How much of the burden of cardiovascular disease in Canada is attributable to ultra-processed foods?

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Acknowledgments

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Executive summary

What did this study do?

This study estimates the burden of major cardiovascular disease (heart disease and stroke) attributable to the consumption of ultra-processed foods and drinks (UPF) among Canadian adults aged 20 and older. More specifically, this study estimates how many new cases of cardiovascular disease (CVD), deaths from CVD and years of life lost or affected by disability from CVD can be attributed to UPF consumption. This study also estimates the potential impact of hypothetical changes in the consumption of UPF on CVD burden in Canada.

What did the study find?

- Canadians consume a lot of UPF: According to the most recent data, these products represented 43.4% of total daily energy intake among adults aged 20 years and older.
- This high level of UPF consumption was associated with a high burden of CVD, representing 38% of all CVD events in 2019. This corresponds to an estimated 96,043 new cases of CVD (heart disease and stroke), 17,417 deaths, and 388,654 years of lost life or affected by disability from these diseases per year.
- If Canadians were to reduce their consumption of UPF by half this would result in 45,914 fewer new cases of CVD, 8,314 fewer deaths from CVD, and 185,209 fewer years of lost life or affected by disability from CVD per year.
- However, if UPF intake were increased by 50%, there would be an additional 19,979 new cases, 3,489 deaths , and 77,691 years of life lost or affected by disability from CVD each year.

What do the findings mean?

This study estimated a high burden of CVD attributable to the consumption of UPF among Canadian adults in 2019: more than a third of the overall CVD burden (38%) was attributable to the consumption of these products. Canada urgently needs a comprehensive approach employing multiple policies and interventions aimed at reducing the ubiquitous exposure to UPF in the Canadian food environment and decreasing the consumption of these products in the population. Such actions would be an important step toward addressing the substantial burden of CVD on Canadian society.

Introduction

Canada is struggling with a high burden of chronic disease.

Cardiovascular disease (CVD), such as coronary heart disease and stroke, are among the leading causes of death in Canada, claiming over 50,000 lives annually (1). Data from the Canadian Chronic Disease Surveillance System for 2017–2018 reveals that approximately 8.5% of Canadian adults have been diagnosed with coronary heart disease, while 2.9% of adults aged 20 or older have survived a stroke (2). The economic health toll is also substantial: heart conditions and stroke cost the Canadian economy more than $21.2 and $3.6 billion per year, respectively (3, 4). Collectively, that is more than $24.8 billion per year.

Diet is a major known risk factor for cardiovascular disease.

While modifiable risk factors including tobacco use, physical inactivity and alcohol consumption contribute significantly to the burden of CVD, dietary factors play a central role (5). According to the Institute for Health Metrics and Evaluation (IHME), 30% of deaths from CVD globally were attributable to unhealthy diets in 2021 (6). The IHME estimated that nearly 50% of deaths from CVD in Canada in 2017 were attributable to dietary risks, including low intake of nutritious foods such as whole grains, vegetables and fruits, as well as high consumption of sodium, sugar- sweetened beverages, trans-fatty acids and processed meats (7).

The Canadian health burden coincides with a significant shift in global dietary patterns.

Characterized by an increased consumption of ultra-processed foods and drinks (UPF) and decreased consumption of home-cooked meals, fruits, and vegetables (8). UPF, as defined by the NOVA classification, are industrial formulations made from refined food substances and additives designed to create durable, convenient, and appealing products such as soft drinks, packaged snacks, fast food, and frozen dinners (9). These products dominate the global food supply (10). In Canada, between 1938 and 2011, the evolution of household food purchases was marked by the replacement of fresh and minimally processed foods by UPF (11). In 2015, nearly half of all calories consumed by Canadians came from UPF (12). This level of UPF consumption has been relatively unchanged since 2004 (12), and sales of UPF have plateaued in the last decade (10). While there are some sociodemographic differences in consumption patterns, the intake of UPF is high across all population groups and highest in children and adolescents (8, 12, 13).

Ultra-processing harms human health.

