HOW ULTRA-PROCESSED FOODS AFFECT HEALTH IN CANADA

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KEY FINDINGS:

In 2015, ultra-processed foods and drinks accounted for **almost half of the total daily calories** (energy intake) consumed by Canadian adults.

Consumption of ultra-processed foods was **alarmingly high among all Canadians** and especially in younger people, those with less formal education, living in rural areas, born in Canada and people with Indigenous identity.

Canadian adults consuming the highest amounts of ultra-processed foods as a proportion of their energy intake had **31% higher odds of obesity**, **37% higher odds of diabetes** and **60% higher odds of high blood pressure**, compared to those consuming the least amount. Obesity, diabetes and high blood pressure are all risk factors for heart disease and stroke.

Canadian public healthcare system in crisis

The Canadian healthcare system, like that of many other high-income nations, is in crisis. It has failed to prevent and manage the epidemics of diet-related chronic disease affecting people of all ages and walks of life (1). What is now a pandemic took root in the industrialisation of food systems which have profoundly altered the nature and quality of human diets (2).

Unhealthy diets are a major and modifiable risk factor for many chronic diseases, including diabetes and cardiovascular disease (3). However, nutritional science, education and policies over recent decades have defined the quality and healthfulness of modern diets using a reductionist approach that focuses on select nutrients or foods and neglects the role of dietary patterns and of food processing (4,5). Today, a decade of research supports the thesis that food processing is a major determinant of the quality of diets and related states of health and well-being (6,7). While many types of food processing are beneficial— and in some cases even essential—ultra-processing is a major culprit in the development of modern unhealthy diets and chronic diseases (7–9).

What are ultra-processed foods?

The NOVA system classifies foods according to the nature, extent and purpose of food processing (10). It enables the study of food systems and supplies and dietary patterns within and between countries and over time. NOVA delineates four major groups, namely: 1) unprocessed or minimally processed foods including fresh, frozen or dry fruits, vegetables, nuts, legumes and plain meats and milk; 2) processed culinary ingredients including sugar, salt, oils and butter; 3) processed foods like canned fruits and vegetables, artisanal breads and cheeses; and 4) ultra-processed foods and drinks.

Ultra-processed foods are formulations of ingredients, mostly of exclusive industrial use, that result from a series of industrial processes (hence "ultra-processed"). Ingredients

that are characteristic of ultra-processed foods can be divided into food substances of no or rare culinary use and classes of additives whose function is to make the final product palatable or often hyper-palatable ("cosmetic additives"). Typically, they contain little to no whole food. The purpose of ultra-processing is to create products that are convenient (durable, ready-to-eat, -drink or -heat), attractive (hyper-palatable) and profitable (low-cost ingredients). Their effect all over the world is to displace those foods that humans have been eating throughout their evolutionary history (11). They are usually branded assertively, packaged attractively and marketed intensively. Examples include carbonated drinks and other packaged sweetened juices and drinks, mass-produced packaged breads, chocolate and candies, cakes, biscuits, pastries, desserts and ice-cream, sweetened breakfast cereals, sweetened and flavoured yogurts and other milk-based drinks, packaged soups and noodles, margarine, as well as many ready-to-eat or ready-to-heat meals and "fast" foods and dishes.

What is the problem with ultra-processed foods?

A 2017 Canadian study led by several authors of the present report and commissioned by Heart & Stroke revealed that ultra-processed foods were associated with consuming a low-quality diet that is more energy dense, higher in free sugars, sodium and fats, and lower in protein, fibre minerals and vitamins (12). The observation that ultra-processed foods have a low overall nutritional quality is supported by studies from multiple countries, including France, the US, the UK and Brazil (13–17).

A first-of-its-kind controlled trial was recently undertaken at the National Institutes of Health in the US to compare the effects of consuming a diet based on ultra-processed foods with one based on unprocessed or minimally processed foods (18). Twenty healthy adults were randomized to consume each diet for a two-week period, and then switched to consume the other diet. Results were striking as participants gained about a pound a week on the ultra-processed diet and lost weight on the unprocessed/minimally processed diet.

