

RESEARCH

Open Access



Evaluation of snacks consumed by young children in child care and home settings

Amy Mireault¹, Linda Mann^{1*} , Karen Blotnick² and Melissa D. Rossiter³

*Correspondence:
linda.mann@msvu.ca

¹ Department of Applied Human Nutrition, Mount Saint Vincent University, Halifax, NS B3M 2J6, Canada

² Department of Business and Tourism, Mount Saint Vincent University, Halifax, NS B3M 2J6, Canada

³ Department of Applied Human Sciences, University of Prince Edward Island, Charlottetown, PE C1A 4P3, Canada

Abstract

Purpose: To evaluate the effectiveness of food and nutrition regulations in developing healthy behaviors of young children, this study profiled the food and nutrient contribution of snacks, the foods and drinks consumed outside of main meals, in the diets of a sample of children between the ages of 3–5 years overall and in regulated child care (RCC) and home settings.

Methods: From a purposive sample of 44 RCC settings from across Nova Scotia, Canada, 19 agreed to participate in this study and with RCC directors' approvals, invitations were sent to parents of enrolled children. Using a 4-day food record, foods and drinks consumed by 79 preschool aged children, were recorded by parents at home and by trained research assistants at RCC. The foods and drinks consumed during morning, afternoon and evening snack occasions coded by the *What We Eat in America* (WWEIA) categories and the provision of energy, sodium, fats, sugar and fiber were calculated. Descriptive statistics and independent *t* tests were used to determine differences between the foods and nutrients by where and when the snacks were consumed.

Results: On average, children consumed 2.3 snacks per day. Fruit, salty/sweet items and dairy items were predominately consumed as snacks. Average daily contributions from snacks were 29% of energy, 22.6% sodium, 27.6% saturated fat, 39.9% sugar and 31.3% dietary fiber. Significantly more variety of food categories and higher sodium and fiber snacks were consumed at RCC than home. Home morning snacks had significantly more sugar than RCC morning snacks.

Conclusions: The findings provide insight into the influences from RCC and home settings on snack intakes and the important role RCC food and nutrition regulations play in supporting healthy eating behaviors. Suggested recommendations are to de-emphasize the requirement for two food group servings for each snack at RCC, focus more on variety and nutrient dense snacks and encourage knowledge sharing between RCC and home environments to promote healthy children's snacking behaviors.

Keywords: Snacks, Preschool, Childcare, Nutrients, Food categories, Regulations

Introduction

Children who have healthy eating behaviors tend to be more open to eating a variety of foods, enjoy the social aspects of eating and able to self-regulate their energy intake, thereby reducing the risks of obesity and related chronic diseases (Haines et al., 2019;

WHO, 2020). Healthy eating behaviors are supported by caregivers following responsive feeding practices that provide nutritious foods on a regular schedule, modeling healthy eating behaviors and allowing children to choose how much to eat (Benjamin et al., 2011; Haines et al., 2019; Health Canada, 2019; Larson et al., 2011; Sleddens et al., 2014).

Snacks, referring to the foods and drinks consumed outside of main meals, have become a common part of westernized eating patterns (Vatanparast et al., 2019). In the USA, the average daily energy intakes of 2–5 years from snacks has more than doubled from 195 kcal in 1977–1978 to 439 kcal in 2011–2014 (Dunford & Popkin, 2018). In Canada, it was reported that 96.4% of children 2–5 years of age consumed one or more snacks per day (Vatanparast et al., 2019) and that preschool children consumed an average of 2.3 snacks daily providing 33.2% of energy from a wide range of items including salty/sweet foods and sugar sweetened beverages (SSB) (Hutchinson et al., 2018). Similarly, in the USA analysis of national data determined that preschool children consumed an average of 2.6 snacks per day and that diet quality was positively associated with snacking frequency and negatively associated with snack energy density and size, recommending more frequent and less energy dense snacks for preschoolers (Kachurak et al., 2019). While energy contributions from children's snacks varied by country from 33% for Australia to 15% for Mexico, it was noted that as snacks across all countries were high in sugar and sodium, suggesting establishment of guidelines for healthy children's snacks (Wang et al., 2018).

While home feeding influences have been found to be most significant in developing healthy eating behaviors (Haines et al., 2019; Sleddens et al., 2014), many families have come to rely on either regulated child care (RCC) or private arrangements (Sinha, 2014). In Nova Scotia (NS), the location of this study, almost half of families have their preschool children attend child care including over one-third at RCC (Sinha, 2014). The high number of children in RCC along with the importance of developing healthy eating behaviors early in life has led to the implementation of RCC food and nutrition regulations (Benjamin et al., 2011; Larson et al., 2011). In NS programs and policies for early child care have been enshrined in legislation (Government of NS, 2018) and a support structure created for the monitoring and implementation in RCC environments, including ongoing review, consultations and training (Kelly et al., 2015). National and provincial healthy eating guidelines and policies (Health Canada, 2019; Government of NS, 2005) in turn directed the development of NS RCC food and nutrition regulations, following a comprehensive scan of current research and a thorough consultation with government, educator, RCC caregiver and parent stakeholders (Government of NS, 2011). The resulting NS food and nutrition regulations defined adequate nutrition and responsive feeding practices for meals and snacks provided at RCC with an expectation of influencing and reinforcing child feeding practices at home (Government of NS, 2011).

