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Canada

A randomized trial testing the efficacy of modifications to the nutrition facts table on comprehension and use of nutrition information by adolescents and young adults in Canada

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Abstract

Introduction: Given the proposed changes to nutrition labelling in Canada and the dearth of research examining comprehension and use of nutrition facts tables (NFts) by adolescents and young adults, our objective was to experimentally test the efficacy of modifications to NFts on young Canadians' ability to interpret, compare and mathematically manipulate nutrition information in NFts on prepackaged food.

Methods: An online survey was conducted among 2010 Canadians aged 16 to 24 years drawn from a consumer sample. Participants were randomized to view two NFts according to one of six experimental conditions, using a between-groups 2×3 factorial design: serving size (current NFt vs. standardized serving-sizes across similar products) $\times$ percent daily value (% DV) (current NFt vs. ''low/med/high'' descriptors vs. colour coding). The survey included seven performance tasks requiring participants to interpret, compare and mathematically manipulate nutrition information on NFts. Separate modified Poisson regression models were conducted for each of the three outcomes.

Results: The ability to compare two similar products was significantly enhanced in NFt conditions that included standardized serving-sizes ($p \leq .001$ for all). Adding descriptors or colour coding of % DV next to calories and nutrients on NFts significantly improved participants' ability to correctly interpret % DV information ($p \leq .001$ for all). Providing both standardized serving-sizes and descriptors of % DV had a modest effect on participants' ability to mathematically manipulate nutrition information to calculate the nutrient content of multiple servings of a product (relative ratio = 1.19; 95% confidence limit: 1.04–1.37).

Conclusion: Standardizing serving-sizes and adding interpretive % DV information on NFts improved young Canadians' comprehension and use of nutrition information. Some caution should be exercised in generalizing these findings to all Canadian youth due to the sampling issues associated with the study population. Further research is needed to replicate this study in a more heterogeneous sample in Canada and across a range of food products and categories.

Keywords: *adolescents, young adults, nutrition policy, food labelling*

Key findings

- Our study provides preliminary evidence, the first in Canada, supporting the efficacy of modifications to the nutrition facts table (NFt) on consumer understanding and use of nutrition information.
- Results suggest that both standardizing serving-sizes and providing descriptors or colour coding to interpret percent daily values (% DVs) on NFts help young Canadians interpret, compare and mathematically manipulate nutrition information. Some caution should be exercised to generalize these findings to all Canadian youth due to sampling issues associated with the study population.
- These findings can be used to support an ongoing review of proposed changes to the NFt.

Introduction

Poor diet is a leading risk factor for chronic disease and premature death in Canada.[1] A higher intake of calories, saturated fat and sodium is linked to a greater risk of obesity, diabetes mellitus and heart disease.[2-4] The development of nutrition-related conditions, such as obesity and diabetes, is increasingly evident in adolescents and young adults in Canada and internationally.[5-8] Adolescence and young adulthood are dynamic stages of human development associated with increasing independence, a growing role in food shopping and preparation, and the development of long-term eating patterns that can remain relatively stable throughout life.[9-11] Population-based nutrition interventions should aim to support the development of healthy eating habits among young people in Canada.

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Providing clear and accurate nutrition information is one way to support healthier and more informed food choices. Mandatory nutrition labelling on prepackaged food was implemented in Canada in 2005 so that consumers can compare the nutritional value of foods and make informed choices.[12] This legislation requires the nutrition facts table (NFt) to be displayed on most prepackaged foods. The NFt provides information about the number of calories and the quantities of 13 nutrients per serving as well as the percentage of these amounts in terms of nutrient recommendations for a 2000-calorie adult diet (daily value [% DV]).

NFts are the most common source of nutrition information in Canada: more Canadians report using nutrition information from food labels on prepackaged foods than from any other source, including the Internet, dietitians and mass media.[13] Moreover, Canadian consumers prefer the NFt over other front-of-package nutrition labelling systems with respect to liking, helpfulness, credibility and influence on purchase decisions.[14] This is consistent with a large body of evidence from a number of countries that demonstrates that mandatory food labels have a broad reach and are sustainable and credible as a health education tool.[15]

Despite their widespread use, recent research has exposed several limitations in Canadian adults' comprehension and use of NFts.[16] First, although the majority of Canadian adults indicate that NFt information is important, they find comparing nutrition information across similar foods to be difficult when serving sizes on NFts are not the same. While the Canadian Food Inspection Agency outlines product-specific ranges for a serving size, food manufacturers ultimately determine the serving size displayed on NFts.[17] Since nutrient disclosures on NFts are based on serving size, consistent use of sizes could help compare the nutrient content of similar foods.

Moreover, most Canadian adults are unable to understand or use % DV listed on NFts.[16] Listing the % DV on NFts is intended to simplify comparisons across foods and assist consumers in determining whether a food has a little or a lot of a nutrient.[18] However, almost one-third of Canadian adults do not understand that the % DV can help them compare foods, and 74% are unable to interpret the % DV on NFts to determine if a food is high or low in a nutrient.[16] Research suggests that enhancing % DV information on NFts with simple descriptors (''low,'' ''medium'' or ''high'') and/or colour may enhance comprehension and, as a result, the use of nutrition information.[15,19] Such interpretational formats to present nutrition information is also well supported in examinations of front-of-package food-labelling systems.[20]

To our knowledge, not a single published study in Canada has examined adolescents' and young adults' comprehension and use of NFts on prepackaged food. The few studies conducted among adolescents internationally suggest that understanding and use of nutrition labels within this group is low.[19,21] Nutrition labelling regulations are currently under review in Canada, providing the opportunity to develop labelling requirements that better support healthier food choices.[22] The objective of our study was to experimentally test the efficacy of modified NFts with the current NFt in terms of comprehension and use of nutrition information by adolescents and young adults. The NFt modifications tested included standardized serving-sizes, and the addition of interpretive information (i.e. simple descriptors or colour coding) to % DV values. These modifications were selected because unequal serving-sizes and challenges in interpreting the % DV have been identified as important barriers to comprehension and use of NFts among Canadian adults.[16] Specifically, we examined the impact of these NFt modifications on participants' ability to interpret, compare and mathematically manipulate nutrition information on prepackaged food.

Methods

Participants and recruitment

An online survey of 2010 participants aged 16 to 24 years from across Canada was conducted in August 2014. Participants were recruited from an established national online consumer panel provided by Nielsen, a market research company (Nielsen: http://www.nielsen.com/ca/en.html). The panel was recruited through online advertisements and social media, targeted emails, online co-registration offers and telephone recruitment. For this study, a stratified random sample of Nielsen panellists of eligible age was sent an email invitation to complete the survey. An equal number of males and females, and an equal number of adolescents (16 to 18 years) and young adults (19 to 24 years) were recruited. Participants residing in the territories were excluded from the sampling frame.

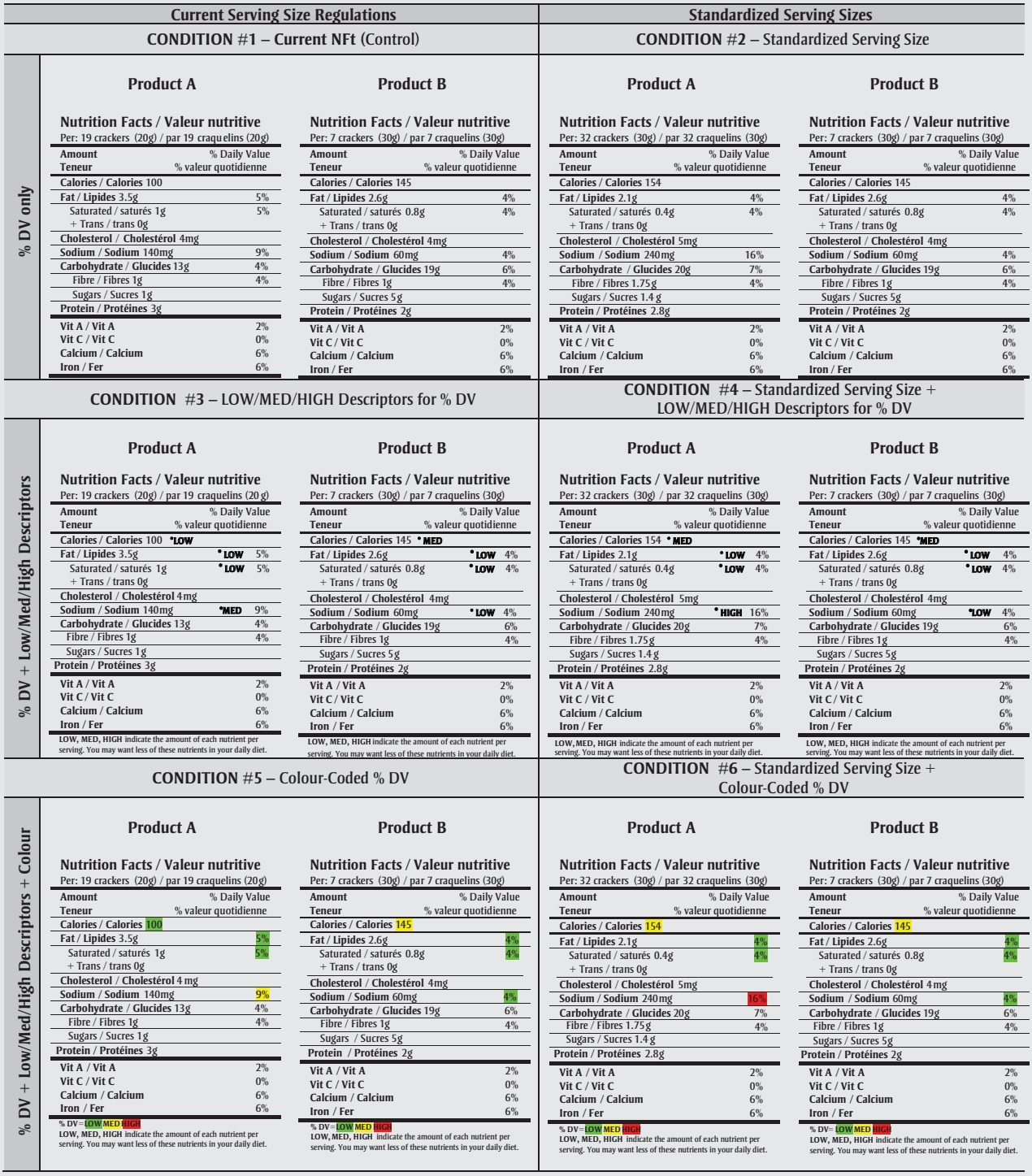
Upon completion of the survey, participants were paid approximately $2.00 to $3.00. Surveys were in English only, and participant consent was obtained.

Ethical approval for the study was received from the Office of Research Ethics at the University of Waterloo.

Study design

We used a between-groups experimental design to test comprehension and use of modified formats of the NFt compared to the current NFt in Canada. Participants were randomly assigned to simultaneously view images of two fictitious brands of crackers displaying an NFt systematically altered according to one of six labelling conditions (Figure 1). The labelling conditions were based on a 2 × 3 factorial design: serving size (current NFt vs. standardized serving-sizes across similar products) × % DV information (current NFt vs. ''low''/''medium''/''high'' descriptors vs. colour coding). Standardized serving-sizes were selected based on recommendations in Canada's Food Guide. Criteria for categorizing % DV were consistent with Health Canada's online educational materials,[18] where 5% DV or less of a nutrient is marked ''low'' or green, 6% to 14% DV of a nutrient is marked ''medium'' or yellow and 15% DV or more of a nutrient is marked ''high'' or red. While standardization of serving sizes affects all nutrients shown on the NFt, the additional interpretive aids (simple descriptors or colour coding) were applied to calories and negative nutrients only (i.e. total fat, saturated fat and sodium) as consumers consult NFts for negative nutrients more frequently than for positive

FIGURE 1
Six nutrition facts table conditions



nutrients,[23] and stronger evidence supports associations between negative nutrients and increased risk for disease.[20]

The nutritional values displayed on the NFts were similar to those on commercial cracker brands, but were manipulated so that one option was high (≥ 15% DV) or moderate (6%–14% DV) and one option was low (≤ 5% DV) in sodium per serving, based on the adequate intake level of 1500 mg/day.[24] The sodium levels in the six conditions were counterbalanced so that for half of the participants, the first cracker box was the low sodium option and for the other half, the second box was the low sodium option.

Crackers were used for this study because they are a widely consumed snack with broad appeal and because their nutritional

quality is perceived as neither extremely healthy nor unhealthy. The NFts were displayed on images of actual cracker boxes using fictional brand names, with a consistent product weight of 225 g. The cracker boxes appeared onscreen as two-dimensional images with views of the side and front of the package to enable participants to view product information including brand, product weight and the NFt. The boxes remained onscreen until the survey items were completed.

Survey measures

Sociodemographics and nutrition-related behaviours

We assessed sociodemographic variables, including gender, age, region, education level (recoded as ''high school or less,'' ''college or some university'' or ''university degree or higher''), employment status and ethnicity. In addition, we asked participants to rate their diet quality and indicate their weight goals and food shopping and preparation responsibilities.

We assessed participants' weight goals by asking ''Which of the following are you trying to do about your weight: lose weight, gain weight, stay the same weight, and not trying to do anything about your weight?'' This question was adapted from a National Health and Nutrition Examination Survey (NHANES) measure that asked participants if they would like to weigh more or less or stay the same.[25]

We examined food shopping and preparation responsibilities using the question, ''Which one of the following statements most accurately reflects your role in your household?'' The response options were ''I am the person who is most responsible for grocery shopping,'' ''I am the person who is most responsible for meal preparation,'' ''I am the person who is most responsible for both grocery shopping and meal preparation'' and ''I am not primarily responsible for either grocery shopping or meal preparation.''

