Dyslipidemia Prevalence, Treatment, Control, and Awareness in the Canadian Health Measures Survey

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ABSTRACT

BACKGROUND: The most recent Canadian population-level data on lipid levels are from 1992. This study presents current estimates of Canadians with dyslipidemia, the proportion aware of their condition, and the proportion being treated and below target values.

METHODS: The Canadian Health Measures Survey (2007-2009) assessed the prevalence, awareness and treatment of dyslipidemia. Dyslipidemia was defined as TC/HDL-C ratio ≥5; measured LDL-C ≥3.5 mmol/L; or taking lipid-modifying medications. The 2009 guidelines for the diagnosis and treatment of dyslipidemia were used to define low, moderate or high cardiovascular disease (CVD) risk and treatment initiation and targets.

RESULTS: Forty-five percent of Canadians aged 18-79 years have dyslipidemia. Fifty-seven percent of respondents were not aware of their condition. Lipid-modifying therapy was initiated in individuals where treatment would be recommended in 49%, 20% and 54% of those at high, moderate, and low risk levels, respectively. The majority (81%) of those taking medication had their lipid levels under desirable levels, however, only 24% of those with dyslipidemia reported medication use. Overall, only 19% of those with dyslipidemia had their lipids under recommended levels. Only 41% of those taking lipid-modifying medication reached a recommended target of LDL-C <2 mmol/L or ApoB <0.8 g/L.

CONCLUSION: There is still a high proportion of Canadians at high risk of CVD, with dyslipidemia, who are not being treated to recommended levels. These data need to be integrated into CVD reduction recommendations and represent an important baseline for assessing progress.

KEY WORDS: Dyslipidemias; population; health surveys; guidelines; Canada

La traduction du résumé se trouve à la fin de l'article.

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High lipid levels are a major risk factor for cardiovascular disease (CVD), which is a leading cause of death for Canadian men and women.[1] It is estimated that dyslipidemia is responsible for about 4.4 million deaths worldwide.[2] Population surveillance is important in monitoring risk factors for cardiovascular and other diseases. However, there is a paucity of population-level data on lipid levels. Estimates in the US indicate that 53% of adults have dyslipidemia.[3] No recent comparable Canadian data have been published. Population-level data on lipid levels in Canadians was last collected in the 1986-1992 Canadian Heart Health Surveys (CHHS), at which time 44% of respondents had elevated total cholesterol levels above 5.2 mmol/L; 14% had LDL cholesterol (LDL-C) levels above 4.1 mmol/L; and 8% had HDL cholesterol (HDL-C) values below 0.9 mmol/L.[4]

The Canadian Health Measures Survey (CHMS) is the most comprehensive population-representative direct measures survey ever conducted in Canada and provides recent laboratory-measured data on lipid levels of Canadians. The purpose of this paper was to determine the proportion of the Canadian population with dyslipidemia, the number aware of their lipid levels status and the number being treated for their condition. The proportion of the Canadian population who adhered with the 2009 Canadian Cardiovascular Society lipid targets[5] was also assessed.

METHODS

Data source

The CHMS is a nationally representative survey of the household population.[6-8] Data for cycle 1 were collected from March 2007 through February 2009 at 15 sites across the country for respondents aged 6 to 79 years. Full-time members of the Canadian Forces and residents of Crown lands, Indian reserves, institutions and certain remote regions were excluded. The sample represented approximately 96% of the population.[9]

The CHMS consisted of a household interview where information about socio-demographic characteristics, health and lifestyle was gathered. This was followed by a visit to a mobile examination centre, which included physical measures and bio-specimen sampling (blood and urine).[10]

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Table 1. Criteria for Determining Risk of Cardiovascular Disease, Treatment Initiation and Treatment Targets Using the 2009 Guidelines for the Diagnosis and Treatment of Dyslipidemia