Analyses of data from national dietary surveys from Canada and other high-income countries have consistently shown an association between the consumption of UPF and poor diet quality, characterized by high intakes of free sugars, saturated fats and sodium, alongside reduced fibre intake, vitamins, and minerals (14, 15, 16). There is also preliminary evidence that several UPF ingredients, such as emulsifiers, preservatives and food colourants are harmful to human health, and more research on the topic is needed (17, 18). Given the link with poor diet quality, it is unsurprising that high UPF consumption has been linked to increased risk of all-cause mortality and chronic disease, including CVD (19, 20, 21). In Canada, consumption of UPF has been associated with higher levels of obesity, diabetes, and hypertension (22). However, Canada lacks specific analyses linking the burden of CVD, including the risk of mortality and disability from CVD to the consumption of UPF. In Brazil, researchers recently conducted a modelling study to estimate the burden of major CVD events (coronary artery disease and stroke) attributable to the consumption of UPF among adults aged 30 to 69 years (23). They estimated that UPF accounted for approximately 19,200 deaths, 74,900 new cases, and 883,000 years of life lost or affected by disability (Disability-Adjusted Life Years or DALYs) from CVD, corresponding to about 22% of all deaths from CVD among Brazilian adults (23).

This study inquires: How much of the burden of cardiovascular disease in Canada is attributable to ultra- processed foods?

To answer this question, this study estimates the number of new cases of CVD (coronary heart disease and stroke), and the number of deaths and years of life lost or affected by disability (DALYs) associated with these diseases that can be attributed to UPF consumption among Canadian adults aged 20 and older. The study also estimates the potential impact of hypothetical changes in UPF consumption on the number of new cases, deaths and DALYs from CVD in Canada.

Estimating the impact of ultra-processed foods on cardiovascular disease morbidity and mortality will provide key evidence to support the development of public policies aimed at supporting a healthier food environment.

The Lancet Commission on the Global "Syndemic" of Obesity, Undernutrition, and Climate Change emphasized the urgent need for global food systems to transition toward healthier, more sustainable diets, particularly those that are less processed and more plant-based (24). The Commission also stated that public policies are key in driving this change. Many middle- and high-income countries have already implemented national, state, and local policies to reduce exposure to UPF, such as front-of-package labelling and restrictions on food advertising targeting children (25). Such policies, recommended by the World Bank (26), were considered in Health Canada's healthy eating strategy (27). This strategy includes the 2019 Canada's food guide, which aligns with these goals by encouraging health professionals and citizens to adopt healthier diets for health and environmental reasons, recommending cooking, preferring fresh or minimally processed foods such as fruits and vegetables, and avoiding highly processed foods (i.e., those that contribute to excess sodium, free sugars or saturated fat), such as soft drinks and packaged snacks (28). Although the food guide's recognition of food processing is an important step forward, the broader impact of food processing on the population's health remains underexplored and neglected.

Methods

Overview of the model

This study used a simulation model developed and validated by a team of Brazilian researchers in 2022 (23). The model is based on a comparative risk assessment method generally used to evaluate changes in population health resulting from modifying the population distribution of exposure to a risk factor. In this study, the risk factor corresponds to a decrease or increase in the intake of ultra-processed foods and drinks (UPF) in the Canadian population.

We employed the model to estimate the number of cardiovascular disease (CVD) events attributable to the consumption of UPF in adults aged 20 years and older in Canada. For this study, CVD events include new cases of coronary heart disease and stroke, deaths from these CVD disease, and Disability-Adjusted Life Years or DALYs from these disease (Box 1). A DALY refers to the loss of the equivalent of one year of full health (29).

We also examined the potential change in the number of CVD events if Canadians were to reduce their intake of UPF by 20% or 50%, and to increase their intake of UPF by 50%.

Box 1. Cardiovascular disease (CVD) events of interest in the current modelling study

New cases of CVD per year:

- Total new cases of CVD from coronary heart disease and stroke
- New cases of coronary heart disease
- New cases of stroke

Deaths from CVD per year:

- Total CVD deaths from coronary heart disease and stroke
- Deaths from coronary heart disease
- Deaths from stroke

DALYs per year:

- Total new cases of DALYs from coronary heart disease and stroke DALYs from coronary heart disease
- DALYs from stroke

Modelling process

Briefly, the modelling process involved:

1. **Estimating the baseline consumption of UPF** using dietary survey data representative of the Canadian population.
2. **Calculating the burden of new cases, deaths, and DALYs** from CVD attributable to UPF consumption.
3. **Estimating potential changes in the consumption of UPF under different alternative scenarios and assessing the impact of these potential changes** on new cases, deaths, and DALYs from CVD through comparative risk assessment analysis.

