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by Jane Y. Polsky and Didier Garriguet

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# The local restaurant environment in relation to eating out and sugary drink intake among Canadian children and youth

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## ABSTRACT

### Background

Accessibility of food retail in communities may play a role in shaping the food choices of local residents. However, previous studies have shown mixed results. This study examined associations between the local restaurant environment and the frequency of eating food from restaurants and intake of sugary drinks among Canadian children and youth.

### Data and methods

The study cohort consisted of 23,776 participants (aged 1 to 17 years) in the 2019 Canadian Health Survey on Children and Youth who resided in large urban population centres across the Canadian provinces. Measures of geographic access to various restaurant types within walking distance of participants' residential areas came from the 2018 Canadian Food Environment Dataset. Poisson regression models with robust standard errors assessed associations between measures of absolute densities (number per km<sup>2</sup>) of full-service, fast-food and other restaurants, and the relative density of fast-food restaurants (as a percentage of total restaurants) with the frequency of eating food from fast-food or full-service restaurants and sugary drink intake in the previous seven days.

### Results

After adjustment for a range of sociodemographic covariates, there were no consistent associations between absolute and relative measures of restaurant access and the frequency of eating food from restaurants or intake of sugary drinks.

### Interpretation

Results reveal no consistent relationships between local restaurant exposures and the frequency of eating food from restaurants or sugary drink intake among Canadian children and youth. Efforts to create environments that foster healthy food choices among young people will remain important but will likely need to target multiple activity spaces beyond the local neighbourhood.

### Keywords

child and adolescent health; dietary behaviours; sugar-sweetened beverages; food environment; restaurants; neighbourhood.

## AUTHORS

Jane Y. Polsky and Didier Garriguet are with the Health Analysis Division at Statistics Canada.

### ***What is already known on this subject?***

- Childhood and adolescence are key periods for learning and shaping food-related preferences and behaviours that track into adulthood.
- These preferences and behaviours do not occur in a vacuum but unfold within an increasingly complex food environment.
- Accessibility of food retail in communities may play a role in shaping the food choices of local residents. However, previous studies have shown mixed results.

### ***What does this study add?***

- This study examined associations between the local restaurant environment and the frequency of eating food from restaurants and intake of sugary drinks among Canadian children and youth living in large urban centres.
- After adjustment for a range of sociodemographic factors, results reveal no consistent associations between various measures of restaurant access and the frequency of eating food from restaurants or intake of sugary drinks.
- Efforts to create environments that foster healthy food choices among young people will remain important but will likely need to target multiple activity spaces beyond the local neighbourhood.

Healthy eating promotes optimal growth and development in children and adolescents and helps reduce the risk of obesity and chronic diet-related conditions like diabetes.<sup>1</sup> Childhood and adolescence are also key periods for learning and shaping food-related preferences and behaviours that track into adulthood.<sup>1</sup> These preferences and behaviours do not occur in a vacuum but unfold within an increasingly complex food environment. There has been growing attention in research and public policy to the role that aspects of the food environment, such as the accessibility of food retail in communities, may play in shaping food-related behaviours and dietary intake.<sup>2-4</sup>

Canadian youth are frequent patrons of fast-food and other restaurant types, such as full-service restaurants and cafés. National-level data from the latest available 2015 nutrition survey show that at least one in five adolescents had consumed some food in a restaurant on the previous day.<sup>5</sup> This figure does not capture foods prepared in restaurants but consumed off premises (e.g., takeout or delivery), which account for more than half of all meals and snacks ordered in restaurants.<sup>6</sup> Restaurant foods tend to be energy dense and of poor nutritional value, and their regular consumption is linked to weight gain and several metabolic conditions.<sup>7-9</sup> Regular consumption of foods from fast-food establishments, as well as higher exposure to these establishments versus other restaurant types, has been differentially associated with higher weight status and adverse metabolic outcomes in a number of previous reports.<sup>9-13</sup>

Studies linking local exposure to various restaurant types with diet-related behaviours and health outcomes have, to date, revealed mixed results.<sup>14-18</sup> For example, while some studies report that the density or proximity of fast-food outlets near home was positively associated with youths' purchases and

consumption of fast food or sugar-sweetened beverages,<sup>19-22</sup> others document a lack of association.<sup>23-25</sup> Two recent meta-analyses found no significant associations between various measures of fast-food and full-service restaurant access and the weight status of children and adolescents.<sup>17,18</sup>

Reasons for the equivocal findings across studies may include small sample sizes, heterogenous food environment measures, and exposure misclassification introduced by the use of inaccurate secondary datasets to identify food retail outlets.<sup>15,16,26</sup> Large-scale studies that rely on highly accurate food outlet data have been suggested for their potential to advance the state of knowledge on how retail food environments shape the diet and health of Canadians.<sup>26</sup> There have also been calls for studies that better delineate the different age groups of children and youth to account for their differing levels of independence and mobility in navigating the food environment.<sup>15,27</sup>

The current study uses a recently developed high-quality pan-Canadian dataset of food retail measures<sup>28</sup> and a large population-based sample of Canadian children and youth to examine links between the local restaurant environment and the frequency of eating food from restaurants and intake of sugary drinks.

## Methods

### Data sources

#### *Canadian Health Survey on Children and Youth, 2019, and analytic sample*

The study sample was derived from the cross-sectional 2019 Canadian Health Survey on Children and Youth (CHSCY).<sup>29</sup> The 2019 CHSCY collected information on issues that impact the physical and mental health of children and youth in Canada. The survey coverage excluded children and youth living on First Nations reserves and other Indigenous settlements in the provinces, children and youth living in foster homes, and the institutionalized population. The survey covered approximately 98% of the Canadian population aged 1 to 17 in all provinces. Data for the 2019 CHSCY were collected from February to August 2019 on children and youth aged 1 to 17 as of January 31, 2019. One questionnaire was administered to the person most knowledgeable about the selected child or youth, and another questionnaire was administered directly to youth aged 12 to 17 and included questions about food and drink behaviours. Data were collected electronically and predominantly self-completed by respondents (70%), while the remaining questionnaires were completed over the phone with interviewer assistance or by using a mix of methods. The overall response rate to the 2019 CHSCY was 52.1%, yielding a final sample size of 47,481 respondents.