Finally, similar to previous studies, we assessed participants' knowledge of recommended calorie intake by asking, ''On average, how many calories should a healthy, moderately active adult [male/female] consume each day to maintain a healthy weight?''[26-28] Numeric responses (limited to between 0 and 100 000) were coded as correct if the response fell within the range of 1500 to 3000 calories per day (based on Health Canada recommendations for daily energy requirements among young adults for varying levels of physical activity[29]).

Outcome measures

We used an online survey to assess participants' ability to interpret, compare and mathematically manipulate nutrition information on NFts. The survey included seven performance tasks that required understanding and use of the NFt information listed on food products. The seven performance tasks were developed based on a tool used in a Health Canada–commissioned study[16] and research by Mackison et al.,[30] who tested the validity and reliability of tasks measuring consumer understanding, use and perceptions of nutrition labels.

Interpreting % DV information on NFts

Two performance tasks assessed participants' ability to interpret % DV information. First, participants were shown one cracker box and asked: ''Does this product contain a lot of sodium, a moderate amount of sodium, or a little sodium?'' Next, participants were asked: ''Looking at this box, is the amount of total fat per serving in this product high, a moderate amount, or low?''

Comparing information between two NFts

Three performance tasks assessed participants' ability to compare nutrition information between two NFts. First, we asked participants: ''Looking at Products A and B, which product do you think would be the best option for someone trying to reduce their risk of high blood pressure by lowering their sodium intake?'' Next, we asked: ''Looking at Products A and B, which product do you think would be the best option for someone trying to eat fewer calories?'' Finally, participants were asked: ''Looking at both Product A and Product B, how do they compare in terms of their sodium content?'' Response options were ''a lot in both,'' ''a little in both,'' ''Product A has a little and Product B has a lot,'' ''Product A has a lot and Product B has a little,'' ''Product A has a little and Product B has a moderate amount'' and ''Product A has a moderate amount and Product B has a little.''

Mathematically manipulating nutrition information on NFts

We used two performance tasks to examine participants' ability to mathematically manipulate nutrition information on NFts. First, participants were asked: ''If you consumed one-half of this box, what percentage of your recommended % Daily Value of total fat would you consume?'' Next, participants were asked: ''How many servings of this product would you have to eat in order to get all of the fibre you need in one day?''

Data analysis

We used chi-square tests to examine differences in participant characteristics between NFt conditions, and differences in the proportion of participants who correctly responded to the survey items for each of the seven performance tasks across the NFt conditions. Next, we conducted separate modified Poisson regression models using combined scores for tasks related to each of the three outcomes: interpret (2 items), compare (3 items), and mathematically manipulate (2 items) to assess the number of correct responses for each NFt condition compared to the control condition. We examined associations between covariates of interest (education, ethnicity, employment status, region, weight goal, food shopping and preparation responsibilities, knowledge of calorie recommendations, and perceived diet quality) and each of the three outcomes in models that included the main effect (condition) and adjusted these for age and gender. Covariates with a p value less than .2 or that altered the beta coefficient of the main effect by more than 20%, were included in the final model. Analyses were conducted using SAS 9.3 (Cary, NC, US).

Results

Participant characteristics are summarized in Table 1. No significant differences ($p < .05$) were observed across NFt conditions for sociodemographic and most nutrition-related behaviours, with the exception of knowledge of calorie recommendations, indicating successful randomization.

TABLE 1
Distribution of participant characteristics by nutrition facts table conditions

Characteristic	Overall (n = 2010)		Current NFt (control) (n = 336)		Standardized serving-size (n = 335)		Low/ medium/ high descriptors for % DV (n = 336)		Standardized serving-size + low/ medium/high descriptors for % DV (n = 334)		Colour-coded % DV (n = 335)		Standardized serving-size + colour-coded % DV (n = 334)		Chi-square	*p* value
	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)		
Age, years																
16–18	50.0	(1004)	53.9	(181)	49.0	(164)	52.7	(177)	46.7	(156)	49.9	(168)	48.2	(161)	5.0	.42
19–24	50.1	(1006)	46.1	(155)	51.0	(171)	47.3	(159)	53.3	(178)	50.2	(167)	51.8	(173)		
Gender																
Female	50.2	(1008)	43.5	(146)	52.2	(175)	50.3	(169)	52.4	(175)	52.2	(175)	50.3	(168)	7.9	.16
Male	49.9	(1002)	56.6	(190)	47.8	(160)	49.7	(167)	47.6	(159)	47.8	(160)	49.7	(166)		
Education level																
Low (high school or less)	56.7	(1139)	54.8	(184)	56.7	(190)	56.9	(191)	58.7	(196)	56.4	(189)	56.6	(189)	2.3	.99
Medium (college or some university)	31.0	(624)	32.4	(109)	31.0	(104)	29.8	(100)	29.3	(98)	32.5	(109)	31.1	(104)		
High (university degree or higher)	12.3	(247)	12.8	(43)	12.2	(41)	13.4	(45)	12.0	(40)	11.0	(37)	12.3	(41)		
Ethnicity																
White	58.4	(1174)	55.4	(186)	59.4	(199)	59.5	(200)	57.2	(191)	57.3	(192)	61.7	(206)	3.4	.63
Other	41.6	(836)	44.6	(150)	40.6	(136)	40.5	(136)	42.8	(143)	42.7	(143)	38.3	(128)		
Region																
Atlantic	8.8	(173)	8.2	(27)	11.6	(38)	10.3	(34)	7.3	(24)	7.3	(24)	7.9	(26)	19.8	.18
Western	42.5	(838)	43.8	(144)	45.3	(148)	41.5	(137)	43.2	(142)	38.5	(127)	42.6	(140)		
Ontario	42.5	(839)	40.1	(132)	37.0	(121)	43.6	(144)	44.1	(145)	45.5	(150)	44.7	(147)		
Quebec	6.3	(124)	7.9	(26)	6.1	(20)	4.6	(15)	5.5	(18)	8.8	(29)	4.9	(16)		
Employment																
Full-time	24.1	(474)	22.3	(73)	24.8	(81)	22.5	(74)	25.6	(84)	23.2	(76)	26.4	(86)	16.8	.67
Part-time	32.9	(646)	31.2	(102)	34.3	(112)	33.7	(111)	30.2	(99)	33.3	(109)	34.7	(113)		
Unemployed (looking for work)	13.2	(260)	13.5	(44)	10.7	(35)	14.3	(47)	14.6	(48)	14.4	(47)	12.0	(39)		
Unemployed (not looking, includes full-time students)	28.5	(559)	30.6	(100)	28.1	(92)	28.6	(94)	29.3	(96)	28.1	(92)	26.1	(85)		
Unable to work	1.3	(25)	2.5	(8)	2.1	(7)	0.91	(3)	0.3	(1)	0.92	(3)	0.92	(3)		
Food shopping and meal preparation responsibilities in household																
Most responsible for food shopping in household	6.4	(126)	5.8	(19)	6.4	(21)	5.4	(18)	7.9	(26)	6.4	(21)	6.5	(21)	19.2	.20
Most responsible for meal preparation in household	7.4	(145)	4.6	(15)	8.5	(21)	8.8	(29)	7.6	(25)	8.2	(27)	6.5	(21)		
Most responsible for both food shopping and meal preparation in household	16.2	(320)	20.5	(67)	17.3	(57)	18.1	(60)	12.2	(40)	16.4	(54)	12.9	(42)		
Not responsible for either	70.0	(1379)	69.1	(226)	67.8	(223)	67.7	(224)	72.3	(238)	69	(227)	74.2	(241)		

Continued on the following page

TABLE 1 (continued)
Distribution of participant characteristics by nutrition facts table conditions

Characteristic	Overall (n = 2010) %	(n)	Current NFt (control) (n = 336) %	(n)	Standardized serving-size (n = 335) %	(n)	Low/medium/high descriptors for % DV (n = 336) %	(n)	Standardized serving-size + low/medium/high descriptors for % DV (n = 334) %	(n)	Colour-coded % DV (n = 335) %	(n)	Standardized serving-size + colour-coded % DV (n = 334) %	(n)	Chi-square	*p* value
Knowledge of calorie recommendations																
Correct understanding of recommended calorie intake	60.0	(1194)	60.2	(200)	62.4	(206)	63.8	(213)	51.7	(171)	60.0	(197)	62.7	(207)	13.5	.02
Incorrect understanding of recommended calorie intake	40.0	(797)	39.8	(132)	37.6	(124)	36.2	(121)	48.3	(160)	41.0	(137)	37.3	(123)		
Self-reported diet quality																
Fair or poor	38.1	(766)	38.7	(130)	36.4	(122)	39.6	(133)	40.4	(135)	36.1	(121)	37.4	(125)	3.6	.97
Good	34.9	(702)	34.8	(117)	35.8	(120)	35.1	(118)	31.4	(105)	36.4	(122)	35.9	(120)		
Excellent or very good	27.0	(542)	26.5	(89)	27.8	(93)	25.3	(85)	28.1	(94)	27.5	(92)	26.7	(89)		
Personal Weight Goal																
To gain weight	15.6	(310)	16.6	(55)	15.2	(50)	12.4	(41)	12.7	(42)	17.4	(58)	19.6	(64)	22.2	.10
To lose weight	40.3	(799)	35.1	(116)	40.0	(132)	42.2	(140)	43.7	(145)	43.8	(146)	36.7	(120)		
To maintain weight	23.5	(467)	23.3	(77)	25.8	(85)	24.7	(82)	21.7	(72)	22.2	(74)	23.6	(77)		
Not trying to do anything about weight	20.6	(409)	25.1	(83)	19.1	(63)	20.8	(69)	22.0	(73)	16.5	(55)	20.2	(66)		

Abbreviations: NFt, nutrition facts table; % DV, percent daily value.

Notes: Totals may not sum to final sample size, reflecting missing values for some respondents. In each case, missing values represent $< 3\%$ of the total sample. Percentages may not add to 100% due to rounding.

Interpreting % DV information on NFts

In the first of two interpretation tasks, significantly more participants accurately interpreted sodium information in four modified NFt conditions (low/medium/high descriptors, standardized serving-size + low/medium/high descriptors, colour-coded % DV information, standardized serving-size + colour-coded % DV; $p < .005$ for all) compared to the control condition (Table 2). Correctly interpreting total fat information was more likely in all five modified NFt conditions compared to the control condition ($p \leq .001$ for all; Table 2).

As shown in Table 3, the adjusted modified Poisson regression model indicates that participants exposed to NFt conditions with low/medium/high descriptors (relative ratio [RR] = 1.67; 95% CL: 1.48–1.89), standardized serving-size + low/medium/high descriptors (RR = 1.80; 95% CL: 1.60–2.03), colour-coded % DV information (RR = 1.61; 95% CL: 1.42–1.82), and standardized serving-sizes + colour-coded % DV information (RR = 1.63; 95% CL: 1.44–1.84) were significantly more likely to correctly interpret NFt information compared to the control condition. In contrast, the NFt condition with standardized serving-sizes only did not significantly improve participants' ability to correctly interpret NFt information ($p = 0.14$; Table 3).

Comparing information between two NFts

In the first of the three comparison tasks, significantly more participants were able to correctly compare two NFts and identify the product with lower sodium in all modified NFt conditions, with the exception of the condition modifying standardized serving-size only, as compared to the control condition ($p \leq .02$ for all; Table 2).

For the second comparison task, comparing and correctly identifying the product with fewer calories was significantly higher for NFt conditions with standardized serving-size ($p < .001$), standardized serving-size + low/medium/high descriptors ($p < .001$) and standardized serving-size + % DV information ($p < .001$).

TABLE 2
Distribution of participant characteristics by nutrition facts table conditions (N = 2010)

	Current NFt (control) (n = 336)		Standardized serving-size (n = 335)			Low/medium/high descriptors for % DV (n = 336)			Standardized serving-size + low/medium/high descriptors for % DV (n = 334)			Colour-coded % DV (n = 335)			Standardized serving-size + colour-coded % DV (n = 334)		
	%	*n*	%	*n*	*p*	%	*n*	*p*	%	*n*	*p*	%	*n*	*p*	%	*n*	*p*
Interpret																	
1. Does this product contain: a lot, a moderate amount, or a little sodium?	43.8	(147)	37.6	(126)	.11	57.7	(194)	< .001	68	(227)	< .001	55.5	(186)	.002	54.8	(183)	.004
2. Is the amount of total fat per serving in this product high, a moderate amount, or low?	34.2	(115)	47.5	(159)	< .001	72.0	(242)	< .001	70.4	(235)	< .001	67.5	(226)	< .001	71.0	(237)	< .001
Compare																	
1. Which product is the best option for someone who is trying to reduce their risk of high blood pressure by lowering sodium intake?	63.7	(214)	68.4	(229)	.20	79.8	(268)	< .001	72.2	(241)	.02	74.3	(249)	.003	76.7	(256)	< .001
2. Which product is the best option for someone trying to eat fewer calories?	25.0	(84)	54.6	(183)	< .001	21.4	(72)	.27	56.6	(189)	< .001	24.2	(81)	.81	57.2	(191)	< .001
3. How do these two products compare for sodium?	28.0	(94)	39.7	(133)	.001	19.1	(64)	.006	57.8	(193)	< .001	23.6	(79)	.19	57.8	(193)	< .001
Mathematically manipulate																	
1. If you consumed one-half of this box, what % DV total fat would you consume?	10.4	(35)	18.5	(62)	.003	9.8	(33)	.80	19.2	(64)	.001	9.9	(33)	.81	16.8	(56)	.02
2. How many servings would you have to eat to get all the fibre you need in a day?	56.6	(190)	56.1	(188)	.91	60.7	(204)	.27	57.5	(192)	.81	57.3	(192)	.84	59.9	(200)	.38

Abbreviations: NFt, nutrition facts table; % DV, percent daily value.