Criteria for determining risk of CVD		
High risk – any one of the following	*Moderate risk*	*Low risk*
- coronary artery disease - peripheral vascular disease - atherosclerosis - most patients with diabetes (men >45 and women >50 years) - Framingham risk score[12] ≥20% - Reynolds risk score[13] ≥20%	- Framingham risk score 10% to 19%	- Framingham risk score <10%
Criteria for determining whether treatment initiation is recommended, by risk category		
High risk	*Moderate risk*	*Low risk*
- Consider treatment in all patients	- LDL-C ≥†3.5 mmol/L - TC/HDL-C ≥5 - hs-CRP >2 mg/L in men older than 50 and in women older than 60 years of age - Family history and hs-CRP risk (RRS ≥10)	- LDL-C ≥5 mmol/L - (supplementary guideline - consider treatment if TC/HDL-C >6)
Primary treatment targets, by risk levels		
High risk	*Moderate risk*	*Low risk*
- LDL-C <2 mmol/L or a reduction in LDL-C of ≥50%‡ - Apolipoprotein B <0.8 g/L	- LDL-C <2 mmol/L or a reduction in LDL-C of ≥50% - Apolipoprotein B <0.8 g/L	- a reduction in LDL-C of ≥50% (not available)

† For all measures but hs-CRP, where the guidelines had > we used ≥.
‡ Reduction in LDL-C of 50% not available.
RRS = Reynolds risk score.

Table 2. Percentage With Dyslipidemia, by Sex and Age Group, Household Population Aged 20 to 79 years, Canada, 2007-2009

	TC/HDL-C Ratio ≥5		LDL-C ≥3.5 mmol/L		TC/HDL-C Ratio ≥5 or LDL-C ≥3.5 mmol/L	
	%	95% CI	%	95% CI	%	95% CI
Total	17.3	14.1-21.0	31.6	27.8-35.7	36.0	33.0-39.2
Sex						
Male†	24.4	19.2-30.5	36.1	29.2-43.5	43.2	37.4-49.2
Female	10.3*	6.9-15.1	27.3*	23.5-31.4	29.0*	25.3-33.1
Age group (years)						
20-39	12.4*	9.1-16.7	23.2*	18.5-28.7	27.9*	23.5-32.7
40-59†	20.2	15.8-25.5	36.6	31.1-42.6	40.9	36.5-45.4
60-79	20.5	16.6-24.9	37.1	30.9-43.7	41.3	36.4-46.4

† Reference category.
* Significantly different from reference category (p<0.05).
Source: March 2007 to February 2009 Canadian Health Measures Survey.

Of the households selected for the survey, 69.6% agreed to participate, 88.3% completed the household questionnaire, and 84.9% participated in the subsequent examination component of the survey. The final response rate, after adjusting for the sampling strategy, was 51.7%.[9]

Blood samples were collected as part of the mobile examination centre component (see Bryan et al.[10] for details). Approximately half of respondents were selected at random to fast before blood samples were taken. This study is based on 1,701 respondents aged 20 to 79 years who were part of the fasting subsample. The overall combined response rate for the fasting subsample was 46.3%. Sampling weights were provided for the fasting subsample which incorporated an adjustment for the probability of being selected into the subsample, a non-response adjustment (based on characteristics available for respondents vs. non-respondents to this component of the survey) and calibration to ensure that estimates based on these weights were representative of the Canadian population by sex, age group and geographical region.[9]

Measures

Respondents were defined as having *measured* dyslipidemia if:

- measured total cholesterol (TC)/HDL-C ratio was ≥5; or
- measured LDL-C was ≥3.5 mmol/L.

In addition to the measured values, respondents who reported taking lipid-modifying medication in the month before the mobile examination component were also considered as having dyslipidemia. Respondents were asked to provide the Drug Identification Numbers (DIN) for all prescription medications they were taking. These were subsequently coded using the Anatomical Therapeutic Chemical (ATC) classification system.[11] *Lipid-modifying medications* were defined as all C10A (lipid-modifying agents) and C10B (lipid-modifying agents, combinations) drugs with the exception of C10AX01 (dextrothyroxine).

Respondents who were classified as having dyslipidemia (measured high lipid levels or taking lipid-modifying medication) were defined as being *aware* if, during the household interview, they reported that they had been told by a health professional that their blood cholesterol was high.

