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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

Table 1 – Mean dietary component intake and recommended intake for Canadian men and women (2004).

	Men		Women	
	Actual mean intake	Recommended intake	Actual mean intake	Recommended intake
Fruits (g/d)[a]	251.9	525.5	270.8	451.5
Vegetables (g/d)[a]	209.6	437.0	253.6	423.5
Fibre (g/d)[b]	19.1	35.5	15.6	23.4
Total fat (% total energy)[b]	31.4	31.4	31.0	31.0
MUFA (% total energy)[c]	12.7	14.4	12.0	14.0
PUFA (% total energy)[c]	5.5	6.0	6.0	6.0
Saturated fat (% total energy)[c]	10.2	10.0	10.2	10.0
Trans fat (% total energy)[c]	3.0	1.0	3.1	1.0
Salt (g/d)[b]	9.0	5.8	6.8	5.8

Abbreviations: MUFA, Monounsaturated fatty acids; PUFA, Polyunsaturated fatty acids; SF, Saturated fatty acids; TF, Trans fatty acids. Actual mean intakes are based on data from the Canadian Community Health Survey, Cycle 2.2 (2004).

[a] Based on Health Canada's Eating Well with Canada's Food Guide. 2007: Men 19–50 years old should eat 8–10 portions of fruits and vegetables per day and men over 51 should eat 7 portions. Women 19–50 years old should eat 7–8 and women over 51 should eat 7 portions. A portion size was assumed to be 125 g as identified in the Food guide.

[b] Based on Health Canada's *Dietary Reference Intakes Tables*: Fibres: Men 19–50 should take 38 g/d, men over 51 should take 30 g/d, women 19–50 should take 25 g/d and women over 51 should take 21 g/d. Total fat: between 20 and 35% of total energy. Salt: The recommendation is for maximum sodium intake not to exceed 2.3 g/d, which can be converted to a maximum of 5.75 g/d of salt.

[c] Joint FAO/WHO Expert Consultation on Fats and Fatty Acids in Human Nutrition (10–14 November, 2008, WHO, Geneva): MUFA: Based on the equation Total fat − PUFA − SF − TF. PUFA: 6–11% of total energy. Saturated fat: 10% of total energy. Trans Fat: 0–1% of total energy.

specifications, the authors weighted recommendations to the Canadian population age distribution. Similarly, given Canada's Food Guide combines fruit and vegetable recommendations into one, the recommendation was divided according to the ratio of fruits and vegetables reported to be consumed by Canadians. For recommendations with a range, the actual average reported dietary of Canadians was used when it fell within the range and the range boundary the closest to the actual intake was used in other cases. Canada does not have specific recommendations for some fat components. For these, recommendations from the joint World Health Organization/Food and Agricultural Organization technical reports on diet, nutrition, and prevention of chronic diseases were used.[19] Whereas relatively little reporting bias is estimated to be associated with the proportion of energy intake obtained from different sources, estimates of total energy intake from 24 h recalls tend to be under-reported by 10–15%.[20–22] Because of this, and because it is not a recommendation to increase energy intake, it has been modelled that a steady energy intake would be maintained under the recommended diet.

Mortality data

2004 Mortality data for coronary heart diseases (ICD-10: I20–25), stroke (ICD-10: I60–69) and diet-related cancers (ICD-10: C00–14, C16, C23, and C33–34), stratified by sex and five-year age band, were acquired from Statistics Canada CANSIM tables.[23,24] The authors also used this source to obtain age and sex-stratified population data for the same year.

Other analyses

For all analyses, weights provided by Statistics Canada to account for the sampling frame of the study were applied.[25] A Monte Carlo simulation is built in PRIME to estimate credible intervals around the results. In this analysis, 95% credible intervals are based on the 2.5th and 97.5th percentiles of results generated from 5000 iterations of the models, where the estimates of relative risks used to parameterize the model were allowed to vary stochastically according to the distributions reported in the literature (i.e., the meta-analyses reported confidence intervals, which were used to estimate the log-normal distribution over which the actual relative risks are likely to lie).

Results

In 2004, there were 11 879 044 men and 13 307 982 women over 15 years old in Canada and 85 527 deaths were attributable to the conditions under study. The average diet of Canadian men included only about 50% of the recommended fruits and vegetables intake (Table 1). Similarly, Canadian women consumed approximately 40% fewer fruits and vegetables than recommended in the Canadian Food Guide. Whereas the diet of men and women provided them with only 54 and 67% of the recommended fibre intake, it surpassed the maximum recommended salt intake by 57 and 17%, respectively. Among fat components, only trans fatty acids consumption was not within or close to recommended intake boundaries.