Note: Chi-square tests were used to determine significant differences in correct responses between each NFt condition and the control.

TABLE 3
Results of modified Poisson models assessing participants' ability to interpret, compare and mathematically manipulate nutrition facts table information within each nutrition facts table condition compared to the current nutrition facts table (control condition)

	Standardized serving-size	Low/med/high descriptors for % DV	Standardized serving-size + low/med/high descriptors for % DV	Colour-coded % DV	Standardized serving-size + colour-coded % DV
	RR (95% CL)	RR (95% CL)	RR (95% CL)	RR (95% CL)	RR (95% CL)
Interpret[a]	1.11 (0.97–1.27)	1.67 (1.48–1.89)	1.80 (1.60–2.03)	1.61 (1.42–1.82)	1.63 (1.44–1.84)
Compare[b]	1.41 (1.24–1.59)	1.03 (0.92–1.15)	1.60 (1.53–1.80)	1.02 (0.91–1.15)	1.64 (1.46–1.83)
Manipulate[c]	1.14 (0.99–1.31)	1.04 (0.91–1.19)	1.19 (1.04–1.37)	1.03 (0.90–1.18)	1.13 (0.99–1.29)

Abbreviations: % DV, % daily value; RR, relative ratio; 95% CL, 95% confidence limits.

[a] Adjusted for age, gender, education level, ethnicity, region, weight goal, food shopping and preparation responsibilities, knowledge of calorie recommendations.

[b] Adjusted for age, gender, employment, region, weight goal, food shopping and preparation responsibilities, perceived diet quality, knowledge of calorie recommendations.

[c] Adjusted for age, gender, education level, employment, ethnicity, region, weight goal, food shopping and preparation responsibilities, perceived diet quality, knowledge of calorie recommendations.

Finally, in the third comparison task, correctly comparing sodium information between two products was significantly higher in three NFt conditions, standardized serving-size ($p = .001$), standardized serving-size + low/medium/high descriptors ($p < .001$) and standardized serving-size + colour-coded % DV information ($p < .001$) compared to the control condition. Correct comparison of sodium information was significantly lower when participants were exposed to low/med/high descriptors ($p = .006$).

In the adjusted modified Poisson regression model, significantly more participants in the NFt conditions with standardized serving-size (RR = 1.41; 95% CL: 1.24–1.59) and standardized serving-size in combination with low/medium/high descriptors (RR = 1.60; 95% CL: 1.53–1.80) or colour-coded % DV information (RR = 1.64; 95% CL: 1.46–1.83) were able to correctly compare between two NFts relative to participants in the control condition (Table 3).

Mathematically manipulating nutrition information on NFts

Participants' ability to mathematically manipulate total fat information was low overall, falling below 20% across all conditions. However, accuracy was significantly higher for three NFt conditions (standardized serving-size, standardized serving-size + low/medium/high descriptors, standardized serving-size + colour-coded % DV information; $p < .05$ for all) compared to the control condition (Table 2). More than half of the participants were able to correctly mathematically manipulate fibre information across all five NFt conditions including the control condition; no overall effect by condition was detected ($p = .79$).

Results of the adjusted modified Poisson regression model indicate that the NFts with standardized serving-size plus low/medium/high descriptors had a modest but significant effect on participants' ability to correctly mathematically manipulate nutrition information compared to the control NFt (RR = 1.19; 95% CL: 1.04–1.37; Table 3). No other labelling conditions significantly improved participants' ability to mathematically manipulate NFt information.

Discussion

This is one of the first peer-reviewed studies in Canada to examine the effect of NFt modification on young people's comprehension and use of nutrition information. It is also among the first empirical studies of NFts conducted among young people internationally.[19,21] Our findings show that standardizing serving-size information and providing simple descriptors or colour coding to interpret % DV information on NFts improves adolescent and young adults' ability to interpret, compare, and mathematically manipulate nutrition information.

Standardized serving-sizes on NFts strongly enhanced young peoples' ability to compare two similar food products. Previous evidence suggests that inconsistencies in the serving sizes listed on NFts across products can bias perceptions and purchase intent in favour of the product with the smaller serving-size, which may not necessarily be the nutritionally superior product.[31] Requiring manufacturers to use standardized serving-sizes across similar products may be a promising strategy for facilitating understanding and accurate use of nutrition information on food labels.

Adding descriptors or colour coding next to calories and nutrient amounts on NFts proved critical for young people to correctly interpret % DV information on products. These findings are consistent with results from expert reports and studies examining front-of-package food-labelling systems.[32] Applying descriptors or colour coding gives consumers interpretational aids to translate complex numeric nutrition information, reducing the nutritional knowledge, cognitive effort and processing time required. Experts have underscored the importance of identifying strategies to communicate complicated nutrition information to consumers in meaningful ways, rather than relying exclusively on numeric data (e.g. kilocalories, grams, milligrams, percentages).[33] The current study tested the application of interpretational aids on calories and negative nutrients only; further research is needed to identify if and how this approach could be applied to positive nutrients.

Similar to a previously published study,[34] a large proportion of participants had difficulty manipulating nutrition information to calculate the nutrient content of multiple servings of a product, particularly when the task required complex math as well as understanding % DV information. Listing standardized serving-sizes and simple descriptors on NFts improved the

participants' ability to mathematically manipulate nutrition information, particularly in the task requiring them to calculate multiple servings of a product and estimate the corresponding % DV for the larger amount; however, the effect was modest and the majority of participants were still unable to correctly mathematically manipulate and use numeric information presented on labels. One explanation for the overall difficulty in manipulating nutrition information is that these tasks require a relatively substantial amount of time, motivation and effort as well as nutrition knowledge and math skills. To enable quick and easier access to nutrition information, previous studies have suggested adding a second column to the NFt presenting nutrient and calorie information for an entire package.[35] This potential modification may help consumers estimate the nutrient profile of products containing multiple servings. However, Roberto and Khandpur[36] noted that providing additional information may increase label complexity. Additional research should compare the dual and single column labels with simpler presentation formats that provide less information, including listing the total number of servings in an entire package on the NFt.

Strengths and limitations

This study has several limitations. First, the study did not use probability sampling techniques to select a representative sample of young people from Canada. The sample was intended to provide a heterogeneous cross-section of participants from across Canada for random allocation across NFt conditions. Research has shown that higher levels of income and education are generally associated with better performance on nutritional labelling tasks.[19] The proportion in our sample of young adults (19–24 y) with more than a high school education was 76%. Poor performance on these tasks among a highly educated sample suggests that consumer understanding and use of serving size and % DV information could be even lower in other population groups. Although the findings may be generalizable to other Canadians of a similar age, further research is necessary to assess whether similar results would be found among subgroups of young people not captured in this survey, including non-English speakers or those less likely to participate or be recruited onto an online panel. To better simulate a real-world situation, the NFts were displayed on two boxes of hypothetical brands of crackers. Crackers are an appropriate product to test various formats of nutrition labels as they offer many nutritive variations and are not necessarily perceived as healthy or unhealthy. There are numerous studies that use a single pre-packaged product to test the efficacy of various formats of nutrition labels and generalize the findings across products[16,36-38]. However, replicating this study with other products and categories is recommended, as results may vary. Finally, the current study uses a conventional method for evaluating communication materials and concepts prior to implementation; however, online, experimental studies cannot replicate a real-world shopping experience. Future research should aim to evaluate the effectiveness of changes to NFts on food selection and dietary behaviours in real-world settings.

Conclusion

Both academics and health organizations have recommended improvements to nutrition labelling, including standardizing serving-sizes and adding interpretative labels to % DV information, and these changes are supported by consumers.[22,39,40] Proposed changes to nutrition labels are under review in Canada and include standardizing serving-size information within similar product categories and adding an interpretational statement defining what is a little or a lot of the % DV.[22] Our research suggests that both of these modifications to the NFt may help young Canadians interpret NFt information when choosing foods, compare information between similar products, and mathematically manipulate numeric information to understand the nutritional content of multiple servings of a product.

Our findings provide preliminary evidence supporting the efficacy of modifications to the NFt on consumer understanding and use of nutrition information. Further research is needed to better understand the efficacy of NFt modifications for supporting more informed food choices across a range of food categories and among adults of other age groups in Canada.

Acknowledgements

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References

1. Global Burden of Disease Study 2010. Country Profiles – GBD Profile Canada [Internet]. Washington (DC): Institute for Health Metrics and Evaluation; [cited 2015 Jul 8]. Available from: http://www.healthdata.org/sites/default/files/files/country_profiles/GBD/ihme_gbd_country_report_canada.pdf

2. Hooper L, Martin N, Abdelhamid A, Davey Smith G. Reduction in saturated fat intake for cardiovascular disease. Cochrane Database Syst Rev. 2015;6:CD011737 DOI: 10.1002/14651858.CD011737.

3. Strazzulo P, D'Elia L, Kandala NB, Cappuccio FP. Salt intake, stroke, and cardiovascular disease: meta-analysis of prospective studies. BMJ. 2009;339:b4567.

4. Abdullaha A, Peetersa A, de Courtena M, Stoelwinder J. The magnitude of association between overweight and obesity and the risk of diabetes: a meta-analysis of prospective cohort studies. Diabetes Res Clin Pract. 2010;89(3):309-19.

5. Amed S, Dean HJ, Panagiotopoulos C, et al. Type 2 Diabetes, medication-induced diabetes, and monogenic diabetes in Canadian children: a prospective national surveillance study. Diabetes Care. 2010;33(4):786-91.

6. Shields M. Overweight and obesity among children and youth [Internet]. Health Reports. 2006 [cited 2015 Jul 08] 17(3):27-42. Available from: http://www.statcan.gc.ca/pub/82-003-x/2005003/article/9277-eng.pdf

7. Public Health Agency of Canada. Chief Public Health Officer's report on the state of public health in Canada: youth and young adults — life in transition [Internet]. Ottawa (ON): Public Health Agency of Canada; 2011 [cited 2015 Jul 15]. Available from: http://www.phac-aspc.gc.ca/cphorsphc-respcacsp/2011/index-eng.php

8. Ribiero RC, Coutinho M, Bramorski MA, Giuliano IC, Pavan J. Association of the waist-to-height ratio with cardiovascular risk factors in children and adolescents: the Three Cities Heart Study. Int J Prev Med. 2010;1:39-49.

9. Nelson MC, Story M, Larson NI, Neumark-Sztainer D, Lytle LA. Emerging adulthood and college-aged youth: an overlooked age for weight-related behavior change. Obesity. 2008;16(10):2205-11.

10. Larson NI, Story M, Eisenberg ME, Neumark-Sztainer D. Food preparation and purchasing roles among adolescents: associations with sociodemographic characteristics and diet quality. J Am Diet Assoc. 2006;106(2):211-8.

11. Dunn JE, Liu K, Greenland P, Hilner JE, Jacobs DR Jr. Seven-year tracking of dietary factors in young adults: the CARDIA study. Am J Prev Med. 2000;18(1):38-45.

12. Health Canada. Regulations amending the Food and Drug Regulations (Nutrition Labelling, Nutrient Content Claims and Health Claims) [Internet]. Canada Gazette, Part 2. 2003 Jan 1 [cited 2015 Jul 15] 137(1):154 Available from: http://publications.gc.ca/gazette/archives/p2/2003/2003-01-01/pdf/g2-13701.pdf

13. Goodman S, Hammond D, Pillo-Blocka F, Glanville T, Jenkins R. Use of nutritional information in Canada: national trends between 2004 and 2008. J Nutr Educ Behav. 2011;43:356-65.

14. Emrich TE, Qi Y, Mendoza JE, Lou W, Cohen JE, L'abbe MR. Consumer perceptions of the Nutrition Facts table and front-of-pack nutrition rating systems. Appl Physiol Nutr Metab. 2014;39(4):417-24.

15. Cowburn G, Stockley L. Consumer understanding and use of nutrition labelling: a systematic review. Public Health Nutr. 2005;8(1):21-8.

16. The Strategic Counsel. Canadians' understanding and use of the nutrition facts table: baseline national survey results. 2011; POR 031-10(HCPOR-10-06).

17. Canadian Food Inspection Agency. Information within the nutrition facts table. Mandatory information and serving size [Internet]. Ottawa (ON): Canadian Food Inspection Agency; [modified 2015 Apr 10; cited 2015 Jul 15]. Available from: http://www.inspection.gc.ca/food/labelling/food-labelling-for-industry/nutrition-labelling/information-within-the-nutrition-facts-table/eng//1389198568400/1389198597278?chap = 1

18. Government of Canada. Food labels: the percent daily value [Internet]. Ottawa (ON): Government of Canada; [modified 2015 May 29; cited 2015 Jul 15]. Available from: http://www.healthycanadians.gc.ca/eating-nutrition/label-etiquetage/daily-value-valeur-quotidienne-eng.php

19. Campos S, Doxey J, Hammond D. Nutrition labels on pre-packaged foods: a systematic review. Public Health Nutr. 2011;14(8):1496-506.

20. Wartella EA, Lichtenstein AH, Boon CS Editors;Committee on Examination of Front-of-Package Nutrition Ratings Systems and Symbols; Institute of Medicine Institute of Medicine (IOM) Front-of-Package Nutrition Rating Systems and Symbols. Phase 1 Report) Washington (DC): The National Academies Press; 2010.

21. Wojcicki JM, Heyman MB. Adolescent nutritional awareness and use of food labels: results from the National Nutrition Health and Examination Survey. BMC Pediatr. 2012;12:55.