Respondents to the 2019 CHSCY were assigned restaurant density measures from the Canadian Food Environment Dataset, described below, based on their residential dissemination area (DA). A DA is a small, relatively stable standard geographical unit with an average population of 400 to 700.<sup>30</sup> Because the local retail food environment (i.e., within walking distance of where people live) is a concept that is primarily meaningful for urban areas, and because DAs in non-urban areas tend to be very large, this analysis was limited to residents of large urban population centres (population of 100,000 or greater). The final analytic sample for this study was 23,776 respondents living in 1 of 28 census metropolitan areas (CMAs) located across the Canadian provinces.

#### *Canadian Food Environment Dataset, 2018*

Data on the local restaurant environment came from the Canadian Food Environment Dataset (Can-FED), which has been previously described.<sup>28</sup> Briefly, the Can-FED is pan-Canadian dataset of neighbourhood retail food environment measures based on data sourced from Statistics Canada's 2018 Business Register. The latter is a central repository of data on businesses operating in Canada. Food retail outlets in the Can-FED were initially selected based on the North American Industry Classification System codes assigned by the Business Register, and further augmented with a name-based assignment method to better classify outlets (e.g., to classify fast-food outlets more accurately, names of chain restaurants were

searched for key terms like “burger,” “pizza,” and “fried”).<sup>28</sup> Restaurant measures were calculated using street network buffers around population-weighted centroids of all 2016 DAs in Canada.

### Measures and definitions

#### *Food-related behaviours*

**Frequency of eating out** was assessed with a single question: “During the past 7 days, how many times did you [or this child] eat food from ‘fast food’ or sit-down restaurants?” All multivariable analyses used the continuous form of this variable, while categories (zero times, once, twice, and three or more times) were created for descriptive purposes only.

**Frequency of sugary drink intake** was assessed only for participants aged 3 or older. Questions asked about the number of times that participants consumed, during the past seven days, each of the following sugary drinks: 100% pure fruit juice, fruit-flavoured drinks, and regular soft drinks. Participants aged 12 to 17 were also asked to report their frequency of intake of sweetened coffee or tea, or iced coffee or tea in the past seven days. For this analysis, beverage intake was grouped as fruit juices and fruit drinks, soft drinks, sweetened or iced coffee and tea drinks, and total sugary drink intake.

#### *Restaurant density measures*

Local exposure to various restaurant types was derived for small residential parcels of land (i.e., DAs), using 1 000 m buffers. More specifically, for each participant, restaurant exposures within 1 000 m street network distance of the population-weighted DA centroid represented a local environment accessible within a 10 to 15 minute walk from the centre to the edge of each buffer area.<sup>28</sup> Although a wide range of buffer distances has been used in previous research, most studies use buffer areas of 500 m to 1 000 m to represent food retail accessible in the local neighbourhood or on foot.<sup>15,16</sup>

This study examined both absolute and relative dimensions of restaurant access based on a full range of available restaurant types. An examination of multiple restaurant types allowed for better alignment with food-related behaviours (e.g., density of cafés and frequency of sweetened coffee and tea drink intake), and for the assessment of any differential effects of exposure to fast-food restaurants versus other restaurant types.<sup>9-13</sup> **Absolute densities** of the following restaurant types were measured as the number of restaurants within each buffer divided by the total buffer area (km<sup>2</sup>):

- full-service restaurants (i.e., sit-down restaurants, typically with table service and where patrons pay after eating)
- chain fast-food restaurants (i.e., limited-service restaurants that sell pre-prepared or quickly prepared foods typically ordered at a counter; this category

captures chain brand names and business names alluding to fast food, e.g., “burger,” “pizza,” “fries”)

- other fast-food restaurants (i.e., other limited-service restaurants not captured in the chain fast-food category)
- cafés (i.e., limited-service restaurants that serve coffee or tea and typically do not offer a full menu)
- total limited-service restaurants (sum of chain fast food, other fast food and cafés)

- total restaurants (sum of all restaurant types).

The **relative density** of chain fast-food restaurants within each buffer was defined as follows: chain fast-food restaurant density / total restaurant density x 100%. Because this measure results in missing values for participants not living near any type of restaurant (i.e., 0 in the denominator, n=2,512), the analytic sample for this relative density measure was 21,264.

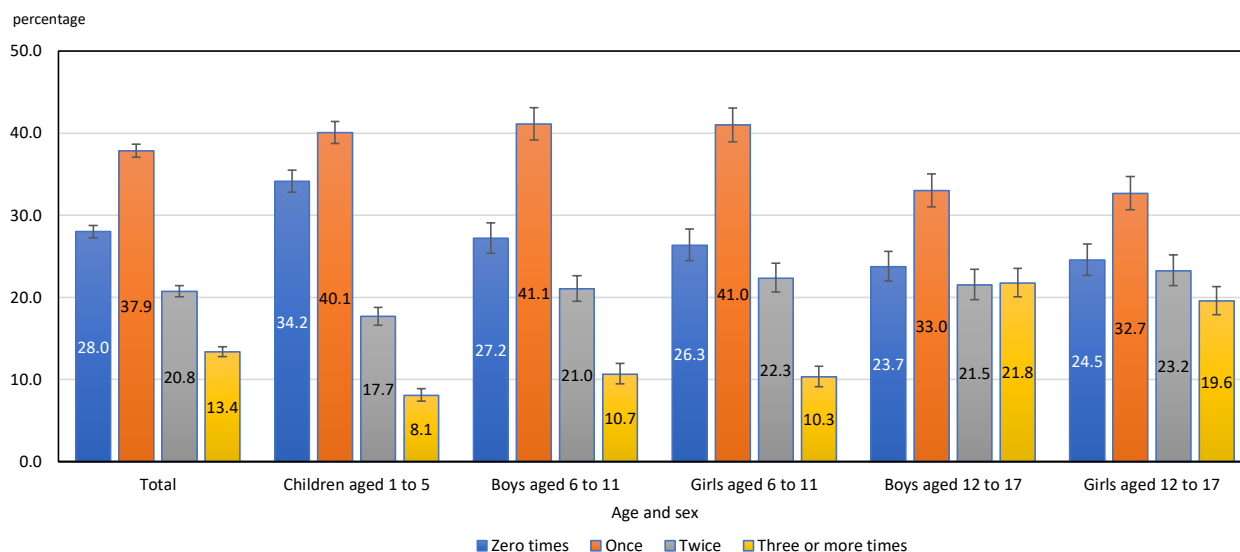
**Table 1**  
**Characteristics of study participants, household population aged 1 to 17 years living in large urban population centres, Canada, 2019 (N=23,776)**

