriginal Canadians living off-reserve, in the provinces, and in private households ($n = 79$, 3.2%[1] [2.1–4.2]).

[1] High sampling variability, estimate should be interpreted with caution.

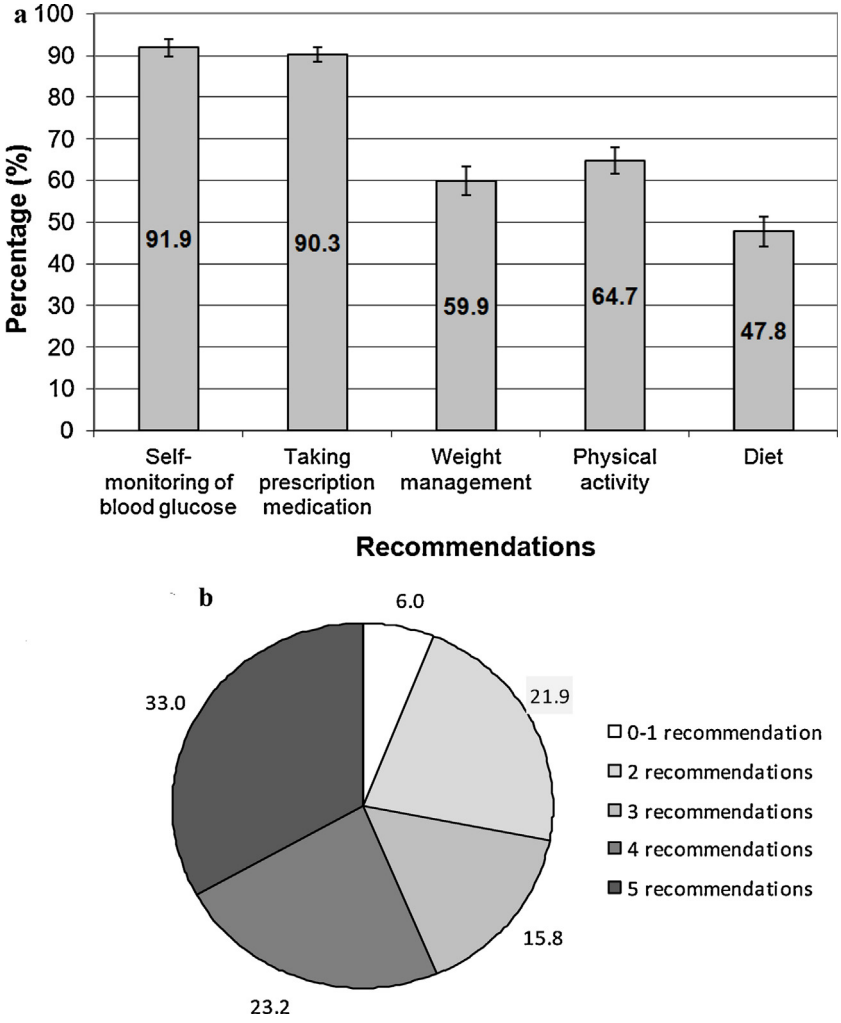

Fig. 3 – (a) Percentage of Canadian adults with type 2 diabetes by self-monitoring and lifestyle management recommendations ** received. (b) Percentage* of Canadian adults with type 2 diabetes by number of self-monitoring and lifestyle management recommendations ** received.

*** Percentages are weighted to reflect the Canadian population aged 20 years and older, living in private dwellings.**

**** The 5 self-monitoring and lifestyle management recommendations provided by health professionals and selected from the Canadian Diabetes Association Clinical Practice Guidelines are: self-monitoring of blood glucose; taking prescription medication to help control diabetes; controlling or losing weight to help control diabetes; participating in physical activity or exercise to help control diabetes; changing the type or amount of food eaten to help control diabetes.**

In addition, as any other study using self-reported data, results should be interpreted with caution as recall and desirability biases may have positively or negatively biased participants' answers [33,34], and as self-reporting of diabetes status and type may have introduced misclassifications. Moreover, it is possible that patients are not always aware of the nature of blood examination performed by their health professionals, including HbA1C and cholesterol tests, which may have concealed or exaggerated gaps related with these indicators. Finally, there was no question on microalbuminuria testing in the SLCDC-D, so its uptake could not be assessed.