However, the impact of ultra-processed foods goes beyond weight gain. Consistent and compelling evidence from a growing number of international studies implicates consumption of ultra-processed food in the development

of a number of adverse health outcomes and risk of death. For example, prospective observational studies from Spain and France have reported that consuming a diet high in ultra-processed foods increased the risk of obesity (19), hypertension (20), cancer (21), cardiovascular disease (22), gastrointestinal disorders (23), depression (24,25) and all-cause mortality (26,27).

In summary, there is mounting evidence that diets high in ultra-processed foods are nutritionally poor and harmful for health. The more ultra-processed foods consumed, the greater the degradation of overall diet quality and the higher the risk of obesity and diet-related disease.

Commissioned by Heart & Stroke, this study is the first in Canada to assess associations between consumption of ultra-processed foods in Canadian adults and several chronic diseases and conditions related to diet, namely, obesity, diabetes, high blood pressure and heart disease.

How was this study done?

This analysis was based on cross-sectional data from the 2015 Canadian Community Health Survey (CCHS)—Nutrition, which provides nationally-representative estimates of foods and drinks consumed by Canadians on the day before the survey. For this study, all foods and ingredients were classified using the NOVA classification (10) and were based on dietary information from the 1st 24-hour recall. This analysis was based on 13,608 survey participants aged 19 or older.

Multivariable logistic regression models were used to estimate the association between the dietary share of ultra-processed foods (expressed as tertiles or as a continuous variable) and obesity (measured or self-reported) and self-reported diabetes, high blood pressure and heart disease. Covariates included age, sex, household income, education, smoking status, alcohol intake, leisure-time physical activity, immigrant status, Indigenous identity, rural/urban residential zone, energy misreporting (under- or over-reporting of caloric intake) and measurement type (self-reported or measured, for obesity analyses only).

All analyses applied survey weights to maintain population representativeness and bootstrap weights to account for the survey's complex sampling design. Data access was granted by Statistics Canada under contract no. 17-SSH-MTL-5282-S001 and all analyses were conducted at the Québec inter-University Centre for Social Statistics in Montreal.

How much ultra-processed food is consumed in Canada?

In 2015, Canadians aged 19 years or older consumed on average 1,819 kcal per day. Measured in terms of energy intake, 39.7% of these calories came from unprocessed or minimally processed foods, 6.7% from processed culinary ingredients, 6.8% from processed foods and 46.8% from ultra-processed foods. The most commonly consumed ultra-processed food products included pre-prepared, "fast food" and frozen dishes (8.6% of daily calories), mass-produced breads (8.6%), cookies, cakes, candies and other sweets (5.3%), sweetened milk-based products (3.4%), sweetened fruit juices and drinks (3.2%) and margarine (3.2%).

In Figure 1, the Canadian population is divided into three groups of equal population size (tertiles) ordered according to the relative intake of ultra-processed foods (as % of total daily energy intake). Thus, the low-intake group is comprised of 33.3% of Canadians who consumed the least ultra-processed foods (24.4% of energy intake, on average) and the high-intake group is comprised of the third who consumed the most ultra-processed foods (72.8% of energy intake, on average).

As shown in Figure 1, the higher the consumption of ultra-processed foods, the lower the consumption of unprocessed or minimally processed foods. For example, unprocessed/minimally processed foods contributed more than half (56.8%) of total energy intake for Canadians in the group with lowest intake of ultra-processed foods; the same foods contributed only 19.6% of energy for Canadians with the highest intakes of ultra-processed foods (p<0.001 for difference). The same pattern was observed for processed culinary ingredients and processed foods. Collectively, these patterns suggest that as Canadians' diets become dominated by ultra-processed foods, they displace foods and meals based on less processed foods and culinary ingredients.