Guidelines for the Diagnosis and Treatment of Dyslipidemia

Based on the 2009 guidelines for the diagnosis and treatment of dyslipidemia,[5] respondents were categorized as being at low, moderate or high risk of CVD. These guidelines define risk according to the criteria in Table 1.

In the CHMS, not all of the information was available for the criteria specified for the high-risk group. Therefore in this study high risk was defined as a Framingham risk score ≥20%,[12] Reynolds risk score ≥20%,[13] diabetes (in men >45 years or women >50 years), or self-reported heart disease, heart attack or stroke. Diabetes was defined as elevated fasting glucose of ≥7 mmol/L or the use of insulin in the previous month.

Table 3. Percent With High Lipid Levels†, by Sex and Age Group, Household Population Aged 20 to 79 Years, Canada, 2007-2009

	Total		Treated With Medication						Not Treated	
			Total		Measured - Not High TC/HDL-C ratio <5 and LDL-C <3.5 mmol/L		Measured High TC/HDL-C ratio ≥5 or LDL-C ≥3.5 mmol/L		Measured High TC/HDL-C ratio ≥5 or LDL-C ≥3.5 mmol/L	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Total	44.6	41.6-47.6	10.5	9.1-12.1	8.5	7.4-9.9	2.0	1.3-2.9	34.0	31.1-37.1
Sex										
Male‡	52.8	47.5-58.0	12.5	10.4-15.1	9.6	7.5-12.2	2.9	2.0-4.3	40.3	34.6-46.2
Female	36.5*	32.6-40.6	8.5*	7.1-10.2	7.5	6.2-9.0	1.1* F	0.4-2.5	28.0*	24.7-31.5
Age group (years)										
20-39	28.1*	23.8-32.9	0.4* F	0.1-1.6	0.2* F	0.0-1.5	0.2* F	0.0-1.4	27.7*	23.4-32.5
40-59‡	47.3	42.1-52.6	8.5	5.0-14.1	6.5	4.0-10.3	2.0 F	0.9-4.6	38.8	34.3-43.5
60-79	69.2*	65.7-72.5	33.1*	28.0-38.6	27.9*	23.6-32.6	5.2	3.3-8.1	36.1	31.6-40.9

† Measured TC/HDL cholesterol ratio ≥5, or LDL cholesterol ≥3.5 mmol/L, or lipid-modifying medication in the previous month.
‡ Reference category.
* Significantly different from reference category (p<0.05).
F Due to high sampling variance (coefficient of variation >33.3%), this estimate does not meet Statistics Canada's quality standards.
Source: March 2007 to February 2009 Canadian Health Measures Survey.

Table 4. Percent With High Lipid Levels† Who Are Aware and Using Lipid-modifying Medication, by Sex and Age Group, Household Population Aged 20 to 79 Years With High Lipids, Canada, 2007-2009

	Aware (self-reported high cholesterol)		Not Aware but Taking Lipid-modifying Medication		Not Aware and Not Taking Lipid-modifying Medication	
	%	95% CI	%	95% CI	%	95% CI
Total	38.8	33.8-44.0	3.9	2.1-7.1	57.4	51.8-62.7
Sex						
Male‡	37.2	31.1-43.7	4.0	2.5-6.5	58.8	51.7-65.5
Female	41.0	34.6-47.7	3.6 F	1.3-9.8	55.4	48.6-61.9
Age group (years)						
20-39	11.6* F	4.2-28.3	0.8 F	0.1-5.4	87.6*	73.8-94.7
40-59‡	39.7	32.5-47.3	2.6 F	0.9-7.2	57.7	48.9-66.1
60-79	57.8*	51.2-64.2	7.8	3.8-15.5	34.4*	29.1-40.1

† Measured TC/HDL-C cholesterol ratio ≥5, or LDL cholesterol ≥3.5 mmol/L, or lipid-modifying medication in the previous month.
‡ Reference category.
* Significantly different from reference category (p<0.05).
F Due to high sampling variance (coefficient of variation >33.3%), this estimate does not meet Statistics Canada's quality standards.
Source: March 2007 to February 2009 Canadian Health Measures Survey.

Based on risk level, the guidelines specify criteria for which *treatment initiation* is recommended. CHMS respondents were categorized based on the criteria in Table 1. *Primary targets* are also specified by risk level (Table 1).

