The economic benefits of fruit and vegetable consumption in Canada

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ABSTRACT

OBJECTIVES: The objectives of this study were to determine the proportion of the population that meets or exceeds Canada's Food Guide (CFG) recommendations regarding the number of daily servings of fruits and vegetables (F/V), to assess trends in this proportion between 2000 and 2013, to estimate the annual economic burden attributable to inadequate F/V consumption within the context of other important risk factors, and to estimate the short- and long-term costs that could be avoided if modest improvements were made to F/V consumption in Canada.

METHODS: We used a previously developed methodology based on population-attributable fractions and a prevalence-based cost-of-illness approach to estimate the economic burden associated with low F/V consumption.

RESULTS: Over three quarters of Canadians are not meeting CFG recommendations regarding the number of daily servings of F/V, leading to an annual economic burden of $4.39 billion. If a 1% relative increase in F/V consumption occurred annually between 2013 and 2036, the cumulative reduction in economic burden over the 23-year period would reach $8.4 billion. Consumption levels of F/V, and the resulting economic burden, varied by sex, age and province.

CONCLUSION: A significant majority of Canadians are not consuming the recommended daily servings of F/V, with important consequences to their health and the Canadian economy. Programs and policies are required to encourage F/V consumption in Canada.

KEY WORDS: Economic burden of disease; populations at risk; risk factors; fruit and vegetable consumption

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

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In Canada, excess weight, tobacco smoking, alcohol use and physical inactivity are among the top risk factors (RFs) in terms of their attributable disease burden in the population.[1] The annual economic burden in Canada ascribed to these RFs has been previously estimated.[2–6] There has been little emphasis, however, on inadequate fruit and vegetable (F/V) consumption, another important RF in Canada.

The evidence indicating a protective effect of F/V consumption on coronary heart and cerebrovascular disease is both consistent and compelling,[7,8] while the evidence for cancers is less clear. Early studies suggested such a protective effect exists[9,10] but more recent high-quality studies have not.[11–14] There is a potential protective effect for cancers of the lung,[15] esophagus,[16] and head and neck.[17] Despite the health benefits of sufficient F/V consumption, the majority of Canadians are not meeting consumption guidelines.[18]

The purpose of the current study is fourfold: 1) to determine what proportion of the population is meeting or exceeding Canada's Food Guide (CFG) recommendations regarding the number of daily servings of F/V, 2) to assess trends in this proportion between 2000 and 2013, 3) to estimate the annual economic burden attributable to inadequate F/V consumption within the context of other important RFs, and 4) to estimate the short- and long-term costs that could be avoided if modest improvements were made to F/V consumption over time.

METHODS

The details of our base model, which includes the RFs of excess weight, tobacco smoking, physical inactivity and alcohol use, have been previously published.[2–4,19] In short, we used an approach based on population attributable fraction (PAF) to estimate the economic burden associated with the various RFs.

Risk factor exposure

The analysis of Canada's consumption of F/V used data from all iterations of the Canadian Community Health Survey (CCHS) between 2000/2001 and 2012.[20] The CCHS includes a derived variable (FVCDTOT) that combines data from six other variables to indicate the total number of times per day the respondent eats F/V. The CCHS states that it is measuring the number of times that respondents consume F/V; however, in the analysis of these data, Statistics Canada refers to the number of "servings" of F/V, and argues that at least one serving, on average, will be consumed each time F/V are consumed.[21] This likely underestimates actual F/V consumption. This conservative approach is favoured by Statistics Canada analysts,[22] and we have used the same assumption for our analysis.

We also excluded potatoes (variable FVCDPOT) from our estimates of F/V consumption.[23] Although potatoes have a role

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in a healthy diet, they do not provide the same benefit in terms of preventing chronic disease as other non-starchy vegetables do.[24,25]

Sex-specific prevalence was calculated for age groups 1–4, 5–9, 10–11, 12–14, 15–17, 18–19, for five-year age groups from ages 20 to 79, and for age group 80 and older. Prevalence was calculated separately for each province, and for Canada as a whole. The territories were not investigated independently due to small sample size, but were included in the overall analysis of the country.

The 2004 CCHS had a focus on nutrition, and assessed F/V consumption for all ages, not just the population aged 12+. The same six questions that were used to assess F/V consumption among adults in other iterations of the CCHS were used for children in the 2004 iteration.[22] We used the data for children aged 1–11 from the 2004 CCHS to determine the relationship between F/V consumption in 1–11 year old children compared with 12–14 year old adolescents for all other years.

The 2011 version of CFG recommends the number of daily servings of F/V based on the sex and age of the individual.[26] We used these age- and sex-specific recommendations to group individuals into the following five categories:

1. Meets or exceeds CFG recommendations (reference category)
2. Consumes 1–2 servings below CFG recommendations (E_{FV1})
3. Consumes 3–4 servings below CFG recommendations (E_{FV2})
4. Consumes 5–6 servings below CFG recommendations (E_{FV3})
5. Consumes 7–8 servings below CFG recommendations (E_{FV4})

Relative risk

We assumed that the risk of *coronary heart disease* is reduced by 4% (relative risk [RR]: 0.96, 95% confidence interval [CI]: 0.93–0.99) for each additional serving per day of F/V,[27] with a linear trend in this relationship.[28] The reference category is those who meet or exceed CFG recommendations for daily consumption of F/V. Populations within categories E_{FV1} to E_{FV4} consumed, on average, 1.57, 3.52, 5.39 and 7.19 fewer servings per day, respectively, than recommended. We assumed that each serving was equivalent to 80 g.[29] Thus those in categories E_{FV1} to E_{FV4} consumed 126 g, 228 g, 431 g and 575 g fewer per day, respectively, than recommended. To estimate the RR for each F/V category on coronary heart disease, the reciprocal of the RR multiplied by the adjusted mean grams per day below the recommended level was calculated for each category. For example, for E_{FV1},

$$e^{(-1\times\ln(0.96)\times(126/80))} = 1.066$$

The RR for each of the four categories is shown in Table 1.

