

Availability of Limited Service Food Outlets Surrounding Schools in British Columbia

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ABSTRACT

Objective: The purpose of this study was to provide a descriptive profile of the availability of limited service food outlets surrounding public schools in British Columbia, Canada.

Methods: Data from the 2010 Canadian Business Data Files were used to identify limited service food outlets including fast food outlets, beverage and snack food stores, delis and convenience stores. The number of food outlets within 800 metres of 1,392 public schools and the distance from schools to the nearest food outlets were assessed. Multivariate regression models examined the associations between food outlet availability and school-level characteristics.

Results: In 2010, over half of the public schools in BC (54%) were located within a 10-12 minute walk from at least one limited service food outlet. The median closest distance to a food outlet was just over 1 km (1016 m). Schools comprised of students living in densely populated urban neighbourhoods and neighbourhoods characterized by lower socio-economic status were more likely to have access to limited service food outlets within walking distance. After adjusting for school-level median family income and population density, larger schools had higher odds of exposure to food vendors compared to schools with fewer students.

Conclusion: The availability of and proximity to limited service food outlets vary widely across schools in British Columbia and school-level characteristics are significantly associated with food outlet availability. Additional research is needed to understand how food environment exposures inside and surrounding schools impact students' attitudes, food choices and dietary quality.

Key words: Food; schools; geographic information systems

La traduction du résumé se trouve à la fin de l'article.

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Improving the eating habits of children and adolescents is a priority area for health promotion, particularly given evidence of increasing rates of obesity and nutrition-related health conditions such as type 2 diabetes among Canadian youth.¹⁻³ Given that youth spend a substantial proportion of their time in or en route to school, there is growing interest in understanding how the food environment inside and surrounding school shapes dietary outcomes.⁴⁻⁶ In British Columbia (BC), several provincial initiatives (including Action Schools! BC, Sip Smart! BC, Farm to School, and the School Fruit and Vegetable Snack Program) aim to improve access to nutritious foods and to reduce exposures to foods of low nutritional quality.⁷ Additionally, revised provincial guidelines restrict the sale of foods and beverages with poor nutritional quality across all settings where foods are sold inside schools, including cafeterias, vending machines, fundraising efforts and school events.^{8,9} The effectiveness of recent school-based healthy eating initiatives may be moderated however if students have pervasive exposure to retailers (and related advertising) selling snack foods, sugar-sweetened beverages and fast food in the immediate vicinity surrounding schools.¹⁰

Recent policy recommendations in BC, Quebec and outside of Canada have called for the development of new guidelines to restrict food and beverages sold in areas surrounding schools,^{10,11} and regulations restricting the number of new fast food restaurants have been implemented in some communities in the United States.^{12,13} While there is a growing body of evidence suggesting

that more frequent visits to fast food outlets are associated with higher energy intake, reduced dietary quality and increased obesity risk,^{14,15} there remain large gaps in knowledge regarding the distribution of food outlets surrounding schools and the net impact on students' food purchases and dietary choices.

In the United States, one third of schools are within walking distance of a fast food outlet or convenience store,¹⁶ with higher exposure reported in commercially dense urban areas, near secondary schools compared to elementary schools, and in neighbourhoods characterized by lower socio-economic status.¹⁶⁻²⁰ Similarly, in a national sample of Canadian schools, approximately 31% of schools were found to be located within 1 km of a fast food restaurant.²¹ In Montreal, schools in the lowest-income neighbourhoods have 10 times more food stores within 750 m compared to schools in the highest-income areas,²² but a dearth of Canadian studies have carefully characterized the food environment surrounding schools in provinces outside of Quebec. To that end, this study aims

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to describe the availability of limited service food outlets within walking distance of BC schools to provide insight regarding the nature of the food environment surrounding schools in this province.