22. Health Canada. Health Canada's proposed changes to the format requirements for the display of nutrition and other information on food labels [Internet]. Ottawa (ON): Health Canada; 2014 Jul 14 [cited 2015 Jul 15]. Available from: http://www.hc-sc.gc.ca/fn-an/consult/2014-format-requirements-exigences-presentation/document-consultation-eng.php#a1

23. Balasubramanian SK, Cole C. Consumers' search and use of nutrition information: the challenge and promise of the Nutrition Labeling and Education Act. J Marketing. 2002;66(3):112-27.

24. Health Canada. Sodium in Canada: recommended intake of sodium [Internet]. Ottawa (ON): Health Canada; 2012 Jun 08 [cited 2015 Jul 13]. Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/sodium/index-eng.php#a2

25. Centers for Disease Control and Prevention. 2011-2012 National Health and Nutrition Examination Survey (NHANES) – Weight history – WHQ: Target group: SPs 16+ [Internet]. Atlanta (GA): NHANES; 2011 [cited 2015 Jul 14]. Available from: http://www.cdc.gov/nchs/data/nhanes/nhanes_11_12/whq.pdf

26. Bleich SN, Pollack KM. The publics' understanding of daily caloric recommendations and their perceptions of calorie posting in chain restaurants. BMC Public Health. 2010;10:121.

27. Elbel B. Consumer estimation of recommended and actual calories at fast food restaurants. Obesity. 2011;19:1971-8.

28. Krukowski RA, Harvey-Berino J, Kolodinsky J, Narsana RT, Desisto TP. Consumers may not use or understand calorie labeling in restaurants. J Am Diet Assoc. 2006;106:917-20.

29. Health Canada. Food and nutrition: estimated energy requirements [Internet]. Ottawa (ON): Health Canada; [modified 2014 Mar 20; cited 2015 Jul 13]. Available from: http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/basics-base/1_1_1-eng.php

30. Mackison D, Wrieden WL, Anderson AS. Validity and reliability testing developed to assess consumers' use, understanding, and perceptions of food labels. Eur J Clin Nutr. 2010;64(2):210-7.

31. Mohr GS, Lichtenstein DR, Janiszewski C. The effect of marketer-suggested serving size on consumer responses: the unintended consequences of consumer attention to calorie information. J Marketing. 2012;76(59):75.

32. Wartella EA, Lichtenstein AH, Yaktine A, Nathan R editors;Committee on Examination of Front-of-Package Nutrition Rating Systems and Symbols (Phase II) Front-of-package nutrition rating systems and symbols: promoting healthier choices. Washington (DC): The National Academies Press; 2011 Oct.

33. Van Herpen E, Hieke S, van Trijp H. C.M. Inferring product healthfulness from nutrition labelling. The influence of reference points. Appetite. 2014;72:138-49.

34. Rothman RL, Housam R, Weiss H, et al. Patient understanding of food labels: the role of literacy and numeracy. Am J Prev Med. 2006;31(5):391-8.

35. Antonuk B, Block LG. The effect of single serving versus entire package nutritional information on consumption norms and actual consumption of a snack food. J Nutr Educ Behav. 2006;38(6):365-70.

36. Hieke S, Wilczynski P. Colour me in – an empirical study on consumer responses to the traffic light signposting system in nutrition labelling. Public Health Nutr. 2013;15(5):773-82.

37. Andrews J, Burton S, Kees J. Is simpler always better? Consumer evaluations of front-of-package nutrition symbols. J Public Policy & Marketing. 2011;30(2):175-90.

38. Hamlin R, McNeill L, Moore V. The impact of front-of-pack nutrition labels on consumer product evaluation and choice: an experimental study. Public Health Nutr. 18(12): 2126-34.

39. Roberto CA, Khandpur N. Improving the design of nutrition labels to promote healthier food choices and reasonable portion sizes. Int J Obes (Lond). 2014;38 Suppl 1: S25-33.

40. Silverglade B, Ringel Heller I. Food labeling chaos: the case for reform [Internet]. Washington (DC): Center for Science in the Public Interest; 2010 [cited 2015 Jul 15]. Available from: http://www.cspinet.org/new/pdf/food_labeling_chaos_report.pdf

Trends in prevalence, incidence and mortality of diagnosed and silent coronary heart disease in Quebec

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This article has been peer reviewed.

Abstract

Introduction: Of all cardiovascular causes of mortality, coronary heart disease (CHD) remains the leading cause of death. Our objectives were to establish trends in the prevalence and incidence of CHD in the province of Quebec, and to determine the proportion of CHD mortality that had no previous CHD diagnosis.

Methods: Trends in prevalence, incidence and mortality were examined with a population-based study using the Quebec Integrated Chronic Disease Surveillance System, which links several health administrative databases. Data are presented using two case definitions for Quebecers aged 20 years and over: 1) a validated definition, and 2) CHD causes of death codes added to estimate the proportion of deaths that occurred without any previous CHD diagnosis as a proxy for sudden cardiac death (SCD).

Results: In 2012/2013, the crude prevalence of CHD was 9.4% with the first definition (593 000 people). Between 2000/2001 and 2012/2013, the age-standardized prevalence increased by 14%, although it has been decreasing slightly since 2009/2010. Age-standardized incidence and mortality rates decreased by 46% and 26% respectively, and represented a crude rate of 6.9 per 1000 and 5.2% in 2012/2013. The proportion identified only by CHD mortality, our SCD proxy, was only significant for the incident cases (0.38 per 1000 in 2009/2010) and declined over the study period.

Conclusion: The prevalence of CHD has tended to decrease in recent years, and incidence and mortality have been declining in Quebec. Most CHD mortality occurs in previously diagnosed patients and only a small proportion of incident cases were not previously identified.

Keywords: *coronary heart disease, trends, epidemiology, incidence, sudden cardiac death*

Key findings

- As Quebec is one of the few provinces in Canada that can link vital statistics with other health administrative data, the data can tell us whether people who died from coronary heart disease (CHD) had been previously diagnosed.
- Our results show that most of the people who died from CHD had been previously diagnosed with the disease. Only a small proportion of undiagnosed incident cases died from CHD.
- The burden of both diagnosed and silent CHD in Quebec is decreasing.
- Men had a higher prevalence and incidence, while mortality rates were the same for both sexes.

Introduction

Although coronary heart disease (CHD) remains the worldwide leading cause of death, cardiovascular mortality in high-income countries is declining.[1,2] This downward trend has been extensively studied.[3-5] In Canada, the proportion associated with the decrease in cardiovascular risk factors (primary prevention) was 48%, and the one associated with advances in medical and surgical treatments (secondary prevention) was 43%.[6] However, recent epidemiological studies have demonstrated that primary prevention of CHD would be more difficult to implement because of the increasing prevalence of risk factors such as hypertension,[7,8] diabetes[9] and obesity,[10] which could contribute to an increase in cardiovascular burden.

Many studies have addressed the public health burden of CHD death as well as of out-of-hospital CHD death, a surrogate for sudden cardiac death (SCD).[11] These studies have documented evidence of a significant decrease in SCD rates.[12,13] However, there is little information about the burden and trends of CHD mortality outside of hospitals and without any previous CHD diagnosis. A recent study revealed modest improvements over time in risk factor profiles of patients without known cardiovascular disease who presented with a first myocardial infarction.[14] Because ventricular arrhythmias are life-threatening complications of acute myocardial infarction that are relatively common among people with no prior history of CHD,[15] documenting the incidence of CHD mortality *without* prior CHD diagnosis would be useful. Chugh et al.[16] (p. 219) went further and mentioned that there exists "a critical need to learn more about patients who suffer SCD

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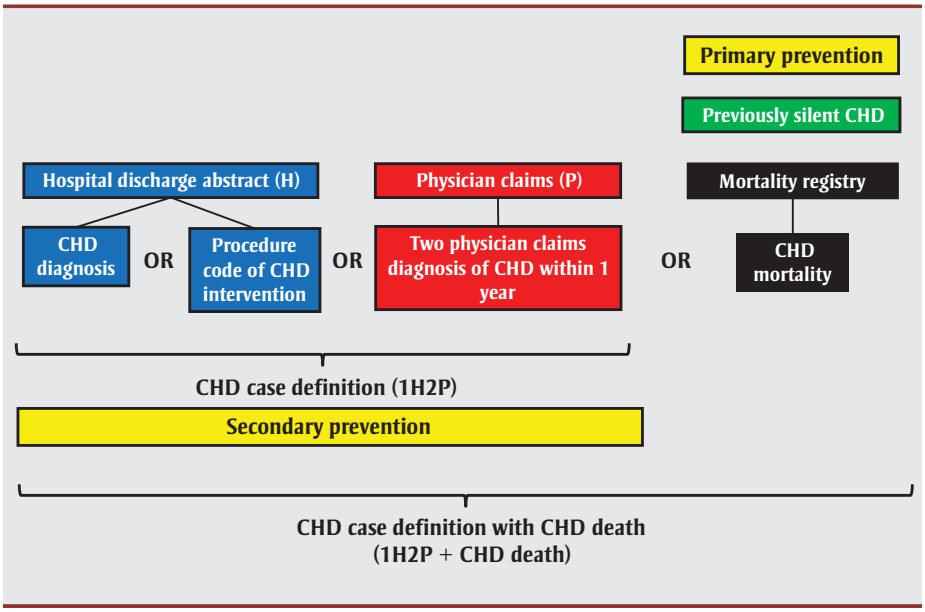
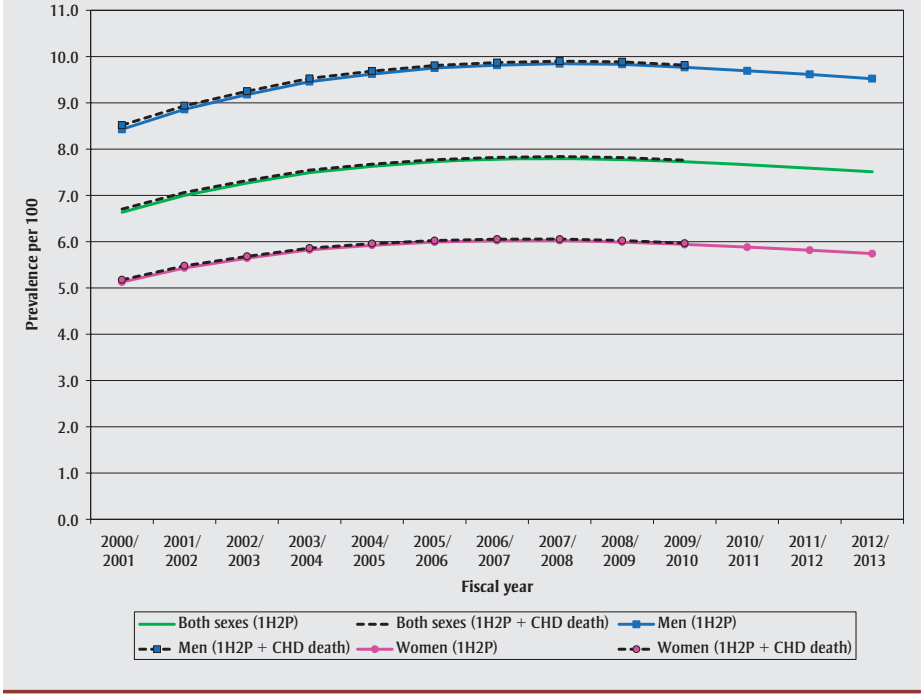
FIGURE 1
Case definitions of CHD plus the addition of CHD as cause of death to identify silent cases and their relationship with primary and secondary prevention



Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.

FIGURE 2A
Age-standardized[a] prevalence of diagnosed coronary heart disease, by sex and for all adults ≥ 20 years, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
[a] Age standardization using 2001 Quebec Census data as the standard population.

in the community, particularly when they do not have previously identified heart disease."

Knowing that both primary and secondary prevention have greatly improved the trends in cardiovascular mortality, our first objective was to determine the trends in CHD prevalence, incidence and mortality in the province of Quebec, by sex and age, using a validated case definition. Our second objective was to determine the proportion of CHD mortality that occurred without any previous CHD diagnosis or treatment, a proxy of SCD, and to establish the trends in this proportion for prevalence, incidence and mortality in the last decade in Quebec, by sex and age.

Methods

Data sources

Our data source was the Quebec Integrated Chronic Disease Surveillance System (QICDSS), developed by the Institut national de santé publique du Québec.[17] Briefly, the QICDSS was created by linking five health administrative databases: the health insurance registry, hospital discharges, physician claims, vital statistics and drug databases (≥ 65 years; not used in this study). The QICDSS covers the entire Quebec population (8 million in 2012 in the health insurance registry) since 1st January, 1996, and is updated annually, except for the mortality database, which is delayed; each fiscal year starts in April. The last year of mortality data we used was 2009/2010, while we used 2012/2013 for the other databases.

Coronary heart disease case definitions

We used two case definitions for adults aged 20 years and over who are eligible for health insurance in Quebec: one for those diagnosed with CHD and the other that added people who received a CHD diagnosis only at death.

