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Temporal snacking patterns among Canadian children and adolescents

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Abstract

Snacking is nearly universal among children but there is growing concern around snacking patterns and energy contribution. This study aimed to characterize temporal snacking patterns among Canadian children and adolescents. A cross-sectional analysis drew on data from 5209 respondents aged 4–18 years from the 2015 Canadian Community Health Survey Nutrition, using one 24 h dietary recall. Descriptive statistics estimated proportions of morning, afternoon, and evening snackers, the mean caloric contribution of each snacking period to total daily energy intake, and the top food categories consumed as snacks (kcal per capita). Snacking was nearly universal and accounted for one of every four calories consumed. Morning snacks were more popular among children vs. adolescents and contributed significantly less energy than afternoon or evening snacking periods for both age groups ($P < 0.001$). The top food groups consumed as snacks were the same for children and adolescents, although the ranking order varied. Fruits were the leading food group in terms of per capita energy for children and second for adolescents. Aside from fruits and milks, all other top per capita energy contributors were generally more energy-dense, nutrient-poor foods such as cookies, biscuits and cereal bars, and other breads. Among children, morning snacks were higher in desirable nutrients compared with afternoon snacks. Not all snacking periods are equal in terms of energy and nutrients. A better understanding of how time of day may influence the quality of snack foods can inform meal-based guidance and help children achieve the recommended daily amounts of foods and nutrients.

Key words: snacking, eating behaviours, time of day, children, adolescents, Canada

Introduction

Snacking (i.e., eating in between meals) is nearly universal among children worldwide and snacks account for at least one of every four calories consumed by children (D. Wang et al. 2018; Vatanparast et al. 2019; O'Kane et al. 2023). The Canadian Pediatric Society recommends one to three snacks per day as part of their dietary recommendations for children (CPS 2020). There are growing concerns around snacking patterns and the amount of energy that snacking provides for children, particularly in Canada where childhood overweight and obesity remains a key public health concern (Public Health Agency of Canada 2012; Rao et al. 2016).

Studies suggest room for improvement in the quality of foods consumed as snacks by Canadians (Gilbert et al. 2012; Wang et al. 2016; Hutchinson et al. 2018; Vatanparast et al. 2019; Mireault et al. 2023) and US children (Wang et al. 2016; D. Wang et al. 2018). Using data from the 2004 Canadian Community Health Survey-Nutrition, Gilbert et al. found that the bulk of the most frequently consumed afternoon snacks by children were energy-dense, nutrient-poor foods (Gilbert et al. 2012). Hutchinson et al. (2018) examined snacking patterns (frequency, quality, and quantity) among young children aged 1.5–5 years and found that just over two-thirds of the snacks consumed contained a food group defined in the 2007 Canada's Food Guide (i.e., vegetables and fruit, grain products, milk and alternatives, and meat and alternatives), leaving almost one-third of snacks with minimal nutritional value. Indeed, their analysis revealed that while some of the commonly consumed foods were "recommended" foods (e.g., whole fruit such as apples), many others were foods such as packaged cookies, sweetened yogurt, and granola bars, resulting in a high proportion of snacking calories (37%) coming from added sugars. In a large nationally representative sample of US children, the most frequently consumed food group as snacks were sweets, followed by sweetened beverages, milk and dairy, and fruit (Wang et al. 2016). Although a better understanding of the types of foods consumed as snacks is needed to provide targeted meal-based dietary guidance, no study has examined commonly consumed snack foods among children and adolescents using the most recent available national-level dietary survey data for Canadians.

The term "meal pattern" is a construct used to describe individuals' eating patterns at the level of a "meal", such as lunch, dinner, or smaller-sized eating occasions such as snacks. Meal patterns have been described based on characteristics such as frequency, timing, nutrient profile/content,

or more contextual factors such as eating with others or eating outside the home (Leech et al. 2015, 2017). Evidence from the US suggests that some aspects of snacking patterns, such as higher snacking frequency, snack size (mean energy (kcal) consumed per snacking occasion), and energy density, may lower children's dietary quality (Shriver et al. 2018; Kachurak et al. 2019). For example, a US study of young children aged 2–5 years identified sweet bakery products (i.e., cakes, cookies, and pastries) as the leading source of energy consumed during snacking occasions (Shriver et al. 2018). Sweet bakery products, along with sweetened beverages, contributed 45% of children's daily added sugar intake (Shriver et al. 2018). Using 2015 national-level dietary survey data in Canada, Vatanparast et al. examined snack consumption patterns among different age groups (Vatanparast et al. 2019, 2020). Among children aged 2–12 years, snacks provided, on average, about a quarter of total daily calories and high shares of total daily intake of vitamin C and total sugars (Vatanparast et al. 2019). Unlike findings from US-based studies, Vatanparast et al. also found that Canadian children and adolescents consumed a high proportion of whole fruit and milk alternatives (e.g., yogurt and cheese) at snacking occasions (Vatanparast et al. 2020). Given the complexities involved in measuring and defining snacking, it is unclear whether snacking has a positive or negative impact on young persons' overall dietary quality.

