Type 2 diabetes prevalence among Canadian Adults - dietary habits and sociodemographic risk factors

Journal:	*Applied Physiology, Nutrition, and Metabolism*
Manuscript ID	apnm-2018-0567.R2
Manuscript Type:	Article
Date Submitted by the Author:	14-Feb-2019
Complete List of Authors:	Hosseini, Zeinab; University of Saskatchewan College of Pharmacy and Nutrition, Nutrition; Whiting, Susan; University of Saskatchewan, Vatanparast, Hassan; University of Saskatchewan, ; College of Pharmacy and Nutrition,
Novelty bullets: points that summarize the key findings in the work:	
Keyword:	dietary intake < diet, epidemiology < epidemiology, insulin resistance, diabetes, national survey, dietary pattern
Is the invited manuscript for consideration in a Special Issue? :	Not applicable (regular submission)

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Manuscripts

(i) Title: "Type 2 diabetes prevalence among Canadian Adults - dietary habits and sociodemographic risk factors"

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Abstract: Patients with diagnosed diabetes receive recommendations by their healthcare providers about lifestyle modification particularly on diet. The aim of this study is to determine the prevalence of type 2 diagnosed diabetes, undetected (undiagnosed) type 2 diabetes and pre-diabetes of Canadian adults, and to evaluate whether individuals with diagnosed diabetes have different dietary intakes compared to the other groups. We used nationally representative data from Canadian Health Measures Survey Cycles 1 and 2 (n=6,807, representing estimated population of 23,022,890). We evaluated prevalence of diagnosed diabetes, undetected diabetes and pre-diabetes and their distribution across socio-demographic and lifestyle factors. The intake from different food/food groups was compared between those with diagnosed diabetes and the rest of the population. Among Canadians 20-79 years of age, 12.4% had pre-diabetese, and 7.5% had diabetes. Among all diabetes cases, 37.3% were undiagnosed. All three diabetic categories were more prevalent among older aged groups (60-79y) compared to younger aged (20-39y) groups. Diagnosed diabetes and pre-diabetes were more prevalent among less educated individuals compared to the higher educated ones. Diagnosed diabetes was more common among individuals with lower-middle income level compared to the highest income level. Diagnosed diabetes individuals had lower intake from juice and ice-cream and higher intake from potatoes and diet soft drinks compared to other groups. More than 600,000 adults were unaware of their diabetes status; the aware ones had lower intakes of sugar-containing foods. In evaluating the association between dietary intake and risk of chronic diseases in populations, diagnosed diabetes cases should be evaluated separately.

Keywords: dietary intake; epidemiology; insulin resistance; diabetes; national survey; dietary pattern.

Introduction

The prevalence of type 2 diabetes has been rising in Canada and throughout the world (International Diabetes Federation 2015). Patients with diabetes have a two to four times higher risk of death from cardiovascular disease compared to other individuals (Cheng and Barnes 2013). In 2009, 2.4 million Canadians were diagnosed with diabetes. The prevalence of diabetes is estimated to increase nearly 50% in Canada from 2015 until 2025 (Diabetes Canada 2016). This high number contributes to not only high burden on the person with diabetes but also on the Canadian healthcare system. Type 2 diabetes usually remains asymptomatic for several months up to years before diagnoses, leading to initiation of microvascular complications (Leiter et al. 2015). Thus, the early diagnoses of the disease will provide benefits for controlling and preventing further complications.

One main factor, which may contribute to a lower risk of diabetes and also controls the condition in those who already have it, is to have an overall healthy diet (Fitzgerald et al. 2008). High intakes of sugar-sweetened beverages, red or processed meat, refined grains, sweets, and snack have been shown to increase the risk of diabetes in individuals (Fitzgerald et al. 2008). Further, health authorities have provided relevant information on dietary practices in their diabetes clinical guidelines, which are available to healthcare providers and patients (Diabetes Canada 2013). This information can assist in controlling diabetes in affected individuals, while at risk population requires more attention with regards to disease prevention.

