Who is consuming ultra-processed food in Canada? A cross-sectional analysis of the 2018/2019 International Food Policy Study

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Abstract

High consumption of ultra-processed foods and drinks (UPF) has been linked to poor diet quality and an increased risk of non-communicable diseases. To inform public policies and interventions aimed at reducing UPF intake in Canada, updated information on UPF intake among different sociodemographic groups is needed. This study, using data from 5872 adults aged 18 years and older from the International Food Policy Study (2018–2019), aims to estimate the dietary energy contribution of UPF and assess its variation among sociodemographic subgroups. All foods and drinks reported in a single 24 h dietary recall were classified using the Nova system. We estimated the mean proportion of total daily energy from UPF and subcategories of UPF in the overall sample and among sociodemographic subgroups. Multivariable linear regression models evaluated the association between sociodemographic characteristics with the proportion of total daily energy from UPF. On average, adults consumed 45.2% of their total daily energy from UPF. UPF consumption was slightly higher among males than females (49.4% vs. 47.6%, $p = 0.039$) and younger adults aged 19–30 years compared with older adults aged 51–64 years (50.0% vs. 47.2%, $p = 0.029$), adjusting for a range of sociodemographic factors. Overall, UPF consumption was relatively high among adults in all sociodemographic subgroups, highlighting the need for policies to decrease UPF consumption in the entire population.

Key words: ultra-processed foods, sociodemographic characteristics, energy contribution, Nova, Canada

Introduction

Ultra-processed foods and drinks (UPF) are industrial formulations of refined substances derived from foods or synthesized from other organic sources, plus cosmetic additives. They usually contain little or no whole foods, are ready-to-consume or ready-to-heat, and are high in sugar, fat, or salt but relatively low in protein, fiber, vitamins, and minerals (Monteiro et al. 2018, 2019). UPF include carbonated soft drinks, chocolate, candies, ice cream, margarine, cookies and pastries, reconstituted meat products, commercial soups, and other food and drink products (Monteiro et al. 2019). High consumption of UPF is associated with poor diet quality, non-communicable disease risks, including obesity, diabetes, hypertension, some types of cancer, and other metabolic diseases, and is also responsible for significant environmental degradation (Martini et al. 2021; Anastasiou et al. 2022; Lane et al. 2024).

In Canada, UPF accounted for 45.7% of the total daily energy intake in the overall population, according to analyses of data from a 2015 national-level nutrition survey (Polsky et al. 2020). This proportion had changed little since 2004 (47.8%) (Polsky et al. 2020). Recognizing that nearly half of the dietary energy in the Canadian population comes from UPF and the health risks associated with high consumption of these products, the 2019 Canada's Food Guide included a recommendation to limit the consumption of highly processed foods (Government of Canada 2019).

Studies worldwide have examined variation in UPF consumption across sociodemographic groups (Adams and White 2015; Baraldi et al. 2018; Calixto Andrade et al. 2021; Costa et al. 2021; Marchese et al. 2022). For instance, in high-income countries like the United States (U.S.), Australia, and France, the proportion of total daily energy contribution from UPF was higher among younger individuals and adults

with lower levels of education (Baraldi et al. 2018; Calixto Andrade et al. 2021; Marchese et al. 2022). In Canada in 2015, UPF energy intakes were higher among children and adolescents, those with lower education, those living in urban areas, and those born in Canada (Nardocci et al. 2021). To inform public policies and interventions to reduce UPF intake in Canada, updated information is needed on the consumption of UPF among groups with different sociodemographic characteristics.

This study aimed to estimate the proportion of total daily energy from UPF among adults in Canada in 2018–2019 and to characterize how consumption of UPF varied by sociodemographic characteristics, namely, sex, age, education, ability to make ends meet, ethnic/racial identity, household food security status, and region of residence.

Methods

Data source and study sample

We used cross-sectional Canadian data from the 2018 and 2019 waves of the International Food Policy Study (IFPS) (Hammond et al. 2018, 2019). The two cycles were pooled to yield a larger sample size. The IFPS collects data on food intake and policy-relevant behaviours among adults aged 18 and older in multiple countries, including Canada (Hammond 2018). Participants were recruited through the Nielsen Consumer Insights Global Panel and partner panels using probability and non-probability sampling methods (Hammond 2018). Email invitations with unique survey access links were sent to a random sample of panelists stratified for age and sex based on quotas that approximated the known proportions in the general Canadian population. Sample targets were also used for education (proportion of respondents with low education similar to the population distribution) and language (English and French-speaking respondents proportional to the population distribution). Inclusion criteria were age (18 years and above) and living in the ten Canadian provinces. Participants who completed the online survey received points-based or monetary rewards according to the panel's typical incentive structure. A total of 4397 participants completed the survey in 2018 and 4107 in 2019. The American Association for Public Opinion Research cooperation rate was 67.1% in 2018 and 60.7% in 2019, which is calculated as the percentage of participants who completed the survey from eligible participants who had accessed the survey link (The American Association for Public Opinion Research 2016). Full details regarding the IFPS methods have been previously published elsewhere (Hammond et al. 2018, 2019).

Participants first completed a survey that included various sociodemographic and food- and nutrition-related questions. The median time to complete the survey was 37 min both in 2018 and 2019. After completing the main survey, participants were redirected to a U.S. National Institutes of Health website to complete an online 24 h dietary recall (24HR) using the 2018 Automated Self-Administered 24 h adapted for Canada (National Cancer Institute 2018). ASA24 is a public-access, freely available, web-based tool that was modeled on the U.S. Department of Agriculture Automated Multiple-Pass Method and helps participants to maximize their recall of the foods and drinks consumed (Subar et al. 2012). Participants were required to complete all reporting in a single session. A total of 3301 respondents completed the 24HR in 2018, and 2606 in 2019, for a total of 5907 respondents. After excluding 35 participants because of missing data, the final analytical sample with sociodemographic and dietary data was 5872 participants.

