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Modelling the impact of compliance with dietary recommendations on cancer and cardiovascular disease mortality in Canada

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ABSTRACT

Objectives: Despite strong evidence indicating that unbalanced diets relate to chronic diseases and mortality, most adults do not comply with dietary recommendations. To help determine which recommendations could yield the most benefits, the number of deaths attributable to cardiovascular diseases and cancer that could be delayed or averted in Canada if adults changed their diet to adhere to recommendations were estimated.

Study design: Macrosimulation based on national population-based survey and vital statistics data.

Methods: A macrosimulation model was used to draw age- and sex-specific changes in relative risks based on the results of meta-analyses of relationship between food components and risk of cardiovascular disease and diet-related cancers. Inputs in the model included Canadian recommendations (fruit and vegetable, fibre, salt, and total-, monounsaturated-, polyunsaturated-, saturated-, and trans-fats), average dietary intake (from 35 107 participants with 24-h recall), and mortality from specific causes (from Canadian Vital Statistics). Monte Carlo analyses were used to compute 95% credible intervals (CI).

Results: The estimates of this study suggest that 30 540 deaths (95% CI: 24 953, 34 989) per year could be averted or delayed if Canadians adhered to their dietary recommendations. By itself, the recommendation for fruit and vegetable intake could save as many as 72% (55–87%) of these deaths. It is followed by recommendations for fibres (29%, 13–43%) and salt (10%, 9–12%).

Conclusions: A considerable number of lives could be saved if Canadians adhered to the national dietary intake recommendations. Given the scarce resources available to promote guideline adhesion, priority should be given to recommendations for fruit and vegetable intake.

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Introduction

Most industrialized countries have developed dietary recommendations to guide their population towards achieving a healthy diet. Although scientifically sound, these guidelines only have a potential to result in healthier populations if they are adhered to. Reports suggest that Canadians have experienced important changes in their dietary intake and lifestyle over the past decades and that these changes distance them from some dietary recommendations. For example, food purchasing data imply that the total energy intake of Canadians increased by nearly 10% between 1981 and 2009.[1] Much of this change is attributable to increases in consumption of fat and carbohydrates.[1] A rise in availability and diversity of food options, in combination with increases in the affordability and convenience of access to energy rich but nutrient poor food are likely related to the observed changes in dietary patterns.[2]

Studies have shown that poorly balanced diets (i.e., high proportion of saturated fat and salt, and low proportion of fruits, vegetables, and fibre) can increase the risk of numerous cancers (i.e., oesophageal, stomach, lung, and colorectal), cardiovascular diseases (i.e., ischaemic heart diseases and cerebrovascular diseases),[3–6] and other chronic conditions such as diabetes and obesity.[7] Chronic diseases are the most important causes of mortality, morbidity, and disability worldwide.[8] In Canada, cardiovascular diseases and cancer are responsible for approximately 70 000 deaths each annually, representing about 59% of all deaths every year.[9] The extent to which these deaths could be averted by modifying the dietary intake of Canadians remains elusive. It is also unclear which dietary recommendation could yield the most beneficial improvement in health if adhered to by Canadians. Such knowledge would provide guidance regarding prioritization of target interventions and where resources should be strategically allocated.

A comparative risk assessment model called PRIME (Preventable Risk Integrated ModEl, previously called DIETRON) has been developed to quantify the change in population mortality from cardiovascular diseases and ten diet-related cancers that would be expected given a change in average dietary quality within a population. The first use of PRIME led to an estimate that 33 000 deaths per year could be delayed or averted in the UK if recommended dietary intakes for fats, fruit and vegetables, salt and fibres for that country were achieved.[10] It has also been used to demonstrate the impact of diet on geographic health inequalities in the UK,[11] achieving environmentally sustainable diets in the UK,[12] sugary drink taxation in the UK[13] and Ireland[14] and taxation of dietary greenhouse gas emissions in the UK.[15] In the current analysis, the number of deaths attributable to cardiovascular diseases and cancer that could be delayed or averted if, on average, Canadians changed their nutritional intake to adhere to their dietary recommendations were estimated. The estimates attributable to specific recommendations and for specific causes of death were also presented to guide the prioritization of intervention targets.

Methods

The PRIME comparative risk assessment model was used to estimate the annual number of deaths from cardiovascular diseases and cancer that could be delayed or averted if the average dietary intake of Canadians changed from current levels to recommended dietary intakes. The PRIME model is described in details elsewhere.[11] Briefly, PRIME draws age- and sex-specific changes in disease risk for a given change in dietary quality based on the results of meta-analyses of relationship between food components and risk of cardiovascular disease, cancer, or one of their biological risk factors (blood pressure, blood cholesterol and overweight/obesity) (The parameter estimates used and the meta-analyses on which they are based are presented in Appendix 1). To be included in the model, food components had to have been recognized as statistically associated to either 1) a cardiovascular disease or cancer, or 2) a demonstrated biological risk factor for cardiovascular diseases or cancer in at least one meta-analysis of trials, cohort studies, or case-control studies. The causal relationship between food components and cancer also had to be considered as 'probable' or 'convincing' by the World Cancer Research Fund to be included in the model.[6] All of the relationships in the PRIME model are assumed to follow a log-linear dose–response relationship, with the exception of the relationships between body mass index (BMI) and mortality which is U-shaped. Further, because it is unlikely that the effects of different food components are independent and additive, the model estimates the overlap in estimated changes in risk of cause-specific mortality as they relate to changes in different dietary components by combining parameters multiplicatively (i.e., the result of changing many dietary components simultaneously is less than the sum of its parts, and can never exceed 100% risk reduction). Estimates in PRIME are based on estimates of dietary intake from a population and a counterfactual dietary intake (based on recommendations herein) for this population.

Dietary data

Dietary intake data were obtained from the Canadian Community Health Survey, Cycle 2.2 (2004).[16] This source of data represents the most complete and most recent diet-focused population-based survey of Canadians.[16] This cross-sectional survey of 35 107 Canadians (response proportion of 76.5%) aimed at providing an accurate representation of usual dietary intake of Canadians. It included a 24-h dietary recall, was computer-assisted and was conducted in person. In this survey, the frequency of fruit and vegetables consumption was measured, but assumptions need to be made with respect to portions. The authors assumed that every occurrence of fruit or vegetable consumption was equivalent to consuming one portion, which they assumed weighted 125 g, as suggested in Canada's Food Guide.[17] Number of portions and portion sizes for other food items were collected through the survey.

Dietary recommendations

Canadian dietary recommendations are presented in Table 1.[17,18] For the input of recommendations with age