People were considered to be diagnosed with a CHD if they had received (1) a hospital discharge abstract with a principal or secondary CHD diagnosis code using *International Classification of Diseases* (ICD); (2) a hospital procedure code in any field of coronary intervention (coronary artery bypass graft or percutaneous coronary intervention); or (3) at least two physician claims with a CHD

TABLE 1A
Number, age-standardized rate and mean age of the prevalent cases of coronary heart disease, adults aged ≥ 20 years, identified using physician claims, hospital data or coronary heart disease mortality data, Quebec, 2000/2001 and 2009/2010

Prevalence		Number (n)[a]			Age-standardized rate, %			Mean age, years		
		Total	Men	Women	Total (95% CI)	Men (95% CI)	Women (95% CI)	Total (95% CI)	Men (95% CI)	Women (95% CI)
2000/2001	Hospital[b] or ≥ 2 physician claims (1H2P)	382 240	212 110	170 130	6.64 (6.61–6.66)	8.43 (8.38–8.48)	5.13 (5.10–5.16)	69 (68–69)	66 (66–66)	71 (71–72)
	Hospital[b] or ≥ 2 physician claims and CHD death[c] (1H2P + CHD death)	386 200	214 225	171 975	6.70 (6.68–6.73)	8.52 (8.47–8.57)	5.18 (5.14–5.21)	69 (69–69)	66 (66–66)	72 (72–72)
	CHD death[c] only	3960	2115	1840	0.07 (0.06–0.07)	0.09 (0.09–0.10)	0.05 (0.05–0.05)	76 (75–76)	71 (70–71)	82 (81–82)
2009/2010	Hospital[b] or ≥ 2 physician claims (1H2P)	562 160	316 825	245 335	7.72 (7.69–7.75)	9.77 (9.72–9.81)	5.94 (5.91–5.97)	70 (70–70)	68 (68–68)	73 (73–73)
	Hospital[b] or ≥ 2 physician claims and CHD death[c] (1H2P + CHD death)	565 135	318 410	246 725	7.76 (7.73–7.79)	9.82 (9.77–9.86)	5.97 (5.93–6.00)	70 (70–70)	68 (68–68)	73 (73–73)
	CHD death[c] only	2975	1585	1390	0.04 (0.04–0.04)	0.05 (0.05–0.05)	0.03 (0.03–0.03)	75 (75–76)	70 (69–70)	81 (80–82)

Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.

Abbreviations: CHD, coronary heart disease; CI, confidence interval.

[a] Sums can differ due to rounding.

[b] A hospital discharge abstract with a CHD diagnosis code or a hospital procedure code of coronary intervention.

[c] CHD causes of death from mortality records.

diagnosis code within a one-year period. The use of ICD and procedures codes has been described elsewhere.[18] This first case definition, with slight modifications in the procedure codes, has been validated by Tu et al.,[19] and is used in the surveillance of CHD by the Canadian Chronic Disease Surveillance System, a collaborative network of provincial and territorial surveillance systems supported by the Public Health Agency of Canada.[18] We call this case definition "1H2P."

For the second case definition, the mortality records data were added to 1H2P to include the number of Quebecers who died of CHD but who had not been previously identified in the hospital or physician claims data (see Figure 1). This "1H2P + CHD death" case definition was applicable when the initial or any secondary causes of death corresponded to the CHD diagnosis codes referenced above.[18] In other words, as the QICDSS links with the mortality records, CHD as cause of death is another possible way to identify cases of people without a diagnosis who died from CHD.

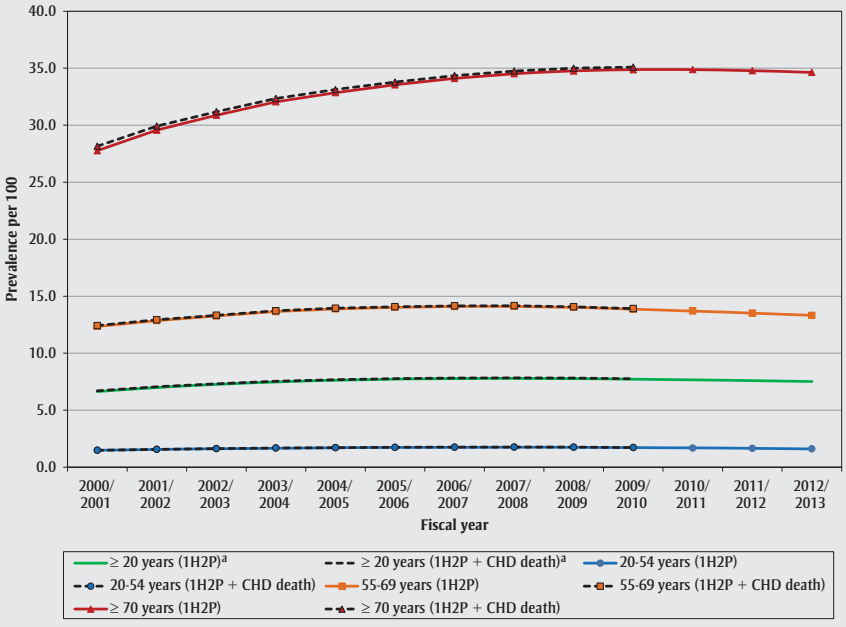
Statistical analysis

We calculated prevalence, incidence and mortality of CHD as previously described[8,18,20] with the number of eligible people in the health insurance registry as the denominator. Prevalent cases remained for the remainder of the follow-up period, as long as they were alive at the beginning of the year studied and had a valid health insurance card. We calculated prevalence by dividing the total number of prevalent cases by the insured population and multiplying by 100. To calculate incidence, we divided the total number of newly diagnosed (incident) cases by the insured population at risk (total number of insured population minus the prevalent cases at the beginning of the fiscal year) and multiplied by 1000. Because a minimum of four years was necessary to differentiate incident from prevalent cases, measures were reported from 2000/2001 even though observation began in January 1996.

We calculated mortality rates as the number of deaths from all causes among CHD patients divided by the number of CHD prevalent cases and multiplied by 100. To analyze time trends, we used age-standardized rates and

FIGURE 2B

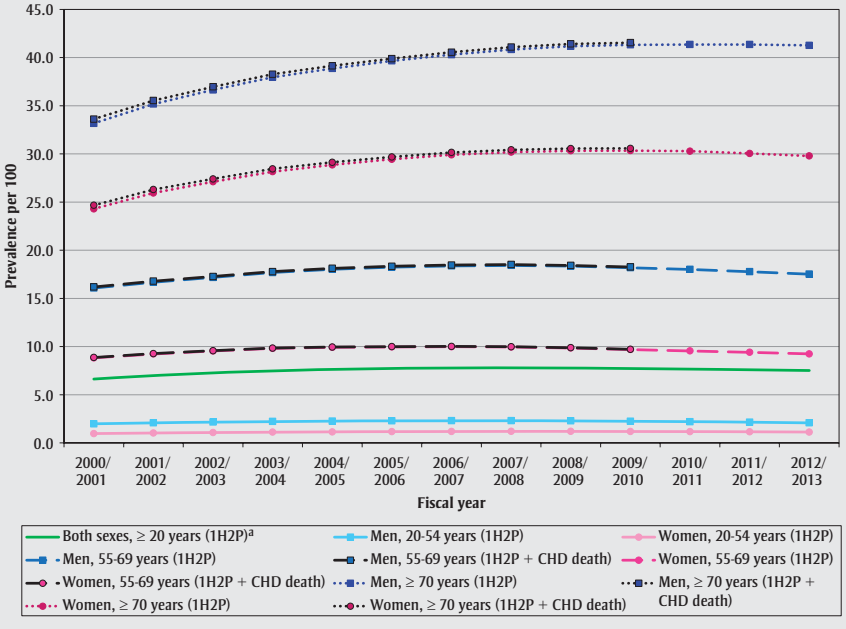
Age-standardized prevalence of diagnosed coronary heart disease, by age group, in adults ≥ 20 years, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
[a] Age standardization using 2001 Quebec Census data as the standard population.

FIGURE 2C

Age-standardized prevalence of diagnosed coronary heart disease, in adults ≥ 20 years, by sex and age group, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
Note: The addition of the cause of death was not shown for the age group 20–54 years because there is no difference for the two case definitions.
[a] Age standardization using 2001 Quebec Census data as the standard population.

the 2001 Quebec Census population aged 20 years and over as the standard population. Relative changes over time and relative difference between sexes were calculated as previously described[7]; 95% confidence intervals (CI) were computed using an inverse gamma distribution. Given the population-based nature of the study, many of the CIs were small and therefore not included in graphs. When the CIs do not overlap, the difference was considered as statistically significant, although this test is considered conservative. Statistical analyses were performed using SAS Enterprise Guide version 5.1 (SAS Institute Inc., Cary, NC, USA).

Results

Prevalence

Trends for 1H2P

In 2012/2013, more than 593 000 Quebecers aged 20 years and over were diagnosed with CHD, which represents a crude prevalence of 9.4% (593 035/6 342 005; 95% CI: 9.3–9.4). Between 2000/2001 and 2012/2013, the age-standardized prevalence increased by 14% among men and women although it has decreased slightly since 2009/2010 (Figure 2A). Over the study period, men had a higher prevalence than women; in 2012/2013, the prevalence in women was 40% lower than in men.

Trends for the 1H2P + CHD death

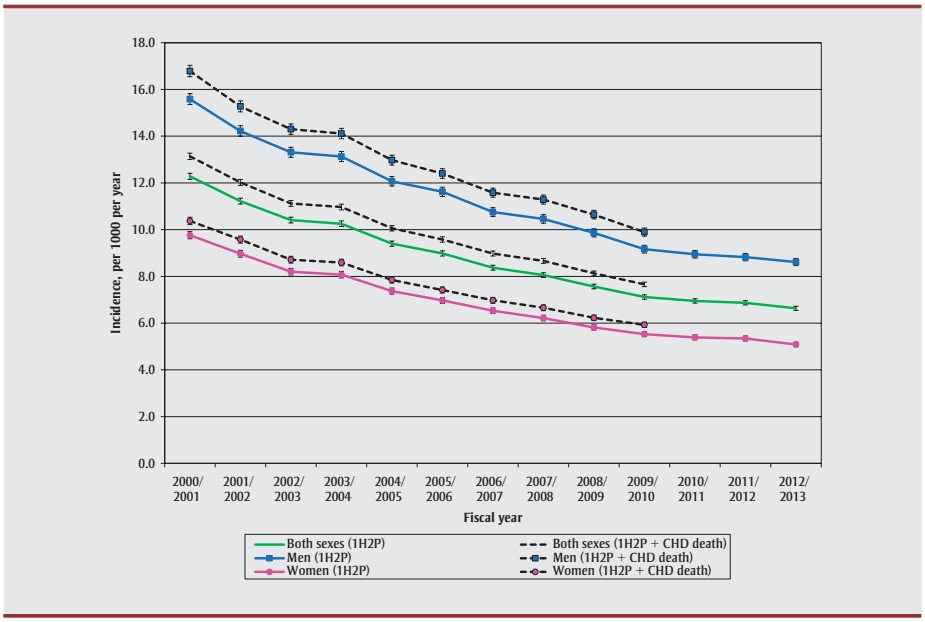
The additional data from the mortality registry—those who died of CHD without having had a previous diagnosis—added only a very small proportion of cases (statistically significant only in 2000/2001) to those already identified (Figure 2A). This proportion decreased during the study period, from the age-standardized rate of 0.07% (95% CI: 0.06%–0.07%) for the total adult population in 2000/2001 to 0.04% (95% CI: 0.04%–0.04%) in 2009/2011 (see Table 1A).

Trends for each case definition based on age

Using the 1H2P definition, the prevalence of CHD in people aged 70 years and over increased the most between 2000/2001 and 2009/2010 and slightly decreased afterwards, while this prevalence decreased in the other age groups between 2008/2009 and 2012/2013 (Figure 2B). Including CHD deaths (1H2P + CHD death) added only a

FIGURE 3A

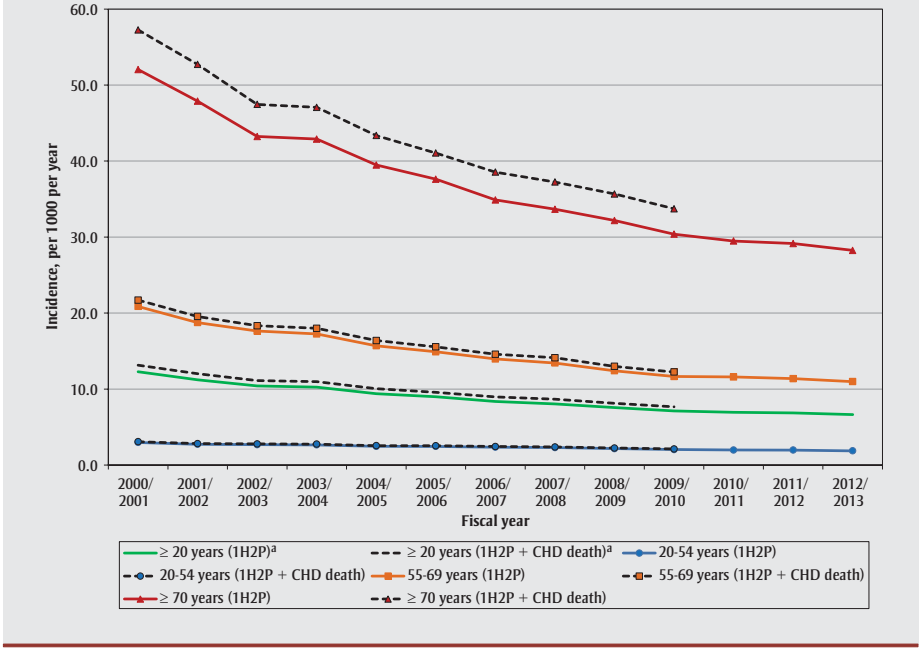
Age-standardized[a] incidence of diagnosed coronary heart disease, by sex and for all adults ≥ 20 years, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
Note: 95% confidence intervals are represented by the vertical bars.
[a] Age standardization using 2001 Quebec Census data as the standard population.

FIGURE 3B

Age-standardized incidence of diagnosed coronary heart disease, by age group, in adults ≥ 20 years, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
[a] Age standardization using 2001 Quebec Census data as the standard population.

few cases, which was barely significant in the first two years, 2000/2001 and 2001/2002, for people aged 70 years and more. Regardless of age, the prevalence in men was continually higher over this period (Figure 2C).