With CHMS data, it was not possible to assess a reduction in LDL-C, but respondents were categorized as treated and achieving target levels based on the other target criteria outlined in Table 1. Individuals treated but not reaching the treatment targets in each risk category were defined as not achieving target levels.

All estimates were based on weighted data using the sampling weights provided for the fasting subsample. Statistical analyses were performed using SAS and SUDAAN software. Standard errors, coefficients of variation and 95% confidence intervals were calculated with the bootstrap technique.[14,15] The number of degrees of freedom was specified as 11 to account for the CHMS sample design.[9] Significance levels were set at p<0.05.

RESULTS

Using a simple definition of dyslipidemia, based on LDL-C levels of ≥3.5 mmol/L or TC/HDL-C ≥5, 36% (95% CI 33-39) of Canadian adults could be classified as having dyslipidemia (Table 2). The prevalence of measured dyslipidemia increased with age and was significantly more common in males (43%, 95% CI 37-49) than in females (29%, 95% CI 25-33).

When the use of lipid-modifying medication was included in the definition of dyslipidemia, the prevalence rose to 45% (95% CI 42-48) (Table 3). The majority (81%, (8.5/10.5), 95% CI 74-86) of those taking medication had their lipid levels under high levels (i.e., LDL-C<3.5 and TC/HDL-C ratio<5). However, only 24% (10.5/44.6, 95% CI 20-27) of those with dyslipidemia reported medication use. When we consider the total population with dyslipidemia, including those taking lipid-modifying drugs, only 19% (8.5/44.6, 95% CI 16-22) of those with dyslipidemia had their lipids under desirable levels. Only 18% (8.5/47.3, 95% CI 11-28) of participants aged 40 to 59 years were taking medication for their dyslipidemia, while for those aged 60 to 79 years, the percentage taking medication was 48% (33.1/69.2, 95% CI 41-54).

Only 39% (95% CI 34-44) of those who had high lipid levels reported on the questionnaire that they had been told by a health care professional that their cholesterol was high, while 57% (95% CI 52-63) were not aware of their condition and 4% (95% CI 2-7) were taking medication for their condition, yet did not report being aware of it (Table 4). Awareness levels were similar in males and females and increased with age.

Tables 5a and 5b present the proportion of the sample meeting the 2009 Canadian cardiovascular guidelines for the diagnosis and treatment of dyslipidemia and the prevention and management of CVD.[5] For this analysis, respondents were classified by their CVD risk status and 24% of Canadians were at either moderate (10%, 95% CI 8-12) or high CVD risk (14%, 12-16). Treatment initiation would be recommended in 80% (95% CI 71-86) of those at moderate CVD risk and in 5% (95% CI 4-8) of those at low CVD risk (8.5% if the additional criteria suggested in the guidelines of TC/HDL-C >6 are used, data not shown). The guidelines recom-

Table 5a. Adherence With 2009 Target Lipid Levels, Household Population Aged 20 to 79 years, Canada, 2007-2009

	Percentage Distribution by Risk Level		% for Whom Treatment Initiation Is Recommended†		% Taking Lipid-modifying Medication‡		% Aware‡ (self-reported high cholesterol)		% With LDL Cholesterol <2 mmol/L Among Those:					
									Taking Lipid-modifying Medication		Not Taking Lipid-modifying Medication			
											Treatment Initiation Recommended		Treatment Initiation Not Recommended	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Total			25.8	22.5-29.4	40.9	35.8-46.2	53.3	46.5-59.9	23.8	15.5-34.8	3.1 F	1.2-7.9	14.7	12.1-17.8
Risk level														
Low	76.2	73.5-78.6	5.4	3.6-8.1	54.4	41.1-67.2	63.0	40.6-80.9	17.0 F	4.8-45.7	0.0		14.6	11.9-17.9
Moderate	10.1	8.3-12.3	79.6	71.2-85.9	20.0	11.4-32.8	43.3	32.8-54.5	7.7 F	1.2-35.8	2.7 F	0.6-12.0	18.0 F	5.6-44.8
High	13.7	11.9-15.8	100.0		48.9	42.9-54.9	56.1	49.4-62.6	29.9	18.9-43.8	4.3 F	1.8-9.7		

