Foodscapes of southern Ontario: Neighbourhood deprivation and access to healthy and unhealthy food retail

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ABSTRACT

OBJECTIVES: We examined whether access to retail sources of healthy and unhealthy food varies according to level of neighbourhood material deprivation in three Ontario regions and whether urban form characteristics help to explain any such variations.

METHODS: Food retail (FR) outlets were identified from a commercial database for 804 urban neighbourhoods in Toronto, Brampton/Mississauga and Hamilton, Ontario. The median number of healthy and unhealthy FR outlets and percentage of outlets that were unhealthy were derived using 720-metre network buffers based on dissemination blocks and aggregated up to neighbourhood level (census tract). The 2006 Canadian Census was used to derive a composite index of material deprivation and three urban form measures related to zoning and urbanization. Multivariate regression models assessed the association between material deprivation, urban form and each measure of FR access.

RESULTS: Compared with the least deprived areas, the most materially deprived neighbourhoods had 2 to 4 times more healthy and unhealthy FR outlets within 720 metres (~ a 10-minute walk) of where most people lived, with the exception of Toronto, where unhealthy FR was more plentiful in less deprived areas. Urban form measures attenuated these associations for Brampton/Mississauga and Hamilton more so than for Toronto. The percentage of unhealthy outlets was generally unrelated to level of neighbourhood deprivation or urban form characteristics.

CONCLUSION: More deprived neighbourhoods had greater access to both healthy and unhealthy FR outlets, with some variation across study regions. Plentiful access to local retail sources of unhealthy food suggests a possible point of intervention for healthy public policy.

KEY WORDS: Food; socioeconomic factors; residential characteristics; geographic information systems

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

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Unhealthy eating patterns and diet-related disease, such as obesity and diabetes, are among the most pressing public health concerns in Canada. Recent reports reveal that less than 1% of Canadians consume a diet consistent with Canada's Food Guide recommendations,[1] and 6 in 10 are either overweight or obese.[2] Major changes in food production and distribution in recent decades have flooded the consumer food environment with highly palatable, processed, energy-dense and low-cost foods, and are recognized to be the core environmental drivers of increased energy intakes and ensuing rates of obesity.[3]

There is growing evidence that the neighbourhood retail "foodscape" or food environment may play a role in shaping dietary behaviours and diet-related health outcomes.[4-6] As well, the availability of local food retail (FR) establishments has been shown to vary according to level of neighbourhood socio-economic profile in urban settings, with fewer retail sources of healthy foods (e.g., supermarkets) and more sources of unhealthy food (e.g., fast-food outlets and conveniences stores) located in communities with higher proportions of low-income and ethnic-minority residents compared with more affluent neighbourhoods or those with fewer minorities.[4] This pattern may, in part, account for the well-documented gradients in diet and obesity by socio-economic status (SES). However, while such disparities have been consistently documented in the United States, systematic differences in FR distribution according to neighbourhood socio-economic profile are less consistent and vary across settings within other developed nations, including Canada.[4,7-14]

Reasons for SES-related disparities in FR distribution are not well specified in the health literature and have been rarely studied empirically but likely include historical market forces, such as pervasive supermarket restructuring resulting in closure of smaller grocery stores in inner-city neighbourhoods, and location of fewer but larger supermarkets in suburban areas offering larger lots and lower rents.[15] The higher prevalence of fast food in lower-income, inner-city communities may be due to purposeful targeting by food retailers, lower rents and retail competition, and less restrictive zoning practices.[16] Three recent Canadian investigations showed that features

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Table 1. Study definitions of food retail types

Food retail type	Definition
	Healthy food retailer
Supermarket	Large national/regional stores offering a full line of grocery products (food and non-food). For independently owned stores, only stores with annual sales volumes of $2 million or more were included.
Grocery store	All food stores, other than supermarkets and convenience/variety stores or specialty food stores, offering a line of dry grocery, canned goods and/or perishable food items.
Fruit & vegetable shop	Smaller stores specializing in the sale of fresh fruits and vegetables.
	Unhealthy food retailer
Convenience or variety store	Smaller stores offering a limited variety of grocery and daily living items (food and non-food) open outside normal business hours and days. Stores within gas stations were included.
Fast-food outlet	Locally owned or franchised limited-service restaurants (i.e., venues without table service where patrons pay before receiving their meal). Outlets that do not serve full meals (e.g., coffee or snack shops, cafes) were excluded.