Incidence

Trends for 1H2P

In 2012/2013, nearly 40 000 people were diagnosed with CHD for the first time, making the crude incidence rate 6.9 per 1000 (39 850/5 788 825; 95% CI: 6.8–7.0). Between 2000/2001 and 2012/2013, the age-standardized incidence of CHD decreased by 46% for both sexes combined (Figure 3A). Over this period, women had a lower incidence of CHD than did men, by as much as 41% in 2012/2013.

Trends for 1H2P + CHD death

Taking into account CHD as the cause of death significantly increased the absolute incidence of CHD by an average of 0.7 between 2000/2001 and 2009/2010 for both sexes combined (Figure 3A). The proportion identified through CHD death only decreased over time and was higher in men (Table 1B).

Trends for each case definition based on age

Based on the 1H2P definition, the incidence of CHD decreased over time and particularly for those aged 70 years and over (Figure 3B). Also taking into account CHD deaths (the 1H2P + CHD death definition) added a significant proportion to the incidence for the oldest age group (≥ 70 years) only: the incidence increased from 30.4 per 1000 (95% CI: 29.8–31.0; n = 17 400 cases) in 2009/2010 to 33.7 per 1000 (95% CI: 33.1–34.4; n = 19 310 cases). As with prevalence, incidence was always higher in men than in women in all the age group (Figure 3C).

All-cause mortality

Trends for 1H2P

Over 30 000 people diagnosed with CHD died in 2012/2013. These people had been hospitalized or had consulted a physician for CHD, and a date of death was recorded in their insurance registry (all causes of death). This represented a crude proportion of 5.2% (30 550/593 035; 95% CI 5.1–5.2). Figure 4A shows that the adjusted mortality

TABLE 1B
Number, age-standardized rate and mean age of the incident cases of coronary heart disease, adults aged ≥ 20 years, identified using physician claims, hospital data or coronary heart disease mortality data, Quebec, 2000/2001 and 2009/2010

Incidence		Number (n)[a]			Age-standardized rate, per 1000 per year			Mean age, years		
		Total	Men	Women	Total (95% CI)	Men (95% CI)	Women (95% CI)	Total (95% CI)	Men (95% CI)	Women (95% CI)
2000/2001	Hospital[b] or ≥ 2 physician claims (1H2P)	58 930	31 545	27 390	12.28 (12.15–12.41)	15.59 (15.35–15.82)	9.76 (9.61–9.91)	67 (67–67)	64 (64–65)	70 (70–70)
	Hospital[b] or ≥ 2 physician claims and CHD death[c] (1H2P + CHD death)	62 880	33 655	29 230	13.14 (13.00–13.27)	16.79 (16.54–17.03)	10.37 (10.22–10.53)	68 (68–68)	65 (65–65)	71 (71–71)
	CHD death[c] only	3950	2110	1840	0.67 (0.64–0.70)	0.90 (0.85–0.95)	0.48 (0.45–0.51)	76 (75–76)	71 (70–71)	82 (81–82)
2009/2010	Hospital[b] or ≥ 2 physician claims (1H2P)	39 680	21 895	17 790	7.12 (7.02–7.21)	9.16 (9.00–9.33)	5.53 (5.42–5.64)	67 (67–67)	64 (64–65)	70 (70–70)
	Hospital[b] or ≥ 2 physician claims and CHD death[c] (1H2P + CHD death)	42 630	23 465	19 175	7.66 (7.56–7.75)	9.90 (9.72–10.07)	5.93 (5.82–6.04)	68 (67–68)	65 (65–65)	71 (71–71)
	CHD death[c] only	2950	1570	1385	0.38 (0.37–0.40)	0.49 (0.46–0.52)	0.28 (0.26–0.31)	75 (75–76)	70 (69–70)	81 (80–82)

Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.

Abbreviations: CHD, coronary heart disease; CI, confidence interval.

[a] Sums can differ due to rounding.

[b] A hospital discharge abstract with a CHD diagnosis code or a hospital procedure code of coronary intervention.

[c] CHD causes of death from mortality records.

rate decreased for both sexes combined by 26% between 2000/2001 and 2012/2013.

Trends for 1H2P + CHD death

In 2009/2010, taking into account CHD deaths among people not previously diagnosed with CHD in addition to all causes of death for prevalent cases increased the age-standardized mortality rate, although this increase was insignificant (Table 1C and Figure 4A). As with prevalence and incidence, this proportion decreased over time.

Sex and age group trends for each case definition

Using either case definition, men and women had similar mortality rates, particularly since 2008/2009 (Figure 4B). Between 2000/2001 and 2009/2010, the addition of CHD death increased average mortality rates nonsignificantly by 0.3 and 0.6 in absolute values, for women and men respectively. Overall mortality rates of the three age groups declined (see Figure 4C). Adding CHD as the cause of death significantly increased mortality rates for all age groups, although it did not have an effect on trends. Mortality rates were very similar in both sexes and all age groups (data not shown).

Mean age for prevalence, incidence and mortality based on sex

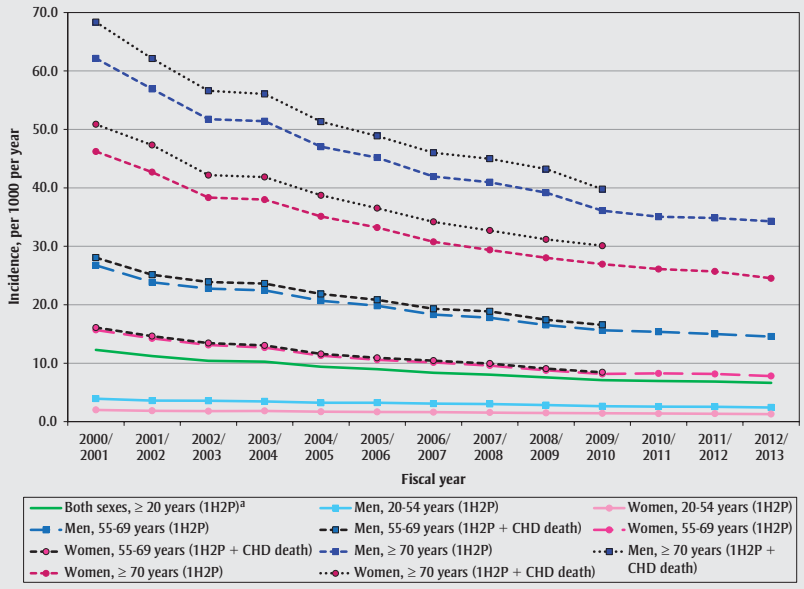
For prevalence and incidence, both sexes combined, the mean age of patients identified through CHD death only was consistently significantly higher than that of patients identified through physician claims or hospital data over the study period (see Tables 1A and 1B, respectively). This age difference was driven by the one observed in women (11 years older in 2009/2010 for incident cases in women, compared to 6 years older for men). However, in the case of mortality rates, the people identified with CHD death only were younger. This difference was most pronounced in men (8 years younger in 2009/2010, compared to 2 years younger for women; see Table 1C).

Discussion

Based on either case definition, 1H2P (hospital or ≥ 2 physician claims) or 1H2P + CHD death (hospital or ≥ 2 physician claims and CHD death), the prevalence of CHD tended to

FIGURE 3C

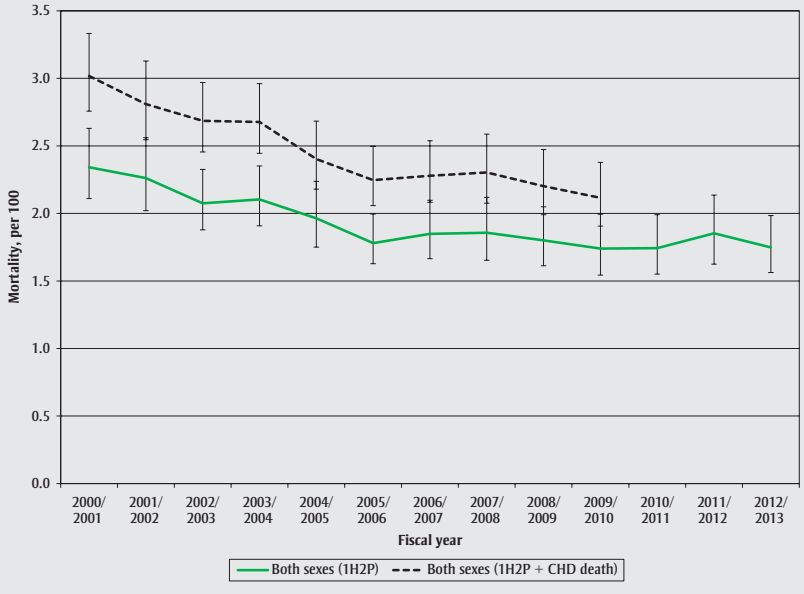
Age-standardized incidence of diagnosed coronary heart disease in adults ≥ 20 years, by sex and age group, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
Note: The addition of the cause of death was not shown for the age group 20–54 years because there is no difference for the two case definitions.
[a] Age standardization using 2001 Quebec Census data as the standard population.

FIGURE 4A

Age-standardized[a] mortality rate for adults aged ≥ 20 years with diagnosed coronary heart disease, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
Note: 95% confidence intervals are represented by the vertical bars.
[a] Age standardization using 2001 Quebec Census data as the standard population.

decrease in recent years, while incidence and mortality declined over the study period. The proportions of CHD mortality that occurred without any previous diagnosis or treatment for CHD, our proxy for SCD, decreased over the study period and were statistically significant for incident cases only, although the differences were small. The incident rate of this proxy for SCD was around 0.38 per 1000 in 2009/2010. Our results thus confirm that a very small proportion of CHD patients in the province of Quebec died without having been diagnosed with CHD by a physician. Men had a significantly higher prevalence and incidence of CHD while their mortality rates were about the same as women's.

Our results are similar to those of Moran et al.,[21] who demonstrated that age-standardized incidence of myocardial infarction and prevalence of angina decreased globally between 1990 and 2010 in 21 world regions. Similarly, in most world regions age-standardized CHD mortality rates have declined since 1980, particularly in high-income regions, which is testament to effective prevention and treatment strategies.[2] The most recent data, from the National Health and Nutrition Examination Survey (NHANES) 2007 to 2010, showed that the prevalence of CHD in the United States was 6.4% among adults 20 years and over.[22] This prevalence is lower than what we found, but this probably reflects underestimation due to the self-reported status of information on the disease.

Shah et al.[14] studied the temporal trends of risk factor profiles in patients without known cardiovascular disease presenting with a first episode of myocardial infarction, and found modest improvements between 2002 and 2008. The majority of the other studies that focussed on SCD presented a problem by selecting common definitions and criteria, which did not help evaluate incidence.[23] For example, some studies included time constraints in their case definitions, others included a geographical location of the event or ''survivors of cardiac arrest;'' most important were the differences in the criteria, from using CHD death only to including cardiovascular etiology. A recent study that used multiple sources of information, such as a death certificate, county, state and national population data, and a prospective population-based surveillance study of SCD, revealed that the

TABLE 1C
Number, age-standardized rate and mean age of patients dying of any cause (prevalent cases of coronary heart disease) or of coronary heart disease causes, adults aged ≥ 20 years, identified using physician claims, hospital data or coronary heart disease mortality data, Quebec, 2000/2001 and 2009/2010

	Mortality	Number (n)[a]			Age-standardized rate, %			Mean age, years		
		Total	Men	Women	Total (95% CI)	Men (95% CI)	Women (95% CI)	Total (95% CI)	Men (95% CI)	Women (95% CI)
2000/2001	Hospital[b] or ≥ 2 physician claims (1H2P)	21 985	11 620	10 370	2.34 (2.11–2.63)	2.57 (2.25–2.99)	2.13 (1.81–2.61)	78 (78–78)	76 (76–76)	81 (81–81)
	Hospital[b] or ≥ 2 physician claims and CHD death[c] (1H2P + CHD death)	25 930	13 725	12 205	3.02 (2.76–3.33)	3.37 (3.00–3.84)	2.58 (2.23–3.07)	78 (78–78)	75 (75–75)	81 (81–81)
	CHD death[c] only	3945	2110	1835	99.8 (69.5–154.0)	99.8 (69.0–154.5)	82.3 (63.3–107.4)	76 (75–76)	71 (70–71)	82 (81–82)
2009/2010	Hospital[b] or ≥ 2 physician claims (1H2P)	27 915	14 345	13 570	1.74 (1.54–1.99)	1.76 (1.57–2.06)	1.72 (1.37–2.21)	80 (80–81)	78 (78–78)	83 (83–83)
	Hospital[b] or ≥ 2 physician claims and CHD death[c] (1H2P + CHD death)	30 855	15 910	14 945	2.11 (1.91–2.38)	2.16 (1.96–2.48)	2.03 (1.66–2.53)	80 (80–80)	77 (77–77)	83 (83–83)
	CHD death[c] only	2940	1565	1380	90.1 (72.2–114.5)	89.8 (64.1–137.8)	90.7 (64.2–129.4)	75 (74–76)	70 (69–70)	81 (80–82)

Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.

Abbreviations: CHD, coronary heart disease; CI, confidence interval.

[a] Sums can differ due to rounding.

[b] A hospital discharge abstract with a CHD diagnosis code or a hospital procedure code of coronary intervention.