Fasting plasma glucose (FPG), 2-hour Oral Glucose Tolerance Test (OGTT) and, recently, hemoglobin A1C (A1C), are used as diagnostic tests for diabetes (Canadian Diabetes Association 2013). The A1C test indicates the average plasma glucose of the

past eight to 12 weeks. This test does not require fasting and can be done at any time of the day (World Health Organization 2011). The A1C especially useful in research using large survey data compared to the former two glucose measuring methods that are less feasible due to time restrictions. The Canadian Health Measures Survey (CHMS) provides levels of A1C in addition to other objective health measures as well as food intake data using a food frequency questionnaire (FFQ) for ages 3 to 79 years. This survey initiated by Statistics Canada in collaboration with Health Canada and the Public Health Agency of Canada (Statistics Canada 2011) is a nationally representative cross-sectional survey that has been ongoing on bi-yearly cycles since 2007 (Statistics Canada 2011). In the present study, the CHMS data are used to i) determine the prevalence of type 2 diagnosed diabetes, undetected (the person has diabetes but is not aware of his/her disease status due to not being diagnosed) type 2 diabetes and pre-diabetes for Canadian adults using the objective measure of A1C levels. ii) to determine the prevalence's of the three diabetes related conditions across levels of different sociodemographic factors and iii) to determine whether individuals with diagnosed diabetes have different usual dietary intakes compared to other individuals.

Subjects and methods

Data resource and study population

The CHMS was conducted focusing on diseases and health, environmental factors, lifestyle and social conditions. The Cycle 5 data of this survey has recently been released. For Cycles 1 and 2 an initial interview was held at the households, which collected demographic and detailed health information. A few days after the household interview, the participant visited the Medical Examination Center for a second interview

and a physical examination or assessment and collection of biological samples for

laboratory analysis. Cycle 1 of this survey was conducted from 2007 to 2009, and

included approximately 5,600 participants aged 6-79 years; Cycle 2 ran from 2009 to

2011, and included approximately 6,400 participants aged 3-79 years (Statistics Canada

2011). The CHMS was estimated to cover 96.3% of the target population that included

ages 3-79 years (cycle 1 included 6 to 79 years) excluding those living on

reserves/remote areas or in other Aboriginal settlements, institutionalized residents, and

Canadian Forces full-time members were excluded from this survey (Statistics Canada

2011). The ethics approval of this survey was obtained from the Health Canada's

Research Ethics Board (Statistics Canada 2011).

The sampling procedure in CHMS was multistage, including the sampling of

collection sites (geographical unit), dwellings and person (Statistics Canada 2011). Two

main questionnaires, including one at the household and one at the clinic, were used to

collect information. The dietary assessment was done through a semi-quantitative food

frequency questionnaire (Statistics Canada 2011 & 2012). The response rate for the

combined Cycles 1 and 2 was 53.5% (Statistics Canada 2011). For the present study, we

used the combined Cycles 1 and 2 data for non-pregnant individuals 20 years and above.

A total of 6807 respondents were included in this study, who were representative of

23,022,890 Canadians aged 20 years and above.

Dietary assessment

An FFQ was used to collect data regarding the usual intake of different food items

(n=32) per day, week, month and year (Table 1) (Statistics Canada 2011). This FFQ was

a part of the "household" questionnaire and the interviewer asked about the frequency of

intake from foods within the past 3 months. We compiled the average daily consumption

of food and food group intake, recorded as times per day, from the targeted food

frequency questions (Statistics Canada 2011 & 2012). These FFQ questions assessed the

intake frequency of the following: meat; fish and shellfish; milk and dairy products;

grains; fruits and vegetables; dietary fat; salt; and water and soft drink groups (Statistics

Canada 2012).

Socio-demographic and lifestyle characteristics

The prevalences of type 2 diagnosed diabetes, undetected type 2 diabetes and pre-

diabetes across different socio-demographic and lifestyle characteristics levels were

calculated in the present study analysis. To create the final dataset, data manipulation,

cleaning, grouping and creating the variables of interest were done. The socio-economic

factors including age, sex, income, education, physical activity, smoking, alcohol intake

and ethnicity were classified into their corresponding categories. For the age variable, the

specific categories developed include: 20 to 39, 40 to 59 and 60 to 79 years. The

household income variable in CHMS was used in this study that include lowest, middle-

lower, Middle-higher and highest income levels. Also, the CHMS household

questionnaire classification for education was used: less than secondary, secondary, other

post-secondary and post-secondary graduate levels (Statistics Canada 2012). In this

survey, the Physical Activity Index with active, moderately active and inactive categories

was used to evaluate the daily physical activity. The total daily leisure-time energy

expenditure (DEE) was used to assign cut-offs for different categories of physical activity

as follows: inactive ($0 \leq DEE < 1.5$), moderate activity ($1.5 \leq DEE < 3$) and active