We assumed that the risk of *cerebrovascular disease* decreased by 32% (RR: 0.68, 95% CI: 0.56–0.82) for every 200 g/day increase in fruit consumption and by 11% (RR: 0.89, 95% CI: 0.81–0.98) for every 200 g/day increase in vegetable consumption, with a linear trend in this relationship and no significant differences in risk by stroke subtype.[30] Using 2012 CCHS data, we estimated that 52% of servings consumed by Canadians are fruits and 48% are vegetables (excluding potatoes), resulting in a weighted RR for F/V consumption of 0.76 (95% CI: 0.65–0.91). We calculated the RR for each category using the same formula as was used for coronary heart disease.

We assumed that the risk of *lung cancer* decreased by 4% (RR: 0.96, 95% CI: 0.94–0.98) for each 100 g/day increase in F/V intake, with a non-linear dose-response relationship that has no additional benefit above a 400 g/day increase in F/V intake.[15] We calculated the RR for each category using the same formula as was used for coronary heart disease. We used the analysis by Freedman and colleagues[31] to estimate the relationship between F/V intake and *esophageal squamous cell carcinoma* (ESCC). We assumed that one third of esophageal cancers are ESCC, that individuals in the highest versus lowest quintile of F/V consumption had a 56% reduced risk of ESCC (RR: 0.44, 95% CI: 0.20–0.96), that this risk was associated with an increase of 4.3 80 g servings, and that the dose-response relationship is linear.[31]

We used a further analysis by Freedman and colleagues[32] to estimate the relationship between F/V intake and *cancers of the head and neck* (H&N). Individuals in the highest versus lowest quintile of F/V consumption had a 29% reduced risk of cancers of the H&N (RR: 0.71, 95% CI: 0.55–0.92). We assumed that the RR of 0.71 was associated with an increase of 4.3 80 g servings, and that the dose-response relationship is linear.[32]

Table 1. Increased relative risk attributable to low fruit and vegetable intake

Category	Coronary heart disease		Cerebrovascular disease		Lung cancer		Esophageal squamous cell carcinomas		Cancers of the head and neck	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Reference*	1.00	–	1.00	–	1.00	–	1.00	–	1.00	–
E_{FV1}†	1.07	1.02–1.12	1.19	1.06–1.31	1.05	1.03–1.08	1.66	1.45–1.91	1.53	1.47–1.60
E_{FV2}‡	1.15	1.04–1.29	1.47	1.14–1.83	1.12	1.06–1.19	2.47	2.26–2.71	2.34	2.28–2.41
E_{FV3}§	1.25	1.06–1.48	1.80	1.23–2.52	1.18	1.08–1.28	2.89	2.69–3.14	2.77	2.70–2.83
E_{FV4}‖	1.34	1.07–1.69	2.18	1.31–3.44	1.18	1.08–1.28	3.18	2.98–3.43	3.06	2.99–3.12

* Servings = Canada's Food Guide level.
† 1–2 servings below Canada's Food Guide.
‡ 3–4 servings below Canada's Food Guide.
§ 5–6 servings below Canada's Food Guide.
‖ 7–8 servings below Canada's Food Guide.

For all of the above relative risk calculations, we assumed that there are no significant differences in risk by sex.

Multiple exposure levels

We considered low F/V intake as a pentachotomous exposure; that is, five categories of exposure are involved. The PAF calculation for low F/V intake is as follows:

$$\text{PAF} = \frac{E_{FV1}(RR_{FV1}-1)+E_{FV2}(RR_{FV2}-1)+E_{FV3}(RR_{FV3}-1)+E_{FV4}(RR_{FV4}-1)}{E_{FV1}(RR_{FV1}-1)+E_{FV2}(RR_{FV2}-1)+E_{FV3}(RR_{FV3}-1)+E_{FV4}(RR_{FV4}-1)+1}$$

The following equation was used to adjust the crude PAF for overestimation that occurs when PAFs are calculated separately for each level of risk factor exposure:

$$\text{adjusted crude PAF} = (\text{combined PAF})\frac{\text{unadjusted crude PAF}}{\text{sum of unadjusted crude PAFs}}$$

Calculating and adjusting costs

We estimated the economic burden associated with the RFs using a prevalence-based cost-of-illness approach,[33,34] and reported this in 2013 Canadian dollars. We used a prevalence-based approach, as long-term estimates of health care costs for individuals with and without the given risk factors required in an incidence-based approach are not available.