In conclusion, although the uptake was high for most clinical monitoring and self-monitoring indicators with more than 70.0% of participants reporting receiving care as recommended, HbA1c measurement and foot examination should be performed more frequently to meet CDA recommendations. This study also highlighted lower levels of uptake of CDA CPGs regarding lifestyle management (weight management, physical activity and diet management) recommendations provided by health professionals to Canadian patients with T2D, particularly to older adults, despite the importance of this component to treat diabetes and to mitigate or prevent comorbidities and diabetes complications. Future studies are needed to further explore determinants of optimal health care, help target vulnerable populations, and develop better health policies, programs, and services. Also, strategies to implement CDA CPGs should be strengthened; this is especially relevant since new CDA CPGs have just been published [35].

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Disclaimer

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Public Health Agency of Canada or the Centers for Disease Control and Prevention.

Conflict of interest statement

None declared.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.diabres.2013.11.022.

REFERENCES

[1] Guariguata L, Linnenkamp U, Beagley J, Whiting DR, Cho NH. Global estimates of the prevalence of hyperglycaemia in pregnancy for 2013 for the IDF Diabetes Atlas. Diabetes Res Clin Pract Nov 23, 2013 [Epub ahead of print].
[2] Public Health Agency of Canada. Diabetes in Canada: facts and figures from a health perspective;Ottawa 2011;1–112.
[3] Public Health Agency of Canada Steering Committee on Health-Adjusted Life Expectancy. Health-adjusted life expectancy in Canada: 2012 report by the Public Health Agency of Canada. Ottawa, Ontario: Public Health Agency of Canada; 2012: 1–85.
[4] UK Prospective Diabetes Study Group. Effect of intensive blood-glucose control with metformin on complications in overweight patients with type 2 diabetes: UKPDS 34. Lancet 1998;352:854–65.
[5] UK Prospective Diabetes Study Group. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. BMJ 1998;317:703–13.
[6] McCabe CJ, Stevenson RC, Dolan AM. Evaluation of a diabetic foot screening and protection programme. Diabetic Med 1998;15:80–4.
[7] CDC Diabetes Cost-effectiveness Group. Cost-effectiveness of intensive glycemic control, intensified hypertension control, and serum cholesterol level reduction for type 2 diabetes. JAMA 2002;287:2542–51.
[8] Gaede P, Vedel P, Larsen N, Jensen GV, Parving HH, Pedersen O. Multifactorial intervention and cardiovascular disease in patients with type 2 diabetes. N Engl J Med 2003;348:383–93.
[9] Collins R, Armitage J, Parish S, Sleigh P, Peto R. MRC/BHF Heart Protection Study of cholesterol-lowering with simvastatin in 5963 people with diabetes: a randomised placebo-controlled trial. Lancet 2003;361:2005–16.
[10] Gaede P, Lund-Andersen H, Parving HH, Pedersen O. Effect of a multifactorial intervention on mortality in type 2 diabetes. N Engl J Med 2008;358:580–91.
[11] Gaede P, Valentine WJ, Palmer AJ, Tucker DM, Lammert M, Parving HH, et al. Cost-effectiveness of intensified versus conventional multifactorial intervention in type 2 diabetes: results and projections from the Steno-2 study. Diabetes Care 2008;31:1510–5.
[12] Look AHEAD Research Group. Long-term effects of a lifestyle intervention on weight and cardiovascular risk factors in individuals with type 2 diabetes mellitus: four-year results of the Look AHEAD trial. Arch Intern Med 2010;170:1566–75.
[13] Pimouguet C, Le Goff M, Thiebaut R, Dartigues JF, Helmer C. Effectiveness of disease-management programs for improving diabetes care: a meta-analysis. CMAJ 2011;183:E115–27.
[14] Wadden TA, Neiberg RH, Wing RR, Clark JM, Delahanty LM, Hill JO, et al. Four-year weight losses in the look AHEAD study: factors associated with long-term success. Obesity (Silver Spring) 2011;19:1987–98.
[15] Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2008 clinical practice guidelines for the prevention and management of diabetes in Canada. Can J Diabetes 2008;32:S1–201.
[16] Canadian Institute for Health Information. Diabetes care gaps and disparities in Canada; 2009;1–21.
[17] Sanmartin C, Gilmore J. Diabetes—prevalence and care practices. Health Rep 2008;19:59–63.
[18] Harris SB, Ekoe JM, Zdanowicz Y, Webster-Bogaert S. Glycemic control and morbidity in the Canadian primary care setting (results of the diabetes in Canada evaluation study). Diabetes Res Clin Pract 2005;70:90–7.
[19] Braga M, Casanova A, Teoh H, Dawson KC, Gerstein HC, Fitchett DH, et al. Treatment gaps in the management of cardiovascular risk factors in patients with type 2 diabetes in Canada. Can J Cardiol 2010;26:297–302.
[20] Harris SB, Stewart M, Brown JB, Wetmore S, Faulds C, Webster-Bogaert S, et al. Type 2 diabetes in family practice. Room for improvement. Can Fam Physician 2003;49:778–85.
[21] Worrall G, Freake D, Kelland J, Pickle A, Keenan T. Care of patients with type II diabetes: a study of family physicians' compliance with clinical practice guidelines. J Fam Pract 1997;44:374–81.
[22] Public Health Agency of Canada. Fast facts about diabetes: data compiled from the 2011 survey on living with chronic diseases in Canada; 2011;1–3, Available from: http://www.phac-aspc.gc.ca/cd-mc/publications/diabetes-diabete/ff-rr-2011-eng.php [accessed 31.07.12].
[23] Statistic Canada. Statistics act; 2012, Available from: http://www.statcan.gc.ca/about-apercu/act-loi-eng.htm [accessed 07.07.12].
[24] Statistics Canada. Survey on living with chronic diseases in Canada – user guide; 2011, Available from: http://www.statcan.gc.ca/imdb-bmdi/document/5160_D4_T1_V2-eng.htm [accessed 07.07.12].
[25] Rust KF, Rao JN. Variance estimation for complex surveys using replication techniques. Stat Methods Med Res 1996;5:283–310.
[26] Kiran T, Victor JC, Kopp A, Shah BR, Glazier RH. The relationship between financial incentives and quality of diabetes care in Ontario, Canada. Diabetes Care 2012;35:1038–46.