($DEE \geq 3$) levels (Statistics Canada 2011 & 2012). Alcohol intake was categorized into

two categories of "ever" drinker and "never" drinker; smoking was categorized to

smoker and non-smoker, and ethnicity was categorized to Caucasian and non-Caucasian,

as previously reported (Statistics Canada 2012).

Diabetes classification

The categorization of type 2 diabetes status was based on two types of data available

in the CHMS data sets: the diabetes diagnosis of the individual by health professionals

(yes/no), and the A1C lab results (Table 2). The A1C level represents chronic

hyperglycemia as it indicates the average plasma glucose over the past eight to 12 weeks

(World Health Organization 2011). Fasting was not required for this blood test. Blood

samples were collected by a phlebotomist in Nalgene clear cap specimen EDTA tubes

and were processed and stored as soon as possible (Statistics Canada 2011). Based on

these criteria, individuals were categorized into the following 3 groups : 1) individuals

with diagnosed diabetes that had been confirmed by health professionals, 2) individuals

with no diagnosis of diabetes but having diabetes according to A1C level (A1C $\geq$

6.5%), catagorized as "undetected diabetes", and 3) individuals with pre-diabetes who

had not been diagnosed with diabetes by a health professional and their A1C was

between 6.0 and 6.49% (Diabetes Canada 2013) inclusive. In the present study, those

individuals who had been diagnosed with diabetes type 1 or with gestational diabetes

were removed.

Data analysis

Statistics Canada provided instructions on combining the first two cycles that

were followed (Statistics Canada 2014a). Weighting and bootstrapping were applied to

obtain generalizable results (Statistics Canada 2012 & 2014a). The prevalence of

diagnosed diabetes, undetected diabetes and pre-diabetes were determined across

demographic and socioeconomic variables as frequencies. Simple binary logistic

regression and Scheffe's test (one of the most conservative tests for multiple

comparisons) (Statistics Canada 2014a) were used to estimate the significant difference

of diabetes prevalence among different categories of socio-demographic variables. The

dietary intake data are presented as times per day, mean ± standard error; and the

independent t-test was used to assess the significance between these means. According to

Statistics Canada's recommendations, the degree of freedom of 24 was used for the

combined data (11 degrees of freedom from CHMS Cycle 1 in addition to 13 degrees of

freedom from CHMS Cycle 2) (Statistics Canada 2014a). Alpha is set at 0.05 to detect

statistical significant differences. STATA/SE (v11, StataCorp LP., College Station, U.S.)

was used for data preparation and statistical analysis.

Results

The results of this study are representative of 23,022,889 Canadians aged 20-79

years. Among this population, 12.4% had pre-diabetese and 7.5% had type 2 diabetes

(diagnosed or undetected). Among individuals with diabetes, 37.3% of them were not

aware of their disease, which translates to 2.8% undiagnosed (undetected) diabetes cases

among Canadians 20-79 years (Figure 1).

All three diabetes categories were more prevalent among older ages (60-79y)

compared to younger ages (20-39y) (p<0.001) (Figure 2). There were more cases of

diagnosed diabetes (p<0.001) and pre-diabetes (p=0.001) among less educated

individuals (less than secondary education) compared to the higher educated (all other

education levels for diagnosed diabetes and secondary level education for pre-diabetes

group) (Table 3). Diagnosed diabetes was more prevalent among individuals with lower-middle income compared to the highest income (p=0.002) (Table 3). Diagnosed and undetected diabetes were both more prevalent among physically inactive group compared to the active group (p=0.026 and 0.011 for diagnosed and undetected diabetes, respectively) and moderately active group (p=0.054 and 0.036 for diagnosed and undetected diabetes, respectively) (Table 3). No significant differences in the prevalence's of the diabetes categories were observed across categories of sex, alcohol intake, smoking status, and ethnic groups.