† Includes those taking lipid-modifying medication.
‡ Among those for whom treatment initiation is recommended/are taking lipid-modifying medication.
Note: If coefficient of variation is greater than 33.3%, estimate is indicated as being less than upper limit of 95% confidence interval.
Source: March 2007 to February 2009 Canadian Health Measures Survey.

mend that treatment should be considered in all those at high risk. Overall, lipid-modifying therapy was initiated in individuals where treatment was recommended in 41% (95% CI 36-46) across all risk categories, and in 49%, 20% and 54% of those at high, moderate, and low risk levels respectively (falls from 54% to 35% in the low-risk group if we include TC/HDL-C >6, data not shown). In these risk categories where treatment initiation is recommended, participants reported overall low levels of awareness (of having been told they had high cholesterol). The overall awareness was 53% (95% CI 47-60) and was lowest in the moderate risk group (43%, 95% CI 33-54).

In terms of reaching treatment targets in the different risk categories where treatment initiation would be recommended, only 41% (95% CI 31-53) of those taking lipid-modifying medication achieved the recommended target of LDL-C <2 mmol/L or ApoB <0.8 g/L. Only 24% (95% CI 16-35) attained the LDL-C target and 40% (95% CI 30-50) the ApoB target. Using a more conservative target for LDL-C, about 90% of those on medication attained a LDL-C <3.5 mmol/L (data not shown).

Interpretation

Despite the recent decrease in mortality due to CVD,[16] this study shows that there is still a high proportion of Canadians at high risk of CVD with dyslipidemia who are not being treated to recommended levels. More than a third of the adult population (36%) has measured dyslipidemia, a slight improvement from the 1986-1992 CHHS data (separate analyses by MJ) where 39% would have been classified with dyslipidemia using the same criteria, while no improvement is apparent if we include individuals taking lipid-modifying medication in the definition (CHMS: 45% vs. CHHS: 44%). Even though 81% of those on medication were under LDL-C <3.5 mmol/L and TC/HDL-C <5, the overall proportion of individuals either treated or with high lipid levels who are below these levels is only 19%. This is significant as it has been estimated that a 1 mmol/L decrease in LDL-C, that is sustained for 5 years, may result in a reduction in CVD events of about 23%.[17]

NHANES data[18] show a decrease in LDL-C (using a 3.36 mmol/L cut-point) between the latest NHANES surveys and the 1999-2006 NHANES, from 41% to 36%. However, there is no change in high LDL-C levels between the CHHS and the CHMS (32% ≥3.5 mmol/L for both surveys). Direct comparisons with NHANES using the same criteria are warranted.

The 2009 guidelines do not provide simple criteria based on lipid levels for the diagnosis of dyslipidemia. They stratify individuals by their overall CVD risk score based on Framingham and the Reynolds risk score and then recommend initiation of treatment by lipid levels, family history and hs-CRP. Therefore we can assume that the diagnosis of dyslipidemia is defined in these guidelines by the algorithm leading to treatment initiation in these CVD risk categories.

By these criteria, about a quarter of participants (26%) are classified as requiring therapy across all levels of CVD risk. Of those for whom treatment initiation is recommended, only 41% were taking a lipid-modifying treatment, and only 24% of those reached a target LDL-C level and 40% a target ApoB level. While treatment initiation therapy would be recommended in 80% of those at moderate CVD risk, only 20% were currently under lipid-modifying therapy. For individuals at high risk, about half were treated (49%), and only 30% reached a target LDL-C level and 47% a target ApoB level. Overall levels of awareness were low, and almost half (47%, i.e., 100%-53%) of those for whom treatment initiation was recommended were not aware that they had dyslipidemia.

Many experts suggest that ApoB is a better marker than LDL-C for CVD and a better index of the adequacy of LDL-C lowering therapy than LDL-C.[5] One of the strengths of the CHMS was the ability to estimate those at high risk who were able to reach treatment targets using ApoB. It is interesting to note that the proportion of individuals reaching a target LDL-C <3.5 mmol/L is lower than those reaching an ApoB <0.8 g/L. It will be important to define which cut-off point for these two targets should be used in future guidelines to assess control.