In total, the estimates of this study suggest that 30 540 deaths could be averted or delayed annually in Canada, if Canadians modified their behaviours to comply with dietary recommendations (Table 2). Of those, more deaths would be averted or delayed among men than women. However, lives saved according to the various dietary recommendations would attain similar proportions in both sexes. In comparison with other recommendations, modifying dietary intake to meet the recommendation for fruit and vegetable intake has the most important death prevention potential. Individually, this recommendation could save as many as 72% of all deaths averted or delayed by a combination of all dietary recommendations. It is followed by recommendations for fibre (29%) and salt (10%). The number of deaths that could potentially be saved providing all fat component-related recommendations were attained was not significant.

Table 2 – Estimated number of deaths averted or delayed by specific dietary guidelines per year in Canada (2004).[a]

	Number of deaths averted or delayed (95% credible interval)					
	Men		Women		Total	
Individual dietary guidelines						
Fruit and vegetables	13 223	(10 259, 15 730)	8833	(6 730, 10 724)	22 056	(16 791, 26 503)
Fibre	6302	(2 891, 9163)	2688	(1 198, 4074)	8990	(4 117, 13 186)
Fats	595	(-1 669, 2603)	289	(-990, 1491)	884	(-2 678, 4045)
Salt	2373	(1 988, 2721)	793	(674, 915)	3166	(2 616, 3604)
All dietary guidelines combined[b]	18 999	(15 824, 21 490)	11 541	(9 294, 13 550)	30 540	(24 953, 34 989)

[a] Estimates are based on 2004 Canadian Mortality data and on dietary data from the Canadian Community Health Survey, Cycle 2.2 (2004).
[b] The dietary guidelines are combined multiplicatively to avoid double counting deaths that could be averted or delayed because of different food components.

Most of the lives that could be saved by improving dietary behaviours of Canadians would be related to coronary heart disease (Table 3). Still, an important number of deaths attributable to stroke, lung cancer, esophageal cancer, and other forms of cardiovascular diseases and cancer could be averted by changing from current to recommended dietary intakes. Stroke is the only disease with similar number of deaths that could be averted in men and women if they improved their dietary habits.

Discussion

This study shows that a considerable number of deaths could be averted or delayed if Canadians modified their current dietary intake to adhere to their nutritional guidelines. Most of the lives saved under this counterfactual behaviour change would be attributable to increases in fruits and vegetables consumption, which is a key recommendation of the World Health Organization.[26] Steps should therefore be taken to target efforts around this recommendation. The large gap between current and recommended fruit and vegetable consumption nevertheless raises the question of whether the recommendation is attainable. For example, the Canadian recommendation calls for approximately 75% more fruits and vegetables than the English, American, and several other countries' recommendations.[27–31] Although literature reviews documented that statistically significant increases in fruit and vegetable intake may be achieved following a variety of community- and individual-level interventions, the increases achieved tend to be small.[32,33] Considerable and concerted efforts will therefore be necessary to markedly raise population level consumption of fruits and vegetables. Correspondingly, various groups recommend the removal of sales taxes from healthy foods such as fruits and vegetables and the distribution of subsidies for these products through taxes collected from unhealthy foods.[34] Considering the costs associated to cardiovascular diseases and cancer exceeds 40 billion $ in Canada every year,[35,36] effective population level interventions to increase fruit and vegetable intake may result in a substantial reduction of the social, systemic, and economic burden of chronic diseases.

Although often discussed, achievement of dietary fat intake recommendations was not associated with large health benefits. Estimates in this study depend on both the strength of association between dietary factors and health outcomes, and the disparity between current and target consumption. The small figures attributable to fatty acids in this study relate to the mean fat intake of Canadians already lying close to recommendations for this food component. The estimates therefore do not imply a weak association between fatty acids and health

Table 3 – Estimated number of deaths averted or delayed by cause if Canadian men and women adhered to dietary guidelines (2004).[a]