	n	Estimate	95% confidence interval	
			from	to
<b>Age–sex group (%)</b>				
Children aged 1 to 5	8,668	29.3	28.8	29.8
Children aged 6 to 11	8,574	35.3	34.8	35.9
Boys aged 12 to 17	3,241	18.0	17.6	18.3
Girls aged 12 to 17	3,293	17.4	17.0	17.8
<b>Sex (%)</b>				
Boys	12,071	50.9	50.4	51.4
Girls	11,705	49.1	48.6	49.6
<b>Household size (%)</b>				
Three or fewer people	5,598	24.1	23.4	24.8
Four people	10,412	41.5	40.7	42.4
Five people	4,975	21.8	21.1	22.5
Six or more people	2,791	12.6	12.0	13.2
<b>Household education (%)</b>				
High school or less	2,795	12.8	12.2	13.4
Trades/college/some university	7,011	32.1	31.3	32.9
Bachelor's degree	7,186	29.0	28.3	29.8
Above bachelor's degree	6,784	26.2	25.5	26.9
<b>Household income (%)</b>				
\$39,999 or less	4,241	18.4	17.7	19.1
\$40,000 to \$69,999	4,135	18.6	17.9	19.4
\$70,000 to \$99,999	4,059	17.7	17.0	18.4
\$100,000 to \$149,999	4,946	21.0	20.3	21.7
\$150,000 or more	6,395	24.3	23.6	25.0
<b>Immigrant status (%)</b>				
Non-immigrant	11,858	51.0	50.2	51.8
Immigrant	11,918	49.0	48.2	49.8
<b>Region (%)</b>				
Atlantic provinces CMAs	1,259	2.7	2.6	2.9
Quebec—CMAs other than Montréal	460	4.2	3.8	4.7
Quebec—Montréal CMA	1,723	16.4	15.8	17.0
Ontario—Ottawa, Kingston and Oshawa CMAs	1,712	7.7	7.4	8.0
Ontario—Toronto CMA	10,085	26.4	26.1	26.7
Ontario—all other CMAs	2,908	11.6	11.4	11.8
Manitoba and Saskatchewan CMAs	1,444	6.1	5.8	6.3
Alberta CMAs	1,972	12.4	12.0	12.8
British Columbia CMAs	2,213	12.5	12.2	12.9
<b>Frequency of eating out in past seven days (mean)</b>	23,766	2.2	2.2	2.2
<b>Frequency of sugary drink intake in past seven days (mean)</b>				
Fruit juices and fruit drinks	20,038	3.9	3.8	3.9
Soft drinks	19,969	0.8	0.8	0.8
Sweetened coffee and tea drinks	6,487	1.5	1.4	1.6
Total drinks	20,045	5.2	5.1	5.3

**Notes:** Frequency of eating out was assessed as the number of times respondents ate food from a fast-food or sit-down restaurant in the past seven days. Questions about sugary drink intake were only asked to children and youth aged 3 or older. The question about the frequency of sweetened coffee and tea drink intake was only asked to youth aged 12 or older. CMA: Census metropolitan area.

**Source:** Statistics Canada, Canadian Health Survey on Children and Youth, 2019.

**Figure 1**  
Frequency of eating out in the past seven days, overall and by age–sex group, household population aged 1 to 17 years living in large urban population centres, Canada, 2019



**Notes:** Frequency of eating out was assessed as the number of times respondents ate food from a fast-food or sit-down restaurant in the past seven days.

**Source:** Statistics Canada, Canadian Health Survey on Children and Youth, 2019.

### Covariates

The choice of covariates for multivariable analyses was informed by the literature and data available on the 2019 CHSCY.<sup>29</sup> Variables included both individual and household-level sociodemographic characteristics.

**Age** was categorized as young children aged 1 to 5, children aged 6 to 11, and youth aged 12 to 17 for descriptive purposes and stratified analyses. Age was entered in continuous format in multivariable analyses.

**Sex** at birth was classified as male or female.

**Household size** was used in continuous format in multivariable models and grouped for descriptive purposes as three or fewer people, four people, five people, and six or more people.

The highest level of **education** achieved within the household was categorized as high school diploma or less; trades certificate or diploma, college or CEGEP, or some university below the bachelor’s level; bachelor’s degree; or university certificate, diploma or degree above the bachelor’s level.

**Total household income** from all sources in 2018, before taxes and deductions, was grouped as less than \$40,000; \$40,000 to less than \$70,000; \$70,000 to less than \$100,000; \$100,000 to less than \$150,000; and \$150,000 or more. In the 2019 CHSCY, household income was imputed using donor imputation when missing values were present for 12% of respondents.<sup>29</sup>

A child or youth was classified as living in an **immigrant** household if the child or youth, the person most knowledgeable

about the child or youth, or their spouse had ever been landed immigrants or permanent residents, or non-permanent residents in Canada.

**Region of residence** was based on CMAs and rolled up to the provincial level where data were sparse: Atlantic provinces (i.e., Newfoundland and Labrador, Nova Scotia, New Brunswick); Quebec CMAs other than Montréal; Montréal; Ottawa, Kingston and Oshawa; Toronto; all other Ontario CMAs; Manitoba and Saskatchewan; Alberta; and British Columbia.