Among all the food categories that were evaluated, individuals with diagnosed diabetes consumed 43.8 servings/y lower intake of fruit and vegetable juice (p=0.002) and 7.3 servings/y ice-cream (p=0.02) and 33.8 serving/y higher intake of potatoes (p=0.005) and 98.6 serving/y diet soft drinks (p<0.001) compared to the rest of the population (Table 4). No significant difference was observed in other food groups.

Discussion

This is the first study in Canada to investigate the prevalences of type 2 diagnosed diabetes, pre-diabetes, and type 2 undiagnosed (undetected) diabetes across different socio-demographic and lifestyle factors using a nationally representative sample with objective health measures. Also, this is the first study to compare the diet of groups with diagnosed diabetes with the rest of the population among Canadian adults. Based on this study, more than three out of ten Canadian adults with diabetes are unaware of their diabetes. Further, diabetes prevalence increased by age and people in the lower education and income categories were shown to have a higher prevalence of diabetes or pre-diabetes than in higher categories. Based on our results, individuals with diagnosed

diabetes tended to modify parts of their diet to conform to dietary recommendations for living with diabetes (Diabetes Canada 2013).

In 2009, in Canada, a report entitled *An Economic Tsunami* forecasted diabetes (including all types) to rise from 4% in 2002 to 7.3% in 2010 (Diabetes Canada 2011). This later value (7.3%) is close to our finding of 7.5% for type 2 diabetes alone. This forecast continued to suggest a prevalence of 10.8% for the year 2020 (Diabetes Canada 2011), which could turn out to be an underestimation of the problem. Results of the present study showed that the prevalence of undiagnosed type 2 diabetes and pre-diabetes were 2.8% and 12.4%, respectively, which together show 15.2% with or at-risk for type 2 diabetes, as also reported by Rosella et al. (2015) (3.09% and 12.5%, respectively for undiagnosed type 2 diabetes and pre-diabetes). The slight difference between their results and the results from our study could be due to the difference between the samples used in each study. The present study included almost double the sample previously used by Rosella et al. (2015) giving results with a higher statistical power (n=3,494 for Rosella et al., (Rosella et al. 2015) and n=6,807 for the present study). Our finding of more than three undiagnosed cases out of every ten diabetes cases in Canada is in agreement with what was reported for the U.S. adult population (Menke et al. 2015).

The use of A1C values to diagnose type 2 diabetes is necessitated by its use in large survey data. The National Health and Nutrition Examination Survey, conducted in the United States measured OGTT, FPG and A1C of the respondents (Cowie et al. 2010), compared the sensitivity of these three methods: the OGTT had the highest detection rate, followed by the FPG and then the A1C method (Cowie et al. 2010). In contrast, a Canadian study using CHMS data has indicated a higher prevalence rate obtained by A1C

method compared to FPG method (Rosella et al. 2015). As the A1C levels indicate average blood glucose for the past 2 to 3 months, less day-to-day variability is observed in this blood glucose measurement test (World Health Organization 2011). More importantly fasting is not a requirement for A1C test (World Health Organization 2011) fasting is not possible for large survey participants to attend clinic in the afternoon.

In the present study, the prevalence of type 2 diagnosed diabetes was higher in individuals from the lower socioeconomic status, as indicated by lower levels of education and income. This result is in agreement with what was reported by other Canadian researchers using the National Population Health Survey (Ross et al. 2010). Based on this longitudinal study, researchers found higher chances of developing diabetes for people in lower income groups even after adjusting for other demographic and lifestyle factors. However, for education, the socio-demographic and lifestyle factors such as obesity and physical activity mediated the effect of education (Ross et al. 2010). Similarly in the present study, a higher prevalence of diagnosed diabetes was found among the physically inactive individuals compared to active individuals. In agreement with our results, a systematic review of prospective and randomized trials, researchers reported a lower risk of diabetes in physically active population with 5-7 hours of leisure time physical activity (Aune et al. 2015). One reason for not observing a significant difference between the prevalence of diabetes across different levels of smoking status, alcohol intake and ethnicity is the small sample sizes for different levels of these variables.