Cause of death	Number of deaths averted or delayed (95% credible interval)					
	Men		Women		Total	
Cardiovascular disease	15 029	(12 004, 17 338)	9682	(7565, 11 605)	24 711	(19 432, 28 713)
Coronary heart disease	12 631	(9 572, 14 764)	7285	(5 248, 9006)	19 916	(14 807, 23 689)
Stroke	2001	(1 249, 2672)	2219	(1 349, 3067)	4219	(2 612, 5693)
Heart failure	145	(117, 176)	70	(55, 85)	215	(170, 257)
Aortic aneurysm	88	(68, 110)	18	(14, 22)	106	(82, 131)
Pulmonary embolism	11	(5, 18)	5	(2, 8)	17	(7, 25)
Rheumatic heart disease	6	(2, 9)	4	(1, 6)	9	(3, 15)
Hypertensive disease	147	(126, 167)	81	(69, 94)	228	(192, 257)
Cancer	3970	(2 782, 4964)	1859	(1 180, 2474)	5829	(3 985, 7368)
Mouth, larynx and pharynx	635	(557, 669)	306	(256, 334)	942	(811, 1004)
Oesophageal	991	(717, 1073)	305	(206, 345)	1296	(944, 1421)
Stomach	411	(96, 639)	147	(6, 261)	558	(95, 896)
Lung	1933	(774, 2923)	1101	(458, 1684)	3033	(1 305, 4600)
Total	18 999	(15 824, 21 490)	11 541	(9 294, 13 550)	30 540	(24 953, 34 989)

[a] Estimates are based on 2004 Canadian Mortality data and on dietary data from the Canadian Community Health Survey, Cycle 2.2 (2004).

outcomes. Recent comparisons of various diets indicate that those with the highest poly and monosaturated fat to saturated fat ratio were associated with the lowest mortality.[37,38] This evidence, combined with the high energy content of fat and the overwhelming prevalence of overweight and obesity,[39,40] suggests it might be appropriate to lower the recommendation for proportion of energy intake coming from saturated fat.

Given the current restructuration of primary health care and the recognition that integrating public health and primary care has considerable benefits for improving population health, the results of this study also provide relevant information for patient-oriented services and interventions.[41] For example, the results suggest that adequate nutrition guidance should be easily accessible. Primary health care has the advantages of providing cost-effective services while integrating continuity and comprehensiveness of care and being regarded as the most accessible point of care within the system.[42] Although access to dieticians would be valuable, previous reports suggest that counselling on simple dietary recommendations could be efficiently disseminated by a variety of primary care health professionals.[43] However, primary care professionals sometimes feel inadequately trained to provide nutrition advice, suggesting that their education programs should include opportunities to learn basic nutritional guidelines and acquire skills to provide counselling on these guidelines.[44] In addition, given the results, it could be recommended that people at risk of coronary heart disease should be adequately screened and more specifically targeted for preventive interventions.

The results from this study can be compared with a recent study that modelled the health impact of achieving dietary recommendations in the UK, which also used the PRIME model.[10] The UK paper suggested that 46% of the deaths averted or delayed could be attributed to meeting the fruit and vegetables recommendations, with a further 23% from achieving the salt recommendation. This compares with 72% and 10% for fruit and vegetables and salt respectively in Canada. However, the primary reason for these large differences is the difference between recommended fruit and vegetable consumption in the UK and Canada: five portions per day in the UK and at least seven portions (depending on sex and age) in Canada. The results of this study can also be compared with results from the Global Burden of Disease project,[45] which used similar methods. The estimates for Canada[46] show that dietary factors caused a greater burden of disease in Canada than smoking, alcohol use or physical inactivity. Of these dietary factors, the highest burden was associated with low fruit, followed by low nuts and seeds and then high sodium. However, the results are not directly comparable with the results here as the counterfactual scenarios that are used are different.

Strengths of this study include that the impact of achieving each of the recommendation was estimated in isolation and combined together. Further, the estimates of this study are based on reported food consumption rather than food purchase data as used in previous analyses.[10,11] These data are nevertheless subject to problems of recall and social desirability bias.[47] The approximation of individuals' usual dietary intake may not be as precise with a 24-h dietary recall as with several recalls. It is nevertheless appropriate for the purpose of estimating usual intake at a population level such as in the context of this analysis. Also, the results are largely drawn from meta-analyses of observational studies. Although the model aims at minimizing the possibility of double counting deaths by including parameters that have been mutually adjusted for other dietary components, overestimation could have occurred if other dietary components and measurement errors, inherent in observation nutritional epidemiologic studies, were not adjusted for appropriately. In general, the meta-analyses that provided the relative risk parameters for the PRIME model used estimates of relative risk from original studies that were adjusted for as many dietary components and other behaviours as possible, but these adjustments varied from study to study. The second table in the appendix provides a description of the confounding variables that were adjusted for in each of the meta-analyses. In addition, the authors had to make assumptions regarding the quantity of fruits and vegetable consumed. However, the estimates of food and vegetable intake are similar to estimates of other countries[48]. In the event that the amount of fruit and vegetable consumed by Canadians was underestimated, this food component would nevertheless have been responsible for the largest number of deaths attributable to cancer and cardiovascular diseases. Yet, it should be noted that estimates for fruit and vegetable in this paper imply that increases of one portion produces the same relative change in risk regardless of the current level of consumption. Although the data included in the meta-analysis suggest that the association is log-linear,[49,50] it is possible that the relationship becomes non-log-linear at very high levels of consumption not detected within the studies included in the analyses.