### Analytic techniques

All statistical analyses were performed using SAS 9.4 (SAS Institute, Cary, North Carolina) or SAS-callable SUDAAN 11.0.3. and applied standard sampling weights provided by Statistics Canada to maintain population representativeness. Bootstrap weights were applied to produce robust standard errors. Weighted frequencies or means were generated to estimate the frequency of eating out and intake of various sugary drinks within the past seven days for the overall sample and by age–sex group. Because the frequency of eating out and drink intake is count data, this analysis used generalized linear models with Poisson distribution and log link function to regress restaurant density measures on the outcome variables. Parameter estimates from these Poisson regression models are exponentiated beta coefficients and represent rate ratios (RRs) for the effect of restaurant density measures on the frequency of eating out or drink intake. Each restaurant density measure was modelled separately because of high correlation between these exposure measures (data not shown). To allow for greater

**Table 2**  
**Descriptive characteristics of restaurant density measures within 1 000 m of residential areas of study participants, household population aged 1 to 17 years living in large urban population centres, Canada, 2019**

	Median	Minimum	Maximum	Interquartile range
<b>Absolute restaurant densities (number/km<sup>2</sup>)</b>				
Full-service	2.7	0.0	142.8	5.2
Chain fast food	1.1	0.0	50.3	2.7
Other fast food	1.4	0.0	61.5	3.2
Café	0.0	0.0	39.4	0.8
Total limited-service	3.0	0.0	138.9	5.2
Total restaurants	5.9	0.0	263.2	9.8
<b>Relative restaurant density (%)</b>				
Chain fast food	16.7	0.0	100.0	33.3

**Notes:** Absolute restaurant densities were defined as the number of restaurants per km<sup>2</sup> within a 1 000 m buffer of participants' residential areas (n=23,776). Relative restaurant density was defined as the percentage of chain fast-food restaurants relative to total restaurants within a 1 000 m buffer of participants' residential areas. The relative density measure was calculated only for participants who lived near at least one restaurant of any type (i.e., non-zero denominator) (n=21,264).

**Sources:** Statistics Canada, Canadian Health Survey on Children and Youth, 2019, and Canadian Food Environment Dataset, 2018.

comparability of effect sizes across variables with different distributions, all restaurant density measures were rescaled by their respective interquartile range (IQR), the difference between the 25th and 75th percentiles of each variable's distribution. Models were generated for the overall sample and the following age groups to account for any differences in the levels of autonomy of children and youth:<sup>15,27</sup> young children aged 1 to 5, older children aged 6 to 11, and youth aged 12 to 17. Sex-specific models were generated for the two older age groups because of evidence of differential effects of food environment exposures by sex among older children and youth.<sup>31-33</sup> Because the question on drink intake was only asked to children and youth aged 3 or older, models predicting the frequency of sugary drink intake grouped younger children as those aged 3 to 11.

## Results

Sample characteristics of study participants (N=23,776) who resided in large urban population centres and had non-missing data on key variables of interest are presented in Table 1. In the overall sample, the mean frequency of eating out in the past seven days was 2.2 times, and the mean frequency of total sugary drink intake was 5.2 times. The frequency of eating out increased with age: more than 40% of youth aged 12 to 17 ate out two or more times in the past seven days, versus approximately one-third of children aged 6 to 11 and one-quarter of young children aged 1 to 5 (Figure 1).

Within a 10 to 15 minute walk of participants' residential areas, the absolute density (i.e., number of restaurants per total buffer zone area in km<sup>2</sup>) of full-service restaurants (median=2.7; IQR=5.2) was similar to that of total limited-service restaurants (median=3.0; IQR=5.2) (Table 2). The median relative density of chain fast-food restaurants from total restaurants was 16.7% (IQR=33.3%).

The association of absolute and relative restaurant densities near participants' homes with the frequency of eating out in the past

seven days is presented in Table 3. For both the overall sample and analyses stratified by age–sex group, estimates from both the unadjusted and fully adjusted models controlling for sociodemographic covariates approximated the null value (i.e., RR of 1.0). When a statistically significant association was observed, the effect size was very small (i.e., for the total sample, every additional café within walking distance was associated with a 1% increase in the frequency of eating out; RR=1.01, 95% confidence interval [CI]: 1.00 to 1.12).

Table 4 presents associations of restaurant densities with the frequency of sugary drink intake. Among boys aged 3 to 11 and 12 to 17, exposure to higher absolute densities of various restaurant types, total limited-service restaurants, and total restaurants near participants' residential areas was generally unrelated to the frequency of intake of total drinks, fruit juices or fruit drinks, and soft drinks, with both unadjusted models and models adjusted for sociodemographic covariates yielding RRs near the null value. For youth aged 12 to 17, intake of sweetened coffee and tea drinks was unrelated to higher absolute densities of nearby cafés. For girls, models adjusted for sociodemographic variables revealed a slightly lower rate of fruit juice or fruit drink intake (i.e., in terms of the number of times consumed in the past seven days) associated with a greater density of various limited-service restaurants and total restaurants (e.g., for girls aged 12 to 17, RR=0.96 for every five additional total restaurants per km<sup>2</sup>; 95% CI: 0.92 to 1.00).

The relative density of chain fast-food restaurants as a percentage of all restaurants within walking distance was unrelated to the frequency of sugary drink intake among all age–sex groups, after accounting for sociodemographic covariates (Table 4). The exception was boys aged 12 to 17, among whom there was a 10% greater rate of soft drink intake across one IQR increase (33.3%) in the percentage of all restaurants that were chain fast food (RR=1.10; 95% CI: 1.01-1.19).