of urban form, including higher population density and more restrictive zoning (which separates residential areas from commercial activity) were important predictors of FR distribution, beyond area socio-economic characteristics.[8,10,17] Thus, there is a need for additional Canadian research into disparities in FR distribution that investigates other factors, such as characteristics related to urbanization and zoning, that may help explain why FR is unevenly distributed by area SES and thus help identify potential points of intervention for public policy concerned with fostering healthier and more equitable neighbourhoods. Additionally, there is a need for more comprehensive FR assessment that moves beyond the common approach of measuring access to just one or two types of retail establishment[8,9,13,17] in order to achieve a more complete representation of the complex set of FR options available to residents.[14]

Accordingly, our study aims to assess whether access to retail sources of healthy and unhealthy food varies systematically according to level of neighbourhood deprivation in three diverse settings in southern Ontario, a region that has, to date, received little attention in the empirical literature. Specifically, this study uses several comprehensive measures of the local foodscape to assess whether access to healthy and unhealthy FR varies according to level of neighbourhood material deprivation, and whether urban form characteristics explain these associations.

METHODS

Study design and area

For this cross-sectional, ecological study we focused on three diverse urban settings in southern Ontario: the City of Toronto, Canada's largest metropolitan centre; the City of Brampton and the City of Mississauga, two contiguous and largely suburban cities adjacent to the west of Toronto; and the City of Hamilton, a medium-size city located southwest of Brampton/Mississauga. Because of data limitations, only neighbourhoods located within the old municipal boundaries of Hamilton were included. Urban census tracts (CTs) have been shown to be good proxies for naturally defined neighbourhoods in previous health-related research,[18] and 2006 CTs were used as neighbourhood units of analysis in this study.

Measures of FR access

All FR records and their geographic coordinates were obtained from a single proprietary commercial database (Dun & Bradstreet Canada, Inc.), which contained a comprehensive inventory of all FR outlets located within the study area and a 5-km buffer of each region's boundaries in January 2008. A list of food stores and restaurants was initially extracted using the North American Industry Classification codes, followed by extensive cleaning to remove duplicate listings and defunct businesses, as well as additional reclassification efforts in a protocol highly consistent with other researchers.[19] We then classified supermarkets, grocery stores and fruit and vegetable shops as "healthy" and fast-food outlets and convenience stores as "unhealthy" FR. This classification scheme is similar to previous research[5,6,20,21] and is summarized in Table 1, along with definitions of each FR type.

We calculated three measures of access to healthy and unhealthy FR outlets within a 10-minute walk of where most people lived within neighbourhoods using network analysis tools in ArcGIS 9.3 software (ESRI, Redlands, CA). Our assessment of "access" incorporated the dimensions of availability (presence and number of outlets) and accessibility (proximity to outlets),[22] and proceeded as follows: first, in order to better account for population distribution within each neighbourhood,[23] we calculated the number of healthy and unhealthy outlets accessible by street network within a 720-metre buffer (a 10-minute walking distance at an estimated speed of 1.2 m/sec) around the centroid of each residential census dissemination block contained within a neighborhood's boundaries (region average of 20 blocks per neighbourhood). Similar to previous studies,[8,11,12] we then calculated median numbers of healthy and unhealthy outlets within each neighbourhood, weighted by block population, to serve as two summary measures of absolute access to 1) healthy and 2) unhealthy FR. Our third measure assessed relative access to unhealthy FR and was calculated as the percentage of all FR outlets that were unhealthy.[24]

Measure of neighbourhood material deprivation

Neighbourhood deprivation was measured using the material deprivation dimension of the 2006 Ontario Marginalization Index, a theoretically informed, empirically derived and validated composite index of Canadian marginalization constructed using measures from the 2006 Canadian Census.[25] The six component measures of this material deprivation index are summarized in Table 2. For ease of interpretation, we created population-weighted region-specific quintiles of neighbourhood material deprivation, which were collapsed into a three-level variable for regression models because of sparse data: most deprived (quintiles 1, 2), middle (quintile 3) and least deprived neighbourhoods (quintiles 4, 5).