In conclusion, the estimates of this study suggest that if Canadians changed from their current dietary intake to the intakes recommended, over 30 000 deaths could be prevented every year. Most of the lives saved would be due to a reduction in the burden of coronary heart diseases and would be the result of an increase in fruits and vegetable consumption.

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Competing interests

None declared.

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Appendix 1. Parameters used in the DIETRON model.

Food component/biological risk factor	Outcome	Unit of change	Relative risk (95% confidence intervals)
Fruit	CHD	106 g/day increase	0.93 (0.89, 0.96)
	Stroke	106 g/day increase	0.89 (0.85, 0.93)
	M/L/P cancer	100 g/day increase	0.72 (0.59, 0.87)
	Oesophagus cancer	100 g/day increase	0.56 (0.42, 0.74)
	Lung cancer	80 g/day increase	0.94 (0.90, 0.97)
	Stomach cancer	100 g/day increase	0.95 (0.89, 1.02)
Vegetables	CHD	106 g/day increase	0.89 (0.83, 0.95)
	Stroke	106 g/day increase	0.97 (0.92, 1.02)
	M/L/P cancer	50 g/day increase	0.72 (0.63, 0.82)
	Oesophagus cancer	50 g/day increase	0.87 (0.72, 1.05)
	Stomach cancer	100 g/day increase	0.98 (0.91, 1.06)
Fibre	CHD	10 g/day increase	0.81 (0.72, 0.92)
Salt	Stomach cancer	1 g/day increase	1.08 (1.00, 1.17)
Serum cholesterol	CHD	1 mmol/l decrease	Under 49: 0.44 (0.42, 0.48)
			50–59: 0.58 (0.56, 0.61)
			60–69: 0.72 (0.69, 0.74)
			70–79: 0.82 (0.80, 0.85)
			Over 79: 0.85 (0.82, 0.89)
	Stroke	1 mmol/l decrease	Under 59: 0.90 (0.84, 0.97)
			60–69: 1.02 (0.97, 1.08)
			70–79: 1.04 (0.99, 1.09)
			Over 79: 1.06 (1.00, 1.13)

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Food component/biological risk factor	Outcome	Unit of change	Relative risk (95% confidence intervals)
Blood pressure	CHD	20 mmHg SBP decrease	Under 49: 0.49 (0.45, 0.53) 50–59: 0.50 (0.49, 0.52) 60–69: 0.54 (0.53, 0.55) 70–79: 0.60 (0.58, 0.61) Over 79: 0.67 (0.64, 0.70)
	Stroke	20 mmHg SBP decrease	Under 49: 0.36 (0.32, 0.40) 50–59: 0.38 (0.35, 0.40) 60–69: 0.43 (0.41, 0.45) 70–79: 0.50 (0.48, 0.52) Over 79: 0.67 (0.63, 0.71)
Body mass index	CHD	5 kg/m^2 increase	Men, BMI 15–25: 1.27 (1.16, 1.39) Women, BMI 15–25: 1.01 (0.86, 1.18) Men, BMI 25–50: 1.42 (1.35, 1.48) Women, BMI 25–50: 1.35 (1.28, 1.43)
	Stroke	5 kg/m^2 increase	BMI 15–25: 0.92 (0.82, 1.03) BMI 25–50: 1.39 (1.31, 1.48)
	Oesophagus cancer	1 kg/m^2 increase	1.11 (1.07, 1.15)
	Pancreas cancer	5 kg/m^2 increase	1.14 (1.07, 1.22)
	Colorectum cancer	1 kg/m^2 increase	1.03 (1.02, 1.04)
	Breast cancer	2 kg/m^2 increase	Under 60: 0.94 (0.92, 0.95) Over 60: 1.03 (1.01, 1.04)
	Endometrial cancer	5 kg/m^2 increase	1.52 (1.35, 1.72)
	Kidney cancer	5 kg/m^2 increase	1.31 (1.24, 1.39)
	Gallbladder cancer	5 kg/m^2 increase	1.23 (1.15, 1.32)
Total fat	Total serum cholesterol (mmol/l)	1% of total calories increase	0.020 (0.010, 0.030)
Saturated fat	Total serum cholesterol (mmol/l)	1% of total calories increase	0.052 (0.046, 0.058)
MUFAs	Total serum cholesterol (mmol/l)	1% of total calories increase	0.005 (−0.001, 0.011)
PUFAs	Total serum cholesterol (mmol/l)	1% of total calories increase	−0.026 (−0.034, −0.018)
Dietary cholesterol	Total serum cholesterol (mmol/l)	1 mg/d increase	0.001 (0.001, 0.001)
Trans fats	Total serum cholesterol (mmol/l)	1% of total calories increase	0.038 (0.018, 0.058)
Salt	Systolic blood pressure (mmHg)	3 g/day reduction	−2.50 (−2.85, −2.15)