Sociodemographic variables

Participants reported their sex at birth (male or female) and age, categorized as 19–30, 31–50, 51–64, and 65+ years. The highest level of education attained by the participant was categorized as less than high school or its equivalent, high school diploma or a high school equivalency certificate, some postsecondary (trade certificate or diploma from a technical/vocational school or apprenticeship training, diploma or certificate from community college or CEGEP[1] or other non-university trades certificates or diplomas), and university degree or above. Perceived personal income adequacy was assessed using the validated proxy question: "How easy or difficult is it to make ends meet?" and response categories were: very difficult, difficult, neither easy nor difficult, easy, or very easy (Litwin and Sapir 2009). Household food security status (food secure, moderately food insecure, severely food insecure) was assessed using the Household Food Security Survey Module, a validated 18-question survey assessing insecure or inadequate access to food due to financial constraints, routinely used to monitor food insecurity in Canada (Government of Canada 2012). Ethnic/racial identity was categorized as majority group (White, i.e., European descent, Caucasian, Canadian, or Jewish), minority group (Middle Eastern, East/Southeast Asian, South Asian, Black, Indigenous, Latino, or multiple ethnicities), or other (not stated, mixed, other, and missing) (Government of Ontario 2018). Urbanicity was based on participants' residential postal code, and categorized as urban, rural zone, or missing. This categorization was created using Statistics Canada's Postal Code Conversion File and applied consistently across provinces (Statistics Canada 2017a). Region of residence was categorized as Atlantic provinces (New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland, and Labrador), Ontario, Quebec, Prairie provinces (Alberta, Saskatchewan, Manitoba), and British Columbia. Data for residents of Atlantic and Prairie provinces were grouped because of sparse data. These sociodemographic variables were selected based on factors associated with UPF consumption in prior research (Adams and White 2015; Baraldi et al. 2018; Costa et al. 2021) and available data in the IFPS.

Food classification according to type of processing

All foods and drinks (hereafter referred to as "foods") reported in the 24HR were classified according to the Nova

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[1] CEGEP are Colleges of general and professional education unique to Quebec province education system.

classification, which groups foods according to the nature, extent, and purpose of industrial processing (Monteiro et al. 2018). One author (MN) initially classified all foods, and this classification was subsequently reviewed and verified by a second author (JCM). A small number of uncertainties in classification were resolved by mutual discussion. Foods were classified into four distinct groups: (1) unprocessed and minimally processed foods, such as frozen fruits and vegetables, plain milk, pasta, and flour; (2) processed culinary ingredients, including oils, butter, sugar, and salt; (3) processed foods, such as canned vegetables, canned fish, fruits in syrup, cheese, and freshly made artisanal bread; and (4) UPF, including mass-produced industrial breads and buns, reconstituted meat products, commercial fruit juices and fruit drinks, and confectionary (e.g., chocolate, candies, desserts). Further details on the Nova classification methods have been previously published (Polsky et al. 2020, Monteiro et al. 2019).

UPF were further categorized into the following subcategories: commercial breads; margarine; sauces, spreads, and salad dressing; fast food and frozen dishes; commercial fruit juices and drinks; sweetened milk- and soy-based products; chips, crackers, and other salty snacks; processed meat products; chocolates and candies; cakes, cookies, and other pastries; sweetened breakfast cereals; carbonated soft drinks; commercial soups; cheese products; and "other" products. "Other" UPF products included baby products; meal replacements; protein powder; protein bars; imitation meat, fish, and chicken; eggnog; instant coffee beverages and coffee substitutes; coffee whitener; artificial sweeteners; artificial vanilla extract; canned mixed dishes; dry mix dishes; frozen French fries and hash brown potatoes made with additives; and cooking spray.

Data analysis

The data underwent weighting using post-stratification sample weights created through a ranking algorithm (Hammond et al. 2018, 2019). This algorithm incorporated population estimates from Statistics Canada for 2018 or 2019 for sex, age group and region and the 2016 Canadian census for education. Post-stratification weights were used to reduce sampling error and non-response bias.

Descriptive statistics were used to calculate the proportion of total daily energy intake (i.e., percentage of total daily kcal) for each Nova category and UPF subcategory. The population ratio approach was used to estimate the mean proportion of energy from each Nova group and UPF subcategory (i.e., total intake of a Nova category or UPF subcategory for the entire population over total energy for the whole population) (Table 1; Fig. 1). This approach better reflects the usual intake at the population level as compared with calculating the proportion for each individual and averaging it to obtain a mean for the sample (Freedman et al. 2008). The predicted mean energy contribution from total UPF intake was generated using multivariable linear regression (i.e., fully adjusted for all sociodemographic characteristics under study). Next, separate multivariable linear regression models were used to assess the association between sociodemographic characteristics and the proportion of energy contributed by each UPF subcategory.

All analyses were conducted in SAS 9.4 software (SAS Institute Inc. 2022) and applied survey sampling weights provided by the IFPS. Statistical significance was set at alpha = 0.05 level.

Results

Half of the participants were female (51.4%), and the majority were aged between 31 and 50 years (34.3%) (Table 1). Over 60% had an education above high school level. More than a third (37.4%) found it neither easy nor difficult to make ends meet, while more than one in four (28.6%) found it difficult or very difficult. More than a quarter (26.6%) were characterized as living in food-insecure households. The majority (82.6%) lived in urban areas, and most resided in Ontario (39.2%) or Quebec (21.3%).

Energy contribution of Nova food groups

In the overall sample, unprocessed and minimally processed foods contributed 40.2% of total daily energy intake, culinary ingredients contributed 6.7%, processed foods contributed 7.9%, and UPF contributed 45.2%.

Energy contribution of total UPF according to sociodemographic characteristics

Table 1 also presents the predicted mean proportion of energy from UPF adjusted for all sociodemographic variables under study. Females consumed, on average, a somewhat lower proportion of energy from UPF than males (47.6% vs. 49.4% of total energy intake, $p = 0.039$). Older individuals consumed, on average, approximately three percentage points less energy from UPF than younger individuals aged 19–30 years, although results were only significant for those aged 51–60 years (50.0% vs. 47.2%, $p = 0.029$). The mean share of total daily energy consumed as UPF was lower among those living in the Prairie provinces (46.5%, $p = 0.012$) and British Columbia (47.2%, $p = 0.047$) than those living in the Atlantic provinces (51.1%). Statistically significant differences in the proportion of total daily energy from UPF were not observed by educational attainment, ability to make ends meet, household food security status, ethnic/racial group, or urbanicity.

Energy contribution of UPF subcategories

Figure 1 presents mean energy contributions of UPF subcategories among the overall sample. Commercial breads, fast food and frozen dishes, and sauces, spreads and salad dressings were the top three energy contributors at 8.3%, 7.6%, and 4.9% of total energy intake, respectively.