The timing of snack consumption may also impact overall dietary quality, but little is known about how snack quality may vary across the day. A nationally representative study of US children aged 4–13 years found that morning, afternoon, and evening snacking periods presented distinct energy and nutrient intake profiles, with the least energy consumed during the morning snacks, and morning snacks exhibited a more desirable nutrient intake profile (i.e., highest densities of calcium and vitamin C, and lower densities of added sugars) compared with afternoon snacks (Y. Wang et al. 2018). Using nation-level data from Canada, Gilbert et al. (2012) examined Canadian children and adolescent snacking patterns during a specific time of the day (afterschool snacks). However, this study used data from an older survey (the 2004 Canadian Community Health Survey). Given evidence that Canadian children's dietary patterns have changed over a 20-year period (Tugault-Lafleur et al. 2019; Tugault-Lafleur and Black 2019), there is a clear need for more recent evidence, including for data on snacks consumed across the entire day.

A better understanding of the timing, quality of foods, and nutrient composition of snacks across the day can help inform interventions to promote healthy snacking behaviours that take into account the various contextual influences that shape snacking behaviours among children and adolescents (Tripicchio et al. 2023). As such, the aim of this analysis was to comprehensively describe the snacking patterns of Canadian children and adolescents using the most recent available nationally representative dietary survey data. The specific objectives were to (1) estimate the proportion of children and adolescents consuming snacks during three snacking periods across the day (i.e., morning, afternoon, and evening) and the energy contribution of these snacking periods to their total energy intake, (2) identify the top food categories consumed as snacks and meals in terms of per capita energy, and (3) compare the nutritional profile of foods consumed as snacks versus meals.

Materials and methods

Analyses were conducted using the 2015 Canadian Community Health Survey (CCHS)–Nutrition "Master Files" (Version 3) (Health Canada 2017) at the Ottawa-Outaouais Research Data Centre at the University of Ottawa. Studies that use Statistics Canada data are exempt from ethical review as indicated in Article 2.2(a) of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.

Data source and participants

This cross-sectional study used data from the 2015 CCHS–Nutrition, a nationally representative survey of Canadians' dietary intake conducted by Statistics Canada and Health Canada. Details of the survey are available elsewhere (Health Canada 2017). Briefly, the survey used a multistage stratified cluster sample that was nationally representative for age, sex, geography, and socioeconomic status ($n = 20\,487$; response rate of 61.6% (Health Canada 2017)). The survey targeted residents aged 1 year and above living in private dwellings in Canada's 10 provinces. The target population did not include individuals who were full-time members of the Canadian Forces or who lived in the Territories, on reserves and other Indigenous settlements, in some remote areas or in institutions (e.g., prisons or care facilities). The survey included a 24 h dietary recall component as well as a health component that queried for sociodemographic characteristics and information on general health. Interviews for children younger than 6 years of age were conducted with proxy respondents and those for children aged 6–11 years were conducted with parental assistance. Children aged 12 years and above were asked to provide their own information.

The 24 h dietary recall was administered using the Automated Multiple-Pass Method, developed by the U.S. Department of Agriculture to enhance the accuracy of interviewer-administered recalls and adapted for the Canadian setting. Briefly, this method is an automated questionnaire that guides the interviewer through a series of questions and probes to maximize the interviewees' recall and reporting of all foods and beverages consumed in the previous 24 h, including types and amounts of foods consumed, eating occasion (e.g., breakfast, lunch, and snack), and time of consumption (Health Canada 2017). The energy and nutrient content from reported foods were derived from food composition data from the 2015 version of the Canadian Nutrient File and a recipe file, both from Health Canada (Health Canada 2015). The use of the two data files provided data for recipes as well as coverage for frequently reported foods and regional foods (e.g., poutine, "tourtière"/meat pie) (Health Canada 2017).

All respondents completed a single 24 h dietary recall primarily in person, and a subset of respondents completed a second recall by telephone 3 to 10 days later. Data from 24 h recalls are affected by within-person variation, driven primarily by day-to-day variation in food consumption (meaning that a single recall is not reflective of a given individ-

ual's usual intake) (Thompson et al. 2015). However, mean intake based on a single recall provides an indication of average usual intake at the group level (Thompson et al. 2015) and is thus suitable for the current analyses. Therefore, only data from the first 24 h dietary recall were used for this study. After excluding participants who either did not report any food in their 24 h recall, those who were breastfeeding or lactating, or had a 24 h recall deemed as unreliable by Statistics Canada, the final analytical sample was 5209 children and adolescents aged 4–18 years.