(1) Estimating the consumption of ultra-processed foods

The dietary intake of UPF among Canadians aged 20 years and older was assessed using 24-hour dietary recall data collected as part of the 2015 Canadian Community Health Survey (CCHS) – Nutrition. This is the most recent available national-level nutrition survey in Canada (30). All foods and beverages reported in the 2015 CCHS – Nutrition were first classified according to the NOVA classification into four major groups according to a previously described approach (12). Briefly, these four groups are: (1) unprocessed or minimally processed foods (e.g., fruits, vegetables, rice, and beans); (2) processed culinary ingredients (e.g., oil and sugar); (3) processed foods (e.g., simple bread and cheese), and (4) UPF (e.g., mass-produced industrial breads and buns, deli meats, soft drinks, sweetened or flavoured milk products, cookies and pastries, chips, crackers and other salty snacks). Next, the consumption level of UPF in the Canadian population was estimated as the average daily proportion (%) of total daily energy intake from UPF and reported by sex (male or female) and age groups.

(2) Calculating how much of the cardiovascular disease burden is attributable to the consumption of ultra-processed foods

Overall, the model relies on estimates of the risk of CVD mortality and cardiovascular disease associated with the consumption of UPF. This is based on epidemiological evidence from three cohort studies, including studies from France and the United States, in which a 10% increase in the daily energy share of UPF in the diet was associated with an 8.2% increase in the risk of mortality from coronary heart disease and a 9.8% increase in the risk of mortality from stroke (31, 32, 33). To be applicable to Canada, the model relies on national health statistics for 2019 (i.e., total deaths from CVD and number of new cases of CVD in Canada in 2019) published by Statistics Canada and the Canadian Chronic Disease Surveillance System (34, 35, 36), and estimates of UPF consumption levels from the 2015 CCHS – Nutrition, a national nutrition survey (30). More details on the model and mathematical calculations used in the model are available from the Brazilian study by Nilson et al. published in 2022 (23).

(3) Estimating the potential impact of changes in ultra- processed foods consumption on cardiovascular disease burden

We simulated different scenarios in which Canadians would reduce their average intake of UPF by 20% or 50%. We also considered a scenario in which Canadians would increase their average consumption of UPF by 50%. For each of these scenarios, we estimated the impact of UPF intake on new cases of CVD, and deaths and DALYs from CVD using the same analytical method described above.

Results

How much ultra-processed foods are Canadians consuming?

According to the latest available national-level nutrition data (2015), UPF contribute, on average, a substantial proportion (43.4%) of the total daily energy consumed by Canadian adults aged 20 years and older.

As shown in **Figure 1**, age- and sex-specific estimates of UPF consumption in 2015 ranged from 38% to 49% of total daily energy intake. Consumption of UPF was lowest (less than 40% of energy intake) among females aged 30 to 34 and those aged 45 to 54, and highest (from 48% to 49% of energy intake) among young males aged 20 to 24, older females aged 80 to 84, and older males aged 85 to 89 years.