Energy contribution of UPF subcategories according to sociodemographic characteristics

Table 2 presents the predicted mean energy contribution of each UPF subcategory, adjusting for all sociodemographic characteristics under study. Overall, there was some variation in the proportion of total energy from several UPF subcategories across sociodemographic subgroups, particularly for sauces, spreads and salad dressings, fast food and frozen dishes, and carbonated soft drinks. The mean energy con-

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Table 1. Sample characteristics and energy contribution of ultra-processed foods (percentage total daily energy intake) according to sociodemographic characteristics, International Food Policy Study (IFPS) 2018–2019 ($n = 5872$).

| | Distribution of participants % | Energy contribution of ultra-processed foods (% kcal/day) | | | | | | |
| | | Mean | 95% CI* | | Adjusted mean† | 95% CI* | | p value |
			From	To		From	To	
Sex								
Male	48.6	46.3	46.0	52.7	49.4	46.0	52.7	—
Female	51.4	44.1	44.4	50.8	47.6	44.4	50.8	0.039
Age (years)								
19–30	23.0	45.3	46.5	53.6	50.0	46.5	53.6	—
31–50	34.3	46.4	46.1	52.6	49.3	46.1	52.6	0.568
51–64	27.0	44.6	43.7	50.7	47.2	43.7	50.7	0.029
65+	15.7	43.6	43.7	51.0	47.3	43.7	51.0	0.076
Educational attainment								
<High school	13.3	46.5	45.4	54.6	50.0	45.4	54.6	—
High school	25.3	46.8	45.4	52.2	48.8	45.4	52.2	0.578
Some postsecondary‡	25.7	45.6	44.9	51.5	48.2	44.9	51.5	0.377
University degree or above	35.7	43.6	43.7	50.2	46.9	43.7	50.2	0.132
Ability to make ends meet								
Very difficult	8.8	48.8	45.0	53.8	49.4	45.0	53.8	—
Difficult	19.8	47.3	45.8	52.8	49.3	45.8	52.8	0.971
Neither easy nor difficult	37.4	45.0	45.9	52.7	49.3	45.9	52.7	0.946
Easy	22.9	44.6	45.2	52.3	48.7	45.2	52.3	0.739
Very easy	11.1	41.4	41.9	49.4	45.6	41.9	49.4	0.078
Household food security status								
Food secure	73.4	44.4	44.0	50.4	47.2	44.0	50.4	—
Moderately food insecure	12.6	47.2	45.4	53.0	49.2	45.4	53.0	0.187
Severely food insecure	14.0	48.3	45.0	52.9	49.0	45.0	52.9	0.276
Ethnic/racial group								
Majority	77.2	45.9	44.8	49.3	47.1	44.8	49.3	—
Minority	20.4	41.8	42.6	48.3	45.4	42.6	48.3	0.149
Other	2.4	52.8	45.3	60.5	52.9	45.3	60.5	0.133
Urbanicity								
Urban	82.6	45.3	45.3	51.2	48.3	45.3	51.2	—
Rural	14.2	45.3	44.5	51.8	48.1	44.5	51.8	0.921
Not stated/missing	3.2	43.6	43.7	54.4	49.0	43.7	54.4	0.771
Province								
Atlantic provinces§	6.7	47.6	46.9	55.2	51.1	46.9	55.2	—
Quebec	21.3	46.3	45.8	52.8	49.3	45.8	52.8	0.325
Ontario	39.2	45.1	45.0	51.6	48.3	45.0	51.6	0.112
Prairie provinces ‖	18.8	45.1	43.0	50.0	46.5	43.0	50.0	0.012
British Columbia	14.0	43.1	43.3	51.0	47.2	43.3	51.0	0.047

*CI, Confidence interval.

†Means generated from multivariable regression model adjusted for all sociodemographic variables listed in the table.

‡Postsecondary includes trade certificate or diploma, college, CEGEP (College of general and professional education unique to Quebec province), or other non-university certificate or diploma, and university certificate or diploma below bachelor level.

§Atlantic provinces include New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland and Labrador.

‖Prairie provinces include Alberta, Saskatchewan, and Manitoba.

tribution of sauces, spreads, and salad dressing was somewhat elevated among adults above age 50, those with difficulty making ends meet, belonging to a majority ethic/racial group, living in a food secure household, and among residents of the province of Quebec. There were also notable differences for fast food and frozen dishes, with relatively high intake among males (12.4% of total daily energy), those aged 19–50 years (ranging from 9.7% to 9.8%), those living

in households with severe food insecurity (8.3%), and residents of Atlantic provinces (8.9%). A slightly elevated mean energy contribution of carbonated soft drinks (ranging from 2.4% to 3.6% of total daily energy) was observed among those aged 31–50 years, with less than high school education, living in urban areas, living in households with moderate food insecurity, and residents of Atlantic provinces, Quebec, and Ontario. Some variations were also observed for sweetened

Fig. 1. Mean energy contribution (percentage of total daily energy intake) of ultra-processed food subcategories, International Food Policy Study 2018–2019. * "Other" UPF subcategory includes baby products; meal replacements; protein powder; protein bars; imitation meat, fish, and chicken; eggnog; instant coffee beverages and coffee substitutes; coffee whitener; sweeteners; vanilla extract; canned mixed dishes; dry mix dishes; frozen French fries and hash brown potatoes; and cooking spray.
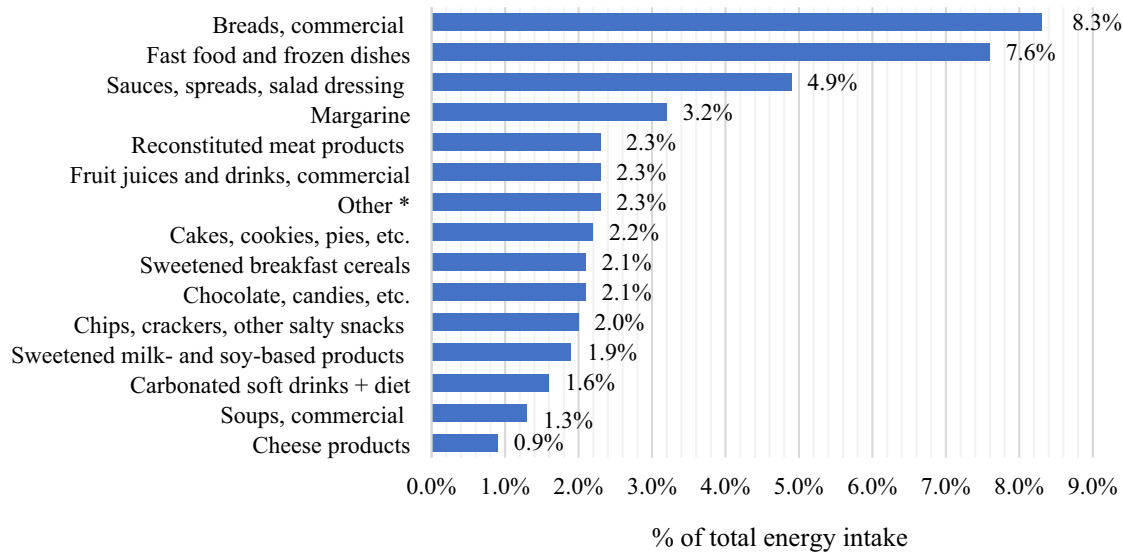
milk- and soy-based products, with higher mean energy intakes among females, those with higher educational attainment, living in food-secure households, and belonging to a majority ethnic/racial group. Commercial breads, the leading energy contributor among UPF subcategories (Fig. 1), showed little variation in mean energy contribution across sociodemographic groups in multivariable regression analysis (Table 2).