Definitions of meals and snacks

In the 24 h dietary recall module, eating occasions were self-reported, and options were breakfast, lunch, dinner, brunch, snacks, drink, "extended consumption". The option "extended consumption" was used for continuous eating occasions without a distinct start or end, or if the respondent could more easily recall the total amount consumed rather than the specific time of the eating occasion (e.g., sipping cups coffee from an eight-cup pot over a period of several hours) (Statistics Canada 2008). All foods and beverages reported at the same time were considered as a single eating occasion (Murakami and Livingstone 2016). For this analysis, a "snack" was defined as any food or beverage consumed outside of a meal occasion (i.e., a "snack", "drink", or "extended consumption"). Consistent with previous research (Wang et al. 2016), all reported foods and beverages were aggregated into morning (AM), afternoon (PM), and evening (HS) snacking periods for any snacks consumed between 0:00 and 11:59, 12:00 and 17:59, and 18:00 and 24:00 h, respectively. For the purposes of this analysis, multiple eating events were combined by time of day when a child reported more than one snack within the morning, afternoon, or evening period. For example, if a child reported two snacks between 12:00 and 17:59 h, foods reported as snacks during this period were categorized as afternoon snacking. Therefore, there was a maximum of three possible snacking periods in a day for each respondent. To represent meal occasions other than snacks, foods and beverages consumed as breakfast, brunch, lunch, and dinner were combined and are henceforth referred to as "meals".

Categorization of dietary sources and nutrient profiles by eating occasion

Foods consumed as snacks or meals were regrouped into food categories using Health Canada's Bureau of Nutritional Sciences (BNS) food group classification (BNS n.d.), with minor modifications to align with a previous study characterizing snacking patterns of Canadian children based on a 2004 nutrition survey (Gilbert et al. 2012). These minor modifications consisted of aggregating similar finer foods categories (e.g., "cookies and biscuits" and "squares and cereal bars") into broader categories ("cookies, biscuits, squares, and cereal bars"). To compare the nutritional profile of foods consumed across snacking periods and meals, nutrient densities of selected macronutrients and micronutrients (i.e., protein, total fat, total sugar, dietary fibre, calcium, sodium, and vitamins C and D) were calculated for each snacking period and all meals combined and then expressed as grams, milligrams, or micrograms per 100 kcal, as appropriate. These nutrients were selected based on their roles in child health and growth (World Health Organization 2017) or because they are nutrients of concern (Elvidge Munene et al. 2015; Health Canada 2019).

Statistical analyses

Descriptive statistics were used to estimate the proportion of morning, afternoon, and evening snackers as well as the mean energy contribution of each snacking period to total daily energy intakes. In light of previous research showing different food intake patterns between younger and older children (Kachurak et al. 2018; Vatanparast et al. 2019, 2020), all analyses were stratified by age group (4 to 12 and 13 to 18 year-olds, hereafter referred to as children and adolescents). Student's *t* tests were used to detect statistical differences between means (such as mean energy intake between different snacking periods) and chi-square tests were used to test for differences in proportions (such as the percentage of children consuming morning, afternoon, and evening snacks). We then determined the top 10 food categories contributing the most per capita energy. We also estimated the proportion of consumers of these top 10 food categories and their mean caloric contributions among consumers. For this analysis, "per capita" refers to the mean energy contribution of a food group or nutrient using the total sample in the denominator (i.e., consumers and non-consumers combined). "Per consumer" refers to the mean energy contribution among consumers only. To compare the nutritional profile of foods between eating occasions, Student's *t* tests were used to test for differences in nutrient densities between snacking periods and meals, and between different snacking periods (e.g., differences in mean total sugar densities between morning and afternoon snacking periods, and between afternoon and evening snacking periods).

All analyses were conducted using Stata 17.0 (StataCorp 2021) with statistical significance set at $P < 0.05$. Sampling weights were applied in all analyses to generate nationally representative estimates and robust standard errors were estimated with the 500 sets of bootstrap weights provided by Statistics Canada.

Results

Distribution of snacking periods among children and adolescents

Nearly all children aged 4–12 years and adolescents aged 13–18 years (about 97%) reported consuming snacks during at least one (i.e., any) snacking period in the previous day (Table 1). Among the three snacking periods, the afternoon period was most popular for all age-sex groups combined, with 79% of children and adolescents reporting consuming an afternoon snack. A significantly higher proportion of children reported snacking during the morning and afternoon periods (68% and 83%, respectively) compared to adolescents (54% and 73%) ($P \leq 0.001$). Among children, afternoon snacks were more commonly consumed by girls (86%) than boys

Table 1. Percentage of children and adolescents consuming snacks by snacking period, 2015 Canadian Community Health Survey—Nutrition.

	Children and adolescents						Children (4–12 years)						Adolescents (13–18 years)					
	All (n = 5209)		Boys (n = 2612)		Girls (n = 2597)		All (n = 2855)		Boys (n = 1447)		Girls (n = 1408)		All (n = 2354)		Boys (n = 1165)		Girls (n = 1189)	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Snacking period																		
Morning	62.6	1.1	62.7	1.5	62.7	1.6	68.4	1.5	68.6	2.1	68.2	2.0	54.0[a***]	1.6	54.5	2.3	53.4	2.4
Afternoon	78.7	1.0	75.6	1.3	81.9	1.2	82.8	1.1	79.6	1.7	85.9[b**]	1.4	72.7[a***]	1.6	70.1	2.2	75.5	2.0
Evening	73.4	1.0	76.4	1.3	70.4	1.6	71.7	1.4	74.2	1.8	69.3	2.1	76.0[a*]	1.4	79.4	1.8	72.2[b*]	2.1
Any period	96.7	0.4	97.0	0.5	96.4	0.6	98.3	0.4	98.3	0.5	98.2	0.5	94.4[a***]	0.8	95.2	1.0	93.5	1.3
Number of snacking periods																		
0	3.3	0.4	3.0	0.5	3.6	0.6	1.7	0.4	1.7	0.5	1.8	0.5	5.6	0.8	4.8	1.0	6.5	1.3
1	16.9	0.8	16.5	1.1	17.3	1.2	15.3	1.1	14.6	1.4	15.9	1.6	19.3	1.3	19.1	1.8	19.6	1.9
2	41.5	1.2	43.4	1.5	39.6	1.6	41.3	1.5	43.4	2	39.3	2.1	41.8	1.7	43.4	2.3	40.1	2.3
3	38.3	1.2	37.2	1.6	39.4	1.7	41.6	1.5	40.3	2.1	42.9	2.2	33.2	1.6	32.8	2.1	33.8	2.3