The parameters above are based on the results of the following meta-analyses:

Food component/ risk factor	Outcome	Meta-analysis details	Adjustments	Source
Fruit	CHD (I20–25)	Six cohort studies (3,446 events)	Age, smoking, obesity	(Dauchet et al., 2006)
	Stroke (I60–69)	Five cohort studies (1,853 events)	Age, hypertension, smoking, obesity	(Dauchet et al., 2005)
	Mouth, pharynx, larynx cancer (C00–14)	Seven case-control studies	Smoking	(AICR/WCRF, 2007)
	Oesophagus cancer (C15)	Eight case-control studies	–	(AICR/WCRF, 2007)
	Lung cancer (C34)	Fourteen cohort studies	Smoking	(AICR/WCRF, 2007)
	Stomach cancer (C16)	Eight cohort studies	–	(AICR/WCRF, 2007)
Vegetables	CHD	Seven cohort studies (3,833 events)	Age, smoking, obesity	(Dauchet et al., 2006)
	Stroke	Four cohort studies (933 events)	Age, hypertension, smoking, obesity, blood cholesterol, physical activity, energy intake, alcohol intake	(Dauchet et al., 2005)
	Mouth, pharynx, larynx cancer	Four case-control studies	Sex, smoking, alcohol intake	(AICR/WCRF, 2007)
	Oesophagus cancer	Five case-control studies	–	(AICR/WCRF, 2007)
	Stomach cancer	Seven cohort studies	–	(AICR/WCRF, 2007)

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Food component/ risk factor	Outcome	Meta-analysis details	Adjustments	Source
Fibre	CHD	Ten cohort studies (2,011 CHD deaths)	Age, energy intake, smoking, obesity, physical activity, education, alcohol intake, multiple vitamin use, raised cholesterol, hypertension, dietary saturated fat, PUFA and cholesterol	(Pereira et al., 2004)
Total fat, saturated fat, MUFA, PUFA, dietary cholesterol	Total serum cholesterol	227 dietary intervention studies with diets persisting at least two weeks	Age, weight, other dietary fat measures	(Clarke et al., 1997)
Trans fats	Total serum cholesterol	40 dietary intervention studies with diets persisting at least two weeks	Age, weight, other dietary fat measures	(Clarke et al., 1997)
Salt	Stomach cancer	Two cohort studies.	–	(AICR/WCRF, 2007)
	Blood pressure	28 randomized controlled trials in hypertensive and normotensive individuals	All potentially confounding factors	(He and MacGregor, 2002; He and MacGregor, 2003)
Total serum cholesterol	CHD	61 cohort studies (33 744 events)	Age, sex	(Prospective Studies Collaboration, 2007)
	Stroke	61 cohort studies (11 663 events)	Age, sex	(Prospective Studies Collaboration, 2007)
Blood pressure	CHD	61 cohort studies (34 283 events)	Blood cholesterol, diabetes, weight, alcohol intake, smoking	(Prospective Studies Collaboration, 2002)
	Stroke	61 cohort studies (11 960 events)	Blood cholesterol, diabetes, weight, alcohol intake, smoking	(Prospective Studies Collaboration, 2002)
Obesity	CHD	57 cohort studies	Age, sex, smoking	(Prospective Studies Collaboration, 2009)
	Stroke	57 cohort studies	Age, sex, smoking	(Prospective Studies Collaboration, 2009)
	Oesophagus cancer	Four case-control studies	–	(AICR/WCRF, 2007)
	Pancreas cancer (C25)	17 cohort studies	Smoking	(AICR/WCRF, 2007)
	Colorectum cancer (C18)	28 cohort studies	–	(AICR/WCRF, 2007)
	Breast cancer (C50)	16 cohort studies	–	(AICR/WCRF, 2007)
	Endometrial cancer (C54.1)	15 cohort studies	–	(AICR/WCRF, 2007)
	Kidney cancer (C64)	Seven cohort studies.	Smoking	(AICR/WCRF, 2007)
	Gallbladder cancer (C23)	Four cohort studies.	–	(AICR/WCRF, 2007)