The *Nutrition Standards in Child Care Project* (NSCCP) (Kelly et al., 2015) explored the influences of the NS RCC food and nutrition regulations (Government of NS, 2011) on the eating behaviors of children while attending RCC and at home. The NSCCP was guided by the *Total Environment Assessment Model for Early Child Development* (Irwin et al., 2007), that identifies a series of spheres of influence on child development from families, communities to regional, national and global policy and social environments (Fig. 1). Relevant to this study, specific regulations included support of child

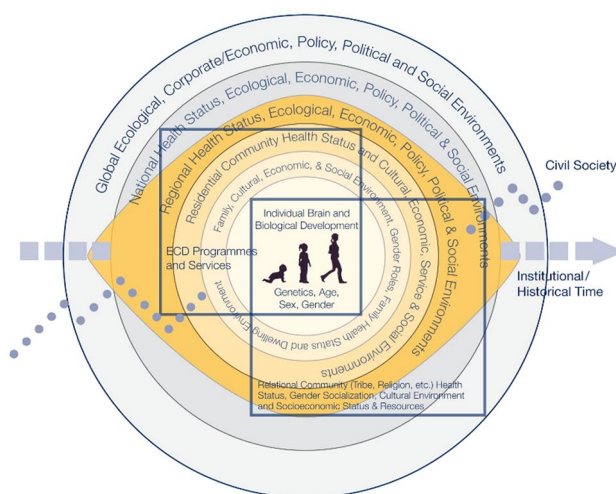


Fig. 1 Total environmental assessment model for early child development (Irwin et al., 2007)

self-regulation of intakes, juice limited to serving no more than twice a week, water provided as desired, and each morning and afternoon snack offering a vegetable/fruit and one other food group (Government of NS, 2011). To address nutrients of concern that can impact health, criteria for maximum levels of sodium, fat and sugar, and minimum level for fiber for processed foods and beverages were also defined according to the Dietary Reference Intakes (Government of NS, 2011; Institute of Medicine, 2006). Using data from the NSCCP (Kelly et al., 2015), the purpose of this study was to profile the overall, RCC and home food and nutrient intakes from snacks, the foods and drinks consumed outside of the main meals, by a sample of children attending RCC in NS. As this analysis of the NSCCP data has not been previously conducted (Kelly et al., 2015; Ros-siter et al., 2021) and with the significant contribution of snacks in the diets of young children (Dunford & Popkin., 2018; Vatanparast et al., 2019), it was hoped that this will provide some insight into the effectiveness of the RCC food and nutrition regulations in influencing the development of healthy eating behaviors among young children as it applies to snack consumption at RCC and home settings.

Methods

Participants and data collection

As previously reported (Kelly et al., 2015), a purposive sample 44 NS RCC's representative of geographical locations across the province, were invited to participate in the NSCCP. Nineteen RCC agreed to participate and with directors' approvals, invitations were sent to parents of enrolled children. Foods and drinks consumed by 79 children aged 3–5 years were recorded by parents at home and by trained research assistants at the RCC both using the NSCCP 4-Day Food and Drink Diary (Kelly et al., 2015), adapted from the Child and Diet Evaluation Tool (Cade et al., 2006). The Diaries, in the form of booklets, identified the days, times and where the food and drinks were consumed as well as examples of how to measure and record the data. Three of the 4 consecutive days of data collection for each child were while attending the RCCs on weekdays when the RCC's were open. The data for these days would include the noon meals and the

morning and afternoon snacks at the RCC and breakfasts, evening meals and evening snacks at home. The fourth day would include all meals and snacks at home and was usually a weekend day but not always as not all children attended RCC each weekday. Therefore, while not all children consumed all snacks offered, the data collection could include up to 6 snacks consumed at RCC and 6 at home in a 4-Day Diary. Research assistants clarified and confirmed the data collected by parents, as necessary.

The NSCCP received ethics approval from the Mount Saint Vincent University Research Ethics Board which follows the Canadian Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (CIHR, NSERC, SSHRC, 2005).

Data analysis

The data were analyzed with Food Processor SQL (Esha Research, version 10.9), an extensive and current food and nutrient analysis software program and compiled in MSExcel (Microsoft 365®). The compilation included the foods, drinks and nutrients consumed by each child and by day, location and type of meal or snack. Only those participants who had completed at least three of the 4-day food records were included in the overall analysis including at least 2 of 3 days at the RCC and 1 day at home. Averages of food and nutrient intakes were based on the number of days reported.

The food and drink items consumed during morning, afternoon and evening snack occasions were coded according to a system adapted from the *What We Eat in America* (WWEIA) food categories (US Department of Agriculture, Agricultural Research Service [USDA ARS], 2018), summarized in Table 1. Adaptations to this system renamed the snacks and sweets category as salty/sweet, sorted protein foods by plant-based, poultry/meats/fish and eggs and moved fat and oil items to condiments/sauces and dairy as appropriate. This coding system was used by the National Health and Nutrition Examination Survey (NHANES) and the Food and Nutrient Database for Dietary Studies (FNDDS) (USDA ARS, 2018).

Calories, sodium, fat, sugar and fiber consumed by each child, by location and by morning, afternoon and evening snacks were analyzed. This also enabled comparison to previous analysis of average daily intakes from all foods and drinks consumed (Rossiter et al., 2021) and to determine if the criteria for nutrients of concern identified in the NS RCC regulations (Government of NS, 2011) influenced RCC and home snacks.

Pivot table summaries were used to organize the WWEIA food categories (USDA ARS, 2018) and nutrients of concern overall, by sex and by where (RCC, home) and when (morning, afternoon, evening) the snacks were consumed. Descriptive statistics, conducted in MSExcel (Microsoft 365®) and SPSS (IBM version 26), included means, standard deviations, ranges and percentages. Independent *t* tests with a *p* value of < 0.05 were used to determine differences between the groups.