Note: SE, standard error. Snacking occasions were categorized into morning, afternoon, and evening snacking periods for snacks consumed between 0:00 and 11:59 h, 12:00 and 17:59 h, and 18:00 and 24:00 h, respectively.
[a]Significantly different from children (both sexes combined) for a given snacking period.
[b]Significantly different from boys in the same age group for a given snacking period, where $^{*}P \leq 0.05$; $^{**}P \leq 0.01$; $^{***}P \leq 0.001$.

(80%), while among adolescents, a higher proportion of boys (79%) consumed evening snacks compared to girls (72%) (each $P \leq 0.05$). In terms of the number of snacking periods, about 42% and 38% of all children and adolescents reported snacking during two or three snacking periods in the previous day, respectively, whereas only 17% reported snacking during a single period and 3.3% did not consume any snacks.

Energy contribution of each snacking period

Snacks consumed during all snacking periods contributed 481 kcal for children and 558 kcal for adolescents, which corresponded to, on average, 27% and 25% of their respective total daily energy intake (Table 2). Of the three snacking periods, the morning period provided the lowest proportion of total energy for both age groups (6% of total energy intake for children and 3% for adolescents). Among children, afternoon snacks contributed, on average, more energy (228 kcal) compared to either the morning or evening periods (98 and 155 kcal, respectively) ($P \leq 0.001$ for both periods), which was consistent with the high percentage of afternoon snack consumers shown in Table 1. Among adolescents, afternoon and evening snacks contributed similar amounts of energy, on average (232 and 249 kcal, respectively), which was significantly higher than morning snacks (77 kcal) ($P \leq 0.001$). Mean energy intake in absolute terms (i.e., kcal) from morning, afternoon, and evening snacks was lower among adolescent girls compared to adolescent boys ($P \leq 0.05$). Among children, only mean energy from evening snacks was slightly lower among girls (143 kcal) compared to boys (167 kcal) ($P \leq 0.05$). However, there were no sex differences in the *percentage* of total energy intake from any snacking period among children or adolescents.

Top foods and beverages consumed as snacks and meals

The top 10 food and beverage categories consumed as *snacks* in terms of mean energy contribution per capita were the same for both age groups, although the ranking order varied (Tables 3 and 4). Other beverages, which include fruit drinks and soft drinks, had the largest shift in ranking position from tenth place among children vs. fourth place among adolescents. Fruits were the most frequently consumed snack food group in both age groups based on the percentage of consumers (53% and 38% of children and adolescents, respectively), but contributed the lowest amount of per capita energy among these top 10 foods for consumers (on average, 106 kcal for children and 116 kcal for adolescents). Fruits ranked as the top energy contributor for children (57 kcal per capita) and second for adolescents (44 kcal per capita), following sweet snacks, sugars, candies, etc. (45 kcal per capita). Aside from fruits and milks, all other top 10 energy contributors in terms of kcal per capita were generally more energy-dense, nutrient-poor foods such as cookies, biscuits, and cereal bars, and other breads in both age groups.

For foods and beverages consumed as *meals*, children and adolescents shared the top five food and beverage categories (i.e., other breads; milks; breakfast cereals and other grains; pasta and rice; cheeses), although with some differences

Table 2. Mean energy contribution of snacking periods among Canadian children and adolescents, 2015 Canadian Community Health Survey—Nutrition.

Snacking period	Energy contribution	Children (4–12 years)						Adolescents (13–18 years)					
		All		Boys		Girls		All		Boys		Girls	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Morning	Kcal	98	4	106	6	92	5	77	6	90	10	63[d]	6
	% EI	5.7	0.2	5.9	0.3	5.5	0.3	3.3	0.2	3.3	0.3	3.3	0.3
Afternoon	Kcal	228[a,c]	8	234	14	221	10	232[a]	11	254	17	208[d]	12
	% EI	12.5	0.4	12.0	0.5	12.9	0.5	10.4	0.4	9.9	0.6	11.0	0.6
Evening	Kcal	155[a,b]	6	167	8	143[d]	9	249[a]	11	294	19	199[d]	12
	% EI	8.6	0.3	9.1	0.5	8.2	0.5	11.1	0.4	11.5	0.6	10.6	0.6
All snacking periods	Kcal	481	11	507	16	456[d]	15	558	19	638	30	470[d]	19
	% EI	26.8	0.5	26.9	0.7	26.7	0.7	24.8	0.6	24.7	0.8	24.9	0.8

Note: Kcal indicates mean energy intake from each snacking period per capita per day; % EI, percent of total energy intake; SE, standard error. Superscripts denote, within each age group, significant differences in the mean energy contribution (kcal) per capita between snacking periods (Student's *t* tests were used).
[a]Compared with the morning snacking period ($P \leq 0.001$).
[b]Compared with the afternoon snacking period ($P \leq 0.001$).
[c]Compared with the evening snacking period ($P \leq 0.001$).
[d]Significantly different from boys within an age group ($P \leq 0.05$).