Direct costs, including hospital care, physician services, other health care professionals (excluding dental services), drugs, health research, and "other" health care expenditures, were extracted for each province from the National Health Expenditure Database.[35] In an extensive literature review in preparing for this analysis, we found limited evidence of a protective effect of F&V consumption on dental health. Hospital care, physician care and drug costs by sex were allocated to each of the co-morbidity categories based on data from the *Economic Burden of Illness in Canada* (EBIC) online tool for 2008.[36] EBIC cost data were not sufficiently detailed for a number of co-morbidities, including ICD-10 codes E11-14, I26, I71, I80-82, K55, K80-82, M45-54. In each of these situations, we estimated the costs based on the proportion of sex-specific acute hospital days in 2011/2012 for the broader co-morbidity category that are attributed to the disease of interest.[37]

EBIC 2008 does not allocate co-morbidity-specific costs for other health care professionals, health research, or "other" health care expenditures. These were estimated by calculating the proportion of total hospital, physician and drug costs that were allocated to each co-morbidity by *EBIC 2008* and then assuming that this proportion would be the same for unallocated costs.

These sex- and co-morbidity-specific direct care costs were then multiplied by the calculated risk factor-, sex-, and co-morbidity-specific PAFs to calculate the direct costs attributable to a given RF. The direct care costs were segmented by cost category, sex, level of RF exposure, province, and specific diseases.

Adjusting direct costs in a multifactorial system

In order to calculate the combined PAF for all five RFs in a multifactorial system, we used the following equation:[38]

$$\text{combined PAF} = 1 - \prod_{n=1}^{N}(1 - \text{PAF}_n)$$

Indirect costs

We calculated indirect costs (short-term disability, long-term disability, and premature mortality) following the method used in *EBIC, 1998* (a modified human-capital approach).[39] We determined the ratio of direct to indirect costs for each diagnostic category within *EBIC, 1998*.[2] The pertinent ratios (by diagnostic category and specific indirect cost category) were applied to the previously identified direct costs within each diagnostic category attributable to individual RFs in order to generate the equivalent indirect cost data.

Sensitivity analysis

Sensitivity analyses were performed in which the putative protective association between F/V and cancers was excluded and the upper and lower RR CIs for all diseases were utilized.

Cost avoidance modelling

Changing unhealthy behaviours at the population level takes time. We have therefore modelled a 1% annual relative increase in F/V consumption over 23 years. This model presents a scenario in which 1% of individuals who consume inadequate F/V will annually move closer to the recommended number of servings. We assume that anyone who was previously in category E_{FV1} or E_{FV2} would move into the category that consumes the recommended number of servings of F/V (and therefore incur no costs associated with the RF). Anyone who was previously in category E_{FV3} or E_{FV4} would move into category E_{FV2} (and therefore would incur the costs associated with category E_{FV2}). The model also takes into account projected population growth. Finally, the results for F/V consumption are placed in the context of tobacco smoking, excess weight, alcohol consumption and physical inactivity. All future costs (and costs avoided) are provided in 2013 constant Canadian dollars.

RESULTS

In 2013, Canadians consumed an average of 4.38 servings of F/V per day. Consumption was higher for females (4.71 servings) than males (4.05 servings) at every age group (Figure 1). Average consumption decreased for males from ages 1 to 4 until age 30, before increasing modestly. Likewise, average consumption decreased for females from ages 1 to 4 until age 25, before increasing modestly.

Just 20.7% of the population ages 1 and older met or exceeded CFG recommendations regarding daily F/V consumption (Figure 2). A higher proportion of females than males met or exceeded CFG recommendations (25.3% and 16.0% respectively), and a higher proportion of males were in the lowest consumption categories. For example, 36.9% of males were five or more servings below CFG recommended daily servings. Alternatively, 17.9% of females were