[c] CHD causes of death from mortality records.

age-adjusted incidence of SCD in the United States was 60 per 100 000 population in 2009, which is similar to what we found in Quebec.[24] In parallel with the decline in CHD mortality, trends in the incidence of SCD also declined.[25]

Limitations

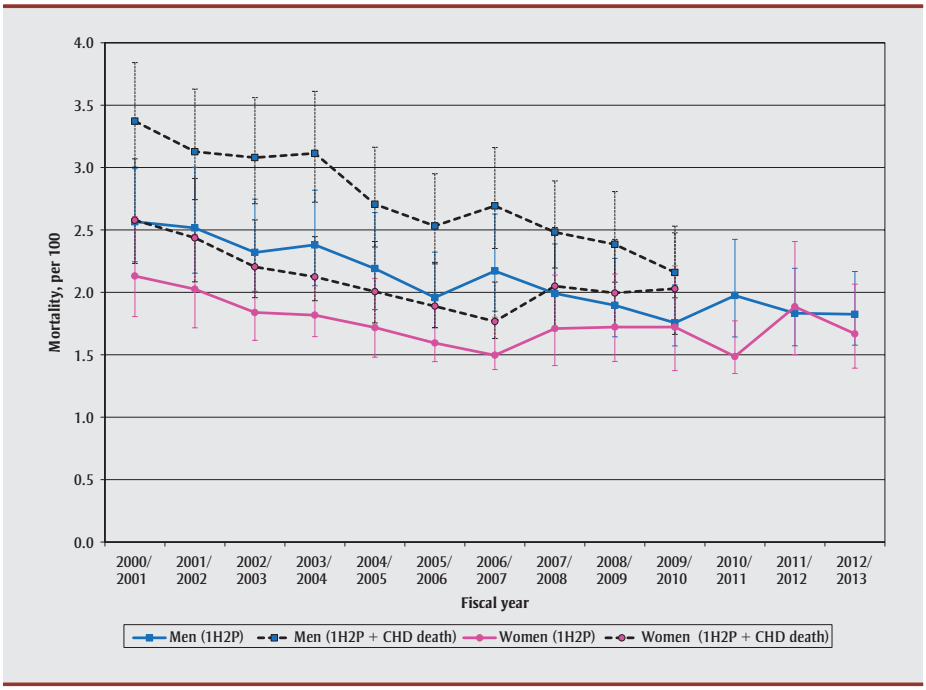
Using retrospective health administrative data to estimate the burden of diseases presents many previously described limitations:[7,8,17,18,20] cases in nursing homes or other institutions may be underestimated; physicians paid through alternative methods; or identified cases are limited to people in contact with the health care system. However, some of these limitations have less impact in the case of CHD, which is often treated in hospitals and it is usually symptomatic. The case definition of CHD maximizes specificity (97.5%) and negative predictive value (97.7%), while sensitivity (77.0%) and positive predictive value (PPV) (75.3%) are not as high.[19] It can be difficult to accurately determine CHD as the cause of death, particularly if there is no prior history of CHD or if no autopsy is performed. Nonetheless, the accuracy of death certificates has been validated in the Framingham Heart Study[26] and Atherosclerosis Risk in Communities[27] (ARIC) cohort studies, and PPV was 67% in both studies. These studies found that death due to CHD, based on death certificates, was overestimated by 24% and 20%, respectively. However, even with this overestimation, our prevalent cases of CHD are not affected by the addition of CHD death. Our proxy of SCD, silent CHD, can be overestimated, because patients could have had diabetes, hypertension or any heart disease that could be related and could explain their CHD death.

Strengths

Because Quebec has universal health care, access to treatment for patients with symptoms suggestive of CHD should be equal.[28] We used a validated definition of CHD with both diagnosis and treatment codes, which increases the sensitivity and specificity, and relies more on hospitalization data, which have been proven to be useful and reliable.[29] The QICDSS has all the health information about several chronic diseases for almost the

FIGURE 4B

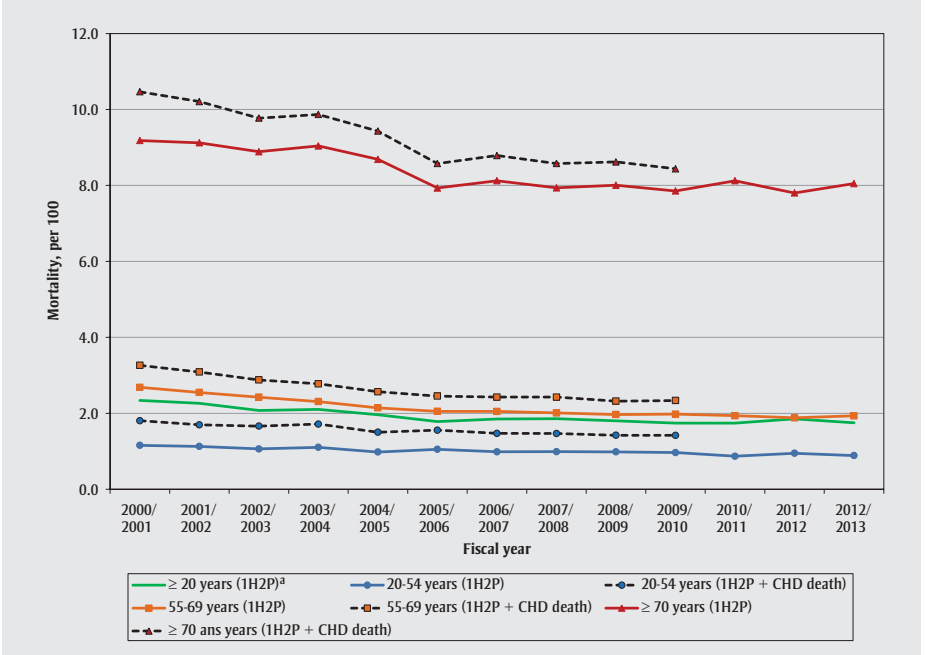
Age-standardized[a] mortality rate for adults ≥ 20 years with diagnosed coronary heart disease, by sex, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
Note: 95% confidence intervals are represented by the vertical bars.
[a] Age standardization using 2001 Quebec Census data as the standard population.

FIGURE 4C

Age-standardized mortality rate for adults ≥20 years with diagnosed coronary heart disease, by age group, Quebec, 2000/2001 to 2012/2013, plus cases identified with coronary heart disease death



Source: Quebec Integrated Chronic Disease Surveillance System (QICDSS) of the Institut national de santé publique du Québec.
Abbreviations: 1H2P, one hospital or ≥ 2 physician claims; CHD, coronary heart disease.
[a] Age standardization using 2001 Quebec Census data as the standard population.

entire Quebec population (95% in 2011/2012[17]) making our data very representative. This surveillance system has already gathered more than 15 years of data, and as it is an on-going process, future trends can be easily determined and health services adjusted accordingly.

Quebec is one of the few provinces in Canada that can link vital statistics with other health administrative data.[18] As a result, our study is strengthened by including the numbers of cases who died of CHD before receiving a diagnosis.

Finally, our proxy of SCD is enhanced by the fact that the majority (62%) of young people with SCD experienced angina.[30] This means that CHD diagnosis, which includes angina, was likely present before death. This proxy is also the most instinctive definition, because it answers one of the first questions that arise when a person dies suddenly: ''Was this person at risk or had any history of CHD?''

Conclusion

The decreasing trends in CHD are encouraging. The proportion identified only through vital statistics is also decreasing and very small. This proxy of SCD represents an insignificant proportion of CHD, as illustrated with the prevalence. We can suppose that secondary prevention has been beneficial. Primary prevention of CHD should be reinforced, as some cases were only identified when death from CHD occurred, particularly among the elderly. However, because we are confirming that a very small proportion of Quebecers were dying suddenly from CHD, a further methodological implication is that claims and hospital data are sufficient to perform CHD surveillance. Because all Canadian provinces and territories have a similar universal health care system, we can extrapolate that CHD surveillance in Canada can be done with these two databases alone.[18] Nonetheless, future studies about silent CHD should include the place of death as well as the history of other diagnoses in order to specify who is more at risk. Public health advice should also emphasize consultation for cardiovascular diseases and its risk factors, that is, primary prevention, as the best way to further improve trends in CHD and SCD.

Acknowledgements

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References

1. Mendis S, Puska P, Norrving B. Global Atlas on Cardiovascular Disease Prevention and Control. 1-155Geneva (CH): World Health Organization; 2011.

2. Moran AE, Forouzanfar MH, Roth G, et al. Temporal trends in ischemic heart disease mortality in 21 world regions, 1980 to 2010: the Global Burden of Disease 2010 Study. Circulation. 2014;129(14):1483-92.

3. Tunstall-Pedoe H, Vanuzzo D, Hobbs M, et al. Estimation of contribution of changes in coronary care to improving survival, event rates, and coronary heart disease mortality across the WHO MONICA Project populations. Lancet. 2000;355(9205):688-700.

4. Kuulasmaa K, Tunstall-Pedoe H, Dobson A, et al. Estimation of contribution of changes in classic risk factors to trends in coronary-event rates across the WHO MONICA Project populations. Lancet. 2000;355(9205):675-87.

5. Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980-2000. N Engl J Med. 2007;356(23):2388-98.

6. Wijeysundera HC, Machado M, Farahati F, et al. Association of temporal trends in risk factors and treatment uptake with coronary heart disease mortality, 1994-2005. JAMA. 2010;303(18):1841-7.

7. Blais C, Rochette L, Hamel D, Poirier P. Prevalence, incidence, awareness and control of hypertension in the province of Quebec: Perspective from administrative and survey data. Can J Public Health. 2014;105(1):e79-85.

8. Robitaille C, Dai S, Waters C, et al. Diagnosed hypertension in Canada: incidence, prevalence and associated mortality. CMAJ. 2012;184(1):E49-E56.

9. Pelletier C, Dai S, Roberts KC, Bienek A, Onysko J, Pelletier L. Repssort summary. Diabetes in Canada: facts and figures from a public health perspective. Chronic Dis Inj Can. 2012;33(1):53-4.

10. Padwal RS. Obesity, diabetes, and the metabolic syndrome: the global scourge. Can J Cardiol. 2014;30(5):467-72.

11. Goraya TY, Jacobsen SJ, Kottke TE, Frye RL, Weston SA, Roger VL. Coronary heart disease death and sudden cardiac death: a 20-year population-based study. Am J Epidemiol. 2003;157(9):763-70.

12. Salomaa V, Ketonen M, Koukkunen H, et al. Decline in out-of-hospital coronary heart disease deaths has contributed the main part to the overall decline in coronary heart disease mortality rates among persons 35 to 64 years of age in Finland: the FINAMI study. Circulation. 2003;108(6):691-6.

13. Arciero TJ, Jacobsen SJ, Reeder GS, et al. Temporal trends in the incidence of coronary disease. Am J Med. 2004;117(4):228-33.

14. Shah B, Bangalore S, Gianos E, et al. Temporal trends in clinical characteristics of patients without known cardiovascular disease with a first episode of myocardial infarction. Am Heart J. 2014;167(4):480-88.

15. Henkel DM, Witt BJ, Gersh BJ, et al. Ventricular arrhythmias after acute myocardial infarction: a 20-year community study. Am Heart J. 2006;151(4):806-12.

16. Chugh SS, Reinier K, Teodorescu C, et al. Epidemiology of sudden cardiac death: clinical and research implications. Prog Cardiovasc Dis. 2008;51(3):213-28.

17. Blais C, Jean S, Sirois C, et al. Quebec Integrated Chronic Disease Surveillance System (QICDSS), an innovative approach. Chronic Dis Inj Can. 2014;34(4):226-35.

18. Robitaille C, Bancej C, Dai S, et al. Surveillance of ischemic heart disease should include physician billing claims: population-based evidence from administrative health data across seven Canadian provinces. BMC Cardiovasc Disord. 2013;13(1):88.

19. Tu K, Mitiku T, Lee DS, Guo H, Tu JV. Validation of physician billing and hospitalization data to identify patients with ischemic heart disease using data from the Electronic Medical Record Administrative Data Linked Database (EMRALD). Can J Cardiol. 2010;26(7):e225-8.

20. Blais C, Dai S, Waters C, et al. Assessing the burden of hospitalized and community-care heart failure in Canada. Can J Cardiol. 2014;30(3):352-8.

21. Moran AE, Forouzanfar MH, Roth G, et al. The global burden of ischemic heart disease in 1990 and 2010: the Global Burden of Disease 2010 study. Circulation. 2014;129(14):1493-501.

22. Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics–2014 update: a report from the American Heart Association. Circulation. 2014;129(3):e28-292.

23. Kong MH, Fonarow GC, Peterson ED, et al. Systematic review of the incidence of sudden cardiac death in the United States. J Am Coll Cardiol. 2011;57(7):794-801.

24. Stecker EC, Reinier K, Marijon E, et al. Public health burden of sudden cardiac death in the United States. Circ Arrhythm Electrophysiol. 2014;7(2):212-7.

25. Ni H, Coady S, Rosamond W, et al. Trends from 1987 to 2004 in sudden death due to coronary heart disease: the Atherosclerosis Risk in Communities (ARIC) study. Am Heart J. 2009;157(1):46-52.

26. Lloyd-Jones DM, Martin DO, Larson MG, Levy D. Accuracy of death certificates for coding coronary heart disease as the cause of death. Ann Intern Med. 1998;129(12):1020-6.

27. Coady SA, Sorlie PD, Cooper LS, Folsom AR, Rosamond WD, Conwill DE. Validation of death certificate diagnosis for coronary heart disease: the Atherosclerosis Risk in Communities (ARIC) Study. J Clin Epidemiol. 2001;54(1):40-50.

28. Blais C, Hamel D, Rinfret S. Impact of socioeconomic deprivation and area of residence on access to coronary revascularization and mortality after a first acute myocardial infarction in Quebec. Can J Cardiol. 2012;28(2):169-77.

29. Lambert L, Blais C, Hamel D, et al. Evaluation of care and surveillance of cardiovascular disease: can we trust medico-administrative hospital data? Can J Cardiol. 2012;28(2):162-8.

30. Jabbari R, Risgaard B, Holst AG, et al. Cardiac symptoms before sudden cardiac death caused by coronary artery disease: a nationwide study among young Danish people. Heart. 2013;99(13):938-43.