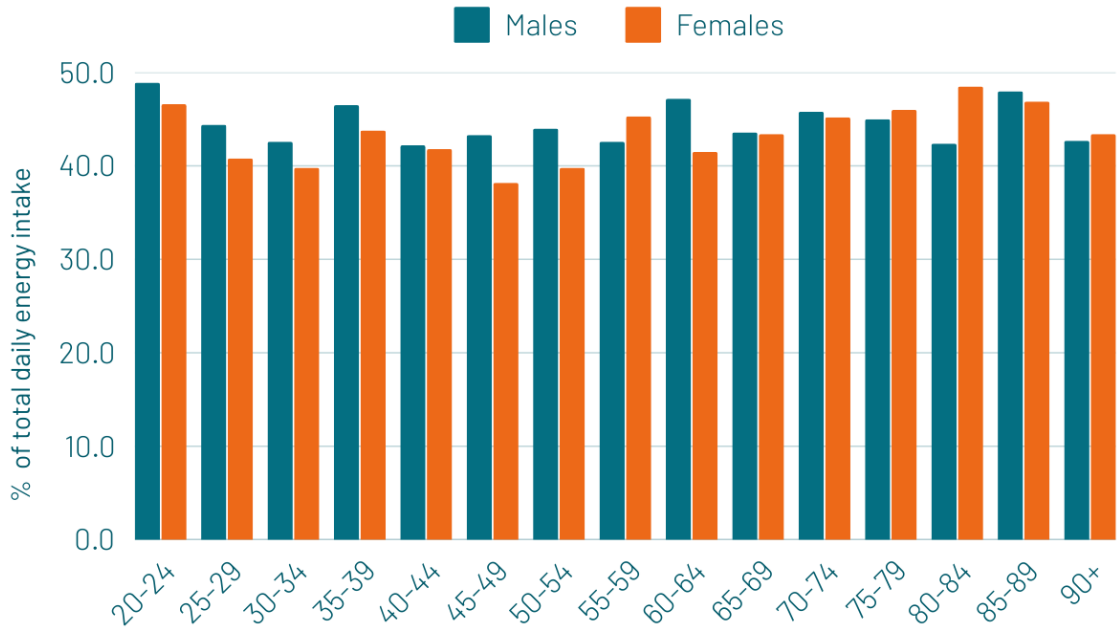

Figure 1. Age- and sex-specific estimates of ultra-processed food and drink consumption among adults in Canada, 2015

Source: Canadian Community Health Survey – Nutrition, 2015

How much of the cardiovascular disease burden is attributable to the consumption of ultra-processed foods in Canada?

In 2019, there was a total of 258,550 new cases of CVD (coronary heart disease and stroke), 46,153 deaths from CVD, and 1,035,667 years of life lost or affected by disability (DALYs) from CVD among Canadian adults aged 20 years and older.

As shown in **Table 1**, we estimated that in 2019, 96,043 new cases of CVD (95% Uncertainty Interval, UI: 34,516 to 161,750), 17,417 deaths from CVD (95% UI: 6,501 to 28,834) and 388,654 DALYs/year (95% UI: 141,803 to 648,420) were attributable to the consumption of UPF in Canada.

Table 1. Estimated burden of cardiovascular disease events attributable to ultra- processed food and drink consumption among Canadian adults aged 20 years and older, 2019

CVD events	Number of events (95% Uncertainty Interval)
New cases/year	
Total CVD Coronary heart diseases Stroke	96,043 (34,516 to 161,750) 58,472 (25,782 to 91,428) 37,931 (8,734 to 70,321
Deaths/year	
Total CVD deaths Deaths from coronary heart disease Deaths from stroke	17,417 (6,501 to 28,834) 11,634 (5,162 to 18,147) 5,783 (1,339 to 10,688)
DALYs/year	
Total CVD Coronary heart disease Stroke	388,654 (141,803 to 648,420) 246,540 (109,009 to 385,224) 142,114 (32,794 to 263,197)

CVD: cardiovascular divsease; DALYs: Disability-Adjusted Life Years.

The percentage of CVD events attributable to UPF consumption was relatively high. As shown in **Figure 2**, an estimated 37% of all new cases of CVD (coronary heart disease and stroke), 38% of all CVD deaths, and 38% of DALYs associated with CVD among Canadian adults in 2019 could be attributed to the consumption of UPF.