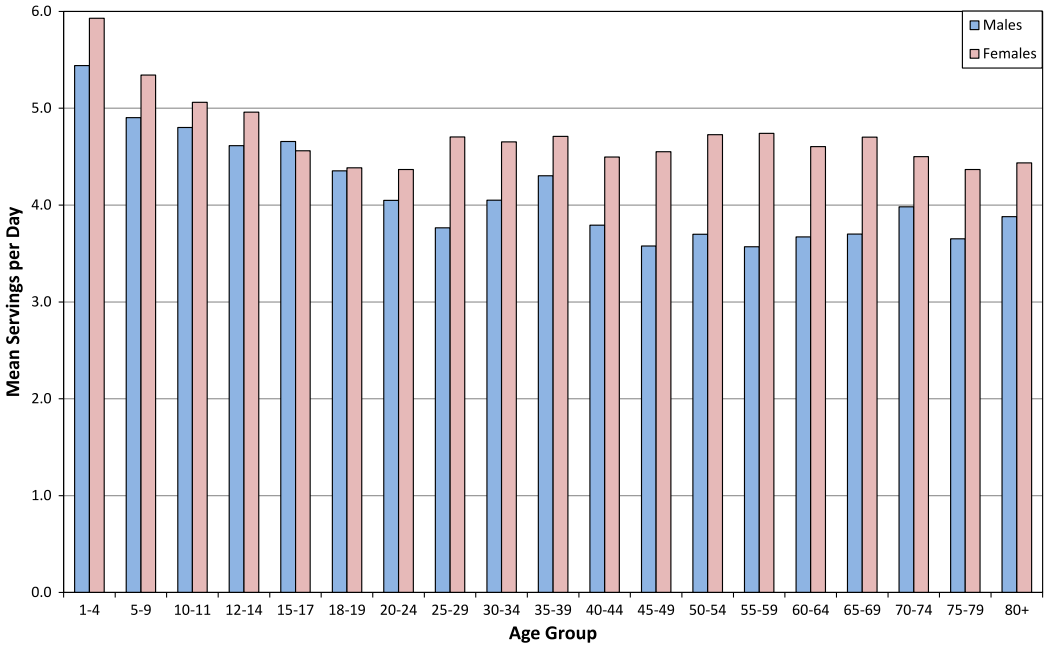

Figure 1. Fruit and vegetable consumption in Canada. By sex and age group, 2013

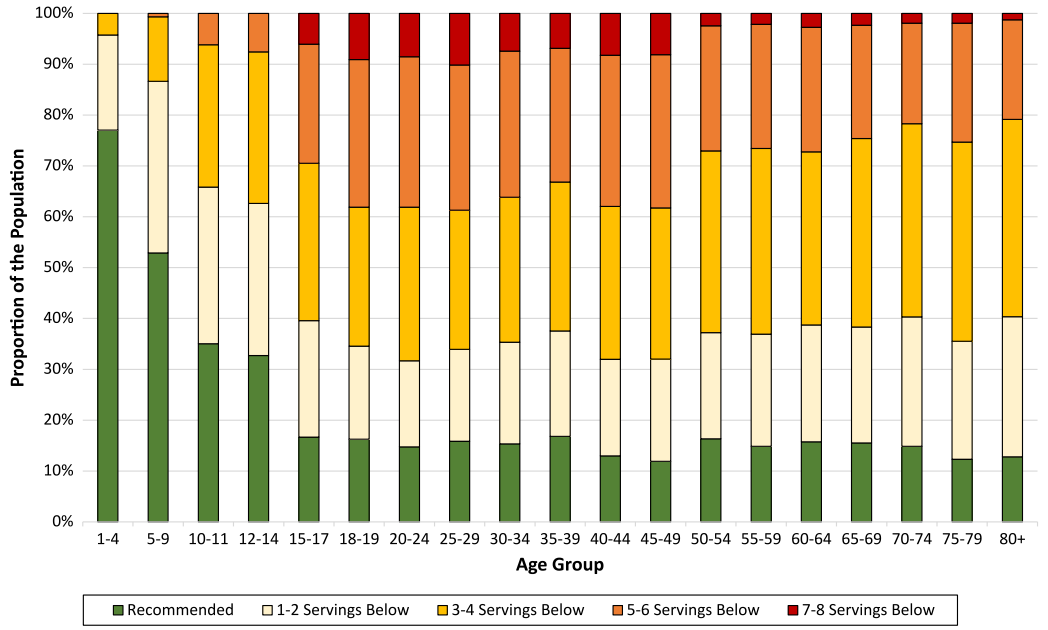

Figure 2. Fruit and vegetable consumption in Canada. Meeting Canada's Food Guide recommendations by age group, 2013

in the same category. A higher proportion of children than adults also met or exceeded CFG recommendations.

There is also significant variation by province in the proportion of the population age 1 and older who met or exceeded CFG recommendations, ranging from a low of 10.3% in Newfoundland and Labrador to a high of 25.9% in Quebec (Figure 3).

There was a statistically significant increase in F/V consumption between 2000 and 2007 in Canada, followed by a significant decrease to 2013 (Figure 4). This pattern was observed in nearly every province, except for Prince Edward Island, Saskatchewan and Manitoba.

The annual economic burden attributable to low F/V intake, physical inactivity, alcohol use, smoking and excess weight in Canada in 2013 was $67.3 billion (Table 2). Of this amount, $4.39 billion ($1.47 billion in direct costs and $2.92 billion in indirect costs) is attributable to low F/V consumption. Of the $2.92 billion in indirect costs, $2.19 billion is attributable to premature mortality, $0.67 billion to long-term disability

