Association between neighbourhood fast-food and full-service restaurant density and body mass index: A cross-sectional study of Canadian adults

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ABSTRACT

OBJECTIVE: Frequent fast-food consumption is a well-known risk factor for obesity. This study sought to determine whether the availability of fast-food restaurants has an influence on body mass index (BMI).

METHODS: BMI and individual-level confounding variables were obtained from the 2007-08 Canadian Community Health Survey. Neighbourhood socio-demographic variables were acquired from the 2006 Canadian Census. The geographic locations of all restaurants in Canada were assembled from a validated business registry database. The density of fast-food, full-service and non-chain restaurants per 10,000 individuals was calculated for respondents' forward sortation area. Multivariable regression analyses were conducted to analyze the association between restaurant density and BMI.

RESULTS: Fast-food, full-service and non-chain restaurant density variables were statistically significantly associated with BMI. Fast-food density had a positive association whereas full-service and non-chain restaurant density had a negative association with BMI (additional 10 fast-food restaurants per capita corresponded to a weight increase of 1 kilogram; $p<0.001$). These associations were primarily found in Canada's major urban jurisdictions.

CONCLUSIONS: This research was the first to investigate the influence of fast-food and full-service restaurant density on BMI using individual-level data from a nationally representative Canadian survey. The finding of a positive association between fast-food restaurant density and BMI suggests that interventions aiming to restrict the availability of fast-food restaurants in local neighbourhoods may be a useful obesity prevention strategy.

KEY WORDS: Obesity; fast foods; body mass index; environment and public health

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

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Adult body mass index (BMI) in Canada and in other developed nations has increased dramatically over the last three decades, and obesity is now considered an epidemic.[1] BMI is defined as weight (kg) divided by height^2 (m^2), and obesity is defined as a BMI of 30 or higher. It is argued by some that obesity can be attributed to modern built environment features that promote unhealthy eating and sedentary lifestyle.[2] One aspect of the built environment is the exposure to fast-food restaurants seen in many neighbourhoods. Fast-food meals are characterized by large portion sizes, high levels of saturated fat and high caloric density.[3] Thus, frequent fast-food consumption is a risk factor for obesity.[4]

Exposure to a fast-food environment is typically measured by the density of fast-food outlets in a defined local neighbourhood or the distance to the nearest fast-food outlet. It is hypothesized that higher densities of neighbourhood-level fast-food outlets contribute to an increased prevalence of obesity. One mechanism by which this hypothesis is argued is the existence of food deserts, whereby residents of socio-economically disadvantaged neighbourhoods tend to have poor access to healthy food vendors (i.e., supermarkets, grocery stores, fruit and vegetable markets).[5] In the United States and internationally, a number of studies have found a positive association between the proximity or density of fast-food restaurants and differences in BMI or risk of obesity;[6-9] some studies have found a negative association,[10] and others have found no association.[11-14] In the Canadian context, there is very little evidence on this topic. Two ecological studies have shown an association between area-level fast-food density and obesity in Canada .[15,16] Only two Canadian studies have analyzed individual-level data, but each focused only on children in a single urban centre (Edmonton, AB; London, ON).[17,18] Both studies found modest associations between fast-food density and childhood obesity. This study aims to address the gap in the Canadian literature and contribute to the evolving international literature on this topic. Specifically, we examine the

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influence of the local food environment (neighbourhood-level fast-food and full-service restaurant densities) on BMI for the first time, using individual-level nationally representative survey data from Canada.

METHODS

Data and variables

The data for this study came from the Canadian Community Health Survey (CCHS) conducted by Statistics Canada. The CCHS is designed to collect information related to health status, health care utilization and health determinants from a nationally representative sample of the Canadian general population. Details on survey methodology can be found elsewhere.[19] The CCHS 2007-08 confidential master file (n=131,959) was used to obtain individual BMI (weight [kg]/height^2 [m^2]), lifestyle and socio-demographic factors. The CCHS master file was accessed through Statistics Canada's Research and Data Centre, which allowed access to respondents' postal codes and unsuppressed data for variables such as income and age.