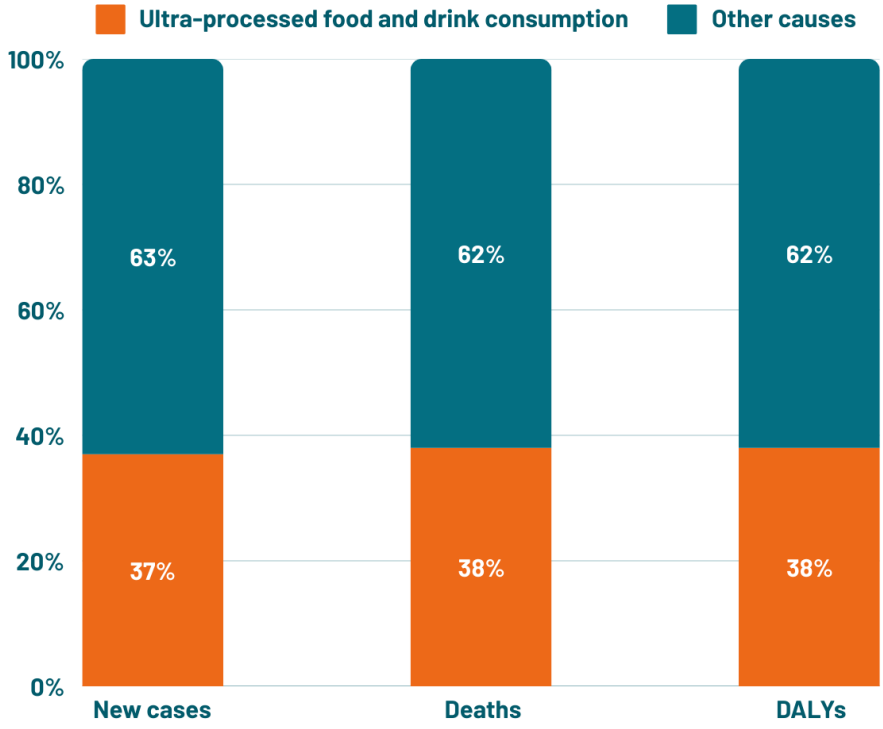

Figure 2. Percentage of cardiovascular disease events attributable to the consumption of ultra-processed foods and drinks in Canada, 2019

DALYs: Disability-Adjusted Life Years.

Considering all deaths from CVD attributable to UPF, 67% were from coronary heart disease and 52% were among men. Approximately 61% of all new cases of CVD attributable to UPF were from coronary heart disease and mostly among men (55%). Finally, 63% of the DALYs attributable to UPF intake were from coronary heart disease and mostly among men (56%).

What if the consumption of ultra-processed foods were decreased or increased in Canada?

We calculated the impact of a potential reduction in UPF consumption on CVD events among Canadian adults (**Figure 3**). First, we estimated that a 20% reduction in the energy contribution of UPF in the diet would avert 16,792 new cases of CVD (95% UI: 5,698 to 29,938), 3,053 deaths from CVD (95% UI: 1,105 to 5,444), and 67,806 DALYs (95 % UI: 23,673 to 120,957) from CVD in 2019. **This number of potentially avoidable CVD events represents 17.5 % of the total burden of CVD events attributable to UPF** (i.e., 87,651 total CVD events attributable to UPF consumption / total 502,111 of CVD events in Canada in 2019 x 100%).

Alternatively, a 50% reduction in the energy contribution of UPF would avert an estimated 45,914 new cases (95% UI: 16,923 to 78,351), 8,314 deaths (95% UI: 3,189 to14,008), and 185,209 DALYs (95% UI: 69,449 to 314,139) from CVD (**Figure 3**). **In other words, reducing UPF intake by half would reduce the CVD burden attributable to UPF by 48%** (i.e., 45,914 cases of CVD could be averted from the total estimated 96,043 cases, and 8,314 deaths could be averted from the total estimated 17,417 deaths).

Finally, we also considered a hypothetical scenario in which the quality of the Canadian diet would deteriorate and UPF intake would increase. We estimated that a 50% increase in the energy contribution of UPF would lead to 116,022 new cases (95% UI: 66,591 to 169,058), 20,889 deaths (95% UI: 12,101 to 30,146), and 466,615 DALYs (95% UI: 268,139 to 677,682) from CVD. Compared to our baseline scenario (i.e., 100% reduction in UPF intake), this means an additional 19,979 new cases, 3,489 deaths, and 77,691 DALYs from CVD (**Figure 3**). **Thus, if Canadians were to increase their consumption of UPF by 50%, the CVD burden attributable to UPF would represent 45% of new cases, 45% of deaths, and 45% of all DALYs from CVD.**