Results and discussion

On average most of the children (96.2%) had snacks daily and consumed 2.3 snacks per day. Eighty-nine percent of children had snacks at the RCC, compared to 77.3% at home. While 82.0% of children had morning snacks, 84.5% consumed afternoon snacks and 63.6% evening snacks. The average daily numbers of snacks and the proportion of children snacking daily in this study was similar to reports from two recent Canadian studies

Table 1 Food categorization adapted from what we eat in America (WWEIA) (USDA ARS, 2018)

Category	Type	Item examples
Vegetable	Vegetables	Carrots, Peas, Cucumbers, Bell peppers
	Potatoes	Fries, Baked potatoes
Fruit	Fresh/Canned	Apple, Oranges, Melons, Canned peaches
	Dried	Raisins, Dried cranberries
Grain	Breads	Yeast breads, Bagels, English muffins, Tortillas
	Quick Breads	Muffins, Loafs, Pancakes/Waffles
	RTE Cereals	Corn, Wheat, Rice, Flavored
	Cooked Grains	Rice, Pasta, Quinoa
Dairy	Cooked Cereals	Oatmeal, Cream of wheat
	Milk	2% fat, 3.25% fat (whole), 1% fat, skim
	Flavored milk	Chocolate milk
	Yogurt	Stirred, Greek style
	Cheese	Cottage, Hard and Soft cheeses
Protein	Alternatives	Soy, Rice, Almond milks
	Cream	Blend, Light and Heavy creams
	Plant-based	Peanut butter Pulses, Nuts, Seeds, Processed soy (Tofu, WOW butter)
	Meats/Fish	Poultry, Beef, Pork, Fish, Shellfish
	Eggs	Eggs, Omelettes
Water	Cured Meats	Cold cuts/Lunch meats, Bacon
	Water	Water
Beverages	Juice (100%)	Apple, Orange
	Sweet Beverages	Fruit drinks, Pop/Sodas, Smoothies
Salty/Sweet	Candy	Candy, Chocolate
	Salty Snacks	Potato chips/Corn chips, Popcorn, Pretzels, Snack mixes
	Crackers	Crackers, Saltines
	Baked Goods	Cakes, Pies, Cookies, Brownies, Squares, Donuts, Pastries
	Snack Bars	Cereal bars, Granola bars, Fruit bars
Mixed dishes	Other	Ice cream, Ice milk, Frozen yogurt, Pudding, Gelatin dessert
	Grain-based	Macaroni and cheese, Pasta dishes
	Pizza	All pizzas
	Sandwiches	Hamburgers, Breakfast sandwiches, Grilled cheese, Peanut butter
	Soups	All soups
Condiments/dips	Dips/Sauces	Hummus, Ranch dressing, Salsa
	Sugars	Honey, Jams, Jellies

(Hutchinson et al., 2018; Vatanparast et al., 2019) and slightly lower than the 2.6 average daily snacks consumed by USA preschool children (Kachurak et al., 2019). The percentages of children who had morning and afternoon snacks were higher than was reported by Hutchinson et al. (2018) at 77.6% for morning and 82.1% for afternoon snacks and slightly lower for the evening snacks at 66.7%. Children in the Hutchinson et al. (2018) study ($n=52$) were home and not attending RCC offering structured snacks which may have explained the differences.

Food categories and types

Children consumed on average 4.15 ± 1.63 food categories at morning RCC snacks compared to an average of 1.25 ± 1.23 food categories at home morning snacks, a

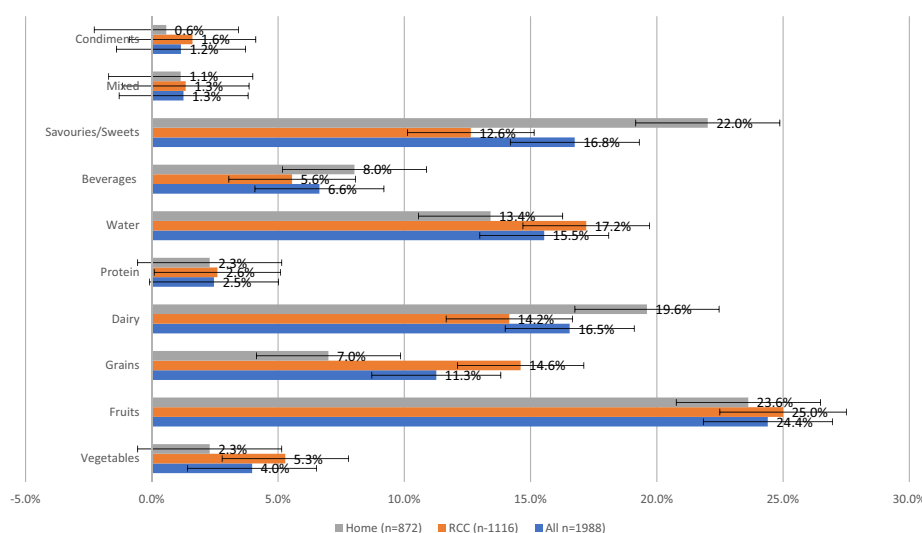


Fig. 2 Food category frequencies for all, regulated child care and home snacks. Snacks referred to the foods and drinks consumed outside of main meals

significant difference ($p < 0.001$). This was likely due to the RCC food and nutrition regulation to offer two or more different food groups for each snack. In contrast, caregivers at home may have prioritized convenience and satiety over serving a variety of foods. Recent qualitative studies reported that home caregivers defined a snack as a small food serving intended to provide satiety and convenient salty/sweet foods were offered before healthier items (Younginer et al., 2016; Jacquier et al., 2017).

As illustrated in Fig. 2, fruit, salty/sweet foods and dairy were the WWEIA categories most consumed by children. The frequency of fruit consumed as snacks was similar for RCC and home but salty/sweet and dairy items were consumed more frequently at home. Similarly, several other studies listed fruit and a wide range of salty/sweet foods as top snack items (Damen et al., 2019; Hutchinson et al., 2018; Jacquier et al., 2017; Marx et al., 2016; Younginer et al., 2016). Approximately 60% of snacks represented WWEIA categories comparable to recommended food guide groups of vegetable/fruit, grain, dairy and protein (Health Canada, 2019) which was lower than the 70% reported by others (Hutchinson et al., 2018; Vatanparast et al., 2019). The variation may have been due in part to the differences in the classification systems.