There were a few limitations to this study. First, due to sample size limitations, we had small numbers and large confidence intervals for some of the estimates by CVD risk status. Awareness levels relied on whether respondents were told by a health professional that they had high levels of cholesterol. Therefore, there may have been some misclassification of awareness due to recall bias. Also, some individuals may have been recently told that their lipid levels were high and just started pharmacological or non-pharmacological treatment. However, this would likely have only a small impact on the estimates. Non-pharmacological treatment was not included in the estimates of treatment prevalence and control since these guidelines focus on treatment with both medications and health behaviours. Health behaviour modifications have been deemed to

Table 5b. Adherence With 2009 Target Lipid Levels, Household Population Aged 20 to 79 Years, Canada, 2007-2009

	% With Apolipoprotein B (apoB) <0.8 g/L Among Those:						% With LDL Cholesterol <2 mmol/L or Apolipoprotein B (apoB) <0.8 g/L Among Those:						% With LDL Cholesterol <3.5 mmol/L Among Those:					
	Taking Lipid-modifying Medication		Not Taking Lipid-modifying Medication				Taking Lipid-modifying Medication		Not Taking Lipid-modifying Medication				Taking Lipid-modifying Medication		Not Taking Lipid-modifying Medication			
	%	95% CI	Treatment Initiation Recommended %	Treatment Initiation Recommended 95%		Treatment Initiation Not Recommended 95% CI	%	95% CI	Treatment Initiation Recommended %	Treatment Initiation Recommended 95%		Treatment Initiation Not Recommended 95% CI	%	95% CI	Treatment Initiation Recommended %	Treatment Initiation Recommended 95%		Treatment Initiation Not Recommended 95% CI
Total	39.6	29.7-50.5	5.9	3.0-11.3	38.6	32.4-45.2	41.5	30.9-52.9	5.9	3.0-11.3	39.1	33.3-45.2	89.6	80.7-94.7	28.4	22.3-35.5	73.6	69.5-77.4
Risk level																		
Low	26.1 F	10.8-50.8	0.0		38.2	32.0-44.8	26.1 F	10.8-50.8	0.0		38.7	32.9-44.9	86.3	72.4-93.8	0.0		72.9	68.6-76.8
Moderate	26.9 F	10.8-52.8	3.4 F	1.0-10.7	51.7	26.9-75.7	28.0 F	11.9-52.7	3.4 F	1.0-10.7	51.7	26.9-75.7	90.0	67.2-97.6	21.5	13.9-31.7	100.0	
High	47.1	32.3-62.5	9.7	4.7-18.7			49.8	33.9-65.7	9.7	4.7-18.7			90.6	73.8-97.1	42.3	33.5-51.6		

† Includes those taking lipid-modifying medication.
‡ Among those for whom treatment initiation is recommended/are taking lipid-modifying medication.
Note: If coefficient of variation is greater than 33.3%, estimate is indicated as being less than upper limit of 95% confidence interval.
Source: March 2007 to February 2009 Canadian Health Measures Survey.

be a cornerstone of CVD prevention, and are central in the 2009 guidelines, as well as in the new 2013 guidelines.[19] While it would have been useful to get an estimate of the level of adherence to health behaviour recommendations, this would have required an additional complex survey to ascertain. Other factors could have been considered in the assessment of risk if we were to follow the 2009 guidelines and/or alternate targets and surrogate markers of CVD. However these surrogate markers may be more relevant for individual-level classification and should not significantly affect results. In particular, to assess the level of "control", we were not able to include in our calculation the primary target decrease of 50% of LDL-C at all risk levels. Self-reported data were used for heart disease, heart attack, and stroke as a proxy for coronary artery disease, peripheral vascular disease, and atherosclerosis.