**Table 3**  
**Associations between restaurant densities and the frequency of eating out in the past seven days,<sup>1</sup>**  
**household population aged 1 to 17 years living in large urban population centres, Canada, 2019**

	Unadjusted			Adjusted <sup>2</sup>		
	Rate ratio	95% confidence		Rate ratio	95% confidence	
		from	to		from	to
<b>Total sample (N=23,776)</b>						
<b>Absolute restaurant densities</b>						
Full-service	1.01	1.00	1.01	1.01	1.00	1.01
Chain fast food	1.01	0.99	1.03	1.01	0.99	1.03
Other fast food	1.01 <sup>‡</sup>	1.00	1.02	1.01	1.00	1.02
Cafés	1.01 <sup>††</sup>	1.01	1.02	1.01 <sup>‡</sup>	1.00	1.02
Total limited-service	1.01 <sup>‡</sup>	1.00	1.02	1.01	1.00	1.02
Total restaurants	1.01	1.00	1.02	1.01	1.00	1.02
<b>Relative restaurant density</b>						
% chain fast food	0.97	0.95	1.00	0.99	0.96	1.02
<b>Children aged 1 to 5 (n=8,668)</b>						
<b>Absolute restaurant densities</b>						
Full-service	1.01	1.00	1.02	1.01	1.00	1.02
Chain fast food	1.02	1.00	1.05	1.03	1.00	1.06
Other fast food	1.01	0.99	1.03	1.01	1.00	1.03
Cafés	1.01 <sup>‡</sup>	1.00	1.03	1.01	1.00	1.02
Total limited-service	1.01	1.00	1.03	1.01	1.00	1.03
Total restaurants	1.01	1.00	1.02	1.01	1.00	1.02
<b>Relative restaurant density</b>						
% chain fast food	1.00	0.96	1.05	1.01	1.00	1.02
<b>Boys aged 6 to 11 (n=4,391)</b>						
<b>Absolute restaurant densities</b>						
Full-service	1.01	1.00	1.03	1.01	0.99	1.02
Chain fast food	1.01	0.97	1.05	1.00	0.96	1.04
Other fast food	1.02	1.00	1.05	1.01	0.98	1.04
Cafés	1.02 <sup>††</sup>	1.01	1.04	1.01	0.99	1.03
Total limited-service	1.02	1.00	1.04	1.01	0.98	1.03
Total restaurants	1.02	1.00	1.04	1.01	0.99	1.03
<b>Relative restaurant density</b>						
% chain fast food	0.95	0.89	1.02	0.97	0.90	1.05
<b>Girls aged 6 to 11 (n=4,183)</b>						
<b>Absolute restaurant densities</b>						
Full-service	0.99	0.97	1.01	0.99	0.98	1.01
Chain fast food	0.97	0.92	1.02	0.97	0.93	1.02
Other fast food	0.98	0.94	1.01	0.99	0.96	1.01
Cafés	1.01	0.99	1.03	1.00	0.99	1.02
Total limited-service	0.98	0.95	1.02	0.99	0.97	1.01
Total restaurants	0.99	0.96	1.02	0.99	0.97	1.01
<b>Relative restaurant density</b>						
% chain fast food	0.95	0.85	1.05	0.95	0.86	1.04
<b>Boys aged 12 to 17 (n=3,241)</b>						
<b>Absolute restaurant densities</b>						
Full-service	1.01	0.99	1.03	1.00	0.98	1.02
Chain fast food	1.04	0.99	1.08	1.02	0.98	1.06
Other fast food	1.03 <sup>‡</sup>	1.00	1.06	1.01	0.98	1.04
Cafés	1.03 <sup>‡</sup>	1.00	1.05	1.01	0.99	1.04
Total limited-service	1.03 <sup>‡</sup>	1.00	1.06	1.01	0.99	1.04
Total restaurants	1.02	1.00	1.04	1.01	0.98	1.03
<b>Relative restaurant density</b>						
% chain fast food	0.99	0.93	1.05	1.00	0.94	1.06
<b>Girls aged 12 to 17 (n=3,293)</b>						
<b>Absolute restaurant densities</b>						
Full-service	1.01	0.99	1.04	1.01	0.98	1.04
Chain fast food	0.99	0.95	1.04	0.99	0.95	1.03
Other fast food	1.03	0.99	1.07	1.02	0.98	1.06
Cafés	1.02	0.99	1.06	1.02	0.98	1.05
Total limited-service	1.02	0.98	1.05	1.01	0.97	1.05
Total restaurants	1.02	0.98	1.05	1.01	0.98	1.05
<b>Relative restaurant density</b>						
% chain fast food	0.98	0.92	1.04	0.99	0.94	1.05

<sup>‡</sup> rate ratio significantly different from 1.00 (p < 0.05)

<sup>††</sup> rate ratio significantly different from 1.00 (p < 0.01)

<sup>1</sup> Frequency of eating out was assessed as the number of times respondents ate food from a fast-food or full-service restaurant in the previous seven days. Results presented in the table are from separate Poisson regression models. Rate ratios are estimated for one interquartile range increase in restaurant densities: 5 per km<sup>2</sup> for full-service restaurants, 3 per km<sup>2</sup> for chain fast food, 3 per km<sup>2</sup> for other fast food, 1 per km<sup>2</sup> for cafés, 5 per km<sup>2</sup> for total limited-service restaurants, 10 per km<sup>2</sup> for total restaurants, and 33.3% for density of chain fast-food outlets relative to total restaurants. Total limited-service refers to total chain fast food, other fast food and cafés.

<sup>2</sup> Adjusted models control for age, sex (except for sex-specific models), household size, education, income, immigrant status and region.

Sources: Statistics Canada, Canadian Health Survey on Children and Youth, 2019, and Canadian Food Environment Dataset, 2018.

## Discussion

The present study leveraged a recently developed and validated pan-Canadian dataset of food retail measures to examine links between the local restaurant environment in large urban centres and the food-related behaviours of children and youth. This study fills a gap in the literature by using a high-quality food outlet database and a large population-based sample of Canadian children and youth, and by examining associations stratified by age group to account for differing levels of autonomy and mobility.<sup>15,27</sup> Overall, results reveal a lack of

consistent associations between both absolute and relative measures of geographic accessibility to various types of restaurants near home with the frequency of consuming food from fast-food or full-service restaurants and intake of sugary drinks. The handful of significant associations were small in magnitude and should be interpreted in the context of multiple comparisons and the possibility of chance findings.