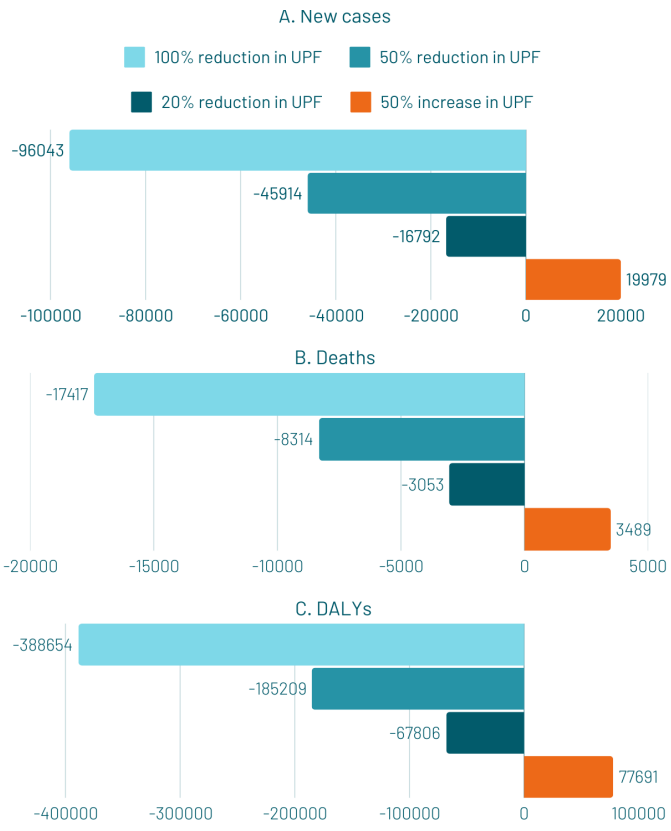

Figure 3. Estimated numbers of (A) new cases, (B) deaths, and (C) DALYs per year from cardiovascular disease (heart disease and stroke) by scenario of change in level of ultra- processed food and drink consumption among Canadian adults aged 20 and older

DALYs: Disability-Adjusted Life Years.

Discussion

Consumption of ultra-processed foods and drinks (UPF) in Canada is high: in 2015, UPF represented, on average, 43% of the total daily energy intake among adults aged 20 years and older. As previously reported, this high level of UPF intake is concerning because these products have low nutritional quality (14) and are associated with an increased risk of several chronic disease (19, 20, 21).

According to this modelling study, a substantial fraction of cardiovascular disease (CVD) events is attributable to the consumption of UPF in Canada, representing an estimated 37% of new cases per year, and 38% of deaths and DALYs from CVD per year. This translates to 96,043 new cases of CVD, 17,417 deaths from CVD, and 388,654 years of life lost or affected by disability (DALYs) associated with CVD per year.

According to alternative scenarios examined in this study, if Canadians were to reduce their UPF intake by 20% to 50%, CVD events would be reduced by 17% to 48%, respectively, saving between 3,053 and 8,314 lives each year.

Reducing ultra-processed foods consumption is more beneficial for health than reformulation of critical nutrients.

UPF have multiple nutritional problems, including being high in free sugars, sodium, and/or saturated fats, while being low in fibre, minerals, and vitamins (15). Furthermore, the lower the caloric contribution of UPF in the diet, the higher the intake of fruits and vegetables (37). Thus, a lower caloric contribution of UPF in the diet is associated with higher overall diet quality (14, 15, 16).

Previous modelling studies from Canada have focused on examining the impact of reducing key nutrients in the Canadian diet on CVD events. For example, one study estimated that 2,176 deaths per year from CVD could be avoided by reducing Canadian adults' mean sodium intake to 2,300 mg/d, and 3,252 deaths if sodium intake were further reduced to 2,000 mg/day (38). The implication of these results to our study is that reducing UPF in the diet would provide larger benefits than reducing a single nutrient such as salt. Our results are in line with those from a 2022 study by the Institute of Health Metrics and Evaluation, which found that increasing vegetable consumption from 0 to 306–372 g daily was associated with a 23.2% decline in the risk of ischemic stroke and a 22.9% decline in the risk of ischemic heart disease (39). Indeed, eating foods like fruit, vegetables, and legumes has been directly associated with lower consumption of UPF (37). Finally, it is important to note that consumption of UPF has been linked to adverse health outcomes independent of their content of specific nutrients or foods (20, 40).

How do ultra-processed foods and drinks harm our health?

Several potential factors and mechanisms linking UPF with CVD have been suggested in addition to their poor nutritional quality (high in free sugars, sodium, and saturated fats, low in minerals, vitamins, and fibre). Indeed, food processing can produce toxins, such as acrylamide or furans, while altering the food matrix, which affects satiety and intestinal transit and ultimately increases consumption (41). Other potential factors include food additives and other industrial ingredients added to UPF, and their single or cocktail effects on gut flora (microbiota) and inflammation, as well as aggressive food marketing that encourages the overconsumption of these products (41). In Canada, UPF dominates the food environment and thus represents a problem of exposure. This underscores the need for research to unravel and elucidate the role of UPF ingredients and mechanisms on human health.