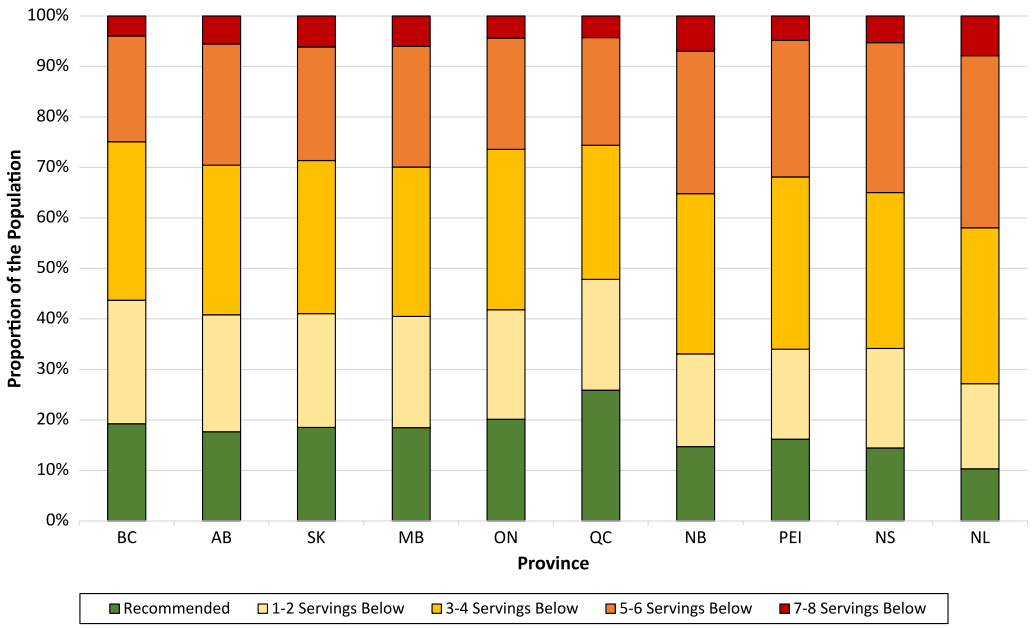

Figure 3. Fruit and vegetable consumption in Canada. Meeting Canada's Food Guide recommendations by province, 2013

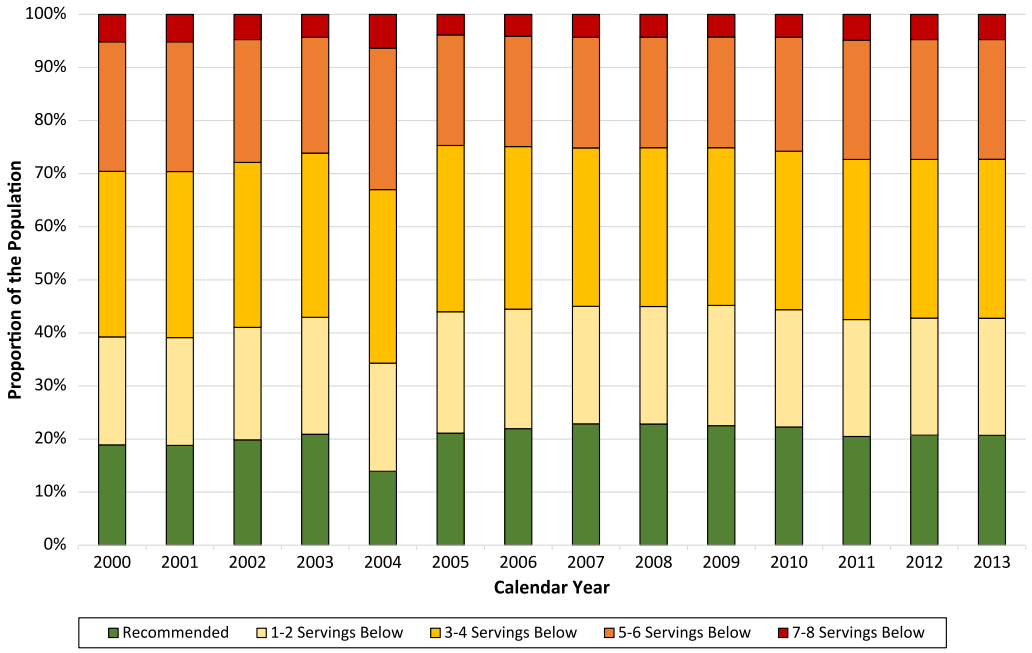

Figure 4. Fruit and vegetable consumption in Canada. Meeting Canada's Food Guide recommendations by year, 2000–2013

and $0.06 billion to short-term disability. As a result of the variation in prevalence between sexes, the annual economic burden attributable to low F/V intake among males is almost twice as high as females ($2.89 billion and $1.50 billion respectively).

On average, the annual economic burden attributable to low F/V intake per capita in Canada is $127, ranging from a low of $115 in Ontario and Quebec to a high of $183 in Newfoundland and Labrador (Figure 5).

The 4.38 servings of fruits and vegetables consumed per day by Canadians in 2013 equates to approximately 55.6 billion servings consumed that year. If the consumption of F/V were to increase by 20%, then average daily consumption would be 5.26 servings and annual total consumption would increase to 66.7 billion servings. If we assume that this increase would only occur among the 78.4% of the population not consuming the recommended daily servings, then we could expect an

Table 2. Estimated prevalence of risk factors (RFs), total economic burden for multifactorial system, and disaggregated costs by RF. Canada, 2013, by sex; adjusted for multiple RFs in one individual