Adults (aged 18 to 65) who resided in one of Canada's 10 provinces were included in our analyses (n=89,733). Residents of the three territories of Canada were excluded because of their distinct demographic and geographic features. Respondents who were pregnant or did not report height or weight (n=4,321), had extreme BMI values (<10 or >70) (n=26), or were still breastfeeding (n=1,045) were excluded, which left 84,341 eligible respondents for analysis. For self-reported surveys, it has been suggested that individuals systematically under-report weight and over-report height, which can lead to biased BMI estimates.[20] Therefore, a validated error correction factor,[20] developed using previous CCHS survey data, was applied as follows: male $BMI_{corrected} = -1.08 + 1.08\ (BMI_{self\text{-}report})$; female $BMI_{corrected} = -0.12 + 1.05\ (BMI_{self\text{-}report})$.

Various lifestyle characteristics (smoking, alcohol use, physical activity, fruit and vegetable consumption, sedentary activity), socio-economic status (immigration, race, labour market, income, education, food security) and demographic characteristics (sex, marital status, having children, urban region and province) were identified as confounding variables. These variables were available in the CCHS and considered as confounders because they were associated with either access to or consumption of fast food and BMI in the literature. These variables, shown in Table 1, were controlled for in the regression analyses so that the independent effects of the primary exposures could be teased out. Neighbourhood-level factors were also shown to confound the relationship in question.[21] Therefore, neighbourhood-level socio-demographic characteristics (transportation to work, marriage, income and education) at the level of the census dissemination area (DA) were controlled. DAs are the smallest geographical unit, consisting of 400 to 700 people, for which data are available in Canada.[22]

The names and geographic locations of all restaurants (standard industry classification code: 5812-08) were purchased from the *infoCanada*® business database. This information was geocoded and linked with the CCHS data. The details of the process have been published elsewhere.[15] Fast-food (or limited service) chain restaurants were defined as those food establishments (including general coffee outlets) that provide services to customers on the basis of food being ordered and paid for before it is eaten or taken out. Full-service restaurants were defined as those establishments that provide food services on the basis of patrons being served food and paying after their meal (i.e., servers are available). This classification system had been used previously.[15]

The names provided in the *infoCanada* business database were cross-referenced with business names published in the 2008 *Canadian Restaurant Directory*.[23] There were 19,524 fast-food restaurants in our database vs. 21,418 reported in the 2008 Directory and 3,894 full-service restaurants in our database vs. 3,823 in the Directory. We identified 4,534 records classified as independent pizza outlets, which were included in our fast-food restaurant category. All other non-chain restaurants were classified as other (n=41,972). These non-chain restaurants were independently owned and very specific to the local community. For example, many ethnic restaurants belonged to this category. It was impossible to classify these restaurants into fast-food or full-service with any verifiable source or directory. For each restaurant category (fast-food, full-service and non-chain restaurants), the number of outlets per forward sortation area (FSA) was divided by the corresponding FSA population (per 10,000) based on the 2006 Census to construct our restaurant density variables. FSAs are geographical areas that consist of the first three digits of Canadian postal codes.

Statistical analysis

The association between BMI and the density of fast-food and full-service restaurants was analyzed using ordinary least squares regression (OLS) with and without control for confounding variables. Sampling weights were applied to all descriptive and regression analyses. Robust standard errors were used to account for unknown forms of heteroskedasticity in the data, which were clustered at the FSA level. Stratified analyses were performed by sex and two levels of geographic classification: census metropolitan areas (CMA) and non-CMA. A CMA consists of neighbouring municipalities and has a total population of at least 100,000 (in which 50,000 or more live in the urban core).[22] Stratified analysis by CMA and non-CMA is relevant for two reasons. First, the eating behaviour of individuals living in urban jurisdictions is expected to be different from that of rural or semi-urban residents because of differential time constraints they face. Second, our restaurant measures are more meaningful in urban areas than rural areas. Exclusion of missing values of all variables resulted in a final sample size of 72,660. The software STATA 12© was used for all analyses.