As summarized in Table 2, on average, significantly more categories of vegetables, fruit, grains, condiments/dips and crackers were consumed as snacks at the RCC than at home. Fruit predominated vegetable consumption as snacks despite the NS food and nutrition regulations emphasis placed on providing a serving from the vegetable/fruit food group for each snack (Government of NS, 2011). However, if offered two or more food group items, children may select the other food item(s) over vegetables (Beets et al., 2014). Caregivers at both settings may also be influenced by convenience, the perceived preferences of children or their own understanding of what constitutes a snack (Damen et al., 2019; Jacquier et al., 2017; Marx et al., 2016; Younginer et al., 2016) and, therefore, may have favored serving fruits instead of vegetables.

Table 2 Average daily intakes of food category/type from all, regulated child care (RCC) and home snacks

Category Type	Average daily intake from All snacks n = 79	Average daily intakes from RCC snacks			Average daily intakes from home snacks			
		All RCC n = 75	Morning n = 73	Afternoon n = 70	All Home n = 77	Morning n = 58	Afternoon n = 65	Evening n = 69
Vegetable	0.26	0.30 ¹	0.03	0.28	0.08 ¹	0.03	0.06	0.06
Vegetables	0.25	0.30	0.03	0.28	0.07	0.02	0.06	0.05
Potatoes	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01
Fruit	1.60	1.40 ²	0.63	0.80	0.87 ²	0.65	0.55	0.57
Fresh/Canned	1.53	1.37	0.63	0.78	0.79	0.59	0.51	0.53
Dried	0.07	0.03	0.00	0.02	0.07	0.06	0.04	0.04
Grain	0.74	0.82 ³	0.52	0.30	0.26 ³	0.26	0.14	0.16
Breads	0.30	0.34	0.19	0.15	0.10	0.07	0.05	0.07
Quick Breads	0.18	0.23	0.13	0.11	0.04	0.06	0.05	0.01
RTE Cereals	0.21	0.22	0.18	0.03	0.08	0.12	0.01	0.06
Cooked Grains	0.03	0.01	0.00	0.01	0.03	0.01	0.02	0.02
Hot Cereals	0.02	0.03	0.02	0.00	0.01	0.00	0.00	0.01
Dairy	1.09	0.79	0.50	0.30	0.72	0.46	0.27	0.59
Milk	0.57	0.46	0.30	0.16	0.34	0.15	0.07	0.34
Flavored Milk	0.02	0.01	0.00	0.01	0.03	0.00	0.01	0.03
Yogurt	30	0.19	0.12	0.07	0.22	0.19	0.09	0.16
Cheese	0.16	0.12	0.06	0.06	0.10	0.09	0.09	0.05
Alternatives	0.02	0.02	0.01	0.00	0.02	0.03	0.00	0.01
Cream	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01
Protein	0.16	0.15	0.04	0.11	0.08	0.01	0.05	0.07
Plant-based	0.12	0.14	0.03	0.10	0.04	0.00	0.02	0.04
Meats/Fish	0.03	0.01	0.00	0.01	0.03	0.00	0.03	0.03
Eggs	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.01
Water	1.02	0.96 ⁴	0.51	0.47	0.49 ⁴	0.40	0.36	0.29
Beverages	0.44	0.31	0.14	0.18	0.29	0.34	0.24	0.13
Juice	0.38	0.26	0.09	0.17	0.26	0.28	0.22	0.12
SSB	0.06	0.06	0.04	0.01	0.03	0.06	0.02	0.01
Salty/Sweet	1.10	0.71	0.21	0.52	0.81	0.47	0.74	0.47
Candy	0.11	0.04	0.01	0.02	0.11	0.04	0.08	0.07
Savoury	0.13	0.07	0.01	0.05	0.11	0.04	0.13	0.06
Crackers	0.49	0.45 ⁵	0.16	0.30	0.25 ⁵	0.13	0.22	0.16
Snack Bars	0.07	0.04	0.00	0.04	0.06	0.09	0.05	0.02
Baked Goods	0.22	0.12	0.01	0.11	0.19	0.13	0.13	0.13
Other	0.07	0.01	0.00	0.01	0.09	0.03	0.13	0.04
Mixed Dishes	0.08	0.08	0.04	0.03	0.04	0.06	0.01	0.03

Table 2 (continued)

Category Type	Average daily intake from All snacks n = 79	Average daily intakes from RCC snacks			Average daily intakes from home snacks			
		All RCC n = 75	Morning n = 73	Afternoon n = 70	All Home n = 77	Morning n = 58	Afternoon n = 65	Evening n = 69
Condi-ments/Dips	0.08	0.09 ⁶	0.02	0.07	0.02 ⁶	0.03	0.00	0.02
Dips/Sauces	0.04	0.06	0.01	0.04	0.00	0.00	0.00	0.01
Sugars	0.04	0.04	0.01	0.03	0.02	0.03	0.00	0.01

As not all children consumed all snacks, while at RCC and home, the numbers varied. Snacks referred to the foods and dinks consumed outside of main meals

¹ $t = (78) = 3.63, p < 0.001$; ² $t = (78) = 4.36, p < 0.001$; ³ $t = (78) = 7.61, p < 0.001$; ⁴ $t = (78) = 5.62, p < 0.001$; ⁵ $t = (76) = -2.52, p = 0.013$; ⁶ $t = (78) = 3.15, p = 0.002$

The average daily frequency 11.3% for grains as snacks for all children in all environments was lower than the 15% reported by Vatanparast et al. (2019) but approached that percentage in the RCC environment. Grain consumption was more than three times higher for RCC snacks and may have been related to the NS regulations for RCCs to offer two or more food groups at snacks (Government of NS, 2011). In both settings, breads and cereals were the most common types of grain items consumed as snacks.