Measures of urban form

Using neighbourhood-level data from the 2006 Canadian Census, we calculated population density per square kilometre of land area, percentage of employed population aged 15+ who used public

Table 2. Socio-economic and urban form characteristics of neighbourhoods by quintile of material deprivation from 2006 Canadian Census (mean values)

	Toronto					Brampton/Mississauga					Hamilton				
	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Neighbourhoods, *N*	116	102	99	103	104	30	36	38	39	42	18	19	19	19	20
*Socio-economic characteristics**															
% Aged 25-64 without certificate, diploma or degree	3.8	8.3	12.1	17.8	21.9	7.1	10.5	10.9	14.8	16.3	9.3	15.8	14.9	21.6	30.9
% Lone-parent families	12.5	16.5	19.6	22.3	29.9	10.7	13.1	16.1	17.8	21.1	13.0	18.3	20.0	23.5	30.5
% Unemployed	5.3	6.8	7.5	8.2	10.5	5.3	6.0	6.1	7.0	8.2	5.3	5.9	7.6	8.5	10.6
% Homes needing major repairs	4.9	6.3	7.7	8.9	11.5	1.7	2.6	3.4	4.7	7.9	4.4	6.7	8.4	9.5	13.2
% Low-income population	12.8	19.5	23.6	26.7	36.4	10.2	11.5	14.2	16.2	22.3	9.7	16.8	20.4	28.4	38.0
% Population receiving gov't transfer payments	5.1	9.3	11.9	14.5	18.9	5.2	6.8	7.8	10.1	12.4	9.8	13.5	15.3	17.6	22.8
Median household income ($)	88,063	63,068	54,842	48,523	39,786	97,211	85,832	75,351	67,415	54,384	70.929	57,634	47,529	43,367	35,543
Urban form characteristics															
Population density (per km^2)	5802	6200	6553	7022	8363	3874	3558	4085	4301	5429	2439	3803	3851	4252	4745
% Detached housing	41.5	38.0	33.0	23.2	17.8	66.6	56.7	45.1	42.8	23.2	77.1	59.1	54.9	46.3	45.5
% Population using public transit	29.2	31.6	33.4	36.7	39.1	11.4	12.6	14.2	13.9	18.2	6.4	10.1	13.7	14.3	18.5

Q1=least deprived and Q5=most deprived neighbourhood.

* All socio-economic indicators listed, except for median household income (before tax), were components of the material deprivation index used to create quintiles of neighbourhood deprivation. The index components were: 1) % of persons aged 25-64 without certificate, diploma or degree; 2) % of families who are lone-parent families; 3) % of persons aged 15+ who are unemployed; 4) % of households living in homes in need of major repairs; 5) % of the population considered low income (i.e., living below the low-income cut-off, before tax, in 2005); and 6) % of the population receiving government transfer payments.

transit to commute to work and percentage of occupied private dwellings that were single detached houses. These indicators were conceptualized as proxy measures of zoning and urbanization, and were significant predictors of neighbourhood access to FR establishments in recent Canadian studies.[8,17]

Statistical analyses

Regression models unadjusted and adjusted for urban form factors assessed the association of material deprivation with each measure of FR access separately. As a result of evidence of interaction between region and deprivation for some measures of FR, all analyses were stratified by region. Negative binomial regression was used to model the number of healthy and unhealthy FR outlets (i.e., absolute access to healthy and unhealthy FR). The results of these models are expressed as rate ratios (RRs), along with their associated 95% confidence intervals (CIs). Tobit regression for censored data[26] was used to model the percentage of unhealthy outlets (i.e., relative access to unhealthy FR), yielding slope coefficients that can be interpreted in a manner similar to linear regression. These models specified a lower bound of zero to include as censored observations neighbourhoods with a zero denominator (i.e., censored for percentage of unhealthy outlets because of lack of any healthy or unhealthy FR for 8 neighbourhoods in Toronto, 12 in Brampton/Mississauga and 4 in Hamilton). A number of sensitivity analyses were also conducted, using alternative modeling approaches and definitions of FR access (i.e., alternative definitions of unhealthy and healthy FR outlets; presence of any outlets; density of outlets per 10,000 residents within census tract boundaries; and access within 3-km buffers). These revealed results highly consistent with those of the final analyses. All analyses were conducted in SAS Version 9.3 (SAS, Cary, NC).

Ethics approval was obtained from the University of Toronto and St. Michael's Hospital Offices of Research Ethics.