	Percentage of population with RF	Number of individuals with RF	Direct cost per individual with RF ($)	Indirect cost per individual with RF ($)	Total cost per individual with RF ($)	Total direct cost of RF (million$)	Total indirect cost of RF (million$)	Total cost of RF (million$)
Males								
Smokers								
Light	7.7%	1 335 866	$787	$1,536	$2,323	$1,052	$2,052	$3,103
Moderate	5.8%	1 017 398	$1,300	$2,514	$3,814	$1,323	$2,558	$3,880
Heavy	6.4%	1 116 660	$1,599	$3,065	$4,663	$1,785	$3,422	$5,207
Subtotal – Male smokers	19.9%	3 469 923	$1,199	$2,315	$3,513	$4,160	$8,032	$12,191
Excess weight								
Overweight	36.8%	6 412 877	$200	$559	$758	$1,281	$3,583	$4,864
Obese	16.1%	2 810 973	$725	$1,658	$2,383	$2,037	$4,661	$6,698
Subtotal – Male excess weight	52.9%	9 223 850	$360	$894	$1,253	$3,318	$8,244	$11,562
Inactive	40.9%	7 123 822	$217	$387	$604	$1,547	$2,759	$4,306
Low fruit and vegetable intake								
Category I	17.9%	3 121 563	$25	$52	$77	$78	$162	$240
Category II	28.6%	4 993 202	$56	$114	$170	$280	$570	$851
Category III	28.8%	5 015 097	$86	$170	$256	$431	$855	$1,286
Category IV	7.7%	1 341 277	$130	$254	$384	$175	$341	$516
Subtotal – Male below recommended intake	83.0%	14 471 139	$67	$133	$200	$965	$1,927	$2,892
Alcohol								
Category I – Low	48.1%	8 379 818	$77	$199	$276	$647	$1,666	$2,313
Category II – Hazardous	6.4%	1 113 332	$488	$1,060	$1,548	$543	$1,181	$1,724
Category III – Harmful	6.0%	1 046 732	$1,235	$2,225	$3,460	$1,292	$2,329	$3,621
Subtotal – Male drinkers	60.5%	10 539 882	$236	$491	$727	$2,483	$5,176	$7,658
Subtotal – Males						$12,472	$26,138	$38,610
Females								
Smokers								
Light	7.5%	1 335 280	$600	$1,147	$1,748	$802	$1,532	$2,334
Moderate	4.8%	858 947	$1,037	$2,004	$3,041	$890	$1,721	$2,612
Heavy	2.8%	489 908	$1,638	$3,161	$4,799	$802	$1,549	$2,351
Subtotal – Female smokers	15.1%	2 684 135	$929	$1,789	$2,718	$2,494	$4,802	$7,296
Excess weight								
Overweight	23.8%	4 218 077	$293	$762	$1,055	$1,234	$3,216	$4,450
Obesity	15.0%	2 651 956	$887	$1,931	$2,818	$2,352	$5,121	$7,473
Subtotal – Female excess weight	38.8%	6 870 032	$522	$1,214	$1,736	$3,586	$8,337	$11,923
Inactive	46.3%	8 214 148	$184	$425	$609	$1,509	$3,494	$5,003
Low fruit and vegetable intake								
Category I	25.7%	4 551 633	$17	$35	$52	$78	$158	$237
Category II	30.5%	5 412 903	$39	$78	$117	$211	$422	$634
Category III	16.0%	2 838 335	$65	$127	$192	$183	$360	$544
Category IV	1.7%	297 623	$99	$189	$288	$29	$56	$86
Subtotal – Female below recommended intake	73.9%	13 100 495	$38	$76	$114	$502	$997	$1,499
Alcohol								
Category I – Low	41.9%	7 435 139	$36	$88	$124	$266	$653	$919
Category II – Hazardous	5.1%	905 236	$279	$565	$845	$253	$512	$764
Category III – Harmful	2.3%	403 673	$1,153	$1,955	$3,108	$465	$789	$1,255
Subtotal – Female drinkers	49.3%	8 744 048	$113	$223	$336	$984	$1,954	$2,938
Subtotal – Females						$9,077	$19,584	$28,660
Both sexes								
Smokers								
Light	7.6%	2 671 146	$694	$1,342	$2,035	$1,853	$3,584	$5,437
Moderate	5.3%	1 876 344	$1,180	$2,281	$3,460	$2,213	$4,279	$6,492

Continued

Table 2. (Continued)

	Percentage of population with RF	Number of individuals with RF	Direct cost per individual with RF ($)	Indirect cost per individual with RF ($)	Total cost per individual with RF ($)	Total direct cost of RF (million$)	Total indirect cost of RF (million$)	Total cost of RF (million$)
Heavy	4.6%	1 606 568	$1,611	$3,094	$4,705	$2,587	$4,971	$7,558
Subtotal – Smokers	17.5%	6 154 058	$1,081	$2,085	$3,167	$6,654	$12,833	$19,488
Excess weight								
Overweight	30.2%	10 630 954	$237	$640	$876	$2,515	$6,799	$9,314
Obesity	15.5%	5 462 929	$804	$1,790	$2,594	$4,390	$9,781	$14,171
Subtotal – excess weight	45.8%	16 093 882	$429	$1,030	$1,459	$6,904	$16,581	$23,485
Inactive	43.6%	15 337 970	$199	$408	$607	$3,056	$6,253	$9,309
Low fruit and vegetable intake								
Category I	21.8%	7 673 196	$20	$42	$62	$157	$320	$476
Category II	29.6%	10 406 104	$47	$95	$143	$492	$993	$1,484
Category III	22.3%	7 853 433	$78	$155	$233	$615	$1,215	$1,830
Category IV	4.7%	1 638 900	$125	$242	$367	$204	$397	$601
Subtotal – Below recommended intake	78.4%	27 571 634	$53	$106	$159	$1,467	$2,924	$4,392
Alcohol								
Category I – Low	45.0%	15 814 957	$58	$147	$204	$913	$2,319	$3,232
Category II – Hazardous	5.7%	2 018 568	$394	$838	$1,233	$796	$1,692	$2,488
Category III – Harmful	4.1%	1 450 405	$1,212	$2,150	$3,362	$1,758	$3,118	$4,876
Subtotal – Alcohol	54.9%	19 283 929	$180	$370	$550	$3,467	$7,130	$10,597
Total						$21,549	$45,722	$67,270

approximate reduction in economic burden of 20% or $878 million annually.