The findings of this study add to a growing but equivocal body of research on the putative links between **absolute** measures of the local retail food environment (e.g., the presence, number or

**Table 4-1**  
Associations between restaurant densities and the frequency of sugary drink intake in the past seven days,<sup>1</sup> household population aged 1 to 17 years living in large urban population centres, Canada, 2019

	Total drinks						Fruit juices and fruit drinks					
	Unadjusted			Adjusted <sup>2</sup>			Unadjusted			Adjusted <sup>2</sup>		
	Rate	95% confidence interval		Rate	95% confidence interval		Rate	95% confidence interval		Rate	95% confidence interval	
		ratio	from		to	ratio		from	to		ratio	from
<b>Boys aged 3 to 11 (n=6,951)</b>												
<b>Absolute restaurant densities</b>												
Full-service	0.99	0.98	1.01	1.00	0.98	1.01	1.00	0.98	1.01	1.00	0.98	1.02
Chain fast food	1.02	0.99	1.06	1.01	0.97	1.04	1.02	0.99	1.05	1.00	0.97	1.04
Other fast food	0.99	0.96	1.01	0.99	0.97	1.02	0.99	0.96	1.01	0.99	0.97	1.02
Cafés	0.98 †	0.96	1.00	1.00	0.98	1.01	0.98 †	0.96	1.00	1.00	0.98	1.02
Total limited-service	1.00	0.98	1.01	1.00	0.98	1.02	1.00	0.98	1.02	1.00	0.97	1.02
Total restaurants	0.99	0.98	1.01	1.00	0.98	1.02	0.99	0.98	1.01	1.00	0.98	1.02
<b>Relative restaurant density</b>												
% chain fast food	1.08 ††	1.02	1.13	1.02	0.97	1.08	1.07 †	1.02	1.14	1.02	0.97	1.08
<b>Girls aged 3 to 11 (n=6,659)</b>												
<b>Absolute restaurant densities</b>												
Full-service	0.98	0.96	1.00	0.98	0.96	1.00	0.98	0.96	1.00	0.98	0.96	1.00
Chain fast food	1.00	0.97	1.03	0.99	0.96	1.03	1.00	0.96	1.03	0.99	0.95	1.03
Other fast food	0.97 †	0.94	1.00	0.97 †	0.94	1.00	0.97 †	0.94	1.00	0.96 †	0.93	0.99
Cafés	0.96 ††	0.94	0.99	0.98 †	0.95	1.00	0.96 ††	0.94	0.99	0.97 †	0.95	1.00
Total limited-service	0.98	0.96	1.00	0.98	0.96	1.00	0.98	0.95	1.00	0.97	0.95	1.00
Total restaurants	0.98 †	0.96	1.00	0.98	0.96	1.00	0.98	0.95	1.00	0.98 †	0.95	1.00
<b>Relative restaurant density</b>												
% chain fast food	1.09 ††	1.02	1.16	1.05	0.99	1.11	1.09 †	1.02	1.17	1.05	0.99	1.12
<b>Boys aged 12 to 17 (n=3,226)</b>												
<b>Absolute restaurant densities</b>												
Full-service	0.99	0.98	1.01	0.99	0.97	1.01	0.98	0.95	1.01	0.98	0.95	1.00
Chain fast food	1.02	0.99	1.05	1.00	0.98	1.03	0.97	0.92	1.02	0.97	0.93	1.02
Other fast food	0.99	0.97	1.02	0.99	0.97	1.01	0.98	0.94	1.02	0.98	0.95	1.02
Cafés	0.99	0.97	1.02	0.99	0.97	1.01	0.98	0.94	1.02	0.99	0.95	1.02
Total limited-service	1.00	0.98	1.02	0.99	0.97	1.01	0.98	0.94	1.02	0.98	0.95	1.02
Total restaurants	1.05	0.98	1.13	0.99	0.97	1.01	0.98	0.94	1.01	0.98	0.94	1.01
<b>Relative restaurant density</b>												
% chain fast food	1.03	0.97	1.09	1.01	0.96	1.07	0.97	0.90	1.05	0.96	0.89	1.03
<b>Girls aged 12 to 17 (n=3,282)</b>												
<b>Absolute restaurant densities</b>												
Full-service	0.98	0.96	1.01	0.98	0.96	1.01	0.97	0.93	1.01	0.97	0.93	1.00
Chain fast food	0.98	0.94	1.02	0.98	0.94	1.02	0.95	0.90	1.00	0.94 †	0.89	0.99
Other fast food	0.97	0.92	1.02	0.97	0.92	1.01	0.96	0.88	1.04	0.95	0.88	1.03
Cafés	0.98	0.96	1.01	0.99	0.96	1.02	0.97	0.92	1.01	0.99	0.95	1.03
Total limited-service	0.98	0.95	1.01	0.98	0.95	1.01	0.96	0.91	1.01	0.95	0.91	1.00
Total restaurants	0.98	0.95	1.01	0.98	0.95	1.01	0.96	0.92	1.01	0.96 †	0.92	1.00
<b>Relative restaurant density</b>												
% chain fast food	0.99	0.93	1.05	0.98	0.92	1.04	0.98	0.90	1.08	0.97	0.89	1.06

... not applicable

† rate ratio significantly different from 1.00 (p < 0.05)

†† rate ratio significantly different from 1.00 (p < 0.01)

<sup>1</sup> Results presented in the table are from separate Poisson regression models. Rate ratios are estimated for one interquartile range increase in restaurant densities: 5 per km2 for full-service restaurants, 3 per km2 for chain fast food, 3 per km2 for other fast food, 1 per km2 for cafés, 5 per km2 for total limited-service restaurants, 10 per km2 for total restaurants, and 33.3% for density of chain fast-food outlets relative to total restaurants. Total limited-service refers to total chain fast food, other fast food and cafés.

<sup>2</sup> Adjusted models control for age, household size, education, income, immigrant status and region.

Sources: Statistics Canada, Canadian Health Survey on Children and Youth, 2019, and Canadian Food Environment Dataset, 2018.