Based on this study, Canadian adults diagnosed with type 2 diabetes tended to adhere to special dietary recommendations provided to them by health

professionals. The lower intake of ice-cream, juice and greater intake of diet soft drinks and potato may be indicative of partial adherence to the recommendation of eating more complex carbohydrates with lower glycemic indices rather than simple carbohydrates (Diabetes Canada 2013). The difference in intake between the groups with and without diabetes seemed to be small but are important. The small differences in usual intake per day make a considerable difference within a year and considering that chronic diseases are developed over years and not days (Diabetes Prevention Program Research Group 2015), this small difference would become important in terms of disease prevention and management. In a study using the National Health and Nutrition Examination Survey data, the researchers reported that the American population with diabetes has not completely met the recommendations provided by the American Diabetes Association (Eilat-Adar et al. 2008). However, this study did not report the dietary intake of the diagnosed diabetes population in comparison with non-diagnosed diabetes population. We previously showed in a study based on CHMS Cycle 1 data that individuals with metabolic syndrome and diagnosed diabetes had significantly lower fruit and vegetable juice intake compared to individuals that were not diagnosed with diabetes (Setayeshgar et al. 2012).

Therefore, screening and diagnosis of type 2 diabetes can lead to positive dietary modifications towards a healthier diet and ultimately better health/disease status. Moreover, based on our study results individuals with diagnosed type 2 diabetes seem to alter their diet; hence future studies evaluating the association between dietary intake and risk of chronic diseases at population level, could evaluate intake of individuals with diagnosed type 2 diabetes separately.

There are a few limitations including the use of cross-sectional data. Therefore, we should be cautious in interpreting the results of diabetes across different socio-demographic and lifestyle factors, as causality cannot be implied. Second, the A1C test may be affected by hemoglobin and red blood cell related diseases such as anemia (World Health Organization 2011). Although, research has shown that the prevalence of these type of diseases are low among Canadians (Cooper et al. 2012). Third, in Canada, only FPG and/or A1C have been included in national surveys. Fourth, the dietary intake data from CHMS were not energy adjusted. Fifth, the FFQ used in CHMS is a valuable tool to demonstrate differences across socio-demographic and lifestyle variables, however a few food items in the group of grains are omitted.

In conclusion, a considerable proportion of the Canadian adults are unaware of their type 2 diabetes or pre-diabetic status. Therefore, they are at risk of not following the lifestyle modification recommendations as individuals with diagnosed diabetes do. Also the higher prevalence of diabetes among populations in lower socioeconomic status levels should draw researchers' attention to conduct interventional studies among these populations with the aim of preventing and controlling diabetes among them. In addition, the diets of those with diagnosed diabetes were different to those without and appeared to reflect the dietary guidelines for people with diabetes. Our findings also suggest that in evaluating the association between dietary intake and risk of chronic diseases, cases with diagnosed diabetes should be excluded.

Acknowledgements

Conflict of interests

We declare that we do not have any conflict of interest.

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Table 1. The Canadian Health Measures Survey Cycle 1 and 2 food groups and dietary intake questions.

Canadian Health Measures Survey Food group	CHMS questions regarding the usual intake of foods within the past 3 months
Meat and Alternatives group	-Beef or pork hot dogs-Cooked dried beans, such as refried beans, baked beans, pea soup or kidney beans, excluding green and yellow beans -Eggs and egg dishes including the yolk (excluding all egg dishes made with only egg whites); egg dishes could include eggs, omelettes, frittata or quiche. -Fish- and shellfish-related questions in Cycle 2 -Liver (including all types of liver such as beef, veal, pork or chicken, but excluding liverwurst and liver pâté) -Other organ meats such as kidneys, heart or giblets -Peanuts, walnuts, seeds, or other nuts, excluding nut butters such as peanut butter -Red meat (beef, hamburger, pork or lamb) -Sausage or bacon (including all types of sausage, such as breakfast, pepperoni and kielbasa but excluding low-fat, light or turkey varieties)
Milk and Alternatives group	-Cottage cheese -Milk or enriched milk substitutes. Questions are asked about the kinds of milk usually consumed (3.25, 1, 0.5, skim or non-fat), flavoured milk beverages (chocolate milk and flavoured milk beverages such as Oh Henry®, rice, soya and other). -Yogurt, excluding frozen yogurt -Ice cream or frozen yogurt
Grain products group	-Any kind of pasta (including spaghetti, noodles, macaroni & cheese or pasta salad) -Any kind of rice -Brown bread, including bagels, rolls, pita bread or tortillas -Hot or cold cereal -Instant, seasoned or wild rice (such as Minute Rice®, Dainty®, Rice-a-Roni®) -White bread, including bagels, rolls, pita bread or tortillas