RESULTS

A total of 1,558 relevant FSAs across Canada had on average 7 fast-food, 1 full-service and 13 other non-chain restaurants per 10,000 individuals. The mean (standard deviation [SD]) age of respondents was 42.2 (13.2) years. The mean (SD) BMI of the sample was 26.97 (5.34), males and residents in non-CMAs having statistically higher BMI ($p<0.001$ for both) than their female and CMA counterparts. The weighted proportion of males and females was about equal. Roughly 80% identified themselves as White and Canadian citizens, and over three quarters were

Table 1. Descriptive statistics

Variable	Value*
Individual level	
BMI, mean (SD)	
Overall	26.97 (5.34)
Males	27.59 (4.9)
Females	26.31 (5.72)
Residents of CMAs	26.61 (5.21)
Residents of non-CMA	27.79 (5.58)
Food service density,† mean (SD)	
Fast-food service (per 10,000 FSA population)	7.67 (7.47)
Full-service restaurant service (per 10,000 FSA population)	1.25 (1.76)
Other restaurant service (per 10,000 FSA population)	13.41 (15.42)
Smoking status, %	
Non-smoker (has never smoked)	36%
Daily smoker (smokes every day)	21%
Always occasional smoker (never a daily smoker or has smoked less than 100 cigarettes lifetime)	5%
Current occasional smoker (former daily smoker)	23%
Current non-smoker (former occasional or former daily)	15%
Alcohol use, %	
Non-drinker (has not drunk in the past year)	15%
Occasional drinker (drinks less than once per month)	15%
Regular drinker (drinks once per month or more)	70%
Physical activity (leisure and transportation), %	
Active (daily energy expenditure >30 minutes)	27%
Moderate (daily energy expenditure 20-30 minutes)	26%
Inactive (daily energy expenditure <15 minutes)	47%
Frequency of fruits & vegetables consumption, %	
Low (<5 times per day)	58%
Middle (5-10 times per day)	37%
High (>10 times per day)	5%
Sedentary activity (excluding reading, e.g., TV, computer games), %	
Low (0-9 hours per week)	20%
Middle (10-20 hours per week)	30%
High (20-30 hours per week)	34%
Very high (30+ hours per week)	16%
Immigration, %	
Canadian	78%
Immigrant (<10 years in Canada)	7%
Immigrant (>10 years in Canada)	15%
Race, %	
White	81%
Other (any race reported other than "White")	16%
Race not reported	3%
Labour market, %	
Work (full or part time)	78%
Student (who does not work)	4%
Does not work	16%
Permanently unable to work	2%
Income decile,‡ %	
Low 1st-2nd	15%
Mid low 3rd-4th	16%
Mid 5th-6th	18%
Mid high 7th-8th	20%
High 9th-10th	20%
Income not reported	10%
Education, %	
Less than secondary	11%
Secondary	17%
Some post-secondary	10%
Post-secondary	62%
Food security, %	
Secure (no, or one, indication of difficulty with income-related food access)	93%
Moderately secure (indication of compromise in quality and/or quantity of food consumed)	6%
Insecure (indication of reduced food intake and disrupted eating patterns)	2%
Sex, %	
Female	49%
Male	51%
Marital status, %	
Currently married	64%
Single, never married	26%
Separated/divorced/widowed	10%
Children, %	
Has a child aged <6	15%
Has a child aged 6-11	16%
Region	
Urban region (population >500,000)	49%
Neighbourhood Dissemination Area (DA) level	**Mean of the proportion (SD)**
Drive to work (population in CCHS respondents' DA who drive or carpool to work)	0.72 (0.17)
Married (population in CCHS respondents' DA over the age of 15 who are married)	0.48 (0.14)
Low income (population in CCHS respondents' DA who meet Statistics Canada's low income cut-off)	0.12 (0.12)
Visible minority (population in CCHS respondents' DA who are visible minorities, i.e., non-White)	0.16 (0.22)
Low education (population in CCHS respondents' DA over the age of 15 who have less than a high-school education)	0.23 (0.11)

* All values represent weighted percentages.
† Density defined as per 10,000 forward sortation area population, based on 2006 census population estimates.
‡ Income adequacy deciles are based on provincial standardization and take into account both income and household size.
CMA=census metropolitan area: total population of 100,000 (in which 50,000 or more live in the central core).

employed. Forty-seven percent of the respondents reported being physically inactive, and the majority were married and had post-secondary education (Table 1).