Results of this study suggest that there have been small improvements in reducing, treating and controlling dyslipidemia in the Canadian population since the 1980s. The situation seems to be similar to that of the 1990s with hypertension, where we had low levels of awareness, treatment and overall control of this condition.[20] While we had a remarkable improvement in the level of treatment and control of hypertension since the last Canadian survey (CHHS),[21] these data suggest that this has not been paralleled in the lipids context. Given the effectiveness of treatment of dyslipidemia, the potential exists to achieve a better control of the condition in Canada. While this paper is based on the 2009 guidelines, which were not available at the time of this study, the 2012 guidelines[19] have a few changes that could slightly affect our current estimates. Some of these changes include: using non-HDL-C as alternate lipid markers; removing hsCRP and the Total Cholesterol-HDL-C ratio as alternate targets; and addition of chronic kidney disease as a high-risk feature.

Despite some study limitations, we were able to use the major 2009 guideline criteria to classify individuals in the different risk, treatment, and control categories, including ApoB, hs-CRP, family history, and the Framingham and Reynolds computed CVD risk levels. These data represent a comprehensive assessment of dyslipidemia prevalence, treatment and control, and prevalence of CVD risk in the Canadian population; they show critical gaps, can be integrated into the C-CHANGE initiative,[22] and will be an important baseline for assessing progress in this area.

REFERENCES

1. Heart and Stroke Foundation of Canada. Heart Disease. Available at: http://www.heartandstroke.com/site/c.ikIQLcMWJtE/b.3484021/k.7C85/Heart_Disease.htm (Accessed September 30, 2012).
2. Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJ; Comparative Risk Assessment Collaborating Group. Selected major risk factors and global and regional burden of disease. *Lancet* 2002;360:1347-60.
3. Bays HE, Chapman RH, Fox KM, Grandy S; SHIELD Study Group. Comparison of self-reported survey (SHIELD) versus NHANES data in estimating prevalence of dyslipidemia. *Curr Med Res Opin* 2008;24:1179-86.
4. MacLean DR, Petrasovits A, Connelly PW, Joffres M, O'Connor B, Little JA. Plasma lipids and lipoprotein reference values, and the prevalence of dyslipoproteinemia in Canadian adults. Canadian Heart Health Surveys Research Group. *Can J Cardiol* 1999;15:434-44.
5. Genest J, McPherson R, Frohlich J, Anderson T, Campbell N, Carpentier A, et al. 2009 Canadian Cardiovascular Society/Canadian guidelines for the diagnosis and treatment of dyslipidemia and prevention of cardiovascular disease in the adult – 2009 recommendations. *Can J Cardiol* 2009;25:567-79.
6. Day B, Langlois R, Tremblay M, Knoppers BM. Canadian Health Measures Survey: Ethical, legal and social issues. *Health Rep* 2007;18(Suppl.):37-51.
7. Giroux S. Canadian Health Measures Survey: Sampling strategy overview. *Health Rep* 2007;18(Suppl.):31-36.
8. Tremblay MS, Wolfson M, Connor Gorber S. Canadian Health Measures Survey: Background, rationale and overview. *Health Rep* 2007;18(Suppl.):7-20.
9. Statistics Canada. Canadian Health Measures Survey (CHMS) Data User Guide: Cycle 1. Available at: http://www.statcan.gc.ca/imdb-bmdi/document/5071_D2_T1_V1-eng.pdf (Accessed September 30, 2012).
10. Bryan S, St-Denis M, Wojtas D. Canadian Health Measures Survey: Clinic operations and logistics. *Health Rep* 2007;18(Suppl.):53-70.
11. WHO Collaborating Centre for Drug Statistics Methodology. ATC/DDD Index 2011. Available at: http://www.whocc.no/atc_ddd_index (Accessed September 30, 2012).
12. D'Agostino RB Sr, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, Kannel WB. General cardiovascular risk profile for use in primary care: The Framingham Heart Study. *Circulation* 2008;117:743-53.
13. Ridker PM, Paynter NP, Rifai N, Gaziano JM, Cook NR. C-reactive protein and parental history improve global cardiovascular risk prediction: The Reynolds Risk Score for men. *Circulation* 2008;118:2243-51.
14. Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001). 1992;18:209-17.
15. Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Stat Methods Med Res* 1996;5:281-310.
16. Public Health Agency of Canada. Tracking Heart Disease and Stroke in Canada. 2009. Available at: http://www.phac-aspc.gc.ca/publicat/2009/cvd-avc/pdf/cvd-avs-2009-eng.pdf (Accessed September 30, 2012).