[27] Schoen C, Osborn R, How SK, Doty MM, Peugh J. In chronic condition: experiences of patients with complex health care needs, in eight countries, 2008. Health Aff (Millwood) 2009;28:w1–6.
[28] Farmer AJ, Wade AN, French DP, Simon J, Yudkin P, Gray A, et al. Blood glucose self-monitoring in type 2 diabetes: a randomised controlled trial. Health Technol Assess 2009;13. iii–iv, ix–xi, 1–50.
[29] Malanda UL, Welschen LM, Riphagen II, Dekker JM, Nijpels G, Bot SD. Self-monitoring of blood glucose in patients with type 2 diabetes mellitus who are not using insulin. Cochrane Database Syst Rev 2012;1:CD005060.
[30] Agborsangaya CB, Gee ME, Johnson ST, Dunbar P, Langlois MF, Leiter LA, et al. Determinants of lifestyle behavior in type 2 diabetes: results of the 2011 cross-sectional survey on living with chronic diseases in Canada. BMC Public Health May 7, 2013;13:451.
[31] Diabetes Prevention Program Research Group. The 10-year cost-effectiveness of lifestyle intervention or metformin for diabetes prevention: an intent-to-treat analysis of the DPP/DPPOS. Diabetes Care 2012;35:723–30.
[32] Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. JAMA 1999;282:1458–65.
[33] Kessels RP. Patients' memory for medical information. J R Soc Med 2003;96:219–22.
[34] McGuire LC. Remembering what the doctor said: organization and adults' memory for medical information. Exp Aging Res 1996;22:403–28.
[35] Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. The Canadian Diabetes Association 2013 clinical practice guidelines for the prevention and management of diabetes in Canada. Can J Diabetes 2013;37:S1–212.