Table 3. Mean energy intake per capita, percentage of consumers, and energy intake per consumer for the top 10 food and beverage groups consumed as snacks or meals among children aged 4–12 years.

Rank	Food and beverage groups	Kcal per capita[a]		% consumers[b]		Kcal per consumer[c]	
		Mean	SE	Mean	SE	Mean	SE
	Snacks						
1	Fruits (raw, cooked, frozen, canned)	57	3	53.4	1.6	106	3
2	Cookies, biscuits and cereal bars	52	3	33.6	1.5	155	6
3	Other breads[d]	52	4	28.9	1.4	180	8
4	Sweet snacks, sugars, candies, etc.[e]	41	3	32.7	1.4	125	8
5	Milks (dairy and plant-based)	32	2	26.7	1.3	120	4
6	Frozen dairy products	29	3	10.3	0.9	281	17
7	Savory snacks[f]	26	4	14.4	1.0	179	23
8	Cakes and pastries	24	3	8.9	0.8	278	18
9	Fried potatoes	21	3	11.7	1.0	182	17
10	Other beverages[g]	21	2	14.9	0.9	139	8
	Meals						
1	Other breads[d]	119	5	53.4	1.5	223	7
2	Milks (dairy and plant-based)	106	3	70.5	1.3	150	3
3	Breakfast cereals, grains, and flours[h]	96	4	60.9	1.4	157	5
4	Pasta and rice	95	4	46.4	1.5	204	6
5	Cheeses	66	3	55.1	1.4	120	4
6	White bread	62	4	31.5	1.3	197	10
7	Fruit juices	46	2	38.5	1.3	118	4
8	Sausage and luncheon meats	45	3	38.5	1.5	117	6
9	Other beverages[g]	42	2	35.5	1.4	118	5
10	Fruits (raw, cooked, frozen, canned)	42	2	48.9	1.6	86	3

Note: SE, standard error.
[a] Mean daily kcal per capita (includes both consumers and non-consumers) of a given food and beverage group.
[b] Indicates the percentage of respondents who reported consuming a given food and beverage group.
[c] Mean daily kcal per food and beverage group among only consumers of that food and beverage group.
[d] "Other breads" include refined breads such as bagels, crackers, muffins and English muffins, pancakes, waffles, and croissants.
[e] "Sweet snacks, sugars, candies, etc." include confectionary, jams, and sugars added to food, such as syrups and white sugar.
[f] "Savory snacks" include popcorn, pretzels, potato chips, and tortilla chips.
[g] "Other beverages" include fruit drinks (excludes 100% fruit juices), regular and diet soft drinks, and milk-based beverages such as chocolate milk and milkshakes.
[h] "Breakfast cereals, grains, and flours" include both whole grain and refined cereals (enriched and non-enriched), other cereals grains, and flours.

Table 4. Mean energy intake per capita, percentage of consumers, and energy intake per consumer for the top 10 food and beverage groups consumed as snacks or meals among adolescents aged 13–18 years.

Rank	Food and beverage groups	Kcal per capita[a]		% consumers[b]		Kcal per consumer[c]	
		Mean	SE	Mean	SE	Mean	SE
	Snacks						
1	Sweet snacks, sugars, candies, etc.[d]	45	4	27.8	1.5	163	14
2	Fruits (raw, cooked, frozen, canned)	44	3	37.6	1.5	116	5
3	Cookies, biscuits and cereal bars	42	3	22.3	1.3	191	8
4	Other beverages[e]	41	3	22.7	1.3	180	9
5	Other breads[f]	40	4	17.1	1.2	235	16
6	Frozen dairy products	33	5	9.5	1.0	348	25
7	Milks (dairy and plant-based)	33	3	22.8	1.3	145	8
8	Fried potatoes	32	5	11.1	0.9	292	37
9	Savory snacks[g]	31	4	11.8	1.0	264	29
10	Cakes and pastries	26	4	8.8	0.9	300	34
	Meals						
1	Other breads[f]	145	7	51.0	1.6	284	10
2	Pasta and rice	118	7	43.7	1.8	271	10
3	Breakfast cereals, grains, and flours[h]	116	7	50.7	1.7	230	11
4	Cheeses	93	5	55.3	1.6	168	7
5	Milks (dairy and plant-based)	93	4	55.1	1.5	167	7
6	Poultry meats	68	5	34.3	1.4	200	11
7	Other beverages[e]	65	4	41.0	1.6	159	6
8	Beef	63	5	33.1	1.6	190	11
9	Fats, oils, gravies, sauces, dressings	63	5	71.4	1.4	86	4
10	White bread	60	4	26.9	1.4	222	9