Dairy consisted of mostly milk and yogurt, and of milk, 48% was 2% fat, 29% was 3.25% fat, 10% was 1% fat and skim, and flavored and milk alternatives were 13%. However, the 16.5% contribution of dairy overall to snacks was less than that reported by Vatanparast et al. (2019) at 24%. At home, milk was mainly served for the evening snack, like the practice noted by Swiss parents (Jacquier et al., 2017).

Protein foods consumed as snacks were mostly plant proteins, such as peanut butter and soy-based spreads. The protein category represented a small proportion of snacks overall suggesting that protein foods may have been perceived as part of a meal rather than a snack (Marx et al., 2016). The NS requirement that RCC snacks provide a full food group serving (Government of NS, 2011) may also have inhibited the provision of protein foods as snacks.

During snack time on average children consumed almost twice the amount of water at the RCC than at home suggesting that home caregivers may not have perceived it as a snack item (Damen et al., 2019; Marx et al., 2016; Younginer et al., 2016). Beverage consumption during snack time was less than half a category overall and was mostly juices. It appeared that consumption of SSB as snacks at 0.06 of a WWEIA category was much less than that reported by another Canadian study at a frequency of 0.2 occasions per day (Hutchinson et al., 2018).

Crackers comprised 45% of snacks consumed in the salty/sweet food category and significantly more were consumed at the RCC. While a convenient snack item to serve, crackers are a processed food item often high in sodium and saturated fat. The marketing strategies of manufacturers of salty/sweet snack items may also have influenced caregivers and children to view these items as healthy and/or desirable snacks (Marx et al., 2016).

Mixed foods such as sandwiches, pizza and soups contributed a very small part of children's snacks in this study. This suggested an opportunity to consider how nutrient-dense mixed foods could play a greater role in children's snacks.

Nutrients

The average daily nutrients of concern consumed by children as snacks were profiled in Table 3. The snacks contributed 29.0% total energy, 22.6% total sodium, 27.6% total saturated fat, 39.9% of total sugar and 31.3% total fiber in this study.

The average daily energy intake from snacks was comparable to other studies (Hutchinson et al., 2018; Vatanparast et al., 2019) but was lower than the 439-kcal reported by a USA national survey (Dunford & Popkin, 2018). No significant differences were found between snack energy contribution by where or when snacks were consumed, which suggested that the children may have been self-regulating their energy intakes from snacks and not influenced by environments.

The average daily percent contribution of sodium from snacks exceeded the 18.6% reported from analysis of national data (Vatanparast et al., 2019). Significantly more sodium was consumed from snacks at RCC than at home which contrasted with the average daily sodium intakes from all meals being significantly higher at home than at the RCC (Rossiter et al., 2021). This may have been due to consumption of significantly more grain items and significantly more crackers from snacks at the RCC than home. The sodium levels were a concern as the average daily contribution of sodium from snacks represented 32.6% of the Chronic Disease Risk Reduction intake for 3 years (1200 mg/day) and 26.1% for 4–8 years (1500 mg) (National Academies, 2019).

Saturated fat intakes from snacks represented on average 10% of total fat and 3.1% of total energy intake. This was low as was the overall daily contribution from all meals (Rossiter et al., 2021).

While the average daily sugar intake from all snacks at RCC and home was similar, the home morning snacks were significantly higher in sugar than the RCC morning snacks. The prevalence of fruits, dairy and salty/sweet items offered at those snacks may have contributed to this result. The average daily percent contribution of sugar from snacks was slightly higher than the 37% reported by Vatanparast et al. (2019) and Hutchinson et al. (2018).

On average, significantly more fiber was consumed from snacks at RCC than home snacks. This may have been due to the significantly higher vegetable, fruit and grain consumption as well as the influence of the NS RCC regulations that identified minimum fiber criteria for processed foods (Government of NS, 2011).

Limitations

Limitations about sample size and nutrient software have been previously noted (Rossiter et al., 2021). While findings are comparable to other studies (Hutchinson et al., 2018; Vatanparast et al., 2019), generalization to all preschool children and other jurisdictions should be done with caution due to the relatively small sample size from one Canadian province. The use of the 4-day food records with efforts to minimize errors was a compensation for the sample size and the risk that home caregivers may not perceive all foods or beverages consumed outside of main meals as snack items (Younginer et al.,

Table 3 Selected nutrient average daily intakes from all, regulated child care (RCC) and home snacks