Discussion

On average, nearly half of the daily calories (45.2%) consumed by adults in Canada came from UPF. This estimate, based on data collected in 2018 and 2019, is very similar to those from national-level 2004 and 2015 nutrition surveys, at 47.8% and 45.7%, respectively (Polsky et al. 2020). These results suggest that the quality of diets with respect to processing among adults in Canada continues to give cause for concern. Further, the current study suggests that the proportion of energy contributed by UPF intake is high across all sociodemographic groups, although some minor differences were observed.

Younger individuals consumed a higher proportion of total energy from UPF compared with older individuals, with adjustment for a range of sociodemographic characteristics. This finding is consistent with results of previous studies from Europe, North America, and South America (Adams and White 2015; Baraldi et al. 2018; Cediel et al. 2018; Marron-Ponce et al. 2018; Khandpur et al. 2020; Polsky et al. 2020; Calixto Andrade et al. 2021; Marchese et al. 2022; Louzada et al. 2023). In our study, older adults, compared with younger adults, consumed a higher proportion of commercial breads, sauces, spreads, and salad dressings, as well as commercial soups, which are foods typically consumed at home or used as ingredients in home kitchens. Furthermore, males consumed a slightly higher proportion of total energy from UPF compared with females. More specifically, males consumed a higher share of energy from fast-food and frozen dishes than females. A previous Canadian study similarly found a higher proportion of total energy from fast food among males (Polsky et al. 2020). Another recent study from Canada revealed that younger adults, especially males, tend to eat more food out of home (Polsky and Garriguet 2021), and may thus be more exposed to environments with high availability of UPF, such as fast food and carbonated soft drinks. Younger individuals and males may also be less likely to cook than older individuals and females, respectively, potentially leading to higher reliance on UPF such as fast food and frozen dishes (Polsky and Garriguet 2021; Wellard-Cole et al. 2022).

This study did not observe statistically significant differences in the total energy share from UPF by participants' perceived financial ability to make ends meet. A previous Canadian analysis similarly found no meaningful differences in the proportion of total daily energy from UPF according to level of household income adequacy, measured as an income-to-poverty ratio and adjusted for household and community size (Moubarac 2017). An analysis of national-level U.S. data using an analogous income-to-poverty measure documented a small inverse association, whereby individuals living with more financial disadvantage consumed slightly a higher share of energy from UPF compared with their more advantaged counterparts (Baraldi 2018). Another national-level study from Australia observed higher UPF intake in the second-lowest income quintile of household income and no significant differences between the lowest and highest income quintiles. While direct comparison across studies is

Table 2. Adjusted mean energy contributions (percentage total daily energy intake) of ultra-processed food (UPF) subcategories according to sociodemographic characteristics.

Variable		Breads, commercial %	95% CI† From	To	p value	Fast food and frozen dishes %	95% CI From	To	p value	Sauces, spreads, salad dressing %	95% CI From	To	p value	Margarine %	95% CI From	To	p value
Sex	Male	8.6	7.1	10.1		12.2	9.4	15.0		3.0	2.3	3.7		2.7	2.2	3.2	
	Women	9.0	7.5	10.6	0.334	8.8	6.2	11.4	<0.0001	3.3	2.6	4.1	0.158	2.9	2.5	3.4	0.104
Age (years)	19–30	7.7	6.1	9.4		12.4	9.8	15.2		2.4	1.6	3.2		2.8	2.3	3.3	
	31–50	7.9	6.4	9.5	0.747	12.5	9.7	15.2	0.938	2.9	2.2	3.5	0.174	2.8	2.3	3.3	0.914
	51–64	9.1	7.5	10.7	0.055	9.2	6.3	12.0	<0.001	4.2	3.4	5.1	<0.0001	2.8	2.3	3.3	0.929
	65+	10.5	8.5	12.4	0.002	7.9	5.1	10.8	<0.0001	3.1	2.2	4.0	0.089	2.9	2.3	3.5	0.731
Educational attainment	<High school	8.9	6.5	11.3		9.8	6.4	13.3		3.2	1.9	4.4		2.7	2.0	3.4	
	High school	8.8	7.2	10.3	0.873	11.0	8.1	13.9	0.425	3.0	2.3	3.7	0.826	3.0	2.4	3.5	0.518
	Some postsecondary‡	9.1	7.6	10.6	0.871	10.7	7.9	13.5	0.554	3.2	2.4	3.9	0.994	3.0	2.4	3.5	0.500
	University diploma	8.4	6.9	9.9	0.620	10.5	7.9	13.2	0.615	3.3	2.5	4.1	0.824	2.6	2.1	3.1	0.828
Ability to make ends meet	Very difficult	8.2	6.4	10.1		10.0	6.9	13.1		2.6	1.8	3.5		2.8	2.1	3.4	
	Difficult	9.1	7.2	11.0	0.339	10.1	7.3	13.0	0.921	3.8	2.8	4.7	0.023	2.8	2.2	3.4	0.969
	Neither easy nor difficult	9.6	8.0	11.3	0.125	11.1	8.2	13.9	0.423	3.3	2.6	4.0	0.137	2.7	2.2	3.3	0.886
	Easy	8.8	7.1	10.5	0.528	12.0	9.0	15.0	0.155	2.6	1.8	3.4	0.981	2.8	2.3	3.4	0.912
	Very easy	8.2	6.3	10.0	0.967	9.3	6.3	12.4	0.643	3.5	2.4	4.6	0.137	2.9	2.3	3.6	0.751
Ethnic/racial group	Majority	9.3	8.0	10.6		7.8	6.1	9.5		4.0	3.5	4.6		3.1	2.7	3.5	
	Minority	8.8	7.3	10.4	0.483	7.8	5.7	9.9	0.940	3.2	2.3	4.0	0.016	3.0	2.5	3.5	0.655
	Other	8.3	5.2	11.4	0.530	15.9	9.2	22.6	0.018	2.3	1.1	3.4	0.002	2.4	1.5	3.2	0.089
Household food security status	Food secure	8.7	7.2	10.2		9.3	6.8	11.9		3.7	3.0	4.4		2.8	2.4	3.3	
	Moderately food insecure	9.8	7.7	11.9	0.198	10.6	7.5	13.6	0.247	2.9	2.0	3.9	0.062	2.8	2.4	3.4	0.765
	Severely food insecure	7.9	6.1	9.7	0.370	11.5	8.3	14.6	0.045	2.8	1.9	3.7	0.045	2.9	2.2	3.5	0.945
Urbanicity	Urban	9.0	7.7	10.3		9.9	7.4	12.4		3.6	3.0	4.2		2.6	2.3	3.0	
	Rural	8.7	6.9	10.4	0.650	9.0	6.3	11.7	0.329	3.1	2.3	3.9	0.271	3.0	2.5	3.6	0.123
	Not stated/missing	8.8	5.9	11.7	0.885	12.3	7.9	16.7	0.238	2.8	1.4	4.1	0.234	2.8	1.8	3.7	0.820
Province	Atlantic provinces§	9.8	7.6	12.0		12.4	8.9	15.9		2.5	1.6	3.4		2.4	1.7	3.1	
	Quebec	9.3	7.5	11.1	0.584	10.6	7.7	13.5	0.206	3.8	2.9	4.6	0.006	2.9	2.4	3.4	0.133
	Ontario	8.4	6.8	10.0	0.131	10.2	7.5	12.8	0.103	3.2	2.5	3.9	0.108	2.6	2.2	3.1	0.383
	Prairies‖	8.5	6.8	10.2	0.173	9.1	6.3	12.0	0.023	3.1	2.3	4.0	0.161	3.1	2.5	3.7	0.026
	British Columbia	8.0	6.2	9.7	0.093	10.2	7.1	13.4	0.165	3.2	2.2	4.1	0.179	3.1	2.4	3.7	0.068