RESULTS

Table 2 describes demographic, socio-economic and urban form characteristics of 524 study neighbourhoods in Toronto (population of 2,501,502), 185 in Brampton/Mississauga (population of 1,023,450) and 95 in Hamilton (population of 327,278). In all study regions, neighbourhoods classified as more deprived according to the material deprivation index had consistently higher levels of socio-economic disadvantage across its component measures, including a higher proportion of lone-parent families and homes needing major repairs, as well as significantly lower household income (region average of $40,867 vs. $92,625 in the most vs. least deprived areas).

In all study regions, unhealthy FR was more readily accessible in absolute terms (i.e., number of unhealthy outlets within a 10-minute walk) than healthy FR, regardless of level of material deprivation (results not shown). Absolute access to both healthy and unhealthy FR differed by level of material deprivation in every region (all p values <0.01), with more outlets found in areas with higher levels of deprivation (median of 0 vs. 1 healthy outlets and 0 vs. 3 unhealthy outlets in the least vs. most deprived areas,

Table 3. Negative binomial regression modeling absolute access to healthy food retailers (i.e., number of healthy outlets) within a 10-minute walk of residential areas in neighbourhoods

	Toronto				Brampton/Mississauga				Hamilton			
	Unadjusted models†		Adjusted model‡		Unadjusted models†		Adjusted model†		Unadjusted models†		Adjusted model†	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Material deprivation												
Least deprived	1.00		1.00		1.00		1.00		1.00		1.00	
Middle	1.18	(0.78, 1.78)	1.05	(0.71, 1.56)	1.30	(0.44, 3.85)	0.56	(0.17, 1.86)	2.19	(0.75, 6.37)	1.07	(0.42, 2.70)
Most deprived	2.07***	(1.50, 2.84)	1.37*	(1.01, 1.87)	1.97	(0.82, 4.69)	1.08	(0.41, 2.86)	4.39***	(1.86,10.36)	1.85	(0.84, 4.05)
Urban form												
Population density (1000 per km^2)	1.16***	(1.11, 1.20)	1.04*	(1.00, 1.07)	1.18**	(1.05, 1.32)	1.09	(0.98, 1.23)	1.33***	(1.19, 1.49)	1.08	(0.97, 1.19)
% Detached housing	0.97***	(0.96, 0.98)	0.98***	(0.97, 0.99)	0.97***	(0.96, 0.99)	0.99	(0.97, 1.01)	0.96***	(0.95, 0.97)	0.98***	(0.96, 0.99)
% Public transit users	1.06***	(1.05, 1.08)	1.03***	(1.01, 1.04)	1.11***	(1.05, 1.17)	1.07	(1.00, 1.15)	1.14***	(1.09, 1.20)	1.04	(0.99, 1.08)

RR=rate ratio; 95% CI=95% confidence interval.
† Estimates obtained from separate unadjusted negative binomial models.
‡ All estimates mutually adjusted for all other variables listed.
* $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Table 4. Negative binomial regression modeling absolute access to unhealthy food retailers (i.e., number of unhealthy outlets) within a 10-minute walk of residential areas in neighbourhoods

	Toronto				Brampton/Mississauga				Hamilton			
	Unadjusted models†		Adjusted model‡		Unadjusted models‡		Adjusted model†		Unadjusted models†		Adjusted model‡	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Material deprivation												
Least deprived	1.00		1.00		1.00		1.00		1.00		1.00	
Middle	0.63**	(0.44, 0.88)	0.69*	(0.51, 0.92)	1.31	(0.59, 2.89)	0.71	(0.33, 1.55)	2.40**	(1.34, 4.27)	1.61*	(1.00, 2.59)
Most deprived	0.90	(0.69, 1.18)	0.73*	(0.57, 0.93)	2.29*	(1.21, 4.31)	1.00	(0.52, 1.95)	4.45***	(2.78, 7.13)	2.11***	(1.36, 3.28)
Urban form												
Population density (1000 per km^2)	1.12***	(1.09, 1.15)	1.04**	(1.01, 1.06)	1.12**	(1.03, 1.21)	1.04	(0.98, 1.11)	1.29***	(1.17, 1.42)	1.12**	(1.05, 1.19)
% Detached housing	0.97***	(0.96, 0.97)	0.97***	(0.97, 0.98)	0.97***	(0.96, 0.98)	0.99	(0.97, 1.00)	0.98***	(0.98, 0.99)	1.00	(1.00, 1.01)
% Public transit users	1.04***	(1.03, 1.06)	1.02**	(1.01, 1.03)	1.13***	(1.08, 1.18)	1.09**	(1.03, 1.14)	1.14***	(1.11, 1.17)	1.09***	(1.05, 1.12)