Nutrients	All snacks All <i>n</i> = 79 Girls <i>n</i> = 38 Boys <i>n</i> = 41 M ± SD (% total) ¹	RCC snacks		Home snacks				
		All RCC <i>n</i> = 75	Morning <i>n</i> = 73	Afternoon <i>n</i> = 70	All Home <i>n</i> = 77	Morning <i>n</i> = 58	Afternoon <i>n</i> = 65	Evening <i>n</i> = 69
Energy (kcal)								
All	401.2 ± 152.6 (29.0%)	299.2 ± 135.2	167.1 ± 76.8	172.5 ± 84.7	276.4 ± 133.7	177.9 ± 95.4	182.8 ± 109.4	181.5 ± 122.4
Girls	418.1 ± 166.0 (30.9%)							
Boys	388.3 ± 144.7 (27.3%)							
Sodium (mg)								
All	392.0 ± 208.1 (22.6%)	318.5 ± 185.2 ²	176.3 ± 94.1	188.0 ± 136.9	228.0 ± 181.3 ²	130.8 ± 157.4	153.6 ± 169.7	153.7 ± 174.5
Girls	427.1 ± 236.3 (24.1%)							
Boys	350.5 ± 194.9 (20.5%)							
Saturated Fat (g)								
All	4.7 ± 2.7 (27.6%)	3.4 ± 2.3	1.8 ± 1.7	2.0 ± 1.9	3.3 ± 3.1	1.7 ± 2.7	2.0 ± 2.5	2.5 ± 3.1
Girls	5.0 ± 3.1 (29.4%)							
Boys	4.2 ± 2.4 (26.3%)							
Sugar (g)								
All	36.7 ± 12.3 (39.9%)	25.7 ± 13.0	13.9 ± 6.9 ³	14.4 ± 8.5	26.3 ± 12.7	19.9 ± 12.5 ^{3,4}	17.3 ± 11.9	15.4 ± 10.4 ⁴
Girls	36.3 ± 12.5 (42.2%)							
Boys	36.3 ± 13.6 (36.7%)							
Dietary Fiber (g)								
All	4.7 ± 2.4 (31.3%)	3.8 ± 2.3 ⁵	2.4 ± 1.3	2.1 ± 1.4	2.9 ± 1.9 ⁵	2.0 ± 1.6	1.8 ± 2.1	1.8 ± 1.5
Girls	5.0 ± 2.9 (33.3%)							
Boys	4.4 ± 1.9 (29.3%)							

As not all children consumed all snacks, while at RCC and home, the numbers varied. Snacks referred to the foods and drinks consumed outside of main meals

¹Total Energy All 1383 ± 245, Girls 1353 ± 249, Boys 1422 ± 256; Total Sodium All 1733 ± 428, Girls 1774 ± 427, Boys 1710 ± 469; Total Saturated Fat All 17 ± 5, Girls 17 ± 6, Boys 16 ± 5; Total Sugar All 92 ± 25, Girls 86 ± 19, Boys 99 ± 28; Total Dietary Fiber All 15 ± 3.4, Girls 15 ± 4.0, Boys 15 ± 3.9 (Blinded for review)

² *t*(74) = 3.04, *p* = 0.003; ³ *t*(57) = 3.28, *p* = 0.002; ⁴ *t*(57) = 2.20, *p* = 0.032; ⁵ *t*(74) = 2.79, *p* = 0.006

2016; Jacquier et al., 2017). Each participant provided 3–4 days of data and research assistants verified the data collected by home caregivers. The adapted WWEIA system (USDA ARS, 2018) may be considered a limitation as the categories do not correspond to the food groups used by the NS RCC food and nutrition regulations (Government of NS, 2011). However, its use by the NHANES and FNDOS (USDA ARS, 2018) provides credibility. The nutrient software (Esha Research, version 10.9) was a limitation as only total, not added, sugars and only dietary fiber could be assessed (Rossiter et al., 2021).

Conclusions and applications

This study provides insight into the important influences that food environments and RCC food and nutrition regulations play in supporting healthy snacking behaviors in young children (Benjamin et al., 2011; Larson et al., 2011; Wang et al., 2018). The higher percentage of children who consumed snacks at the RCC than at home suggests there may be influences from the availability of snack items and group social aspects, both related to the NS RCC food and nutrition regulations (Government of NS, 2011). The food and nutrition regulations also appear to have had a positive influence on the food and nutrient quality of snacks consumed as significantly more vegetables, fruits, grains, water and fiber and less sugar were consumed at RCC than home.

As noted in the Introduction, the NS RCC food and nutrition regulations (Government of NS, 2011) were the result of early child care legislation and healthy eating policies (Government of NS, 2005; Government of NS, 2018). Ongoing review of current research and stakeholder consultations are important for ensuring their relevance. It is hoped that the findings of this study and the following suggestions for changes and future research will contribute toward the ongoing review of the regulations in recognition of the influence they can play in the provision of snacks in RCC's and at home to best support early child development of healthy eating behaviors (Haines et al., 2019; Irwin et al., 2007).

Adjustments to RCC food and nutrition regulations are suggested by the findings. Rather than requiring that each snack offer a vegetable/fruit with another food group, the choice for one or both RCC snacks might be another vegetable/fruit to promote consumption of this food group. As noted by Beets et al. (2014) children tend to select the other food group items rather than the vegetable as a snack. However, when vegetables were served with fruits as a pairing, elementary school age children were more likely to consume the vegetables as well as the fruits as snacks (Snelling et al., 2017). This additional vegetable/fruit offering may also reduce the emphasis on grains (such as crackers) as the second food group serving at RCC snacks which could be contributing to the higher sodium consumption.

The current Canada Food Guide (Health Canada, 2019) with three food groupings and no numbers of servings by age or serving sizes, creates an opportunity for RCC food and nutrition regulations to be more flexible in the criteria for RCC snacks. Less emphasis on two full food group servings could lead to more creative, nutrient dense snacks such as small sandwiches, bite sized snack items and cups of soups or smoothies to promote consumption of more vegetables, vegetable proteins and whole grains in a convenient and economical manner.

Further investigation to explore the impacts of these suggested changes to the RCC snack structure is indicated. Studies similar to those reported by others (Beets et al., 2014; Snelling et al., 2017) could be conducted in RCC settings to determine if children would consume more vegetables if paired with fruits at snacks and, if so, the effects on the nutrients of concern, in particular sodium and sugar. There is an opportunity for the development and testing of a wider variety of snack items under more flexible RCC food and nutrition regulations. This could be undertaken as a collaborative effort by groups of RCCs and families thereby establishing a sense of ownership and excitement about the changes. It is hoped that the findings from this and future studies may inform the establishment of guidelines for healthy children's snacks in other regions (Kachurak et al., 2019; Wang et al., 2018).