In both model 1 (bivariate) and model 2 (adjusted) OLS regression analyses, fast-food density was statistically significant in the positive direction, and full-service and other non-chain restaurant density was statistically significant in the negative direction with respect to BMI (Table 2). After the confounding effects of lifestyle, socio-demographic and neighbourhood factors had been controlled for, the estimated coefficients of restaurant density variables were lower (Table 2). The adjusted estimated regression coefficient for fast-food density was 0.031 (95% confidence interval [CI]: 0.017 to 0.045). This finding suggests that for an average individual 1.76 metres tall (5' 10") weighing 72.5 kg (160 lb), an increase of 10 fast-food restaurants (per 10,000 population) is associated with a positive weight difference of 1 kg (weight difference [kg]=β*density*m^2). The negative association found between full-service restaurants and BMI (β= -0.06 [95% CI: -0.11 to -0.013]) shows that an increase of 10 full-service restaurants per 10,000 population is associated with a negative weight difference of 1.9 kg for the same average person.

In model 3 (stratified by sex), the estimated coefficients for fast-food and other restaurant density for males and females were similar to the overall results. Full-service restaurant density was not significant for women or men (Table 3). Model 4 (CMA/non-CMA) (Table 3) shows that the magnitude of the association between fast-food availability and BMI exists only in urban areas. The interaction between sex and urbanicity is presented in model 5, in which we found the strongest association between the food service environment and BMI (Table 4). For males, the estimated coefficient of fast-food density did not differ substantially when further stratified by CMA (β=0.032; 95% CI: 0.001 to 0.063), but the estimated coefficients of full-service restaurant density were amplified (β= -0.1 (-0.19 to -0.0018). For men, an increase of 10 full-service restaurants (per 10,000 population) was associated with a decrease in BMI by one point. The association between fast-food

Table 2. Bivariate and multivariate association* between BMI and restaurant density, by restaurant service type

Restaurant type†	Total sample: (95% CI)	
	Model 1 (Bivariate)	Model 2 (Multivariable)‡
Fast-food service	0.037 (0.022 to 0.053)§	0.031 (0.017 to 0.045)§
Full service	-0.116 (-0.17 to -0.062)§	-0.06 (-0.11 to -0.013)§
Other restaurant service	-0.024 (-0.03 to -0.016)§	-0.014 (-0.019 to -0.008)§

* Survey sampling weights provided by Statistics Canada were used in all regressions.
† Density: outlets per 10,000 forward sortation area population based on the 2006 Canadian Census.
‡ Individual-level factors controlled for: demographic characteristics, socio-economic status, lifestyle and geographic characteristics, dissemination area. The estimated coefficients for these covariates are presented in the Appendix.
§ Statistically significant at $p<0.05$.

Table 3. Multivariate association* between BMI and restaurant density stratified by sex and urbanicity, by restaurant service type

Restaurant type†	Model 3 by sex: β (95% CI) ‡		Model 4 Urbanicity: β (95% CI) ‡	
	Males	Females	CMA	Non-CMA
Fast-food service	0.029 (0.0015 to 0.057)§	0.03 (0.003 to 0.05)§	0.037 (0.023 to 0.052)§	-0.003 (-0.025 to 0.019)
Full service	-0.084 (-0.174 to 0.005)	-0.022 (-0.107 to 0.062)	-0.06 (-0.11 to -0.011)§	-0.054 (-0.15 to 0.038)
Other service	-0.01 (-0.018 to -0.003)§	-0.017 (-0.025 to -0.009)§	-0.016 (-0.023 to -0.009)§	-0.0006 (-0.013 to 0.012)

* Survey sampling weights provided by Statistics Canada were used in all regressions.
† Density: outlets per 10,000 forward sortation area population based on the 2006 Canadian Census.
‡ Individual-level factors controlled for: demographic characteristics, socio-economic status, lifestyle and geographic characteristics, dissemination area level.
‡ Statistically significant at $p<0.05$.

Table 4. Association* between BMI and restaurant density for those living in CMAs, stratified by sex, by restaurant service type

Restaurant type†	Model 5 CMA: β (95% CI)‡	
	Males	Females
Fast-food service	0.032 (0.0009 to 0.063)§	0.041 (0.01 to 0.072)§
Full service	-0.1 (-0.19 to -0.0018)§	-0.008 (-0.1 to 0.08)
Other restaurant service	-0.01 (-0.018 to -0.001)§	-0.024 (-0.034 to -0.014)§

* Survey sampling weights provided by Statistics Canada were used in all regressions.
† Density: outlets per 10,000 forward sortation area population based on 2006 Canadian Census.
‡ Individual-level factors controlled for: demographic characteristics, socio-economic status, lifestyle and geographic characteristics, dissemination area level.
§ Statistically significant at $p<0.05$.

density and BMI was stronger in women residing in a CMA compared with the overall and sex-only stratification. The estimated regression coefficient of 0.041 (95% CI: 0.01 to 0.072) can be interpreted as a positive weight difference of 1.14 kg for a woman 58 kg (128 lb) in weight and 1.67 m (5′ 6″) in height with an additional 10 fast-food outlets (per 10,000 population) in an FSA. Full-service density was not statistically significant for women in the interaction model.