Table 2. (*continued*).

Variable		Reconstituted meat products %	95% CI† From	To	p value	Fruit juices and drinks, commercial %	95% CI From	To	p value	Others¶ %	95% CI From	To	p value	Cake, cookies, other pastry %	95% CI From	To	p value
Sex	Male	2.5	1.9	3.1		2.0	1.3	2.6		2.8	1.6	4.1		1.3	0.7	1.9	
	Women	2.0	1.4	2.5	0.044	1.9	1.3	2.5	0.797	2.7	1.5	3.8	0.523	1.5	0.9	2.1	0.325
Age (years)	19–30	2.5	1.8	3.1		2.2	1.5	3.0		3.4	2.1	4.6		1.8	1.1	2.5	
	31–50	2.3	1.7	2.9	0.641	1.6	1.0	2.2	0.101	3.1	1.9	4.3	0.547	1.4	0.7	2.0	0.232
	51–64	2.3	1.6	3.0	0.647	1.9	1.2	2.7	0.466	2.3	1.1	3.5	0.005	1.1	0.5	1.8	0.066
	65+	1.8	1.1	2.6	0.134	1.9	1.2	2.7	0.511	2.3	0.9	3.7	0.013	1.4	0.6	2.1	0.338
Educational attainment	<High school	2.5	1.4	3.6		1.9	0.9	2.9		2.5	1.0	4.0		1.1	0.3	1.8	
	High school	2.4	1.7	3.0	0.834	2.1	1.4	2.9	0.683	3.3	1.9	4.6	0.261	1.2	0.5	1.9	0.729
	Some postsecondary‡	2.2	1.6	2.8	0.658	1.8	1.2	2.4	0.832	2.9	1.6	4.2	0.559	1.6	0.8	2.4	0.241
	University diploma	1.8	1.2	2.4	0.271	1.9	1.2	2.5	0.926	2.3	1.2	3.5	0.727	1.8	1.2	2.4	0.099
Ability to make ends meet	Very difficult	2.4	1.4	3.4		2.9	1.7	4.2		3.7	1.9	5.4		1.4	0.3	2.5	
	Difficult	2.2	1.6	2.9	0.764	1.9	1.1	2.7	0.125	2.9	1.7	4.1	0.376	1.4	0.7	2.1	0.993
	Neither easy nor difficult	2.1	1.5	2.8	0.595	1.8	1.0	2.6	0.130	3.0	1.6	4.4	0.419	1.4	0.7	2.1	0.975
	Easy	2.5	1.7	3.2	0.915	1.2	0.5	1.9	0.015	2.4	1.1	3.6	0.122	1.5	0.8	2.2	0.892
	Very easy	1.9	1.2	2.5	0.309	1.9	1.1	2.7	0.179	1.8	0.6	3.1	0.029	1.4	0.4	2.5	0.942
Ethnic/racial group	Majority	2.3	1.8	2.7		2.1	1.5	2.6		2.9	1.9	4.0		1.7	1.2	2.3	
	Minority	2.3	1.5	3.1	0.891	2.8	2.0	3.6	0.054	2.7	1.4	4.0	0.610	1.6	0.9	2.3	0.620
	Other	2.1	1.0	3.1	0.687	0.9	0.1	1.8	0.006	2.6	0.2	5.0	0.777	0.9	0.1	1.7	0.027
Household food security status	Food secure	2.3	1.7	2.9		2.1	1.4	2.8		2.6	1.5	3.7		1.4	0.8	2.0	
	Moderately food insecure	2.2	1.5	2.9	0.717	2.0	1.1	2.9	0.864	2.1	1.0	3.3	0.226	1.1	0.3	1.9	0.300
	Severely food insecure	2.2	1.4	3.0	0.716	1.7	0.7	2.7	0.513	3.5	1.7	5.2	0.209	1.7	0.8	2.7	0.581
Urbanicity	Urban	2.3	1.7	2.8		2.1	1.7	2.6		2.3	1.3	3.2		1.7	1.3	2.0	
	Rural	3.0	2.1	3.8	0.083	2.4	1.6	3.1	0.539	2.4	1.2	3.5	0.809	1.3	0.8	1.9	0.160
	Not stated/missing	1.4	0.7	2.2	0.017	1.3	0.1	2.5	0.185	3.6	1.0	6.2	0.300	1.3	0.0	2.6	0.523
Province	Atlantic provinces§	1.6	0.9	2.3		1.6	0.8	2.4		3.4	1.5	5.3		1.2	0.5	2.0	
	Quebec	2.3	1.7	3.0	0.076	2.0	1.3	2.7	0.297	2.5	1.2	3.8	0.223	1.5	0.9	2.1	0.441
	Ontario	2.0	1.4	2.5	0.331	2.3	1.6	3.0	0.050	2.5	1.4	3.7	0.216	1.8	1.2	2.5	0.111
	Prairies‖	2.3	1.7	3.0	0.068	1.8	1.2	2.5	0.491	2.6	1.5	3.7	0.262	1.5	0.8	2.3	0.408
	British Columbia	2.9	1.8	4.0	0.027	1.9	1.0	2.9	0.437	2.7	1.5	4.0	0.377	1.0	0.3	1.7	0.524

Table 2. (*continued*).