Figure 1. Distribution of total daily energy intake according to NOVA food groups by level of consumption of ultra-processed foods (% of energy intake), Canadian adults (≥19 years), CCHS 2015
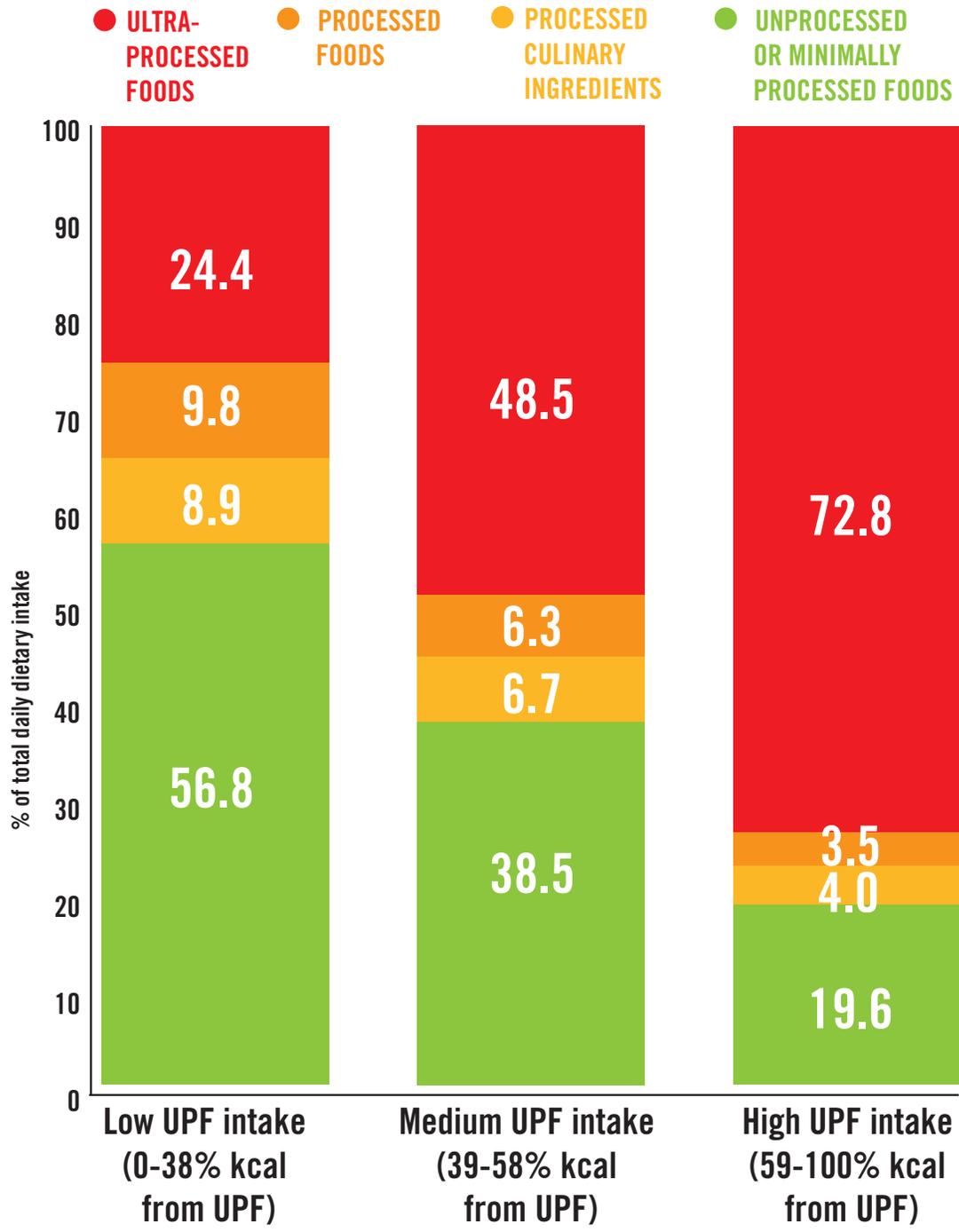
UPF: ultra-processed foods.
Data source: Statistics Canada, 2015 Canadian Community Health Survey (CCHS)–Nutrition
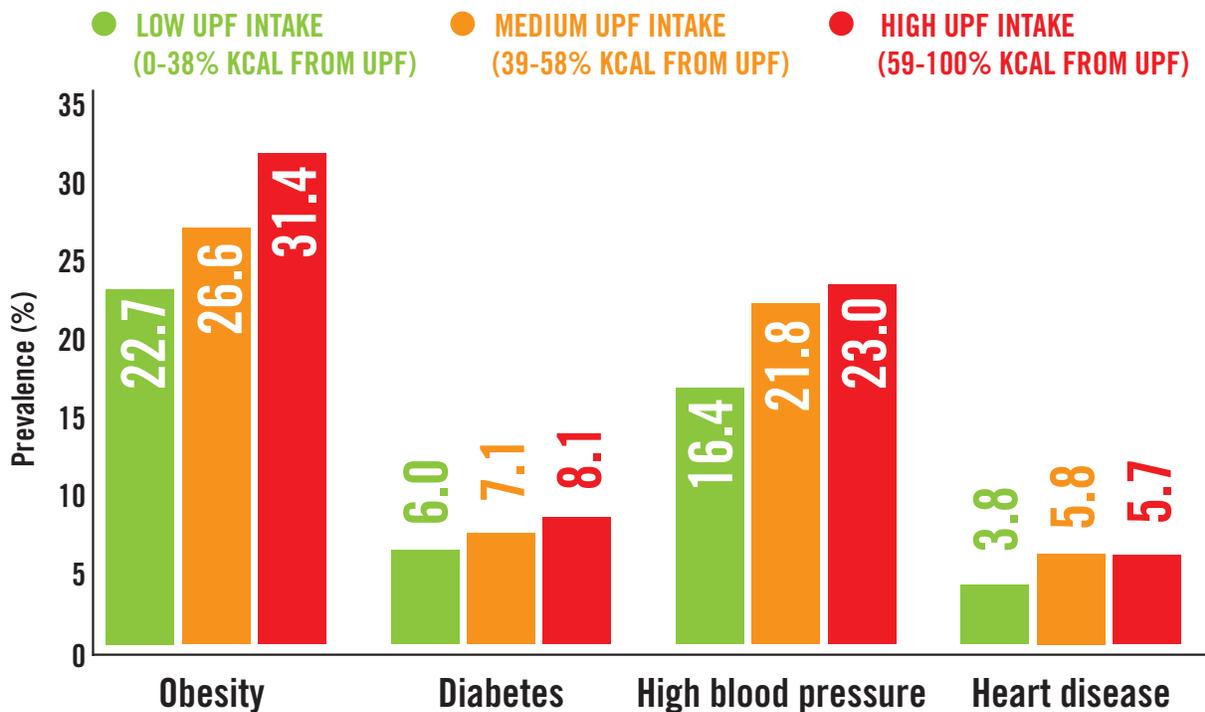
Who is consuming ultra-processed foods?