CHRONIC DISEASE AND INJURY INDICATOR FRAMEWORK

QUICK STATS, 2015 EDITION

INDICATOR GROUP	INDICATOR MEASURE(S)	LATEST DATA[a]	DATA SOURCE (YEAR)
SOCIAL AND ENVIRONMENTAL DETERMINANTS			
Education	% of population with less than a high school education, population aged 20+ years	12.8%	CCHS (2014)
Income	% of population living below low-income cut-offs, after tax, total population	9.7%	CIS (2013)
Employment	Average annual unemployment rate (% of labour force that was unemployed during reference period), population aged 15+ years	6.8%	LFS (2015)
EARLY LIFE/CHILDHOOD RISK AND PROTECTIVE FACTORS			
Breastfeeding	% of women who reported exclusive breastfeeding of their child for at least the first 6 months of life, women aged 15+ years	26.2%	CCHS (2012)
Birth weight	% of live births with a low birth weight	6.1%	CVS (2011)
Exposure to second-hand smoke	% of households with children aged less than 12 years regularly exposed to environmental tobacco smoke at home	3.1%	CTADS 2013
Family violence	% of population that experienced any of three types of child abuse [physical abuse, sexual abuse or exposure to intimate partner violence] before the age of 16 (NEW)	32.3%	CCHS-MH (2012)
BEHAVIOURAL RISK AND PROTECTIVE FACTORS			
Physical activity	% of children and youth who met physical activity guidelines by accumulating at least 60 minutes of moderate-to-vigorous physical activity per day, population aged 5–17 years (NEW)	9.3%	CHMS (2012–2013)
	% of adults who met physical activity guidelines by accumulating at least 150 minutes of moderate-to-vigorous physical activity each week, in bouts of 10 minutes or more, population aged 18+ years (NEW)	22.2%	CHMS (2012–2013)
Sedentary behaviour	% children and youth who reported exceeding sedentary behaviour guidelines by spending more than 2 hours per day watching television or using computers during leisure-time, population aged 5–17 years	72.7%	CHMS (2012–2013)
	Average amount of time per day spent sedentary, excluding sleep time, population aged 5–17 years (NEW)	8.5 hours	CHMS (2012–2013)
	Average amount of time per day spent sedentary, excluding sleep time, population aged 18+ years (NEW)	9.8 hours	CHMS (2012–2013)
Healthy eating	% of population that reported consuming fruit and vegetables at least 5 times/day, population aged 12+ years	39.7%	CCHS (2014)
Unhealthy eating	% of children and youth who reported drinking sugar-sweetened beverages daily, population aged 5–17 years	17.2%	CHMS (2012–2013)
Adequate sleep	% of children and youth who reported obtaining adequate daily sleep (10–13 hours for those aged 5 years, 9–11 hours for ages 6–13 years and 8–10 hours for ages 14–17 years), population aged 5–17 years (NEW)	74.6%	CHMS (2012–2013)
Chronic stress and coping	% of population that reported a high level of coping, population aged 18+ years (NEW)	56.9%	CCHS-MH (2012)
	% of population that reported life to be "quite a bit" or "extremely" stressful most days in the last 12 months, population aged 12+ years	22.4%	CCHS (2014)
Alcohol use	% of population that exceeds low risk alcohol drinking guidelines for chronic drinking, population aged 15+ years	15.7%	CTADS 2013
Smoking	% of population that reported being current smokers (daily or occasional), population aged 15+ years	14.6%	CTADS 2013
	% of population that reports being current smokers (daily), population aged 15+ years	10.9%	CTADS 2013
RISK CONDITIONS			
Obesity	% of population that is obese (measured), children and youth aged 5–17 years	12.5%	CHMS (2012–2013)
	% of population that is obese (measured), population aged 18+ years	26.4%	CHMS (2012–2013)
Elevated blood glucose	% of population that has elevated[b] blood glucose (measured), population aged 20+ years	4.1%	CHMS (2012–2013)
Elevated blood cholesterol	% of population that has elevated[b] blood cholesterol [TC:HDL-C ratio] (measured), population aged 20+ years	16.8%	CHMS (2012–2013)
Elevated blood pressure	Prevalence of hypertension, population aged 20+ years (NEW)	24.2%	CHMS (2012–2013)
DISEASE PREVENTION PRACTICES (SECONDARY PREVENTION)			
Contact with health care professional	% of population that reported consulting a family physician or general practitioner at least once in the past 12 months, population aged 12+ years	75.6%	CCHS (2014)
	% of population that reported consulting a dentist, dental hygienist or orthodontist at least once in the past 12 months, population aged 12+ years	66.9%	CCHS (2014)
Disease screening	% of women who reported having a mammogram at least once in the past 5 years, population aged 50–74 years	83.5%	CCHS (2012)
	% of women who reported having at least 1 Pap smear test in the past 3 years, population aged 25–69 years	79.7%	CCHS (2012)
	% of population that reported having at least 1 fecal occult blood test, colonoscopy and/or sigmoidoscopy in the recommended time period, population aged 50–74 years	51.1%	CCHS (2012)
Vaccination (influenza)	% of population living with a chronic health condition that reported having a seasonal flu shot in the past 12 months, population aged 12+ years	50.4%	CCHS (2014)
HEALTH OUTCOMES/STATUS			
General health	% of population that rates their health as "very good" or "excellent", population aged 12+ years	59.1%	CCHS (2014)
	% of population that rates their mental health as "very good" or "excellent", population aged 12+ years	71.2%	CCHS (2014)
	Life expectancy at birth	83.0 years	CCDSS (2009/10–2011/12)
	Life expectancy at 65 years	21.5 years	CCDSS (2009/10–2011/12)
	Health-adjusted life expectancy at birth	72.6 years	CCDSS (2008/09–2010/11)
	Health-adjusted life expectancy at 65 years of age	16.4 years	CCDSS (2008/09–2010/11)
Morbidity – Prevalence	% of population with at least one of 10 main chronic diseases[c], population aged 20+ years (NEW)	38.4%	CCHS (2014)
	% of population with at least 1 major[d] chronic disease (cancer, diabetes, cardiovascular disease, chronic respiratory diseases), population aged 20+ years	21.4%	CCHS (2014)
	Prevalence of diabetes, children and youth aged 1–19 years	0.3%	CCDSS (2011/12)[e]
	Prevalence of diabetes, population aged 20+ years	10.0%	CCDSS (2011/12)[e]

INDICATOR GROUP	INDICATOR MEASURE(S)	LATEST DATA[a]	DATA SOURCE (YEAR)
	Prevalence of cardiovascular disease, population aged 20+ years	6.2%	CCHS (2014)
	Prevalence of stroke, population aged 20+ years	1.2%	CCHS (2014)
	Prevalence of heart failure, population aged 40+ years	3.6%	CCDSS (2011/12)
	Prevalence of ischemic heart disease, population aged 20+ years	8.6%	CCDSS (2011/12)
	Prevalence of asthma, children and youth aged 1–19 years	15.7%	CCDSS (2011/12)[e]
	Prevalence of asthma, population aged 20+ years	9.5%	CCDSS (2011/12)[e]
	Prevalence of chronic obstructive pulmonary disease, population aged 35+ years	9.7%	CCDSS (2011/12)[e]
	Prevalence of arthritis, population aged 20+ years	17.9%	CCHS (2014)
	Prevalence of lifetime mental illness and substance use disorders, population aged 15+ years (NEW)	33.3%	CCHS-MH (2012)
	Prevalence of the use of health services for mental disorders, children and youth aged 1–19 years	8.9%	CCDSS (2011/12)
	Prevalence of the use of health services for mental disorders, population aged 20+ years	16.3%	CCDSS (2011/12)
	Prevalence of mood disorders and/or anxiety, children and youth aged 12–19 years	9.3%	CCHS (2014)
	Prevalence of mood disorders and/or anxiety, population aged 20+ years	12.0%	CCHS (2014)
	Prevalence of diagnosed osteoporosis, population age 40+ years	11.4%	CCDSS (2011/12)
	% of the population that has been diagnosed with cancer in the previous 10 years	2.4%	CCR (1999–2008)
Morbidity – Incidence	Incidence rate of diabetes, children and youth aged 1–19 years	41.0 per 100 000	CCDSS (2011/12)
	Incidence rate of diabetes, population aged 20+ years	795.6 per 100 000	CCDSS (2011/12)
	Incidence rate of asthma, children and youth aged 1–19 years	1090 per 100 000	CCDSS (2011/12)
	Incidence rate of asthma, population aged 20+ years	347.1 per 100 000	CCDSS (2011/12)
	Incidence rate of chronic obstructive pulmonary disease, population aged 35+ years	878.3 per 100 000	CCDSS (2011/12)
	Incidence rate of heart failure, population aged 40+ years	523 per 100 000	CCDSS (2011/12)
	Incidence rate of ischemic heart disease, population aged 20+ years	630.6 per 100 000	CCDSS (2011/12)
	Incidence rate of acute myocardial infarction, population aged 20+ years	225.5 per 100 000	CCDSS (2011/12)
	Annual hip fracture rates, population aged 40+ years	151.5 per 100 000	CCDSS (2011/12)
	Incidence rate of all cancers, all male population	438 per 100 000[f]	CCR (2010)
	Incidence rate of all cancers, all female population	368 per 100 000[f]	CCR (2010)
	Incidence rate of all unintentional injuries, total population	512.3 per 100 000	HMDB (2010–2011)
	Incidence rate of all injuries due to intentional self-harm, total population	47.3 per 100 000	HMDB (2010–2011)
	Incidence rate of all injuries due to assault, total population	26.0 per 100 000	HMDB (2010–2011)
Multimorbidity	% of population with multiple chronic diseases[c] (2+ of 10 chronic diseases), population aged 20+ years	14.8%	CCHS (2014)
Disability	% of population that reported being limited in their activities "sometimes" or "often" due to disease/illness, population aged 12+ years	32.7%	CCHS (2014)
Mortality	Mortality rate due to a major chronic disease (cardiovascular diseases, all cancers, chronic respiratory disease), total population	454.3 per 100 000	CVS (2010)
	Mortality rate due to cardiovascular diseases, total population	199.1 per 100 000	CVS (2010)
	Mortality rate due to cancer, total population	211.4 per 100 000	CVS (2010)
	Mortality rate due to chronic respiratory diseases, total population	43.8 per 100 000	CVS (2010)
	Mortality rate due to all unintentional injuries, total population	32.0 per 100 000	CVS (2010)
	Mortality rate due to homicides, total population	1.5 per 100 000	CVS (2010)
	Mortality rate due to suicide, total population	11.6 per 100 000	CVS (2010)
	All-cause mortality rate ratios among people with and without diabetes, population aged 20+ years	2.0 rate ratio[f]	CCDSS (2011/12)
Premature mortality	Potential years of life lost due to cancer	1480.6 per 100 000	CVS (2010)
	Potential years of life lost due to cardiovascular diseases	733.1 per 100 000	CVS (2010)
	Potential years of life lost due to chronic respiratory diseases	118.8 per 100 000	CVS (2010)
	Potential years of life lost due to suicide	314.8 per 100 000	CVS (2010)
	Probability of dying (%) between ages 30 and 69 years from major chronic diseases (CVD, cancer, chronic respiratory disease, diabetes)	11.0%	CVS (2010)
	Probability of dying (%) between ages 30 and 69 years from cardiovascular disease	3.4%	CVS (2010)
	Probability of dying (%) between ages 30 and 69 years from cancer	6.9%	CVS (2010)
	Probability of dying (%) between ages 30 and 69 years from chronic respiratory diseases	0.7%	CVS (2010)
	Probability of dying (%) between ages 30 and 69 years from diabetes	0.5%	CVS (2010)

Abbreviations: CCDSS, Canadian Chronic Disease Surveillance System; CCHS, Canadian Community Health Survey; CCR, Canadian Cancer Registry; CHMS, Canadian Health Measures Survey; CIS, Canadian Income Survey; CTADS, Canadian Tobacco, Alcohol and Drugs Survey; CVS, Canadian Vitals Statistics; LFS, Labour Force Survey; HDL-C, high-density lipoprotein cholesterol; HMBD, Hospital Morbidity Database; MH, Mental Health; TC, total cholesterol.
Notes: Rates from CCDSS data do not include Alberta. Rates from CVS data do not include Quebec.
[a]All rates are crude unless otherwise stated.
[b]This indicator captures people found to have elevated levels of the condition when assessed at a single clinical visit regardless of diagnosis status (i.e. those previously diagnosed and well controlled are not captured).
[c]The ten chronic diseases included are heart disease, stroke, cancer, asthma, chronic obstructive pulmonary disease, diabetes, arthritis, Alzheimer's or other dementia, mood disorder (depression), and anxiety.
[d] The four main groups of chronic diseases include cancer, diabetes, cardiovascular disease (heart disease and/or stroke), chronic respiratory diseases (asthma and/or chronic obstructive pulmonary disease).
[e]CCHS 2014 data exist for this indicator and are available for use when disaggregating by demographic and social markers.
[f]Rates are age-standardized to the 1991 Canadian population.
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Fu TS, Jing R, **McFaull SR**, Cusimano MD. Recent trends in hospitalization and in-hospital mortality associated with traumatic brain injury in Canada: a nationwide, population-based study. J Trauma Acute Care Surg. 2015;79(3):449-55.

Lyons J, Pressey T, **Bartholomew S**, **Liu S**, Liston RM, Joseph KS. In reply: Delivery of breech presentation at term gestation, Canada, 2003 to 2011. Obstet Gynecol. 2015;126(3):673-4.

Tonmyr L, **Martin WK**. How has child maltreatment surveillance data been used in Canada? Health Res Policy Syst. 2014;12(1).

Vos T, Barber RM, Bell B, […] **Badawi A**, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015;386(9995):743-800.