Adequate nutrition early in life is needed for appropriate growth and development. Snacks consumed throughout the day can be an important contributor to nutrient quality and overall energy targets for young children. However, a range of factors, including social economic status, education, cultural diversity, caregiver habits, child preferences, time, media and perceptions of what constitutes a snack, have been found to influence caregivers in the provision of snacks for their children (Damen et al., 2019; Dunford & Popkin, 2018; Haines et al., 2019; Jacquier et al., 2017; Larson et al., 2011; Marx et al., 2016; Younginer et al., 2016). The differences in the snacks consumed at home compared to the RCC in this study need to be further understood, so that children may experience more consistent support as they develop healthy eating behaviors. Given the complex nature of food consumption and feeding patterns future studies should explore the impacts of these diverse factors on NS caregivers and their children.

While the focus of this study was on the foods and nutrients consumed by children as snacks, the role of responsive feeding practices with snacks is also an area for future study at home and RCC settings. While it has been found that home caregivers do not commonly use snacks to reward child behavior (Younginer et al., 2016; Jacquier et al., 2017), there are indications that not all follow responsive feeding principles with snacks (Haines et al., 2019; Sleddens et al., 2014). While responsive feeding practices, including modelling of healthy eating behaviors and allowing children to self-regulate intakes, are incorporated in the NS RCC food and nutrition regulations (NS Government, 2011), it is not known how consistently these practices are applied with snacks at the RCC.

Finally, there is an opportunity to explore how RCCs and families could form stronger partnerships that support the development of healthy eating behaviors of young children. The importance of these relationships has been identified by others (Benjamin et al., 2011; Kelly et al., 2015; Larson et al., 2011). Implementation studies or action research to establish models or best practices for such partnerships are suggested.

Abbreviations

RCC	Regulated child care
NS	Nova Scotia
NSCCP	Nutrition Standards in Child Care Project
WWEIA	What We Eat in America
SSB	Sugar sweetened beverages
NHANES	National Health and Nutrition Examination Survey
FNDDS	Food and Nutrient Database for Dietary Studies

Acknowledgements

Not applicable.

Author contributions

The article has not received prior publication and is not under review for publication elsewhere. AM compiled the foods consumed as snacks from the main project database, coded the foods according to the methodology, assisted with the food analyses and contributed to the writing of the manuscript. LM was co-principal investigator of the main project. She initiated and guided this study, conducted analysis of the nutrients and took the lead in writing the manuscript. KB provided expertise with the statistical analysis of the foods and contributed to the writing the manuscript. MDR was co-principal investigator of the main project, initiated the main project and coordinated its data collection, compilation and analysis. She contributed to the writing of the manuscript. All authors have seen and approve the manuscript being submitted. All authors read and approved the final manuscript.

Funding

Funding for this research opportunity was provided through an Establishment Grant from the Nova Scotia Health Research Foundation (currently Research Nova Scotia). A grant from the Department of Health and Wellness, Public Health Branch was also received and allowed for the addition of a rural extension to the project. The funding agencies had no role in the design of the study, the collection, analysis and interpretation of the data, and the writing of this manuscript.

Availability of data and materials

The data sets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The main study received ethics approval including the requirement for participant signed informed consent, from the Mount Saint Vincent University Research Ethics Board which follows the Canadian Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (CIHR, NSERC, SSHRC, 2005).

Consent for publication

No details, images or videos relating to individuals are included in the manuscript.

Competing interests

The authors declare that they have no competing interests.

Received: 23 July 2021 Accepted: 6 January 2023

Published online: 18 January 2023

References

- Beets, M. W., Tilley, F., Kyriiuk, R., Weaver, R. G., Moore, J. B., & Turner-McGrievy, G. (2014). Children select unhealthy choices when given a choice among snack offerings. *Journal of the Academy of Nutrition and Dietetics*, 114(9), 1440–1446. <https://doi.org/10.1016/j.jand.2014.04.022>
- Benjamin, S. E., Neelon, B., & Briley, M. E. (2011). Position of the American Dietetic Association: Benchmarks for nutrition in child care. *Journal of the American Dietetic Association*, 111(4), 607–615. <https://doi.org/10.1016/j.jada.2011.02.016>
- Cade, J., Frear, L., & Greenwood, D. (2006). Assessment of diet in young children with an emphasis on fruit and vegetable intake: Using CADET—Child and Diet Evaluation Tool. *Public Health Nutrition*, 9(4), 501–508. <https://doi.org/10.1079/PHN2005871>
- CIHR, NSERC & SSHRC. (1998 with 2000, 2002, 2005 amendments). *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*. Retrieved from www.pre.ethics.gc.ca
- Damen, F. W. M., Luning, P. A., Fogliano, V., & Steenbekkers, B. L. P. A. (2019). What influences mothers' snack choices for their children aged 2–7? *Food Quality and Preference*, 74, 10–20. <https://doi.org/10.1016/j.foodqual.2018.12.012>
- Dunford, E. K., & Popkin, B. M. (2018). 37 year snacking trends for US children 1977–2014: Snacking in US children. *Pediatric Obesity*, 13(4), 247–255. <https://doi.org/10.1111/ijpo.12220>
- Government of Nova Scotia. (2005). *Healthy Eating Nova Scotia*. <https://novascotia.ca/dhw/healthy-communities/documents/Provincial-Healthy-Eating-Strategy.pdf>
- Government of Nova Scotia. (2011). *The Standards for food and nutrition in regulated child care settings*. <https://www.ednet.ns.ca/earlyyears/providers/FoodandNutritionalSupport.shtml>
- Government of Nova Scotia. (2018). *Day Care Act*. <https://novascotia.ca/coms/licensing/day-care-family-home-day-care.asp>
- Haines, J., Haycraft, E., Lytle, L., Nicklaus, S., Kok, F. J., Merdji, M., Fisberg, M., Moreno, L. A., Goulet, O., & Hughes, S. O. (2019). Nurturing children's healthy eating: Position statement. *Appetite*, 137, 124–133. <https://doi.org/10.1016/j.appet.2019.02.007>
- Health Canada. (2019). *Canada's Food Guide*. <https://food-guide.canada.ca/en/>
- Hutchinson, J. M., Watterworth, J. C., Haines, J., Duncan, A. M., Mirotta, J. A., Ma, D. W. L., Buchholz, A. C., Guelph Family Health Study. (2018). Snacking patterns of preschool-aged children: Opportunity for improvement. *Canadian Journal of Dietetic Practice and Research*, 79(1), 2–6. <https://doi.org/10.3148/cjdp-2017-022>
- Institute of Medicine. (2006). *Dietary reference intakes: The essential guide to nutrient requirements* (p. 11537). National Academies Press. <https://doi.org/10.17226/11537>
- Irwin, L., Siddiqi, A., & Hertzman C. (2007). Early child development: A powerful equalizer. *World Health Organization*. http://www.who.int/maternal_child_adolescent/documents/ecdc_final_m30/en/2007.