Vegetables and Fruit group	Fruit (fresh, frozen or canned); Lettuce or green leafy salad with or without other vegetables; Other than French fries, home fries, or hash brown potatoes, including baked, boiled, mashed or in potato salad, but excluding sweet potatoes; Spinach, mustard greens or collards excluding kale; Tomatoes or tomato sauce, including salsa, tomato soup and spaghetti sauce but excluding tomato paste, ketchup or pizza sauce; French fries, home fries, or hash brown potatoes; Fruit and vegetables juice (includes fruit juice and vegetables juice); All other types of vegetables excluding those already mentioned
Dietary fat	Regular-fat potato chips, tortilla chips or corn chips (excluding low fat chips and pretzels); Regular-fat salad dressing or mayonnaise (including on salads and sandwiches)
Beverages	Diet soft drinks; Sugar sweetened beverages (includes fruit flavoured drinks, regular soft drinks, sport drinks, such as Gatorade® or PowerAde®); Fruit and vegetables juice (includes fruit juice and vegetables juice)

Table 2. Categorizing individuals based on their diabetes status using two variables

available in the Canadian Health Measures Survey Cycles 1 and 2.

	Diagnosed by health professional	Glycated hemoglobin A1C (A1C)[a]

No diabetes	No	< 6.0 %
Pre-diabetes	No	$6.0 \leq A1C < 6.5$
Undetected diabetes	No	$\geq 6.5\%$
Diagnosed diabetes	Yes	Not applicable

[a]Canadian Diabetes Association. Clinical Practice Guidelines Expert Committee.

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Table 3. Prevalence of diagnosed diabetes, pre-diabetes, undetected diabetes by socio-

demographic characteristics of Canadian adults, Canadian Health Measures Survey,

Cycles 1 & 2, 2007–2011 (n= 6,807).

a Reference group.

	Diagnosed diabetes prevalence (%) [Standard Error] (95% Confidence interval)	Pre-diabetes prevalence [Standard Error] (95% Confidence interval)	Undetected diabetes prevalence [Standard Error] (95% Confidence interval)
Total	**4.7**	**12.4**	**2.8**
Age			
20-39 [a]	0.4 [0.17](0.09-0.75)[b]	5.1[1.32] (2.4-7.9)[c]	0.3[0.19] (0.06-0.7)[b]
40-59	4.2 [0.69] (2.8-5.7)[d]	13.8[2.34] (8.9-18.6) [c d]	4.1[1.0] (2.0-6.1)[d]
60-79	13.1[0.84] (11.3-14.7)[d]	22.2[2.91] (16.2-28.2)[d]	4.6[1.02] (2.5-6.7)[d e]
Education			
Less than secondary [a]	12.2 [1.58] (8.9-15.4)	17.4[3.07](11.1-23.7)[c]	3.9 [1.1](1.4-6.3)[c]
Secondary	4.0[0.58] (2.8-5.2)[d]	15.9[2.46] (10.8-20.9)[d]	2.0 [0.5] (1.0-3.0)[c]
Other post-secondary	2.6.[0.99] (0.5-4.6)[bd]	5.6 [1.61] (2.3-9.0)[c]	3.0 [0.9] (1.1-4.9)[c]
Post-sec graduate	3.5[0.35](2.8-4.2)[d]	11.2[1.88] (7.315.1)	2.8 [0.7](1.4-4.2)[c]
Physical Activity			
Active	3.2[0.75] (1.6-4.7)[cd]	9.3[2.43] (4.2-14.3)	1.8[0.46] (0.8-2.7)[d]
Moderately active	3.6[0.44] (2.7-4.5)[d]	11.5 [2.1] (7.3-15.7)	1.8[0.58] (0.6-3.0)[cd]
Inactive [a]	5.8[0.63] (4.5-7.1)	14.0 [2.] (9.9-18.1)	3.7[0.78] (2.0-5.3)[c]
Income[f]			
Lowest income	5.7[1.49] (2.6-8.7)[c]	13.8 [3.5] (6.7-21.1)[c]	2.1 [1.1](0.2-4.3)[b]
Middle-lower income	7.6[0.88] (5.8-9.5)[d]	13.4[2.3](8.7-18.2)[c]	2.9[0.8](1.2-4.7)[c]
Middle-higher income	5.3[0.59] (4.1-6.5)	14.6[2.5](9.5-19.7)[c]	3.3[0.9](1.4-5.2)[c]
Highest income [a]	3.3[0.57](2.2-4.5)[c]	10.5[1.6](7.2-13.9)	2.5 [0.5](1.4-3.6)[c]