Variable		Sweetened breakfast cereals %	95% CI† From	To	p value	Chocolate and candies %	95% CI From	To	p value	Chips, crackers, other salty snacks %	95% CI From	To	p value	Sweetened milk- and soy-based products %	95% CI From	To	p value
Sex	Male	4.1	2.6	5.6		1.8	0.8	2.8		2.0	0.8	3.3		0.9	0.4	1.3	
	Women	3.4	1.8	5.0	0.028	2.5	1.5	3.4	0.001	2.8	1.5	4.1	0.003	1.6	1.1	2.0	<0.0001
Age (years)	19–30	4.0	2.3	5.8		2.3	1.2	3.4		2.6	1.3	3.9		0.9	0.4	1.4	
	31–50	3.6	2.0	5.2	0.416	2.0	1.1	2.9	0.249	2.5	1.2	3.9	0.868	0.8	0.3	1.3	0.495
	51–64	3.2	1.7	4.7	0.111	2.2	1.2	3.2	0.760	2.3	1.0	3.5	0.389	1.5	1.0	2.0	0.015
	65+	4.2	2.5	5.8	0.836	2.1	1.1	3.1	0.522	2.2	0.9	3.6	0.388	1.7	1.0	2.4	0.023
Educational attainment	<High school	4.0	1.8	6.1		2.6	1.3	3.9		2.7	1.1	4.2		0.7	0.0	1.4	
	High school	3.7	2.1	5.2	0.720	1.9	0.8	2.9	0.174	2.6	1.2	4.0	0.881	1.2	0.7	1.7	0.134
	Some postsecondary‡	3.7	2.2	5.2	0.753	2.1	1.1	3.1	0.395	2.2	1.0	3.4	0.398	1.3	0.8	1.9	0.071
	University diploma	3.7	2.1	5.3	0.739	2.0	1.1	2.9	0.260	2.2	1.0	3.4	0.409	1.6	1.2	2.1	0.006
Ability to make ends meet	Very difficult	3.3	1.7	4.9		2.6	1.3	3.8		2.5	1.0	4.0		0.9	0.4	1.5	
	Difficult	4.0	2.2	5.8	0.256	2.1	1.0	3.2	0.400	2.9	1.4	4.4	0.446	1.6	1.0	2.1	0.045
	Neither easy nor difficult	3.6	2.1	5.2	0.565	2.0	1.1	2.9	0.280	2.4	1.2	3.6	0.830	1.1	0.6	1.6	0.616
	Easy	3.9	2.2	5.6	0.359	1.9	0.9	2.9	0.248	2.5	1.1	3.8	0.949	1.1	0.5	1.7	0.660
	Very easy	3.9	2.0	5.7	0.469	2.2	0.9	3.4	0.535	1.8	0.6	3.0	0.184	1.4	0.7	2.1	0.201
Ethnic/racial group	Majority	2.9	2.0	3.7		1.8	1.3	2.4		2.0	1.4	2.6		1.6	1.1	2.0	
	Minority	2.9	2.0	3.9	0.865	1.8	1.1	2.5	0.878	1.8	0.9	2.7	0.536	1.0	0.5	1.5	0.006
	Other	5.5	1.1	9.8	0.251	2.8	0.2	5.4	0.470	3.4	0.4	6.5	0.322	1.1	0.3	1.8	0.185
Household food security status	Food secure	3.9	2.3	5.4		1.9	1.0	2.8		2.7	1.4	4.0		1.6	1.1	2.0	
	Moderately food insecure	3.9	2.1	5.8	0.899	2.5	1.3	3.8	0.166	2.2	0.9	3.5	0.213	0.9	0.4	1.5	0.015
	Severely food insecure	3.4	1.9	5.0	0.436	2.0	1.0	3.0	0.884	2.4	1.0	3.7	0.417	1.2	0.6	1.8	0.168
Urbanicity	Urban	3.8	2.1	5.4		2.5	1.5	3.5		2.4	1.3	3.4		1.2	0.9	1.5	
	Rural	3.9	2.2	5.7	0.768	2.5	1.5	3.5	0.948	2.7	1.5	3.9	0.381	1.2	0.6	1.8	0.979
	Not stated/missing	3.6	1.6	5.5	0.810	1.5	0.4	2.6	0.056	2.2	0.1	4.2	0.805	1.2	0.4	2.2	0.887
Province	Atlantic provinces§	4.7	2.7	6.8		2.1	0.8	3.3		3.2	1.5	4.9		1.1	0.4	1.8	
	Ontario	3.6	2.1	5.2	0.125	2.1	1.2	3.0	0.907	2.6	1.2	3.9	0.275	1.3	0.9	1.8	0.518
	Quebec	3.6	1.8	5.3	0.120	2.2	1.2	3.3	0.755	1.7	0.4	2.9	**0.009**	1.0	0.6	1.5	0.851
	Prairies‖	3.5	1.9	5.0	0.100	2.3	1.3	3.2	0.720	1.9	0.7	3.2	0.045	1.4	0.8	2.1	0.390
	British Columbia	3.4	1.8	4.9	0.083	2.0	0.8	3.2	0.883	2.7	1.3	4.2	0.476	1.2	0.6	1.8	0.761

Table 2. (*concluded*).