RR=rate ratio; 95% CI=95% confidence interval.
† Estimates obtained from separate unadjusted negative binomial models.
‡ All estimates mutually adjusted for all other variables listed.
* $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Table 5. Tobit regression modeling relative access to unhealthy food retailers (i.e., % of outlets that were unhealthy) within a 10-minute walk of residential areas in neighbourhoods

	Toronto				Brampton/Mississauga				Hamilton			
	Unadjusted models†		Adjusted model‡		Unadjusted models†		Adjusted model‡		Unadjusted models†		Adjusted model‡	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Material deprivation												
Least deprived	–		–		–		–		–		–	
Middle	–0.34	(–4.23, 3.54)	–0.93	(–4.30, 2.44)	–2.46	(–10.54, 5.62)	–0.86	(–9.06, 7.34)	8.01	(–2.12, 18.13)	6.44	(–3.96, 16.84)
Most deprived	–2.27	(–5.39, 0.85)	–4.28*	(–8.15, –0.42)	–2.90	(–9.64, 3.85)	0.52	(–7.14, 8.17)	6.76	(–1.59, 15.10)	5.25	(–4.78, 15.28)
Urban form												
Population density (1000 per km^2)	0.31*	(0.07, 0.55)	0.15	(–0.16, 0.46)	–0.98*	(–1.91, –0.05)	–0.66	(–1.70, 0.38)	–0.35	(–1.98, 1.28)	–0.05	(–2.05, 1.96)
% Detached housing	–0.08**	(–0.14, –0.03)	–0.09*	(–0.16, –0.02)	0.13*	(0.01, 0.25)	0.06	(–0.11, 0.23)	0.11	(–0.03, 0.26)	0.27**	(0.08, 0.46)
% Public transit users	0.11	(–0.03, 0.25)	–0.01	(–0.19, 0.18)	–0.53	(–1.08, 0.03)	–0.26	(–0.95, 0.42)	0.48	(–0.16, 1.12)	0.94*	(0.01, 1.86)

β=parameter estimate (unstandardized slope coefficient); 95% CI=95% confidence interval.
† Estimates obtained from separate unadjusted Tobit regression models.
‡ All estimates mutually adjusted for all other variables listed.
* $p<0.05$, ** $p<0.01$.

overall). Relative access to unhealthy FR, expressed as percentage of outlets that were unhealthy, was high across the study regions, ranging from 71.1% to 85.7%, but showed no significant differences by level of neighbourhood deprivation.

In unadjusted analyses for all study regions, the most deprived neighbourhoods had a 2- to 4-fold greater median number of healthy FR outlets than the least deprived areas (Table 3). After adjustment for urban form factors, these associations were substantially attenuated and remained significant only for Toronto.

Patterns for absolute access to unhealthy FR in relation to material deprivation differed across study regions (Table 4): in unadjusted analysis for Toronto, higher levels of deprivation were related to fewer unhealthy food retailers (RR=0.90; 95% CI: 0.69-1.18 for most vs. least deprived areas) but substantially more unhealthy outlets in Brampton/Mississauga (RR=2.29; 95% CI: 1.21-4.31) and Hamilton

(RR=4.45; 95% CI: 2.78-7.13). For the latter two regions, inclusion of urban form measures substantially attenuated the effect of material deprivation, reducing the RR to null in Brampton/Mississauga; however, deprivation remained significantly related to increased absolute access to unhealthy FR in Hamilton's middle (RR=1.61; 95% CI: 1.00-2.59) and most deprived (RR=2.11; 95% CI: 1.36-3.28) vs. least deprived areas. In Toronto, the adjusted effect of deprivation remained negative for both middle and highest levels of material deprivation (RR=0.7, $p<0.05$).

In all unadjusted analyses, urban form measures were significantly related to absolute access to both healthy and unhealthy FR (all p values<0.001; Tables 3 and 4). In all regions, population density and public transit use were positively related to absolute FR access, while proportion of detached housing had a negative association. In adjusted models, estimates for population density and public transit use diminished consistently for all study regions, whereas estimates for proportion of detached housing remained relatively unchanged.