^b Coefficient of variation higher than 33.3 %. Unreliable for publishing based on Statistics Canada's recommendation.

^c Coefficient of variation between 16.6-33.3 %, interpret with caution

^d Significant value compared to reference indicated with superscript "a" in each colum. If no superscripts are indicated, there was no significance at the level of alfa=0.05.

^e Simple binary logistics regression and Scheffe test for multiple comparisons between groups.

^f Includes total household income from all individuals in the household. Lowest income < $15,000 if 1-2 people or < $30,000 if more than four people were living in the household. The lower-middle income level indicated having an income of $15,000-$29,999 if 1-2 people; $20,000- 153 $39,999 if 3-4 people; $30,000-$59,999 if more than four people were living in the household. The upper-middle category indicated income of $30,00-$59,999 if 1-2 people; $40,000-$79,999 if 3-4 people; $60,000-$79,999 if more than four people were living in the household. Finally the highest-level income indicated an income of $60,000 or more if one/two people and an income of $80,000 if more than two people were living in the household (Statistics Canada 2014b).

Table 4. Dietary consumption among Canadians aged **20-79** years for diagnosed diabetes versus the rest of the population aged 20-79 (n=6,807) (Only foods with significant intake difference between the two groups are presented).

Food/food group category[a]	Diagnosed diabetes groups	The rest of the population
	Serving /day [b](standard error)(95% confidence interval)	
Ice-cream	0.10 (0.01) (0.09- 0.11)	0.12(0.01)(0.11-0.13)
Potato (including all types)	0.49 (0.01) (0.43-0.56)	0.4 (0.03)(0.37-0.43)
-Including baked, boiled, mashed or potato salad, excluding sweet potatoes and any type of fries.	0.36(0.02)(0.31-0.41)	0.27(0.01)(0.25-0.29)
Diet soft drinks	0.42(0.06)(0.29-0.56)	0.15(0.01)(0.13-0.17)
Fruit and vegetable juice	0.54(0.04) (0.46-0.61)	0.66 (0.01) (0.62-0.7)

[a] There is a significant difference for all foods presented in this table between the two groups.

CI=Confidence interval (95%)

[b] The serving was reported for usual intake of the food per year and for analysis, it has been divided by 365 days to obtain daily intake. It indicates the amount of times per day the food was taken by the respondent.

Table 1 should be inserted after the "Dietary Assessment" section under Methods section.

Table 2 should be inserted after the "*Diabetes classification*" Section under Methods section.

Table 3 should be inserted after the second paragraph under Results section.

Table 4 should be inserted after the third paragraph under Results section.

Figure Captions

Figure 1: Prevalence (by weight to be nationally representative) of pre-diabetes, undetected diabetes and diagnosed diabetes among Canadians (20-79y), Canadian Health Measures Survey, Cycles 1 & 2, (2007-2011).