In 2015, the overall consumption of ultra-processed foods in Canadian adults was high in all socio-demographic groups with one exception: immigrants to Canada consumed lower levels (on average, 36.9% of total energy intake from ultra-processed foods) compared to those born in Canada (50.6% of energy intake). Consumption was slightly higher among men than women (48.4% vs. 45.2% of energy intake) and among younger adults (19-31 years old), those with Indigenous identity, less formal education, living in rural areas and among smokers. There was no significant difference in intake of ultra-processed foods according to household income.

Consumption of ultra-processed foods and chronic diseases in Canadian adults

In 2015, one in four Canadians had obesity (26.5%) and one in five self-reported having high blood pressure (20.0%). The self-reported prevalence of diabetes was 7.0% and 5.0% for heart disease.

As shown in Figure 2, the unadjusted prevalence of obesity, diabetes and high blood pressure increased along with increasing levels of ultra-processed food consumption. For heart disease, prevalence did not differ between the middle and highest levels of consumption.

Figure 2. Prevalence of obesity, diabetes, high blood pressure and heart disease according to level of consumption of ultra-processed foods (% of energy intake), Canadian adults (≥19 years), CCHS 2015

Legend:
- LOW UPF INTAKE (0-38% KCAL FROM UPF)
- MEDIUM UPF INTAKE (39-58% KCAL FROM UPF)
- HIGH UPF INTAKE (59-100% KCAL FROM UPF)