Note: SE, standard error.
[a] Mean daily kcal per capita (includes both consumers and non-consumers) of a given food and beverage group.
[b] Indicates the percentage of respondents who reported consuming a given food and beverage group.
[c] Mean daily kcal per food and beverage group among only consumers of that food and beverage group.
[d] "Sweet snacks, sugars, candies, etc." include confectionary, jams, and sugars added to food, such as syrups and white sugar.
[e] "Other beverages" include fruit drinks (excludes 100% fruit juices), regular and diet soft drinks, and milk-based beverages, such as chocolate milk and milkshakes.
[f] "Other breads" include refined breads such as bagels, crackers, muffins and English muffins, pancakes, waffles, and croissants.
[g] "Savory snacks" include popcorn, pretzels, potato chips, and tortilla chips.
[h] "Breakfast cereals, grains, and flours" include both whole grain and refined cereals (enriched and non-enriched), other cereals grains, and flours.

in ranking order (Tables 3 and 4). More differences were observed in the bottom five categories, with fruit juices, sausages, and luncheon meats, and fruits present only for children and poultry meats, beef, and fats and oils, gravies, etc. present only for adolescents.

Nutrient densities by eating occasion

The mean nutrient density of selected nutrients for snacks consumed during the morning, afternoon, and evening snacking periods and for all other meals combined is shown in Table 5. Compared with nutrient densities of meals, snacks were generally lower in protein, total and saturated fat, vitamin D and sodium but higher in total sugars and vitamin C for both age groups ($P \leq 0.05$). Among children, morning and afternoon snacks had significantly higher densities of fibre and vitamin C compared with meals ($P \leq 0.05$). Among adolescents, vitamin C densities were higher for afternoon and evening snacks compared with meals ($P \leq 0.05$).

There were several statistically significant differences in mean nutrient densities across the morning, afternoon, and evening snacking periods, as well as between age groups (Table 5). Among children, morning snacks were on average higher in fibre, total sugars, potassium, and vitamin C compared with afternoon snacks ($P \leq 0.05$). In both age groups, total fat and saturated fat were lowest for morning snacks compared with the other two snacking periods ($P \leq 0.05$). Among children, afternoon snacks were lower in calcium compared with morning snacks (45 g/100 kcal vs. 53 g/100 kcal), whereas the opposite pattern was observed among adolescents (46 g/100 kcal vs. 36 g/100 kcal) ($P \leq 0.05$ for both comparisons). Evening snacks were higher in protein and vitamin D than either the morning or afternoon snacks ($P \leq 0.05$), but only among children. For morning snacks, the mean densities of protein, fibre, total fat, saturated fat, total sugars, calcium, potassium, and vitamins C and D were all lower among adolescents compared with children ($P \leq 0.05$).

Discussion

This study is the first, to our knowledge, to comprehensively characterize temporal snacking patterns in a large, nationally representative sample of Canadian children aged 4–

Table 5. Nutrient densities of meals and morning, afternoon, and evening snacks, stratified by age group (children and adolescents).

				Snacking period					
		Meals		Morning snack		Afternoon snack		Evening snack	
Nutrient	Age group	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Protein	4–12 years	4.4	0.0	1.9[a]	0.0	2.0[a]	0.1	2.3[a,b,c]	0.1
	13–18 years	4.6[d]	0.1	1.3[a,d]	0.1	2.2[a,b]	0.1	2.1[a,b]	0.1
Fibre	4–12 years	0.9	0.0	1.4[a]	0.1	1.0[a,b]	0.0	0.9[b]	0.0
	13–18 years	0.8[d]	0.0	0.7[d]	0.1	0.9[b]	0.0	0.9[b]	0.0
Total fat	4–12 years	3.4	0.0	1.9[a]	0.1	2.8[a,b]	0.1	2.8[a,b]	0.1
	13–18 years	3.6[d]	0.0	1.4[a,d]	0.1	2.6[a,b]	0.1	2.8[a,b]	0.1
Saturated fat	4–12 years	1.2	0.0	0.7[a]	0.0	1.0[a,b]	0.0	1.1[a,b]	0.0
	13–18 years	1.2	0.0	0.5[a,d]	0.0	0.9[a,b]	0.0	1.0[a,b]	0.0
Total sugars	4–12 years	5.1	0.1	9.9[a]	0.3	9.1[a,b]	0.2	8.4[a,b]	0.2
	13–18 years	4.5[d]	0.1	6.4[a,d]	0.3	8.6[a,b]	0.3	8.9[a,b]	0.3
Calcium	4–12 years	54	0.7	53	2.0	45[a,b]	2.0	57[c]	2.0
	13–18 years	46[d]	0.8	36[a,d]	3.0	46[b]	2.0	50[b]	2.0
Potassium	4–12 years	137	1.0	164[a]	6.0	129[b]	4.0	133[b]	4.0
	13–18 years	129[d]	2.0	111[d]	8.0	151[b]	12.0	173[b]	21.0
Sodium	4–12 years	161	2.0	82[a]	13.0	84[a]	3.0	75[a]	3.0
	13–18 years	161	2.0	51[a]	4.0	84[a,b]	4.0	83[a,b]	3.0
Vitamin C	4–12 years	6.5	0.2	15.9[a]	1.0	9.9[a,b]	0.6	8.4[b]	0.8
	13–18 years	5.7[d]	0.2	8.4[d]	1.0	10.1[a]	0.9	7.5[a]	0.7
Vitamin D	4–12 years	0.3	0.0	0.2[a]	0.0	0.2[a]	0.0	0.3[a,c]	0.0
	13–18 years	0.3[d]	0.0	0.1[a,d]	0.0	0.2[a,b]	0.0	0.2[a,b]	0.0