As far as the direction of the association for the other covariates is concerned, the results were in the expected direction. For example, on average BMI increased with age ($p<0.001$) and was higher for those who were married ($p<0.01$) and those who had no education ($p<0.001$). Recent immigrants and visible minorities had lower BMI, but mean BMI increased with duration of time since immigration. Several confounders were more important in stratified analyses. For example, income adequacy was not statistically significant in the full sample, as shown in the Appendix. However, when stratified by sex, income became significant and in the opposite directions for males and females (high vs. low income: $\beta=0.56$, $p<0.001$, for males; $\beta=-0.82$, $p<0.001$, for females). This suggests that for males, a high income is associated with a 0.56 points higher BMI on average compared with low-income male counterparts, whereas for women, a high income is associated with an average BMI that is 0.82 points lower than that of low-income females. Similarly, men who were married had a higher BMI than those who were single, but the effect of marriage was not significant in females (married vs. single: $\beta=0.63$, $p<0.01$, for males; $\beta=-0.2$, $p>0.05$, for females).

DISCUSSION

This study found that adult BMI was higher in areas in Canada that had a greater density of fast-food restaurants. An inverse association was seen with full-service restaurant density. The findings were robust even after the influence of individual-level lifestyle, socio-economic and demographic factors, as well as neighbourhood-level socio-economic factors, had been controlled for. The observed associations were predominantly found in Canada's CMAs, where the magnitude of associations for men and women differed. For a female of average height (1.67 m), a mean difference of 1.14 kg was estimated between FSAs that differed by 10 fast-food outlets (per 10,000 population). For men living in CMAs, the negative association between full-service restaurant density and BMI was more pronounced. On average, an FSA with 10 additional full-service restaurants corresponded to a negative weight difference of 3 kg (for males 1.76 metres tall).

This study adds to a growing body of literature focusing on the contextual effects of the built environment that promote unhealthy eating and sedentary lifestyle.[2] Exposure to fast-food outlets is argued by some to be a primary contributor in this regard.[15,24] Ecological studies, in which fast-food restaurant density has been linked to higher obesity rates, have offered evidence supporting the findings shown in this study.[25] In Canada, a recent study demonstrated an association between BMI and fast-food restaurant density using FSA-level data, citing the need for further research using individual-level data.[15] When individual-level data have been considered, the results so far have been largely mixed. Many studies have found a statistically

Appendix. Estimated Coefficients of All Covariates (Model 2)