METHODS

The study sample included 1,392 BC public schools offering standard educational programs listed in the BC Ministry of Education's school database as of February 2011 with a physical address that could be geocoded.²³ Twenty-three percent of these schools are located in areas that are considered rural by Canada Post.²⁴ Schools serving any of grades 8-12 were defined as secondary schools (n=380). Grade 8 is commonly designated as the first year of secondary school in BC and students in grade 8 and higher are likely to have more autonomy over food choices, including permission to leave school campus during lunch periods. In BC, secondary schools have significantly higher numbers of enrolled students compared to elementary schools and may therefore provide a larger customer base for nearby food retailers.

Additional school-level attributes were derived from the 2006 Canadian Census, including median family income and population density per square kilometre. These school-level attributes were derived by the BC Ministry of Education Analysis and Reporting Group based on weighted average attribute values from Census dissemination area values where students reside, weighted by the proportion of students per school in 2006/7 residing in each dissemination area.²⁵ School-level income and population density variables were coded into tertiles to compare schools representing students from neighbourhoods with diverse levels of relative median family income (lowest <\$59,879, medium \$59,880-\$72,474, highest ≥\$72,495) and population density (lowest <934, medium 935-2,777, highest ≥2,778 residents per square km).

Food retailer data and geographic coordinates were obtained from the 2010 Canadian Business Data files, a proprietary database of Canadian business information including company names, industry codes and geographic coordinates.²⁶ Four categories of limited service food outlets, described below, were defined in consultation with the BC Ministry of Health. Categories aimed to be comparable with previous estimates in the literature and where possible were delineated by North American Industry Classification System (NAICS) descriptions.^{27,28}

- 1) **Beverage and snack food stores** were identified with NAICS description "snack & nonalcoholic beverage bars" and included chain and independent vendors selling coffee, ice cream, donuts and snacks.
- 2) **Fast Food Outlets** were defined as restaurants without waiter service where customers select and purchase food before consumption, with three or more outlets in BC.
- 3) **Delis** included food stores coded with NAICS description "limited-service restaurants" and included delicatessens and independent take-out shops with one or two locations.
- 4) **Convenience stores** were classified with NAICS description "convenience stores".

Data analyses

School and food store locations were mapped with geographic information systems (GIS) using ArcMap GIS software (ESRI, Red-

lands, CA). The number of food outlets within 800 m buffer distances surrounding each school were estimated, comparable with recent studies,^{17,20,29} to characterize food outlet availability within a 10-12 minute walking distance. The closest distance from schools to food outlets along street routes was calculated as an additional measure of proximity, using ArcMap's Network Analyst tool, with street routes identified using CanMap® RouteLogistics, v2010.3 (DMTI Spatial Inc., Markham, ON).

Descriptive statistics were calculated for the combined sample and stratified by school type, school size (categorized as enrollment less than versus greater than or equal to the sample median) and by tertiles of median family income and population density. Logistic regression models then examined the associations between school-level factors with food outlet availability within 800 m of schools. Sensitivity analyses further tested these associations using negative binomial models with the number of outlets within 800 m as the outcome variables (data not shown), and yielded findings similar to those from binary logistic regression models. Analyses were conducted using Stata version 11 (College Station, TX).

RESULTS

Table 1 describes the availability of limited service food outlets surrounding BC schools, showing that 54% of schools had at least one limited service food outlet within 800 m (median=1, mean=3). Availability varied widely ranging from 0 to 83 outlets (SD=5.47), and 8% of schools had 10 or more outlets within walking distance. Beverage and snack food stores and fast food outlets were the most commonly available outlet categories, while only 16% and 22% of schools had a deli or convenience store within 800 m, respectively.

The median closest distance to any outlet was just over 1 km (1016 m). Approximately 15% of schools had at least one food outlet available within 400 m (by road), which represents a walking time of approximately 5 minutes. However, 26% of schools were over 2 km from the nearest snack/beverage, fast food, deli or convenience store.