- Jacquier, E. F., Gatrell, A., & Bingley, A. (2017). "We don't snack": Attitudes and perceptions about eating in-between meals amongst caregivers of young children. *Appetite*, 108, 483–490. <https://doi.org/10.1016/j.appet.2016.11.003>
- Kachurak, A., Bailey, R. L., Davey, A., Dabritz, L., & Fisher, J. O. (2019). Daily snacking occasions, snack size, and snack energy density as predictors of diet quality among US children aged 2 to 5 years. *Nutrients*, 11(7), 1440. <https://doi.org/10.3390/nu11071440>
- Kelly, E., Mann, L., & Rossiter, M. (2015). Assessment of impact: The Standards for Food and Nutrition in Regulated Child Care Settings in Nova Scotia. Report of the Nutrition Standards in Child Care Project (NSCCP). Mount Saint Vincent University. <https://childfoodfutures.files.wordpress.com/2017/07/nsccp-project-report-2016.pdf>
- Larson, N., Ward, D. S., Neelon, S. B., & Story, M. (2011). What role can child-care settings play in obesity prevention? A review of the evidence and call for research efforts. *Journal of the American Dietetic Association*, 111(9), 1343–1362. <https://doi.org/10.1016/j.jada.2011.06.007>
- Marx, J. M., Hoffmann, D. A., & Musher-Eizenman, D. R. (2016). Meals and snacks: Children's characterizations of food and eating cues. *Appetite*, 97, 1–7. <https://doi.org/10.1016/j.appet.2015.11.010>
- National Academies of Sciences, Engineering, Medicine. (March 2019). *Dietary Reference Intakes for Sodium and Potassium. Consensus Study Report*. [https://www.nap.edu/resource/25353/030519DRI_SodiumPotassium.pdf\(nap.edu\)](https://www.nap.edu/resource/25353/030519DRI_SodiumPotassium.pdf(nap.edu))
- Rossiter, M. D., Mann, L., Kelly, E., Kirk, S., & Cahill, N. (2021). Food and nutrient intakes of Nova Scotian children in home and childcare environments. *Canadian Journal of Dietetic Practice and Research*, 82(4), 176–182. <https://doi.org/10.3148/cjdp-2021-011>
- Sinha, M., & Statistics Canada. (2014). *Child Care in Canada, Analytical paper. Spotlight on Canadians: Results from the general social survey*. Statistics Canada. <http://www.statcan.gc.ca/pub/89-652-x/89-652-x2014005-eng.pdf>
- Sleddens, E. F. C., Kremers, S. P. J., Stafleu, A., Dagnelie, P. C., De Vries, N. K., & Thijs, C. (2014). Food parenting practices and child dietary behavior. Prospective relations and the moderating role of general parenting. *Appetite*, 79, 42–50. <https://doi.org/10.1016/j.appet.2014.04.004>
- Snelling, A., Newman, C., Watts, E., Van Dyke, H., Malloy, E., Ghamarian, Y., Guthrie, J., Mancino, L. (2017). Pairing fruit and vegetables to promote consumption in elementary school cafeterias. *The Journal of Child Nutrition and Management*, 41(1), <https://schoolnutrition.org/newspublications/jcnm//2017/spring/>
- US Department of Agriculture, Agricultural Research Service (USDA ARS). (2018). *What We Eat in America (WWEIA) Food Categories 2015–2016*. www.ars.usda.gov/nea/bhnrc/fsrg
- Vatanparast, H., Islam, N., Patil, R. P., Shafiee, M., Smith, J., & Whiting, S. (2019). Snack consumption patterns among Canadians. *Nutrients*, 11(5), 1152. <https://doi.org/10.3390/nu11051152>
- Wang, D., van der Horst, K., Jacquier, E., Afeiche, M., & Eldridge, A. (2018). Snacking patterns in children: A comparison between Australia, China, Mexico, and the US. *Nutrients*, 10(2), 198. <https://doi.org/10.3390/nu10020198>
- World Health Organization. (2020). *Fact Sheets. Health Diet*. <https://www.who.int/news-room/fact-sheets/detail/healthy-diet>
- Younginer, N. A., Blake, C. E., Davison, K. K., Blaine, R. E., Ganter, C., Orloski, A., & Fisher, J. O. (2016). "What do you think of when I say the word 'snack'?" Towards a cohesive definition among low-income caregivers of preschool-age children. *Appetite*, 98, 35–40. <https://doi.org/10.1016/j.appet.2015.12.002>

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Submit your manuscript to a SpringerOpen[®] journal and benefit from:

- Convenient online submission
- Rigorous peer review
- Open access: articles freely available online
- High visibility within the field
- Retaining the copyright to your article

Submit your next manuscript at ► [springeropen.com](https://www.springeropen.com)