Note: SE, standard error. Means indicate nutrient densities expressed as g/100 kcal for protein, fibre, total and saturated fats, total sugars; as mg/100 kcal for calcium, potassium, and sodium; and as μg/100 kcal for vitamins C and D. Superscripts denote statistically significant differences in means ($P \leq 0.05$).
[a] Compared with meals in the same age group.
[b,c] Compared with the morning ([b]) and afternoon ([c]) snacking periods in the same age group.
[d] Compared with the same eating occasion in the 4–12 year-old group.

12 years and adolescents aged 13–18 years, and to explore how time of the day may be associated with differences in nutrient intake patterns. Snacking was nearly ubiquitous and accounted for about one quarter of total energy intake in the previous day among both children and adolescents. However, the popularity of snacking periods varied by age group, with morning snacks being more popular among children compared with adolescents. Morning snacks provided the lowest caloric contribution compared to the afternoon and evening snacking periods. Aside from fruits and milks, the top energy contributors in kcal per capita among snacks were generally energy-dense, nutrient-poor foods such as cookies, biscuits and cereal bars, sugars and candies, and other breads including bagels, crackers, and muffins. Our results also document differences between children and adolescents in the quality of food choices consumed during snacks. Finally, results show distinct nutrient intake profiles of snacks vs. meals, as well as differences in nutrient densities between snacking periods, particularly among children.

The current study documented a high prevalence of snacking among Canadian children and adolescents, which is consistent with previous analyses (Wang et al. 2016; D. Wang et al. 2018; Vatanparast et al. 2019, 2020; O'Kane et al. 2023). Similar to previous research documenting the popularity and timing of snacking within Canadian samples (Hutchinson et al. 2018; Vatanparast et al. 2020), we found that the afternoon was the most popular snacking period within the broader sample of children and adolescents. However, our analysis also revealed differences in snacking patterns across age groups. In line with a recent analysis of contextual factors associated with snacking patterns among US children and adolescents (Tripicchio et al. 2023), we similarly found that

Canadian adolescents reported snacking more commonly in the afternoons and evenings compared with children, who reported more frequent snacking in the morning and afternoon periods. There are several potential explanations for these age-related differences in the timing of snacking. These could include both person-level factors, such as greater autonomy around the timing of eating occasions among older children (Ziegler et al. 2021), as well as more environment-level factors. For example, elementary schools typically have nutrition breaks built into the school schedule, which allows students to consume a morning snack. In contrast, the daily schedules of secondary schools and high schools typically do not include structured nutrition breaks. Differences in the accessibility of school nutrition programs between elementary and secondary students could also potentially play a role. In Canada, there are no national or provincial school nutrition programs. Instead, many provinces involve non-profit and/or volunteer-led organizations to increase student access to food in schools (Godin et al. 2017; Colley et al. 2018; Ruetz and McKenna 2021; Ismail et al. 2022). While little empirical research has examined the reach of such programs in Canadian schools, a nation-wide survey on existing programs found that breakfast or a mid-morning meal is the most common type of school nutrition program in elementary schools (Ruetz and McKenna 2021). More research is needed to examine the contribution that foods provided by school-based nutrition programs make to Canadian children's diet.

Snacks accounted for about a quarter of total daily energy among both Canadian children and adolescents, which is highly consistent with results of previous analyses of national-level dietary data from Canada (Vatanparast et al. 2019, 2020) and the US (Wang et al. 2016; D. Wang et al. 2018; O'Kane et al. 2023; Tripicchio et al. 2023). Fruits (excluding fruit juice) and milks ranked among top energy contributors in kcal per capita among snacks, which echoes results of previous Canadian and US investigations (Wang et al. 2016; Vatanparast et al. 2020). However, other commonly consumed snacks were nutrient-poor foods such as sweet snacks, sugars and candies, and other breads including bagels, crackers, and muffins. These findings resonate with a previous analysis that examined the quality of after-school snack choices of Canadian children (Gilbert et al. 2012), which collectively show room for improvement in the quality of food choices consumed as snacks, particularly for adolescents.