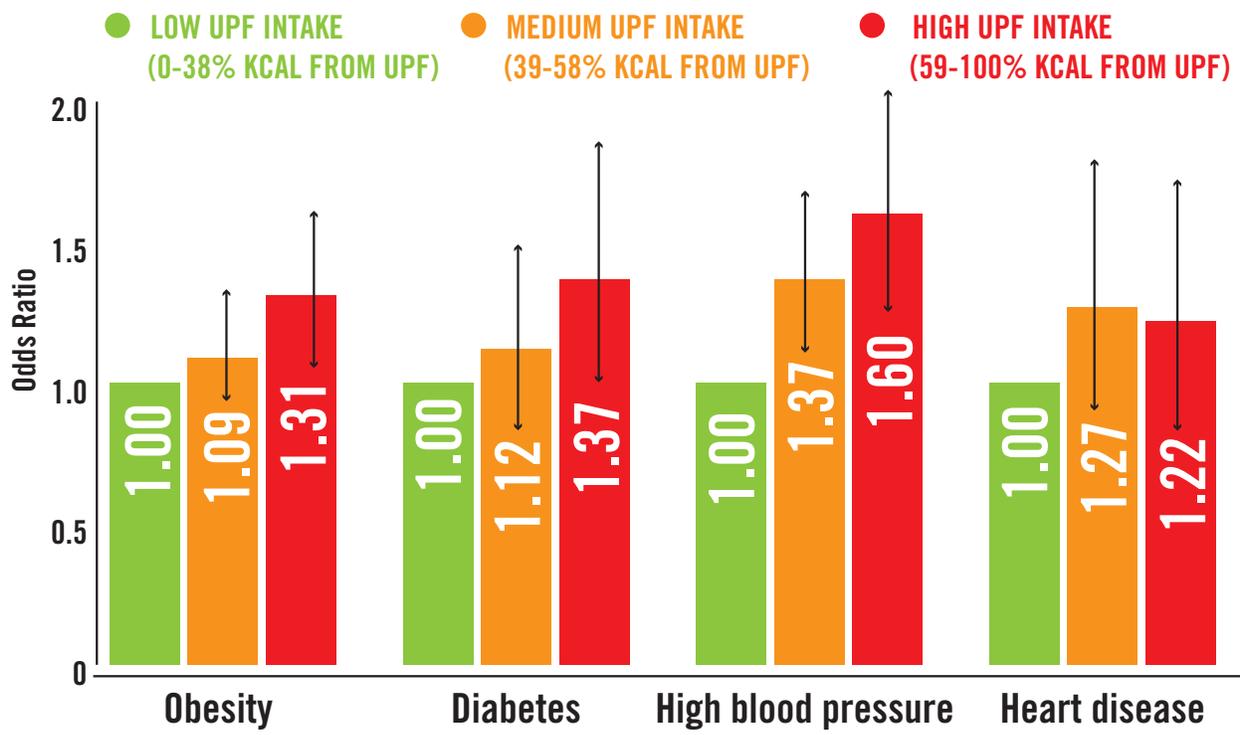|	Low UPF	Medium UPF	High UPF
Obesity	22.7	26.6	31.4
Diabetes	6.0	7.1	8.1
High blood pressure	16.4	21.8	23.0
Heart disease	3.8	5.8	5.7

Prevalence (%)

UPF: ultra-processed foods.
Data source: Statistics Canada, Canadian Community Health Survey (CCHS) 2015–Nutrition.
Diabetes, high blood pressure and heart disease were self-reported. Obesity was measured or self-reported.

Figure 3. Adjusted odd ratios and associated 95% confidence intervals for the association between level of consumption of ultra-processed foods (% of energy intake) and prevalence of obesity, diabetes, high blood pressure and heart disease, Canadian adults (≥19 years), CCHS 2015

● **LOW UPF INTAKE (0-38% KCAL FROM UPF)**   ● **MEDIUM UPF INTAKE (39-58% KCAL FROM UPF)**   ● **HIGH UPF INTAKE (59-100% KCAL FROM UPF)**

UPF: ultra-processed foods.

Data source: Statistics Canada, Canadian Community Health Survey (CCHS) 2015—Nutrition.

Diabetes, high blood pressure and heart disease were self-reported. Obesity was based on measured or self-reported weight and height.

Odds ratios are adjusted for age, sex, socio-economic factors, lifestyle factors, Indigenous identity, immigrant status and urban/rural residence. Odds ratios for obesity were additionally adjusted for energy misreporting status and height/weight measurement mode (self-reported or measured).