Variable	Model 2 (Multivariable) β: (95% CI)
Fast-food restaurant density	0.031*** (0.017 to 0.045)
Full-service restaurant density	-0.061** (-0.110 to -0.013)
Other restaurant density	-0.014*** (-0.019 to -0.008)
Age	0.263*** (0.230 to 0.296)
Geography	
Urban (>500K pop)	-0.323*** (-0.500 to -0.147)
Non-urban (ref)	–
Sex	
Female	-1.524*** (-1.649 to -1.399)
Male (ref)	–
Marital status	
Married	0.221** (0.051 to 0.392)
Widowed/separated/divorced	0.035 (-0.214 to 0.283)
Single (ref)	–
Education	
Secondary	-0.309** (-0.544 to -0.074)
Some post-secondary	-0.363*** (-0.634 to -0.092)
Post-secondary	-0.552*** (-0.769 to -0.334)
No education (ref)	–
Immigration	
Immigrant (<10 y in Canada)	-1.459*** (-1.778 to -1.140)
Immigrant (>10 y in Canada)	-0.486*** (-0.701 to -0.270)
Canadian (ref)	–
Minority	
Non-White	-1.004*** (-1.278 to -0.729)
Race missing	0.579*** (0.270 to 0.888)
White (ref)	–
Labour market	
Student	-0.482*** (-0.776 to -0.189)
No work	0.043 (-0.133 to 0.219)
Unable to work	0.155 (-0.296 to 0.606)
Working (ref)	–
Income adequacy	
Mid low	0.015 (-0.177 to 0.207)
Mid	0.163* (-0.020 to 0.345)
Mid high	0.115 (-0.075 to 0.305)
High	-0.046 (-0.235 to 0.143)
Income missing	0.015 (-0.177 to 0.207)
Low (ref)	–
Child age (0-6)	
Yes	0.261*** (0.068 to 0.455)
No (ref)	–
Child age (6-11)	
Yes	-0.093 (-0.272 to 0.087)
No (ref)	–
Food security	
Moderate	0.840*** (0.528 to 1.153)
Insecure	0.422 (-0.088 to 0.933)
Secure (ref)	–
Fruit and vegetable consumption	
Medium	-0.064 (-0.187 to 0.059)
High	-0.444*** (-0.707 to -0.181)
Low (ref)	–
Smoking status	
Daily	-1.080*** (-1.259 to -0.901)
Occasional	-0.069 (-0.345 to 0.208)
Former daily	0.443*** (0.282 to 0.605)
Former occasional	0.043 (-0.123 to 0.210)
Never (refs)	–
Drinking habits	
Occasional	0.533*** (0.294 to 0.773)
Regular	-0.688*** (-0.880 to -0.496)
Never (refs)	–
Physical activity	
Moderate	0.471*** (0.324 to 0.618)
Inactive	1.099*** (0.957 to 1.240)
Active (ref)	–
Sedentary activity	
Moderate	0.232*** (0.077 to 0.386)
High	0.852*** (0.691 to 1.013)
Very high	1.316*** (1.123 to 1.510)
Low (refs)	–
Province	
NL	0.502** (0.117 to 0.887)
PE	0.299** (0.048 to 0.550)
NS	0.291** (0.031 to 0.551)
NB	0.196 (–0.068 to 0.459)
QC	–0.490*** (–0.696 to –0.284)
MB	0.219 (–0.092 to 0.530)
SK	0.502*** (0.231 to 0.773)
AB	0.228** (0.005 to 0.451)
BC	–0.682*** (–0.876 to –0.487)
ON (ref)	–
Neighbourhood-level variables Proportion in Dissemination Area	
Drive to work	0.495* (–0.021 to 1.010)
Married	0.094 (–0.585 to 0.772)
Low-income families	0.557 (–0.147 to 1.260)
Visible minority	–0.731*** (–1.231 to –0.230)
Low education	2.114*** (1.486 to 2.742)

* $p<0.1$.
** $p<0.05$.
*** $p<0.01$.

significant positive association between fast-food restaurant density and adult obesity,[6-9] though others have not,[11-14] and some have actually reported an inverse relationship.[10] Where a significant association was not observed, often the data were beset by a small sample or a potential lack of neighbourhood restaurant data variability. For instance, Simmons et al.[14] studied only 7 towns, and Wang et al.[13] used only 82 neighbourhoods. In this study, over 1,500 FSAs across a large sample of nationally representative adults were used, and the results were not dramatically different after accounting for confounding effects.

This study offered a comprehensive analysis of the local food-service environment with the inclusion of full-service restaurants and other non-chain restaurants in the analyses. As with Mehta and Chang in the US,[7] we found that the density of full-service restaurants had an inverse association with BMI in Canada. The opposite effects seen between fast-food and full-service restaurants may highlight the importance of consumer demand for convenience in developed nations. Dining at full-service restaurants is often for social or entertainment purposes, and purchasing decisions are not as likely to be made spontaneously, driven by time constraints and convenience. Full-service restaurants also have more restrictive hours than chain fast-food restaurants; in fact, irregular eating patterns, especially at night, are associated with increased obesity risk.[26] Overall, greater full-service restaurant density may also represent a more advantageous eating environment. One study found that consumers who valued healthy foods were 29% more likely to choose full-service establishments over fast-food outlets.[27] A negative effect was also seen for non-chain restaurant density, though the strength of the association was less than that for full-service restaurants. The findings suggest that, as a risk factor for obesity, on average non-chain restaurants may have some characteristics similar to those of full-service restaurants rather than of chain fast-food outlets.