Variable		Carbonated soft drinks				Commercial soups				Cheese products			
			95% CI[†]				95% CI				95% CI		
		%	From	To	p value	%	From	To	p value	%	From	To	p value
Sex	Male	2.3	1.0	3.7		2.1	1.4	2.7		1.1	0.7	1.5	
	Women	1.9	0.8	3.1	0.164	2.2	1.5	2.8	0.633	1.1	0.6	1.5	0.746
Age (years)	19–30	2.1	0.9	3.3		1.7	1.0	2.4		1.1	0.7	1.6	
	31–50	3.0	1.6	4.4	0.018	1.9	1.2	2.7	0.450	1.0	0.6	1.4	0.494
	51–64	2.2	0.9	3.5	0.829	1.9	1.1	2.6	0.566	1.0	0.6	1.5	0.561
	65+	1.3	0.0	2.5	0.021	3.0	1.9	4.0	0.018	1.1	0.6	1.7	0.970
Educational attainment	<High school	3.6	1.6	5.6		2.6	1.3	3.9		1.2	0.6	1.8	
	High school	2.0	0.8	3.2	0.060	1.8	1.0	2.5	0.266	1.0	0.6	1.4	0.522
	Some postsecondary[‡]	1.5	0.2	2.7	0.016	1.8	1.2	2.5	0.284	1.1	0.7	1.5	0.645
	University diploma	1.5	0.2	2.7	0.017	2.3	1.5	3.1	0.667	1.0	0.6	1.4	0.385
Ability to make ends meet	Very difficult	2.0	0.6	3.4		3.0	1.7	4.3		1.0	0.5	1.6	
	Difficult	1.8	0.6	3.0	0.673	1.7	1.1	2.4	0.075	1.0	0.5	1.5	0.924
	Neither easy nor difficult	2.1	0.7	3.5	0.861	2.0	1.2	2.8	0.156	1.2	0.7	1.6	0.576
	Easy	2.6	1.1	4.0	0.427	1.8	1.0	2.5	0.088	1.2	0.7	1.8	0.401
	Very easy	2.2	0.8	3.6	0.750	2.1	1.3	3.0	0.253	1.0	0.5	1.5	0.976
Ethnic/racial group	Majority	1.8	1.3	2.4		2.5	1.8	3.2		1.2	0.8	1.6	
	Minority	1.8	1.1	2.5	0.914	2.5	1.7	3.3	0.972	1.3	0.8	1.9	0.301
	Other	2.8	-0.6	6.2	0.597	1.3	0.6	2.1	0.002	0.8	0.3	1.2	0.065
Household food security status	Food secure	1.6	0.5	2.6		1.6	1.1	2.2		1.0	0.6	1.3	
	Moderately food insecure	2.7	1.0	4.3	0.032	2.3	1.4	3.2	0.127	1.2	0.7	1.7	0.217
	Severely food insecure	2.2	0.9	3.5	0.225	2.4	1.6	3.3	0.057	1.1	0.6	16	0.427
Urbanicity	Urban	2.4	1.1	3.8		1.7	1.3	2.2		0.8	0.6	1.0	
	Rural	1.7	0.4	3.0	0.021	2.2	1.5	2.9	0.212	1.0	0.6	1.4	0.277
	Not stated/missing	2.3	0.8	3.8	0.857	2.4	0.9	3.9	0.383	1.5	0.4	2.5	0.234
Province	Atlantic provinces[§]	2.4	1.0	3.7		1.6	0.8	2.4		1.0	0.5	1.4	
	Quebec	2.4	1.2	3.6	0.966	1.8	1.2	2.5	0.463	1.2	0.8	1.6	0.237
	Ontario	2.6	1.0	4.1	0.642	2.6	1.8	3.4	0.011	1.0	0.6	1.4	0.895
	Prairies[‖]	1.9	0.7	3.1	0.223	2.0	1.2	2.8	0.257	1.4	0.8	1.9	0.071
	British Columbia	1.5	0.3	2.7	0.033	2.5	1.6	3.4	0.044	0.9	0.4	1.3	0.573

*Results of multivariable linear regression models mutually adjusted for all sociodemographic variables shown. Each UPF subcategory was modeled separately.

[†] CI, confidence interval.

[‡] Postsecondary includes trade certificate or diploma, college, CEGEP (College of general and professional education unique to Quebec province), or other non-university certificate or diploma and university certificate or diploma below bachelor level.

[§] Atlantic provinces include the provinces of New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland, and Labrador.

[‖] Prairie provinces include Alberta, Saskatchewan, and Manitoba.

[¶] "Other" UPF subcategory includes baby products; meal replacements; protein powder; protein bars; imitation meat, fish, and chicken; eggnog; instant coffee beverages and coffee substitutes; coffee whitener; sweeteners; vanilla extract; canned mixed dishes; dry mix dishes; frozen French fries and hash brown potatoes; and cooking spray..

challenged by the use of disparate measures of household income or financial status, collectively, these studies point to a pervasive level of UPF intake across the income spectrum. Although this study lacked relevant data to examine this, it's possible that higher income individuals consume more "premium" products marketed as being healthier or with functional properties (Scrinis and Monteiro 2018), which tend to be more expensive than traditional UPF. Future research should further explore any differential UPF purchasing or consumption patterns according to income level.

Household food insecurity is closely linked with household income and is a highly sensitive marker of material hardship, independent of income (Tarasuk 2020). A recent national-level Canadian study found that the mean proportion of energy derived from UPF was highest among adults and children living in households with severe food insecurity, even after accounting for household income (Hutchinson and Tarasuk 2022). In the current study, although household food security status was not significantly associated with energy intake from total UPF in multivariable analyses, higher proportions of energy were observed among those in food-insecure households for some UPF subcategories, including carbonated soft drinks and fast food and frozen dishes. These results are consistent with a systematic review that concluded that socioeconomically disadvantaged groups tend to consume more lower-cost, energy-dense, and higher-satiety foods, including many UPF such as soft drinks and fast food, particularly in high-income countries (Darmon and Drewnowski 2015). In the current study, the proportions of energy from sauces, spreads, and salad dressings, as well as from sweetened milk and soy-based products, were lower among those in food-insecure households versus the food secure. Sauces, spreads, and salad dressings, as well as sweetened milk and soy-based products, tend to be non-essential and expensive products (Statistics Canada 2017b, 2024), which could at least in part account for this finding. Milk- and plant-based products such as chocolate milk or almond beverages can be more than twice the price of soft drinks (Statistics Canada 2017b), thus making them less accessible for those affected by income-related food insecurity (Kirkpatrick and Tarasuk 2008; Statistics Canada 2017b).

This study's finding that the proportion of energy intake from UPF did not vary significantly by educational attainment stands apart from results of studies from Australia, Brazil, U.S., and one previous Canadian study (Baraldi et al. 2018; Moubarac 2017; Marchese et al. 2022; Louzada et al. 2023), which have generally observed a modest negative association with education level. However, we found variations for several UPF subcategories. For example, individuals with less than high school education consumed a higher proportion of energy from carbonated soft drinks than individuals with a postsecondary diploma or a university degree. In contrast, sweetened milk- and soy-based products contributed a higher proportion of energy among university-educated individuals compared with those with less than high school degree. It is possible that individuals with higher educational attainment are more likely to purchase alternatives to meat and other animal-based products, such as soy and almond

beverages, for perceived environmental and health reasons (Aggarwal and Drewnowski 2019).