Relative access to less healthy FR (percentage of outlets that were unhealthy) had no clear relationship with either neighbourhood deprivation or urban form characteristics (Table 5). For material deprivation, the only significant association was seen in Toronto, where, on average, the most deprived areas had a 4.3% lower proportion of unhealthy FR outlets than the least deprived areas, after accounting for urban form factors.

DISCUSSION

This study adds to the growing Canadian FR environment literature by describing the distribution of commonly accessed FR establishments across more and less materially deprived neighbourhoods in three geographically and socially diverse regions in southern Ontario. Across all study regions, the most materially deprived neighbourhoods had 2 to 4 times more stores selling healthy (supermarkets, grocery stores, and fruit and vegetable stores) and unhealthy food (fast-food and convenience stores) within a 10-minute walk of where most people lived compared with the least deprived areas, except in Toronto, where unhealthy FR was more plentiful in less deprived areas. Urban form factors, such as population density and proportion of detached dwellings, helped to explain these associations for Brampton/Mississauga and Hamilton more so than for Toronto.

In addition to measures of absolute access (number of outlets), this study is among the first to assess relative access to unhealthy FR (unhealthy food outlets as a percentage of both healthy and unhealthy FR) according to level of neighbourhood deprivation. We found that relative access to unhealthy FR was generally unrelated to level of neighbourhood material deprivation in Brampton/Mississauga and Hamilton. In Toronto, the average proportion of unhealthy FR was 4.3% lower in the most vs. least deprived areas.

Our findings are consistent with those of recent reports from Montreal, Edmonton and urban areas of British Columbia in demonstrating that areas with a higher proportion of materially deprived residents are not systematically disadvantaged in terms of absolute access to retail sources of fresh produce, such as supermarkets, grocery stores, and fruit/vegetable shops, and have similar or better access compared to more affluent areas.[8-11,14,17] In contrast, a recent study from London, Ontario, showed worse access to supermarkets among residents of lower SES neighbourhoods, which supports a need for future region-specific examinations of FR distribution and consideration of its unique demographic, economic and political histories and profiles.[12]

Our findings also resonate with recent investigations in Montreal and Edmonton in showing higher levels of exposure in more socio-economically disadvantaged areas to retail sources of unhealthy food (fast-food outlets and conveniences stores) – areas also known as "food swamps."[7,8,13,14] In terms of relative access to unhealthy FR, our results were generally consistent with the only analogous study in the literature, to our knowledge, which found that residents of the poorest areas in Montreal were exposed to fewer fast-food restaurants as a proportion of all restaurants in the area, and more fruit and vegetable stores as a proportion of all stores, relative to the wealthiest areas.[14] Collectively, these findings show little support for the notion raised by some US researchers that socio-economically disadvantaged neighbourhooods may be systematically targeted by unhealthy food retailers,[16] and indicate that such areas generally provide better local access to FR establishments of all types, given their commonly higher levels of density and mixed land use.

With regard to the last point, we showed that higher population density and lower proportion of single detached dwellings (proxy measures of areas zoned for mixed residential and commercial use) and higher levels of public transit use (a possible attraction for FR site selection[17]) were indeed related to better FR access in absolute terms, and adjustment for these factors explained much of the association between neighbourhood deprivation and number of food outlets within walking distance in Brampton/Mississauga and to a lesser extent Hamilton. These findings are in line with existing research from British Columbia, Quebec and Alberta,[8,10,17] and suggest that urban planning factors likely play a role in shaping the distribution of FR in urban areas, perhaps more so than area socio-demographic composition. In other words, socio-economically disadvantaged residents may be more likely to find affordable housing in more densely populated areas with higher levels of retail density, which commonly includes diverse types of FR. In contrast, wealthier residents have the option of attaining some level of "isolation" from both more and less desirable types of FR by settling in more sparsely populated areas zoned exclusively for residential purposes.[8] Interestingly, the same urban form correlates had little impact on the neighbourhood deprivation-FR access association in Toronto. This may suggest that urban form factors other than those included in our study relate more strongly to siting and distribution of FR, or reflect considerable variation in urban form characteristics between neighbourhoods of similar SES profile. For example, while many of Toronto's low-income residents live in neighbourhoods with high levels of food and other retail activity, a large proportion resides in clusters of post-war high-rise apartment buildings surrounded by open space and few retail amenities.[27]