Some age-related differences in snacking patterns emerged between children and adolescents. Among adolescents, "other" beverages, which include fruit drinks, soft drinks, and energy drinks, tend to be high in free sugars, and these ranked as the 4th top source of energy per capita, while among children, they ranked 10th. These drinks contributed twice as many calories per capita for adolescents vs. children (41 vs. 21 kcal, respectively). Therefore, a reduction in intake of free sugars continues to be an important public health nutrition priority for this age group. Nutrient densities varied between snacking periods and by age group. Among children (but not adolescents), morning snacks tended to provide higher densities of several nutrients and minerals (i.e., fibre, total sugars, calcium, potassium, and vitamin C) compared to afternoon or evening snacks, while also providing lower densities of total fat and saturated fats. High nutrient densities of these minerals/nutrients suggest that children may be consuming more vegetables and/or fruits during the morning snacking period, which is an encouraging finding. In contrast, among adolescents, the afternoon and evening snacking periods provided higher densities of virtually all nutrients (i.e., protein, fibre, total fat, saturated fat, total sugars, calcium, sodium, potassium, and vitamins C and D) compared to morning snacks. Previous research does not paint a consistent picture on the impact of snacks on dietary quality among young persons, with some studies indicating a positive impact (Vatanparast et al. 2020) and others negative (Shriver et al. 2018; Kachurak et al. 2019). Our findings suggest that temporal factors may play a moderating role: that is, the contribution of snacks to young persons' dietary quality could vary based on *when* snacks are consumed during the day (at least among children). Comparisons to previous research is challenging because this study is among the few to examine temporal differences in the nutritional profile of snacks. A US population-based study of younger children aged 4 to 13 years documented several differences in nutrient densities across morning, afternoon, and evening snacks and between age groups (Wang et al. 2016). Additional data on adolescents would be valuable to corroborate results from the present study and to better understand any relationship between the timing of snacks and their nutritional profile to help inform appropriate interventions.

Our study found some differences in food choices and associated nutrient densities between foods consumed as meals vs. snacks, including some differences by age group. These findings align with previous research documenting differences in the nutritional content of foods based on eating occasion and other contextual factors (Wang et al. 2016; Jensen et al. 2019). We found that compared to meals, foods consumed as snacks by both children and adolescents were lower in protein, total and saturated fat, vitamin D and sodium, but higher in total sugars and vitamin C. Among children only, morning snacks provided higher densities of fibre, potassium, and vitamin C compared to foods consumed as meals. These age-related differences are likely related to the fact that adolescents wield more autonomy over food choices, and particularly snacks, including greater ability to prepare or purchase foods and beverages, and more time spent without adult supervision. A recent US-based study showed that older children and adolescents consumed substantially more snacking energy outside the home than younger children, with restaurants, convenience stores, and social sources (i.e., snacks obtained from others or as a "gift") serving as important snack food sources (Tripicchio et al. 2023). Additional studies are needed to help shed light on the contextual factors shaping food choices across various eating occasions among children and youth. As discussed by Tripicchio, our current ability to comprehensively capture these influences could be advanced by improved methodology (e.g., development of standard snacking definitions) and more robust data collection approaches, such as longitudinal studies.

Strengths and limitations

This study is strengthened by drawing on data from the 2015 CCHS-Nutrition, which is a large, population-based cross-sectional dietary survey. As such, this study provides a descriptive snapshot of children and adolescents' snacking habits in Canada using the most recent available national-level data. A key limitation in this study is the use of self-reported dietary data, which is subject to random and systematic measurement error and recall bias, including some degree of under-reporting, even when the Automated Multiple-Pass Method is used. Additionally, because our findings are based on a single 24 h recall, the dietary intake of each individual is not representative of their usual snacking intake patterns, although mean values are representative at the population level (Thompson et al. 2015). Another limitation stems from the lack of a universally accepted definition of snacking (Potter et al. 2018), which creates challenges in comparing results across different studies. Nonetheless, we relied upon the participants to identify the eating occasions they considered as a snack, rather than imposing any time of day or calorie criteria.

Conclusion

This study takes important descriptive steps toward better understanding the timing, frequency, and nutritional quality of snacks consumed by children and adolescents in Canada. Results show that snacking is ubiquitous among both children and adolescents and contributes substantially to total daily energy intakes. Our findings indicate that not all daily snacking periods are equivalent in terms of the energy and nutrients they provide. This study also highlighted age-related differences in the nutrient composition of different snacking periods. While morning snacks were the least energy dense for both age groups, they also had a more desirable nutrient intake profile among children, including more fibre, potassium, vitamin C, and calcium. In contrast, afternoon and evening snacks provided the highest share of both desirable (e.g., potassium, vitamin C) and less desirable nutrients (e.g., total fat, saturated fats, sodium) for adolescents.

A better understanding of how time of day may influence the quality of snack food items and their contribution to energy and nutrient intakes can inform updates to meal-based guidance and help populations achieve the recommended daily amounts of foods and nutrients. Collectively, these findings point to the need for age-specific recommendations and guidance about the nutrient quality of snacks selected by children and particularly adolescents. Specifically, foods consumed at snacking occasions represent an opportunity to improve intakes of foods recommended in the 2019 Canada's Food Guide, such as vegetables and fruits, whole grains, and protein foods, and to reduce intakes of energy-dense, nutrient-poor foods such as sweet and salty snacks.

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Data availability

Data analysed during this study may be made available from Statistics Canada upon formal request.

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