**Table 4-2**  
Associations between restaurant densities and the frequency of sugary drink intake in the past seven days,<sup>1</sup> household population aged 1 to 17 years living in large urban population centres, Canada, 2019

	Soft drinks						Sweetened coffee and tea drinks					
	Unadjusted			Adjusted <sup>2</sup>			Unadjusted			Adjusted <sup>2</sup>		
	Rate ratio	95% confidence interval from to		Rate ratio	95% confidence interval from to		Rate ratio	95% confidence interval from to		Rate ratio	95% confidence interval from to	
<b>Boys aged 3 to 11 (n=6,951)</b>												
<b>Absolute restaurant densities</b>												
Full-service	0.99	0.96	1.02	1.00	0.96	1.03	...	...	...	...	...	...
Chain fast food	1.05	0.98	1.11	1.04	0.97	1.11	...	...	...	...	...	...
Other fast food	0.98	0.94	1.02	0.99	0.94	1.04	...	...	...	...	...	...
Cafés	0.96 †	0.92	1.00	0.97	0.93	1.01	...	...	...	...	...	...
Total limited-service	1.00	0.96	1.03	1.00	0.96	1.04	...	...	...	...	...	...
Total restaurants	0.99	0.96	1.02	1.00	0.96	1.03	...	...	...	...	...	...
<b>Relative restaurant density</b>												
% chain fast food	1.08	0.98	1.20	1.06	0.95	1.17	...	...	...	...	...	...
<b>Girls aged 3 to 11 (n=6,659)</b>												
<b>Absolute restaurant densities</b>												
Full-service	0.99	0.94	1.03	1.00	0.96	1.05	...	...	...	...	...	...
Chain fast food	1.04	0.98	1.10	1.02	0.95	1.09	...	...	...	...	...	...
Other fast food	1.01	0.96	1.06	1.02	0.97	1.08	...	...	...	...	...	...
Cafés	0.97	0.92	1.02	0.99	0.94	1.03	...	...	...	...	...	...
Total limited-service	1.01	0.97	1.05	1.01	0.97	1.05	...	...	...	...	...	...
Total restaurants	0.99	0.95	1.04	1.01	0.96	1.05	...	...	...	...	...	...
<b>Relative restaurant density</b>												
% chain fast food	1.08	0.95	1.23	0.98	0.85	1.12	...	...	...	...	...	...
<b>Boys aged 12 to 17 (n=3,226)</b>												
<b>Absolute restaurant densities</b>												
Full-service	1.02	0.99	1.05	1.01	0.98	1.04	1.01	0.97	1.05	1.00	0.97	1.04
Chain fast food	1.08 **	1.03	1.12	1.04	1.00	1.09	1.06	0.99	1.14	1.03	0.96	1.10
Other fast food	1.03	0.99	1.07	1.01	0.98	1.05	0.99	0.94	1.04	0.97	0.92	1.03
Cafés	1.02	0.98	1.06	1.01	0.98	1.04	1.00	0.95	1.05	0.99	0.94	1.04
Total limited-service	1.04 †	1.01	1.07	1.02	0.99	1.05	1.01	0.97	1.06	0.99	0.95	1.04
Total restaurants	1.03	1.00	1.06	1.02	0.99	1.05	1.01	0.97	1.05	1.00	0.96	1.04
<b>Relative restaurant density</b>												
% chain fast food	1.11 †	1.02	1.21	1.10 †	1.01	1.19	1.10	0.99	1.22	1.09	0.98	1.22
<b>Girls aged 12 to 17 (n=3,282)</b>												
<b>Absolute restaurant densities</b>												
Full-service	1.00	0.96	1.04	1.00	0.96	1.05	1.00	0.97	1.04	1.01	0.97	1.04
Chain fast food	1.02	0.95	1.10	1.00	0.93	1.08	1.03	0.96	1.10	1.03	0.96	1.10
Other fast food	0.98	0.93	1.05	0.99	0.93	1.06	0.99	0.93	1.04	0.99	0.93	1.04
Cafés	1.00	0.95	1.05	1.00	0.95	1.06	1.00	0.96	1.05	0.99	0.95	1.04
Total limited-service	1.00	0.95	1.05	1.00	0.94	1.05	1.00	0.96	1.05	1.00	0.95	1.05
Total restaurants	1.00	0.95	1.05	1.00	0.95	1.05	1.00	0.96	1.05	1.01	0.96	1.05
<b>Relative restaurant density</b>												
% chain fast food	1.04	0.94	1.14	1.01	0.92	1.11	0.98	0.91	1.07	0.99	0.91	1.06

... not applicable

† rate ratio significantly different from 1.00 (p < 0.05)

\*\* rate ratio significantly different from 1.00 (p < 0.01)

<sup>1</sup> Results presented in the table are from separate Poisson regression models. Rate ratios are estimated for one interquartile range increase in restaurant densities: 5 per km2 for full-service restaurants, 3 per km2 for chain fast food, 3 per km2 for other fast food, 1 per km2 for cafés, 5 per km2 for total limited-service restaurants, 10 per km2 for total restaurants, and 33.3% for density of chain fast-food outlets relative to total restaurants. Total limited-service refers to total chain fast food, other fast food and cafés.

<sup>2</sup> Adjusted models control for age, household size, education, income, immigrant status and region.

Sources: Statistics Canada, Canadian Health Survey on Children and Youth, 2019, and Canadian Food Environment Dataset, 2018.

density of various outlet types in neighbourhoods) and food-related behaviours and health outcomes among both young people and adults.<sup>15-18</sup> For example, a study from London, Ontario, found that youth aged 11 to 13 were more likely to purchase fast food when a greater number of fast-food outlets was present within 1 km of home.<sup>19</sup> By contrast, a study of adolescents in Minnesota, United States, found that higher densities of fast-food outlets and total restaurants near home were not associated with more frequent fast-food purchasing, but were related to higher intake of sugar-sweetened

beverages.<sup>22</sup> Results of the present study, in line with several others,<sup>17,23-25</sup> find no consistent associations between greater absolute densities of various restaurant types near home and the frequency of eating out or sugary drink intake. In the current study, most associations tested were rendered null after accounting for sociodemographic characteristics.