Several limitations of this research deserve mention. As in other ecological analyses, our discussion is limited to the association between deprivation and FR access at the level of the neighbourhood and not among individuals, and we were unable to assess the impact of such area-based measures on individuals' food purchasing or dietary behaviours. Additionally, the study assessed only two dimensions of FR access (availability and

accessibility). Other dimensions include financial affordability and socio-cultural acceptability of foods to consumers, which are also important in shaping food choices.[22] Further, our use of store type as a proxy measure for access to "healthy" and "unhealthy" food is a limitation that may have introduced some degree of misclassification into our assessment of FR exposure. In reality, stores and restaurants offer a variety of more and less healthy foods. For example, supermarkets stock many unhealthy, processed food products; however, they are also the most important and reliable source of affordable fresh produce for consumers.[28] Similarly, while many fast-food restaurants offer healthier, "better-for-you" menu choices, traditional energy-rich, nutritionally deficient foods remain the dominant default within most fast-food establishments and are the foods most heavily marketed both outside and inside restaurants.[29] Regular consumption of fast food has been linked to weight gain and other adverse cardio-metabolic outcomes.[30,31]

This study's finding that more socio-economically disadvantaged areas did not have systematically better relative access to unhealthy food is a positive one from a social equity perspective. However, our finding of plentiful access to unhealthy food sources in absolute terms (alongside better absolute access to healthy FR) in Hamilton and Brampton/Mississauga is a concern, given recent research linking a greater share of unhealthy FR to poorer dietary patterns and higher levels of obesity and diabetes.[5,6,21] There are also growing concerns that "food swamps" may influence food choices more strongly than poor access to sources of healthy food.[7] Additionally, residents of lower-income areas may be more vulnerable to their surrounding FR environment because of limited transportation options, time and financial constraints, and value for money of fast food.[13,32]

Evidence of plentiful access to sources of unhealthy food (particularly in low-income areas) from this and other studies indicates that better eating and obesity prevention strategies in Canadian urban areas could concentrate on encouraging healthier menu offerings within the highly accessible convenience stores and fast-food outlets to ensure that there is a mix of FR outlets maximizing exposure to healthy food choices. Future research using more comprehensive FR measures is needed to better understand how various population groups interact with their local foodscape, and which policies will have a positive impact on food choices and diet-related health outcomes.

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RÉSUMÉ

OBJECTIFS : Nous avons voulu déterminer si l'accès aux sources de détail d'aliments sains et malsains varie selon le niveau de défavorisation matérielle du quartier dans trois régions de l'Ontario et si les caractéristiques de la forme urbaine contribuent à expliquer de tels écarts.

MÉTHODE : Les points de vente au détail (PVD) d'aliments ont été identifiés à partir d'une base de données commerciale pour 804 quartiers urbains de Toronto, de Brampton/Mississauga et de Hamilton en Ontario. Le nombre médian de PVD d'aliments sains et malsains et le pourcentage de points de vente d'aliments malsains ont été dérivés à l'aide de zones tampon de 720 mètres fondées sur les îlots de diffusion et regroupées au niveau du quartier (secteur de recensement). Le Recensement de 2006 du Canada a servi à dériver un indice composite de la défavorisation matérielle et trois indicateurs de la forme urbaine liés au zonage et à l'urbanisation. Des modèles de régression multivariée ont évalué l'association entre la défavorisation matérielle, la forme urbaine et chaque indicateur d'accès aux PVD d'aliments.

RÉSULTATS : Comparativement aux zones les moins défavorisées, les quartiers les plus défavorisés sur le plan matériel avaient de deux à quatre fois plus de PVD d'aliments sains et malsains dans un rayon de 720 mètres (~ 10 minutes de marche) du lieu d'habitation des gens, sauf à Toronto, où les PVD d'aliments malsains étaient plus nombreux dans les zones moins défavorisées. Les indicateurs de la forme urbaine ont atténué ces associations pour Brampton/Mississauga et pour Hamilton davantage que pour Toronto. Le pourcentage de points de vente d'aliments malsains était généralement sans lien avec le niveau de défavorisation du quartier ou les caractéristiques de la forme urbaine.

CONCLUSION : Les quartiers plus défavorisés avaient davantage accès aux PVDA sains et malsains, avec certains écarts selon les régions à l'étude. L'accès facile à des sources de détail locales d'aliments malsains pourrait être un point d'intervention pour l'élaboration de politiques publiques saines.

MOTS CLÉS : aliments; facteurs socioéconomiques; caractéristiques résidentielles; systèmes d'information géographique