If a 1% annual relative increase in F/V consumption occurred between 2013 and 2036, the annual reduction would reach $700 million by 2036, with a cumulative reduction in economic burden of $8.4 billion over the 23-year period (Figure 6).

Sensitivity analysis

When using the upper and lower CIs of the RR values for low F/V consumption, the annual economic burden ranges from $1.78 billion (−59.5%) to $6.55 billion (+49.1%). Cancers contribute $0.78 billion, or 17.9% of the $4.39 billion. Excluding cancers from the analysis would reduce the annual economic burden to $3.61 billion (95% CI: $1.12–$5.63 billion).

DISCUSSION

Over three quarters of Canadians are not meeting CFG recommendations regarding the number of daily servings of F/V, leading to an annual economic burden of $4.39 billion. If a 1% relative increase in F/V consumption occurred annually between 2013 and 2036, the cumulative reduction in economic burden over the 23-year period would reach $8.4 billion. This reduction is calculated based on average rather than marginal costs and therefore does not represent potential cost savings. Rather, it represents the maximum change in economic burden over a period of time given specific assumptions about changes in risk factor(s).[3,40]

Several important conclusions might be drawn from this analysis. First, consumption levels appear to be highest in children, and steadily decrease until age 25 for females and age 30 for males. Unfortunately, consumption levels in children under the age of 12 are based solely on the 2004 CCHS, which differed from all other years possibly due to a change in the sequencing of data entry in 2004.[22] Parents are generally reliable when reporting their child's food intake,[41] particularly when both parents are present.[42]

Second, consumption tends to be consistently higher for females than males. We assumed that the number of *times* F/V are consumed is the same as the number of *servings* consumed, which may partly account for the difference if males consume larger portions. Data purchased from AC Nielsen by the Canadian Produce Marketing Association, which assessed *servings* consumed, however, also found that the mean number of servings of F/V consumed was higher for Canadian females than males. In the September 2015 survey, females consumed an average of 4.48 servings of F/V daily, compared with 3.68 servings for males. A further comparison using AC Nielsen data also confirmed that the number of *times* F/V are consumed daily and the number of *servings* consumed daily are similar – the assumption favoured by Statistics Canada analysts and used in this study.

There has been a statistically significant increase in F/V consumption between 2000 and 2007 in Canada, followed by a significant decrease thereafter to 2013. The reasons for this observed trend are likely complex. It is interesting to note, however, that the timing of the change in consumption roughly corresponds with the global recession in 2008 and 2009. Furthermore, between 2008 and 2013, the Consumer Price Index

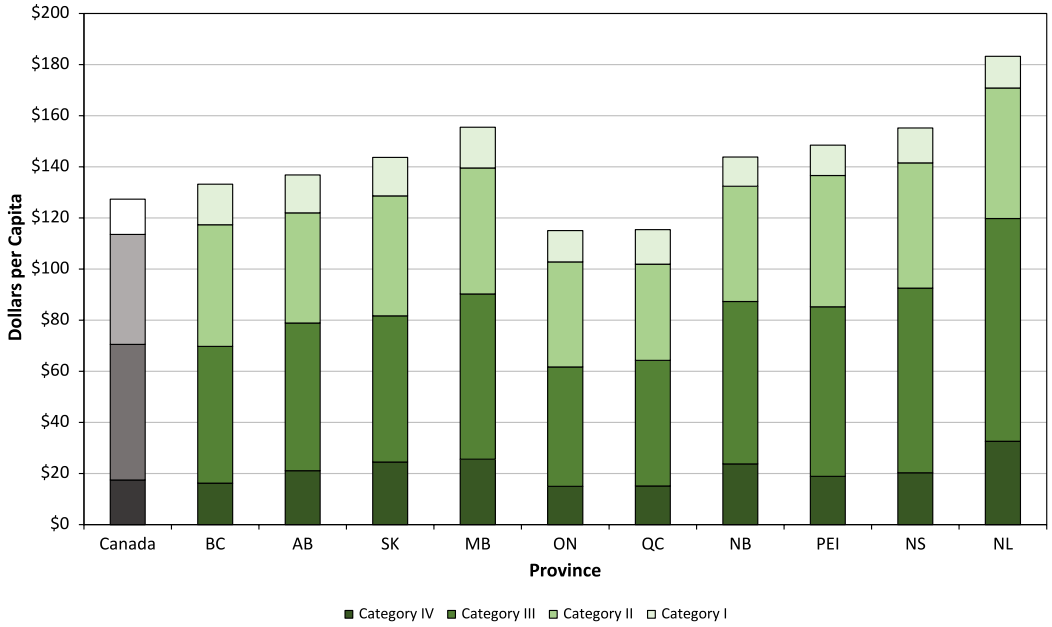

Figure 5. Estimated annual economic burden per capita attributable to low fruit and vegetable intake. Canada and the Provinces, 2013