To further explore these patterns while taking into account a range of socio-demographic and lifestyle factors, we estimated the association between the consumption of ultra-processed foods (expressed as tertiles or in continuous form) and obesity, diabetes, high blood pressure and heart disease using multivariable regression analyses.

After adjusting for a range of covariates, high consumption of ultra-processed foods was associated with significantly increased odds of having obesity, diabetes and high blood pressure (Figure 3). In 2015, Canadian adults consuming the highest amounts of ultra-processed foods as a proportion of their total energy intake had 31% higher odds of obesity,

37% higher odds of diabetes and 60% higher odds of high blood pressure, compared to those consuming the least amount. A positive association was also observed between consumption of ultra-processed foods and heart disease but this association did not reach statistical significance.

When the consumption of ultra-processed foods was modeled as a continuous variable, a 10% increase in the dietary share of their intake was associated with 6% greater odds of obesity (odds ratio: 1.07; 95% confidence interval: 1.02-1.11), 6% greater odds of diabetes (odds ratio: 1.06; 95% confidence interval: 1.01-1.12) and 9% greater odds of high blood pressure (odds ratio: 1.09; 95% confidence interval: 1.04-1.14).

Discussion and recommendations

The current study provides the first Canadian evidence that high intake of ultra-processed foods is significantly associated with the prevalence of multiple chronic diseases and conditions, namely, obesity, diabetes and high blood pressure, which are all risk factors for heart disease and stroke. This is consistent with a growing body of evidence from multiple countries indicating that consumption of ultra-processed foods is detrimental to overall human health and is associated with the development of chronic diseases (18–28).

Our results are not surprising considering that in Canada, diets heavily based on ultra-processed foods have numerous nutritional problems known to be linked to chronic diseases: they are energy dense and high in free sugars, sodium and saturated fats, while being relatively low in fibre, protein, minerals and vitamins (12,13).

But ultra-processed foods are unhealthy for reasons beyond just their nutrient content. Indeed, a recent landmark randomized controlled trial showed that healthy adults consuming an ultra-processed diet ate an average of 500 more calories per day than when the same individuals consumed an unprocessed/minimally processed diet (18). This was despite the fact that both diets offered the same nutrient profile in terms of the amounts of calories, sugar, carbohydrates, protein, fat and fiber, and participants were free to eat as much or as little as they wanted. Participants experienced hormonal changes affecting satiety differently on the two diets, and this may in part explain the results. This study offers not only the first causal evidence linking ultra-processed foods to weight gain, but it also suggests that reformulation of ultra-processed foods will not be enough to address their obesogenic characteristics (29).

Results of analyses presented in this report are based on cross-sectional data and thus cannot be used to make inferences about causality or the direction of the association between consumption of ultra-processed foods and health. Because people often change their diet to be more healthful after being diagnosed with a chronic disease like diabetes or heart disease, these results could be underestimating the true association between consuming high levels of ultra-processed foods and chronic disease. Other limitations of these analyses include the fact that information on dietary intakes and health outcomes was self-reported.

Overall, the evidence provided in this report strongly supports recommendations in the newly revised 2019 Canada's Food Guide to "cook more often" and to choose fresh or minimally processed food on a daily basis (30). While the new food guide provides valuable guidance to limit "highly processed foods," it nevertheless defines these foods based on their content of common "risk" nutrients, i.e. "excess sodium, free sugars or saturated fat" (30). However, collectively the evidence from this report and a growing number of international studies suggests that the adverse effects of ultra-processed foods on diet and health go well beyond their content of "risk" nutrients and importantly—as shown in this and previous reports—include the displacement of nutritious whole or minimally processed foods and dishes from the diet. This evidence thus builds a compelling case for using the dietary share of ultra-processed foods as an important global indicator of "unhealthy" diets (13–15).

Adding considerations about the types of processing to define more and less healthful foods and diets has important implications for the design of public health policies such as restrictions on the marketing and taxation of foods and beverages not conducive to good health (e.g. sugary drinks), and front-of-package nutrition labeling (31). Public policies in Canada and globally would go a long way toward improving population diet quality if they shifted focus away from reformulation of packaged foods based on "risk" nutrients toward policies and actions that strive to make whole and minimally processed foods and meals more available, affordable, accessible and appealing for all segments of the population (8).

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