This study found regional disparities in the proportion of energy from UPF whereby participants residing in the Atlantic provinces consumed a higher proportion of total energy in the form of UPF compared with residents of British Columbia and the Prairies' provinces. This result, while consistent with findings from an earlier Canadian study based on national-level 2015 data (Moubarac 2017), is difficult to interpret given the limitations of our study. Indeed, while we did not find meaningful differences in the energy contribution of UPF according to level of urbanicity (i.e., urban or rural region) in our sample, we could not verify this relationship at the level of the provinces because of low sample size in some provinces. However, it is possible that urbanicity plays a role for residents of some regions, such as the Atlantic provinces, where sparsely populated communities may face challenges related to food availability and quality (Mah et al. 2018; Gilham et al. 2020). Nevertheless, our results are consistent with evidence of lower levels of fruit and vegetable consumption among residents of Atlantic provinces compared with residents of other Canadian provinces (Colapinto et al. 2018). Lower intakes of fruit and vegetables have been shown to be correlated with higher levels UPF consumption (Dicken and Batterham 2021). Moreover, it is possible that provincial differences in UPF intake are related to cultural or sociodemographic differences across provinces, such as ethnic composition. For example, the Atlantic provinces have the lowest proportion of ethnic minorities among all provinces, and British Columbia has a much larger Chinese population than in the Atlantic provinces (Statistics Canada 2022). A recent analysis showed that Canadians of Chinese ethnicity are among the lowest consumers of UPF in Canada (Jovovic 2023). More granular analysis within provinces and regions would be necessary to better understand how cultural and sociodemographic factors intersect with and influence UPF intakes among subpopulations.

The current study did not find meaningful differences in the energy contribution of UPF between minority and majority ethnic/racial groups after accounting for other sociodemographic covariates. This finding contrasts with those of a previous study from Canada, which reported lower UPF intake in 2004 and 2015 among some ethnic/racial minority groups compared with the majority group (White), possibly reflecting the maintenance of more traditional dietary patterns (Olstad et al. 2023). One possible explanation for the lack of observed differences in our study is that grouping different ethnic/racial identities into broad groups (majority and minority) because of sparse data may have masked within-group heterogeneity and thus hindered our capacity to detect differences in UPF intakes according to race or ethnicity. A 2022 study on the intersection of ethnic/racial identity and perceived income adequacy in relation to dietary quality among adults in Canada found no overall difference in diet quality based on ethnic/racial identity alone (Doan et al. 2022). However, when considering the joint effect of ethnic/racial identity and perceived income adequacy, the study revealed variations in dietary quality, and particularly lower dietary quality, among certain racialized groups,

notably Black and Indigenous adults. Such evidence highlights the importance of a more granular examination of UPF intake among diverse ethnic/racial groups and its intersection with socioeconomic variables. Future studies should further explore variations in UPF intake and factors driving any variations within and across diverse ethnic/racial identities while considering immigration status, cultural practices, and experiences of racism and discrimination.

Strengths and limitations

This study has several strengths. The analysis was based on recent data from a relatively large sample of participants from all ten Canadian provinces, contributing to the existing literature on UPF. We also used the Nova classification system, which was previously used in Canada (Polsky et al. 2020; Nardocci et al. 2021; Hamel et al. 2022; Hutchinson and Tarasuk 2022) and is internationally recognized (Monteiro et al. 2018; Baker et al. 2020).

A number of limitations also deserve mention. The food database used by IFPS was not specifically designed to classify foods according to type of processing. Food brands and ingredient details were not always available, which challenged the classification of some food items. This likely introduced some misclassification errors, which may underestimate or overestimate UPF intake. We adopted a conservative approach for classification uncertainties (i.e., assigning the lowest level of processing). Expanding food composition databases to include information on product brand-names and ingredients would facilitate the use of Nova in future research.

Social desirability bias may lead to underreporting of foods socially regarded as unfavorable or unhealthy, which may lead to underestimation of UPF consumption. If this underreporting differed across various sociodemographic groups, this may have resulted in either underestimation or overestimation of the observed associations. Furthermore, while data from a single 24HR cannot capture intra-person variability and thus the usual dietary intake of individuals, it is appropriate for estimating mean dietary intake at the population level (National Cancer Institute 2020), which was done in this study.

This analysis was unable to examine UPF intake within distinct ethnic/racial subgroups due to small sample sizes, resulting in the grouping of diverse ethnic/racial groups into "majority" and "minority." Additionally, the sample was recruited using non-probability sampling, which does not enable the generation of nationally representative population estimates. Although sampling weights for sex, age group, region, and education were applied to improve representation, sampling weights for ethnic/racial group and income were unavailable. Finally, as with all observational research, one cannot rule out the presence of residual confounding by unmeasured or mismeasured characteristics.

Implication for research and policy

This study provides insights into the sociodemographic factors associated with the consumption of UPF among a sample of adults in Canada in 2018–2019. This understanding could inform the development of tailored health promotion campaigns and public health policies, such as targeting specific population groups (e.g., youth). For instance, results of this study showing that certain UPF, such as fast foods, are consumed more commonly by males and younger individuals can guide public health interventions to directly address this category of products in recommendations or interventions for these population subgroups. Moreover, our findings underscore the importance of implementing public policies aimed at reducing the consumption of UPF in the entire population. This may include exploring policies to improve the food environment (e.g., marketing restrictions and taxes on sugary beverages or UPF), which have the potential to reduce intakes among high-volume UPF consumers and to shift social norms, as proposed by the World Bank Group (Shekar and Popkin 2020). Further research is necessary to understand the underlying motivations driving individuals' consumption of UPF, both overall and for specific subcategories of UPF. Additionally, both qualitative and quantitative investigations of UPF intake patterns across various sociodemographic groups, such as by ethnic/racial identity or immigration status, is essential for a more nuanced and granular understanding of UPF consumption in various segments of the population and the design of appropriate policies and interventions.

Conclusion

The results of this study show that UPF consumption is high among adults in Canada and is modestly associated with being younger, male, and a resident of the Atlantic provinces. Our study reiterates the importance of developing and implementing policies aiming to decrease overall UPF consumption in all segments of the population, considering the documented health risks associated with high intake of UPF.

Article information

Data availability

The International Food Policy Study data are not publicly available due to pre-existing data-sharing agreements with investigators in different countries.

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Competing interests

The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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