What can Canada do to reduce population exposure to ultra- processed foods?

Addressing the high consumption of UPF requires strengthening the implementation of food-based dietary guidelines and improving consumer knowledge, attitudes, and behaviours. However, strategies targeted at individuals to change their dietary behaviours have limited effectiveness (24, 42). This highlights the critical need for public policies to create healthy food environments that encourage the consumption of fresh and minimally processed foods while reducing exposure to UPF and discouraging UPF intake through fiscal and regulatory measures.

Such policies include restricting the marketing of unhealthy foods and beverages to children, subsidizing healthy foods and beverages as well as increasing taxes on sugary drinks, restricting the sale of unhealthy foods in schools and recreation centres and implementing front-of-package nutritional labelling. For instance, in Chile, the introduction of front-of-package nutritional warnings led to a 23.8% reduction in the purchase of high-calorie foods (43). Similarly, in Mexico, a 10% tax on sugar-sweetened beverages resulted in a 6.3% decrease in their consumption (44).

These initiatives align with health goals set by several countries. For example, as part of its most recent Programme National Nutrition Santé (2019–2023), France established a target to reduce UPF consumption by 20% within five years (45). Our findings suggest that reducing UPF consumption by 50% would significantly improve the diet quality of the Canadian population, resulting in a new population average of 22% of total daily calories coming from UPF. This lower level of UPF intake matches the average UPF consumption among the 20% of Canadians who primarily consumed fresh and minimally processed foods based on a 2015 national nutrition survey (14). This group of Canadians were the only ones to meet the World Health Organization's recommendations for free sugars intake (14).

There is emerging evidence that chronic disease can be reversed by reducing dietary levels of UPF. A recent clinical study of coronary heart patients conducted at the Montreal Institute of Cardiology implemented an intensive lifestyle intervention that included exercise and reduction in UPF consumption (46). After 6 months of the intervention, 50% of participants achieved remission from prediabetes and 70% achieved remission from metabolic syndrome (46).

Finally, it is critical that governments invest in research to determine the role that the various ingredients and components of UPF play in human health and chronic disease. This will help us to develop better policies.

Strengths and limitations of this study

The current study is the first to estimate the contribution of UPF consumption to CVD events in Canada. This study's analytic approach is based on a previously developed and validated simulation model from Brazil (23). However, some caution regarding the interpretation of results is warranted. Because Canada currently lacks data on the relative risk of CVD events associated with UPF intake, our model relies on estimates provided by cohort studies done in other countries of similar economic status, such as the U.S. and France (47). To better estimate the relative risk of CVD events associated with the consumption of UPF in Canada, well-designed cohort studies are needed. Furthermore, our study is based on UPF consumption levels estimated using the most recent national nutrition survey in Canada, which dates to 2015 (30). Commercial data suggest that UPF sales have plateaued in Canada over the last decades (10). Therefore, 2015 data likely provide a fair estimate of the current levels of intake of UPF in Canada. Lastly, the health data used in this study date from 2019. More recent data on new cases of CVD and associated deaths, once available, should be used in future modelling studies.

Recommendations for policy and research

Over the past decade, we have presented evidence that UPF are detrimental to the diet and health of Canadians (48, 49), as well as to the revenues of Canadian farmers (50). The current study builds on this evidence by estimating a high burden of CVD attributable to UPF in Canada.

These findings suggest the need to develop strong public policies to create healthy and sustainable food environments aimed at helping Canadians reduce consumption of UPF. Restricting the marketing of UPF to children, taxes on sugary drinks, and subsidies that reduce the cost of vegetables and fruits are also needed to help curb the chronic disease epidemic in the country. These policies would complement measures adopted in recent years, including removal of trans fats from the food supply, a new food guide that discourages consumption of UPF, and a new front-of-package nutrition labelling scheme.

Canada needs to invest in research on monitoring the consumption of UPF and understanding their impact on human health, in particular the mechanisms and toxicity of UPF ingredients.

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