Tables 2 and 3 describe the unadjusted and multivariate relations between school type, school size, median income and population density with food outlet availability. A slightly higher proportion of secondary schools (58%) had a limited service outlet within 800 m compared to elementary schools (53%), and schools with larger student enrollments (64%) were significantly more likely to be located near food outlets compared to smaller schools (44%, $p<0.001$). After adjusting for school-level income and population density, schools with larger student enrollments were still significantly more likely than smaller schools to be within walking distance of a snack and beverage outlet (OR=1.36, $p<0.05$), a chain fast food outlet (OR=1.43, $p<0.01$) and a convenience store (OR=1.41, $p<0.05$). Although secondary schools were more likely than elementary schools to be located near food outlets, differences were not statistically significant after controlling for school size.

Compared to schools with students from neighbourhoods with the highest median family incomes, schools characterized by the lowest or medium income levels were significantly more likely to be located near all categories of limited service food outlets. Schools comprised of students from neighbourhoods with higher population densities were also significantly more likely to have snack/beverage, fast food, deli and convenience stores nearby.

Table 1. Descriptive Profile of the Limited Service Food Outlets Surrounding BC Schools

	Snack/ Beverage Stores	Fast Food Outlets	Delis	Convenience Stores	All Snack, Fast Food, Deli and Convenience Stores
All Schools (n=1392)					
Mean±SD (number of outlets within 800 m)	1.27±2.64	1.27±2.37	0.24±0.64	0.27±0.57	3.05±5.47
Median (number of outlets within 800 m)	0	0	0	0	1
Range (min-max number of outlets within 800 m)	0-44	0-29	0-5	0-5	0-83
% with at least one outlet within 800 m	43.68%	40.30%	16.09%	21.98%	54.17%
Median distance to closest outlet (metres)	1271	1392	3281	2387	1016

Table 2. Limited Service Food Outlet Availability and Proximity by School-level Characteristics

	Percent of Schools (n=1392)	Median Number of Outlets Within 800 m	% of Schools With At Least One Outlet Within 800 m†	Median Distance to Closest Outlet (Metres)
School Type				
Elementary Schools	27%	1	52.57	1086
Secondary Schools	73%	1	58.42	898
			p=0.051	
School Size‡				
Lower Enrollment	50%	0	43.95	1412
Higher Enrollment	50%	2	64.33	861
			p=0.000	
School-level Median Family Income§				
Lowest Income Tertile	33%	1	57.11	873
Medium Income Tertile	33%	1	59.17	947
Highest Income Tertile	33%	0	46.94	1226
			p=0.000	
School-level Population Density				
Lowest Density Tertile	33%	0	32.68	2468
Medium Density Tertile	33%	1	55.12	992
Highest Density Tertile	33%	3	75.16	745
			p=0.000	

† p-values from chi square tests of significance.

‡ School size defined as below or above sample median (< or ≥293 students enrolled per school).

§ Median family income (lowest <\$59,879, medium \$59,880-\$72,474, highest ≥\$72,495).

|| Population density (lowest <934, medium 935-2,777, highest ≥2,778 residents per square km).

Table 3. Logistic Regression Models Predicting Odds (95% CI) of Limited Service Food Outlets Within 800 Metres of Schools

	Snack/Beverage Stores	Fast Food Outlets	Delis	Convenience Stores	Any Snack, Fast Food, Deli or Convenience Store
School Size					
Lower Enrollment	1.00	1.00	1.00	1.00	1.00
Higher Enrollment	1.36* (1.05,1.78)	1.43** (1.09,1.89)	1.01 (0.71,1.44)	1.41*(1.03,1.92)	1.60*** (1.22,2.08)
School Type					
Elementary School	1.00	1.00	1.00	1.00	1.00
Secondary School	1.19 (0.90,1.56)	1.24 (0.93,1.64)	1.09 (0.76,1.58)	1.09 (0.80,1.51)	1.24 (0.93,1.64)
Median Family Income					
Lowest Income	2.63*** (1.95,3.54)	2.94*** (2.16,4.00)	2.99*** (2.01,4.42)	2.55*** (1.85,3.60)	2.60*** (1.92,3.51)
Medium Income	1.88*** (1.42,2.49)	2.26*** (1.70,3.02)	1.61*(1.09,2.39)	1.55* (1.11,2.17)	1.94*** (1.46,2.58)
Highest Income	1.00	1.00	1.00	1.00	1.00
Residential Density					
Lowest Density	1.00	1.00	1.00	1.00	1.00
Medium Density	2.80*** (2.07,3.80)	2.92*** (2.12,4.00)	2.38*** (1.47,3.93)	2.36*** (1.60,3.51)	2.82*** (2.10,3.78)
Highest Density	5.47*** (3.98,7.50)	6.56*** (4.73,9.11)	7.07*** (4.50,11.12)	4.80*** (3.26,7.06)	6.37*** (4.62,8.77)

Odds Ratios (95% confidence intervals in brackets).