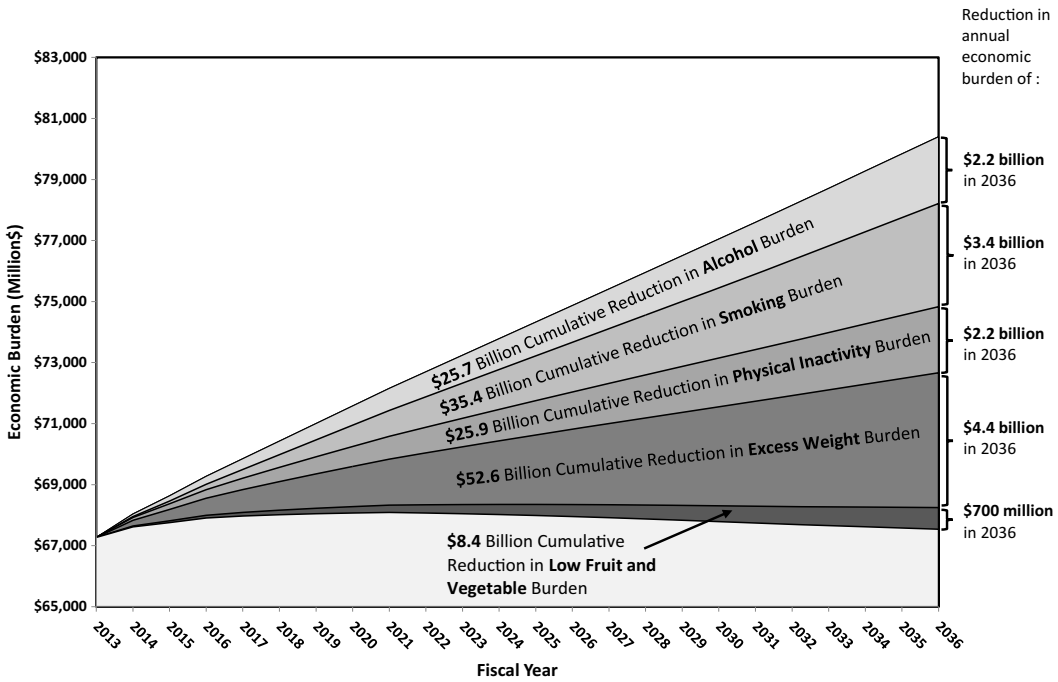

Figure 6. Changes in economic burden of smoking, excess weight, physical inactivity, alcohol use, and low fruit and vegetable consumption. One percent (1%) reduction in risk factor prevalence compared to no reduction. Canada, 2013–2036 (constant million$)

increased by 7.6% in Canada; however the price of fresh F/V increased during this time by 14.5% and 16.7% respectively.[43]

The evidence of F/V consumption protecting against cancers is evolving. Early estimates suggested that approximately 23% of global cancer cases were attributable to low F/V consumption.[44–46] By 2006, estimates of the global proportion of cancers attributable to low F/V consumption had decreased to between 5% and 12%,[47] based on methodologically stronger studies.[48] A 2011 review of a series of large, prospective cohort studies concluded that there is little or no association between F/V consumption and cancers.[14] Excluding cancers from our analysis would reduce the annual economic burden attributable to low F/V consumption in Canada from $4.39 to $3.61 billion (–17.9%).

A significant majority of Canadians are not consuming the recommended daily servings of F/V, with important consequences to their health and the Canadian economy. The World Health Organization has suggested the following four strategies to increase F/V access, availability and consumption:[49]

1. Behavioural interventions to increase F/V consumption;
2. Pricing incentives;
3. Promotion and support of gardening in home, community and school settings; and
4. Improvements in agricultural and food systems.

It is likely that improving fruit and vegetable consumption in Canada will require a range of interventions using a multi-faceted approach with collaboration among industry, retail, government, and not-for-profit organizations promoting public health.

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RÉSUMÉ

OBJECTIFS : Déterminer la proportion de la population qui respecte ou dépasse les recommandations du Guide alimentaire canadien (GAC) quant au nombre de portions quotidiennes de fruits et de légumes (F et L) pour évaluer les tendances dans cette proportion entre 2000 et 2013, afin d'estimer le fardeau économique annuel imputable à la consommation insuffisante de F et L dans le contexte d'autres importants facteurs de risque et d'estimer les coûts évitables à court et à long terme si l'on apportait de légères améliorations à la consommation de F et L au Canada.

MÉTHODE : Nous avons utilisé une méthode déjà élaborée, fondée sur les fractions attribuables dans la population, et une démarche de calcul du coût de la maladie fondée sur la prévalence pour estimer le fardeau économique associé à la faible consommation de F et L.

RÉSULTATS : Plus des trois quarts des Canadiens ne respectent pas les recommandations du GAC quant au nombre de portions quotidiennes de F et L, ce qui mène à un fardeau économique annuel de 4,39 milliards de dollars. S'il y avait chaque année une augmentation relative de 1 % de la consommation de F et L entre 2013 et 2036, la baisse cumulée du fardeau économique sur cette période de 23 ans atteindrait 8,4 milliards de dollars. Les niveaux de consommation de F et L, et le fardeau économique qui en résulte, ont varié selon le sexe, l'âge et la province.

CONCLUSION : Une grande majorité de Canadiens ne consomment pas les portions quotidiennes recommandées de F et L, ce qui a d'importantes conséquences pour leur santé et pour l'économie canadienne. Des programmes et des politiques sont nécessaires pour encourager la consommation de F et L au Canada.

MOTS CLÉS : fardeau économique de la maladie; populations à risque; facteurs de risque; consommation de fruits et de légumes