Figure 2. Age-specific prevalence (by weight to be nationally representative) of diagnosed diabetes, pre-diabetes, undetected diabetes of Canadians (20 -79y), Canadian Health Measures Survey, Cycles 1 & 2, 2007–2011. (* Significant compared to R (reference level).
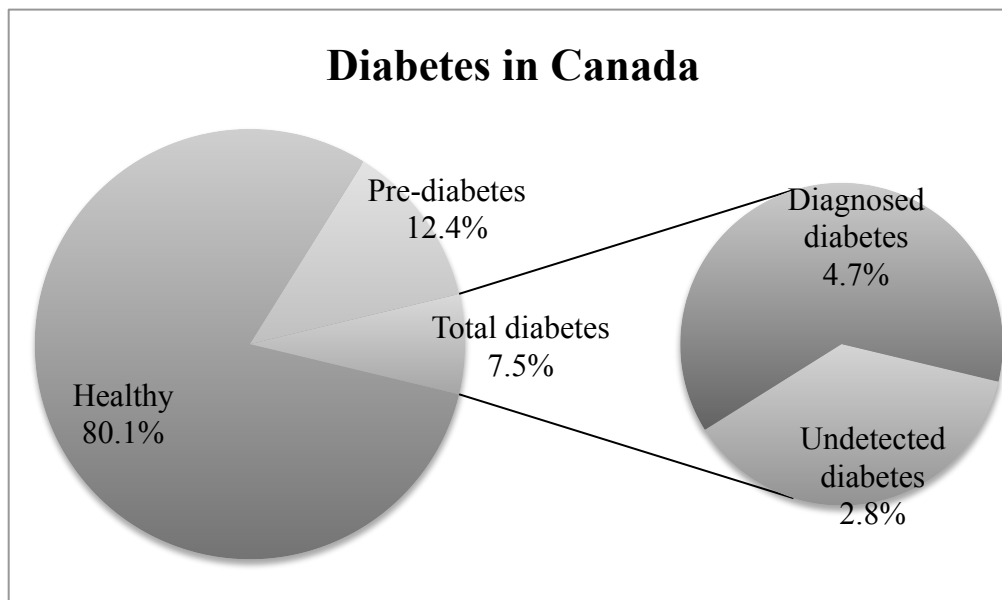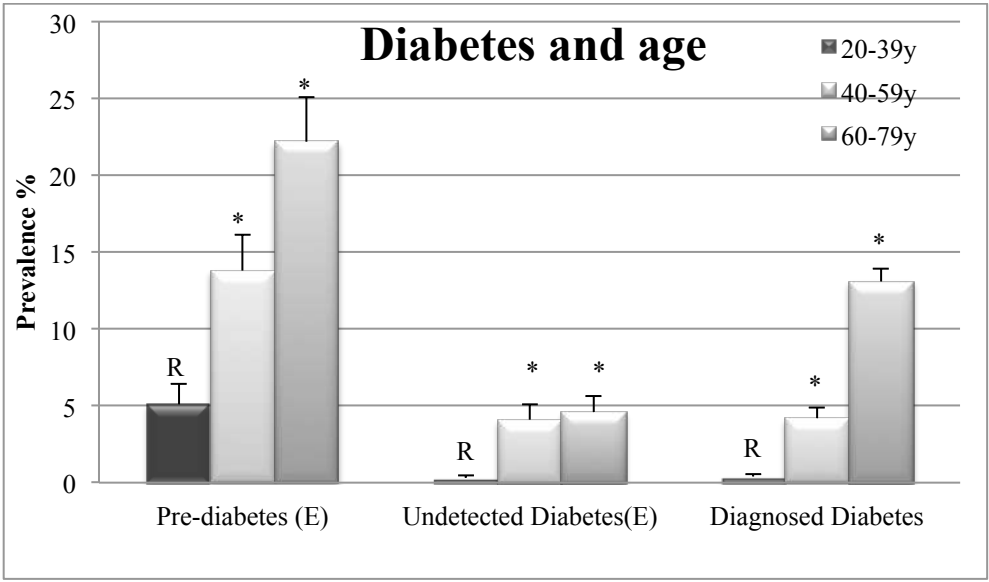
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Figure 1.

Diabetes in Canada

Pre-diabetes
12.4%

Diagnosed
diabetes
4.7%

Total diabetes
7.5%

Healthy
80.1%

Undetected
diabetes
2.8%

Figure 2.