* p<0.05, ** p<0.01, *** p<0.001

DISCUSSION

This study provides valuable insight about the availability, proximity and variety of limited service food outlets near public schools across BC and reveals wide disparities in food environment exposures across the province. Over half of the schools in this sample (54%) had at least one limited service food outlet within a 10-12 minute walk and 10% of schools were within walking distance of nine or more outlets. On the other hand, a substantial proportion of schools (46%) had no limited services outlets within 800 m, and 17% of schools were over 3 km away from the nearest outlet.

While it is difficult to make direct comparisons with previous studies due to varied classifications of food outlets and definitions of access and proximity, current findings suggest that overall, BC public schools have similar if not higher rates of exposure to limited service food outlets compared to estimates from outside BC.

For example, in Quebec, 37% of public schools are within a 15-minute walk to a fast food outlet, similar to estimates from a Canadian national school sample.^{16,21,30} Estimates from the United States similarly report that approximately one third of secondary schools have a fast food restaurant within an 805 m walking distance,¹⁶ a seemingly lower proportion compared to current estimates from BC.

Older students in secondary school have increased mobility and autonomy over food choices during the school day compared to younger students and likely serve as an important customer base for local food retailers who offer inexpensive and convenient food options. One third of Canadian teens (age 14-18 years) report having consumed food prepared by a fast food restaurant the day before completing national health surveys, and are more frequent consumers of fast food compared to younger children.³¹ Moreover,

the transition to secondary school is associated with decreased consumption of fruits, vegetables and milk, and increased intake of low nutritional quality foods such as soft drinks and fast food.³² Previous studies have suggested that secondary schools have increased exposure to fast food outlets compared to schools serving younger students,^{16,17,20} which may contribute to changes in dietary practices among older adolescents. In BC, secondary schools were also slightly more likely to have food outlets nearby compared to elementary schools; however, differences were not statistically significant in multivariate models. School size emerged as a more salient predictor of food outlet availability than school type, with food outlets more likely to be located near schools with a larger student body.

This study is in line with previous national estimates from Canada and the United States that report higher availability of limited service food outlets near schools in large urban centres compared to rural areas, in neighbourhoods with higher commercial and population densities and in neighbourhoods characterized by lower socio-economic status.^{18,19,22} However in BC, in addition to limited service outlets, lower-income neighbourhoods and those with higher population densities in urban neighbourhoods are also likely to have increased access to a host of food options, including supermarkets and fresh food vendors.³³ Therefore, students attending schools in lower-income neighbourhoods may have access to a variety of both nutritious and “obesogenic” beverages and snacks near school. It remains to be seen how the complex set of competing food options inside and surrounding BC schools contribute to students’ food-related attitudes and behaviours.

This study has several strengths and limitations that should be considered. An important strength was the use of a comprehensive sample of public schools characterized in the BC Ministry of Education’s school database. This database provided key information about the enrollment size, programs and grades offered by each school, allowing for the comparison of schools serving secondary school students versus students in younger grades. However, this sample excluded private schools, alternate programs, distributed learning programs and youth custody educational centres and findings should not be generalized to such settings. This study was strengthened by applying school-level census variables derived by the BC Ministry of Education based on the weighted characteristics of students’ neighbourhoods of residence. However, the median family income and population density of neighbourhoods where students live may differ from the characteristics of neighbourhoods where schools are located. Additional analyses were therefore conducted and found that these school-level measures were highly correlated with Census attributes of the forward sortation areas (FSA) where schools were located. An FSA represents the geographic region delineated by the first three digits of a Canadian postal code (e.g., V6T).²⁴ Sensitivity analyses that replicated the multivariate regression models reported in Table 3 using FSA-level Census variables yielded conclusions comparable to models presented in this paper.