17. Baigent C, Keech A, Kearney PM, Blackwell L, Buck G, Pollicino C, et al. Efficacy and safety of cholesterol-lowering treatment: Prospective meta-analysis of data from 90,056 participants in 14 randomised trials of statins. *Lancet* 2005;366:1267-78.
18. Cohen JD, Cziraky MJ, Cai Q, Wallace A, Wasser T, Crouse JR, Jacobson TA. 30-year trends in serum lipids among United States adults: Results from the National Health and Nutrition Examination Surveys II, III, and 1999-2006. *Am J Cardiol* 2010;106:969-75.
19. Anderson TJ, Grégoire J, Hegele RA, Couture P, Mancini GB, McPherson R, et al. 2012 update of the Canadian Cardiovascular Society guidelines for the diagnosis and treatment of dyslipidemia for the prevention of cardiovascular disease in the adult. *Can J Cardiol* 2013;29(2):151-67.
20. Joffres MR, Ghadirian P, Fodor JG, Petrasovits A, Chockalingam A, Hamet P. Awareness, treatment, and control of hypertension in Canada. *Am J Hypertens* 1997;10:1097-102.
21. McAlister FA, Wilkins K, Joffres M, Leenen FH, Fodor G, Gee M, et al. Changes in the rates of awareness, treatment and control of hypertension in Canada over the past two decades. *CMAJ* 2011;183:1007-13.
22. Tobe SW, Stone JA, Brouwers M, Bhattacharyya O, Walker KM, Dawes M, et al. Harmonization of guidelines for the prevention and treatment of cardiovascular disease: The C-CHANGE Initiative. *CMAJ* 2011;183:E1135-E1150.

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RÉSUMÉ

CONTEXTE : Les plus récentes données en population sur les niveaux de lipides au Canada datent de 1992. Notre étude présente les estimations actuelles sur les Canadiens ayant une dyslipidémie, la proportion de gens connaissant leur état et la proportion traitée pour une dyslipidémie, mais présentant des valeurs sous-optimales.

MÉTHODE : L'Enquête canadienne sur les mesures de la santé (2007-2009) a évalué la prévalence, la connaissance et le traitement des dyslipidémies. Une dyslipidémie était définie ainsi : ratio CT/HDLc ≥ 5; LDLc mesuré ≥ 3,5 mmol/L; ou prise de médicaments hypolipémiants. Nous avons utilisé les directives de 2009 pour le diagnostic et le traitement des dyslipidémies pour définir le risque de maladie cardiovasculaire (MCV) – faible, modéré ou élevé – ainsi que l'instauration du traitement et les valeurs cibles du traitement.

RÉSULTATS : Quarante-cinq p. cent des Canadiens de 18 à 79 ans ont une dyslipidémie. Cinquante-sept p. cent des répondants n'étaient pas conscients de leur état. Des traitements hypolipémiants avaient été instaurés, dans les cas où ces traitements étaient recommandés, chez 49 %, 20 % et 54 % respectivement des sujets présentant un niveau de risque élevé, modéré et faible. La majorité (81 %) des sujets prenant des médicaments avaient des niveaux de lipides sous-optimaux, mais seulement 24 % des sujets ayant une dyslipidémie disaient prendre des médicaments. Globalement, seulement 19 % des sujets ayant une dyslipidémie avaient des niveaux de lipides sous les niveaux recommandés. Seulement 41 % des sujets prenant des hypolipémiants atteignaient la cible recommandée (LDLc <2 mmol/L ou Apo B <0,8 g/L).

CONCLUSION : Il y a encore une proportion élevée de Canadiens présentant un risque élevé de MCV, avec dyslipidémie, qui ne sont pas traités selon les niveaux recommandés. Ces données devraient être intégrées dans les recommandations sur la réduction des MCV; elles représentent aussi une importante base de référence pour évaluer les progrès.

MOTS CLÉS : dyslipidémies; population; enquêtes de santé; directives; Canada