Any links between the retail food environment and food-related behaviours are undoubtedly multifaceted and complex.<sup>2,34</sup> It is plausible that exposure to various types of food retail in residential areas may both consciously and subconsciously

shape food-related preferences and behaviours by way of the opportunities such venues provide to purchase foods and by cueing an automatic desire for eating.<sup>34</sup> For example, living near a high volume of fast-food outlets may not only make it convenient for adolescents to gather in such venues and purchase fast food, but it may also stimulate desire for eating, regardless of appetite. However, the food environment near home is just one dimension of the overall food environment, which also includes food outlet availability around schools, workplaces (for adults), and daily travel routes and other commonly accessed venues. The limited focus on the neighbourhood food environment in most existing studies has been offered as one potential explanation for the weak and inconsistent associations documented in previous research.<sup>16,35</sup> Yet evidence for food retail availability surrounding schools is similarly mixed, identifying weak and inconsistent associations with food purchases and consumption among children and youth.<sup>27</sup> This suggests a limited role of **absolute** access to food retail near home and school in shaping the food-related behaviours of young people. Studies that capture the varied activity spaces and mobility patterns of young people in a more dynamic way, using tools like global positioning systems or interactive mapping,<sup>36,37</sup> may better represent everyday experiences and exposures than static place-based exposures alone.

This study is among a handful to examine links between **relative** measures of restaurant access and the food-related behaviours of young people.<sup>15,20,23,38</sup> While relative measures do not capture the absolute volume of food retail, it has been argued that these measures may be more strongly related to diet-related behaviours and health outcomes than absolute measures because they better capture the relative **balance** of available food retail venues offering more and less healthy options.<sup>13,16,26,34</sup> Relative densities of unhealthy and healthy food retail may also function as normative benchmarks that “invisibly” guide individuals’ use of unhealthy outlets in favour of healthier outlets (or vice versa).<sup>34</sup>

In the present study, a higher **relative** density of fast-food outlets from total restaurants was not associated with higher frequency of eating out in any age group but was associated with a modestly elevated intake of soft drinks among boys aged 12 to 17. We are not aware of previous studies with which to directly compare our findings. However, three recent studies of Canadian and English children and youth examined the impact of relative exposure measures (which included both food stores and restaurants) in residential or school neighbourhoods.<sup>20,23,38</sup> For residential-based measures, no associations were found with the frequency of intake of sugar-sweetened beverages or fast food or takeaway.<sup>20,23</sup> By contrast, a higher relative share of unhealthy outlets near school was generally associated with markers of poorer diet quality.<sup>20,23,38</sup> Together with the present report, these findings suggest that it may be worthwhile to further explore **relative** dimensions of the food environment in everyday settings (e.g., near home or school) in relation to food-related preferences and behaviours of young people.

Additionally, it is possible that the normative influence of relative densities of healthy and unhealthy food outlets may be more salient for older children and adolescents, who have more autonomy and may be more sensitive to peer social norms<sup>39</sup> than younger children.

There is no question that since early 2020, the COVID-19 pandemic and ensuing public health measures have had a profound impact on the Canadian food service industry, causing many restaurants to close temporarily or permanently.<sup>40</sup> The notable growth of e-commerce since 2020,<sup>40</sup> such as food-delivery platforms, is an important shift in the retail food landscape that likely reduces the salience of the physical access dimension in shaping food-related behaviours (i.e., physical distance becomes less of a barrier to accessing food).<sup>41</sup> While the present study predates this period, future studies should explore, using both qualitative and quantitative methods, the changing nature of how young people navigate and interact with the evolving food environment throughout their daily activity spaces. In addition to food outlet location data, more novel data sources could be leveraged, such as retail transaction data and food delivery data from restaurants or third parties.<sup>41</sup>

### Strengths and limitations

Strengths of this study include a large, population-based sample of Canadian children and youth covering a large geographic area. The use of a high-quality, validated dataset on geographic access to restaurants is an important improvement on previous studies that commonly relied on inaccurate secondary datasets.<sup>42,43</sup> Reliance on poor-quality food outlet location data introduces exposure misclassification, which can bias associations toward the null; this has been cited as one possible contributing factor to the weak and inconsistent findings of previous studies.<sup>16,26</sup> This study also improves on previous research by examining exposure to a range of restaurant types, rather than only one or two outlet types,<sup>16</sup> as well as absolute and relative dimensions of restaurant access.

Several limitations warrant mention. The cross-sectional nature of this analysis precludes the determination of any temporal or causal associations between the restaurant environment and food-related behaviours. As with all observational research, and despite this study’s robust control for sociodemographic covariates, it is possible that residual confounding by mismeasured or unmeasured characteristics may have distorted or masked any true associations. Furthermore, respondents’ frequency of consuming food from restaurants was assessed using a single question that grouped together fast-food and full-service restaurants. This did not allow the examination of dietary intake from each restaurant type separately and may have led to attenuation of effect sizes. Future studies should employ more refined outcome assessment measures that are most relevant to particular exposures (e.g., intake of fast food near home assessed relative to local density of fast-food outlets), as well as more comprehensive dietary assessment tools validated for children and youth. A systematic review of food environment research concluded that studies that used

higher-quality dietary assessment instruments (e.g., 24-hour dietary recalls) yielded associations more consistently in the expected direction than studies that used more error-prone measures like brief screeners.<sup>44</sup> Finally, this study assessed only the geographic dimension of access to local restaurants. “Access” is a multidimensional construct that is also shaped by financial affordability and the social and cultural acceptability of available food outlets and the food options offered within.<sup>14</sup> Combining measures of geographic access with in-store measures (e.g., food quality and price), as well as measures of perceived acceptability of available food venues and menu options, would provide a more comprehensive assessment of food access.<sup>14,15</sup>

## Conclusions

This study found no consistent associations between local access to various types of restaurants and the frequency of eating out and intake of sugary drinks among children and youth living in urban Canada. These findings add to the equivocal body of research linking geographic accessibility of food retail in residential spaces with food-related behaviours and outcomes. Such mixed results, combined with the shifting retail food landscape in the wake of the pandemic and particularly the growth of e-commerce, call into question the relative influence of the geographic access dimension on food choices and diet-related outcomes. Future studies should incorporate novel data sources, beyond food outlet location data, to better understand how young people navigate and interact with the evolving retail food landscape in various everyday activity spaces. Striving to create food environments that promote and support healthy diets for children and youth in multiple spheres of daily life should continue to be an important goal for public health and policy makers.

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