All food store data were obtained from the Canadian Business Data files, a database of commercial businesses and food vendors.²⁶ To our knowledge, this is the highest-quality proprietary data source of commercial food outlets available in BC, and is comparable to datasets used previously in the literature that have demonstrated acceptable levels of agreement compared to direct

observations made through systematic social observation.³⁴ The definitions and categorization of food outlets were informed by several recent studies in the US and Canada and were completed with input from local stakeholders from the BC Ministry of Health. However, it was not possible to systematically ground truth the geospatial accuracy of outlets or the types and costs of food sold in these stores. This study also did not quantify snack and take-out foods available at grocery stores, full-service restaurants, drug stores, or inside public buildings such as recreation centres where students may also purchase foods and beverages.³⁵ Hence, current estimates likely underestimate true exposures to inexpensive food with minimal nutrition quality surrounding schools.

Still, this analysis captured a substantial proportion of vendors where BC students purchase snacks, beverages, fast food and convenience food, and provides a baseline profile needed to inform provincial and municipal efforts to create and support healthy communities.¹¹ Overall, these findings are in line with previous studies that highlight differences in food environment exposures among schools in varied geographic contexts. In BC, the predicted probability of having a limited service food outlet within walking distance was 87% for a large secondary school with students from the lowest-income and highest-density neighbourhoods, but only 17% for a small elementary school characterized by students from the highest-income, lowest-density areas. Despite these differences, it remains to be seen whether varied exposures surrounding schools translate into divergent dietary outcomes for BC’s youth. Additional research is needed to evaluate the impacts of proposed municipal policies and bylaws that restrict access to limited service food outlets in close proximity to schools and to fill gaps in current understanding regarding the role of the food environment in shaping dietary behaviours and health outcomes.

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RÉSUMÉ

Objectif : Notre étude vise à dresser un profil descriptif de la présence des débits de restauration à services limités autour des écoles publiques en Colombie-Britannique (Canada).

Méthode : À l'aide de données sur les entreprises canadiennes (fichiers Canadian Business Data 2010), nous avons identifié les débits de restauration à services limités : restaurants rapides, magasins de boissons et de grignotines, charcuteries et dépanneurs. Nous avons calculé le nombre de débits de restauration à 800 mètres des 1 392 écoles publiques et la distance entre les écoles et les débits de restauration les plus proches. En utilisant des modèles de régression multivariée, nous avons étudié les associations entre la présence de débits de restauration et les caractéristiques au niveau des écoles.

Résultats : En 2010, plus de la moitié des écoles publiques de la C.-B. (54 %) étaient situées à 10 ou 12 minutes de marche d'au moins un débit de restauration à services limités. La distance médiane la plus proche d'un débit de restauration était d'un peu plus de 1 km (1 016 m). Les écoles dont les élèves habitaient des quartiers urbains densément peuplés et des quartiers à faible statut socioéconomique étaient plus susceptibles d'avoir accès à des débits de restauration à services limités à distance de marche. Après avoir apporté des ajustements en fonction du revenu familial médian et de la densité de population au niveau des écoles, nous avons constaté que la probabilité d'exposition aux commerces d'alimentation était plus élevée pour les grandes écoles que pour les écoles ayant peu d'élèves.

Conclusion : La présence et la proximité de débits de restauration à services limités varient beaucoup d'une école à l'autre en Colombie-Britannique, et les caractéristiques au niveau des écoles présentent une corrélation significative avec la présence de débits de restauration. Il faudrait pousser la recherche pour comprendre en quoi l'environnement alimentaire à l'intérieur et autour de l'école a une incidence sur les attitudes, les choix alimentaires et la qualité du régime des élèves.

Mots clés : aliments; établissement scolaire; systèmes d'information géographique