Limitations

The cross-sectional study design limits the ability to draw causal inferences from observed associations. A study in which both BMI and area-level restaurant density were tracked longitudinally could be more useful, as the effect of changes in restaurant density on changes in BMI or a measure of obesity could be studied in order to ascertain causal associations. Another potential drawback arises from BMI being derived from self-reported data. Although an error correction factor was applied, point estimates may still be biased in the downward direction as a result of under-reporting of weight. We think this bias might have underestimated the strengths of the associations between restaurant density and BMI in this study. Another limitation of CCHS data is that First Nations people living in a First Nations community are excluded from the sampling frame. With regard to the classification of restaurants, no rigid definition for what constitutes a fast-food restaurant exists in the literature. The drawback of our approach is a certain degree of inevitable misclassification, as a number of independent establishments may offer fast-food services. This may be especially true for independent ethnic restaurants.

Another issue is the decision to use FSA as the relevant neighbourhood-level geographic unit for exposure to the local food-service environment. Other studies have used more exact measures, such as buffer zones of varying areas around individual places of residence.[13,24] In our case, the use of buffer zones was not possible because the smallest unit of geographic identification available in the CCHS data was postal codes. However, constructing restaurant density variables at a lower level of geographic classification, such as six-digit postal codes or dissemination areas, may not be meaningful since individuals are more likely to consume restaurant foods in the vicinity of their residence and workplace.

Despite the above limitations, this study has a number of strengths. Most important, it was carried out using data from a large nationally representative sample of Canadian adults. Moreover, we had access to reliable geographic data on the locations of all restaurants in Canada, from which we were able to construct area-level restaurant density variables. This study was able to control for a rich set of socio-economic and neighbourhood-level confounding variables.

CONCLUSIONS

This research is the first to investigate the association of fast-food and full-service restaurant density with BMI using individual-level data from a nationally representative survey from Canada. These findings are important, as fast-food availability is potentially a practical policy lever. For instance, zoning bylaws could be implemented at the municipal level to regulate the number and density of fast-food restaurants, and their proximity to schools and hospitals, or to institute an outright ban in certain areas.[28,29] Several US cities have begun adopting similar bylaws recently.[28] Epidemiologic evidence is needed to consider and understand the effectiveness of these types of initiatives in Canada.

BMI was the primary outcome examined in this study, but the adverse health effects of fast food on health outcomes may be wide-ranging. Among other health problems, exposure to fast-food restaurants has been associated with mortality and hospital admissions for acute coronary events in Ontario,[30] further highlighting the overarching health risks associated with exposure to fast food.

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RÉSUMÉ

OBJECTIF : La consommation fréquente d'aliments de restauration rapide est un facteur de risque d'obésité bien connu. Nous avons cherché à déterminer si la présence de restaurants rapides a une influence sur l'indice de masse corporelle (IMC).

MÉTHODE : L'IMC et les variables de confusion individuelles ont été puisés dans l'Enquête sur la santé dans les collectivités canadiennes de 2007-2008. Les variables sociodémographiques par quartier ont été obtenues dans le Recensement du Canada de 2006. Nous avons déterminé l'emplacement géographique de tous les restaurants au Canada à partir d'un registre des entreprises validé. Nous avons calculé la densité pout 10 000 habitants des restaurants rapides, plein service et n'appartenant pas à une chaîne, selon la région de tri d'acheminement des répondants. Nous avons effectué des analyses de régression multivariées pour étudier l'association entre la densité des restaurants et l'IMC.

RÉSULTATS : Les variables de densité des restaurants rapides, plein service et n'appartenant pas à une chaîne présentaient une corrélation significative avec l'IMC. Pour la densité des restaurants rapides, cette association était positive, tandis que pour les restaurants plein service et n'appartenant pas à une chaîne, la densité était négativement associée à l'IMC (chaque tranche supplémentaire de 10 restaurants rapides par habitant correspondait à une hausse pondérale d'1 kilogramme; p<0,001). Ces associations étaient principalement observées dans les grands centres urbains du Canada.

CONCLUSIONS : Notre étude est la première à analyser l'influence de la densité des restaurants rapides et plein service sur l'IMC à l'aide de données individuelles provenant d'une enquête nationale représentative menée au Canada. La découverte d'une association positive entre la densité des restaurants rapides et l'IMC donne à penser que les interventions visant à limiter la présence des restaurants rapides à l'échelle des quartiers pourraient être des stratégies utiles pour prévenir l'obésité.

MOTS CLÉS : obésité; aliments de restauration rapide; indice de masse corporelle; environnement et santé publique