Relative and absolute availability of fast-food restaurants in relation to the development of diabetes: A population-based cohort study

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ABSTRACT

OBJECTIVES: To determine whether residents living in areas with a high proportion of fast-food restaurants (FFR) relative to all restaurants are more likely to develop diabetes and whether the risk varies according to the volume of FFR.

METHODS: The study cohort consisted of adult respondents (20–84 years) to the Canadian Community Health Survey (cycles 2005, 2007/2008, 2009/2010) who resided within walking distance (720 m) of at least one restaurant in Toronto, Brampton, Mississauga or Hamilton, ON. The development of diabetes was established by linking participants to the Ontario Diabetes Database. Cox proportional hazards models were used to estimate hazard ratios (HRs) of incident diabetes associated with relative and absolute measures of restaurant availability.

RESULTS: During a median follow-up of 5 years, 347 of 7,079 participants (4.6%) developed diabetes. Among younger adults (20–65 years, n = 5,806), a greater proportion of fast-food relative to all restaurants was significantly associated with incident diabetes after adjustment for a range of individual and area-level covariates, but only in areas with high volumes of fast-food retailers (3+ outlets) (HR = 1.79, 95% confidence interval: 1.03–3.12, across the interquartile range). Adjusting for body mass index rendered this association non-significant. No significant associations were observed in areas with low volumes of FFR or among older adults (65–84 years, n = 1,273). Absolute availability (number) of fast-food and other restaurants was generally unrelated to incident diabetes.

CONCLUSION: Areas with the double burden of a high volume of FFR and few dining alternatives may represent an adverse environment for the development of diabetes.

KEY WORDS: Diabetes mellitus; fast food; restaurants; body mass index; cohort studies

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

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Diabetes has emerged as one of the most serious public health challenges of the 21st century because of the heavy burden it imposes on individuals, families and the health care system.[1,2] In Canada, rates of diabetes have risen dramatically over the past two decades,[3] with an estimated 3.4 million Canadians (9.3%) currently living with diabetes and another 1.6 million expected to develop the condition by 2025.[4] Overweight and obesity are important drivers of the diabetes epidemic in the population, particularly in developed nations like Canada.[2] Physical inactivity, sedentary living and the Western diet play a key role as risk factors for overweight and obesity, and through their independent effects on diabetes risk.[2]

Canadians frequently consume meals away from home, many of which are purchased at fast-food restaurants (FFR).[5] Fast food tends to be energy dense and of poor nutritional quality,[6] making it a convenient target for public policies promoting healthier eating. Prospective studies have linked regular consumption of fast food to the risk of obesity, insulin resistance and type 2 diabetes.[7,8] However, studies exploring the relationship between local exposure to FFR and obesity have yielded mixed results.[9] For example, a recent national study observed a positive association between mean body mass index (BMI) and a greater number of chain FFR within large administrative areas, and a negative association for other restaurant types.[10] Other studies using smaller geographic levels (e.g., the number of FFR within walking distance of residential areas) found no association or results in the opposite direction.[11–13] Measures of FFR exposure also vary widely across studies (e.g., absolute numbers or density of outlets, proximity to outlets), and most studies on the topic are cross-sectional, which limits any conclusions about causality.[9]

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Moreover, there is a dearth of data exploring *direct* links between the retail food environment and the development of other diet-related outcomes, like diabetes.

A growing number of recent reports indicate that *relative* measures, such as the ratio or proportion of various types of food retail outlets, may be more useful than absolute measures for understanding associations with dietary behaviours and related health outcomes, because they better reflect the balance of available resources.[11,12,14] A recent study from Ontario found a strong relationship between the concentration of fast-food relative to other types of restaurants and obesity in areas with high volumes of fast-food retailers.[11] In light of these findings, the primary aim of this study was to assess whether this exposure accelerates the risk of diabetes. More specifically, we tested whether the percentage of all local restaurants that offer fast food is associated with the development of diabetes, and whether this association varies according to the volume of FFR. Our secondary aim was to assess whether BMI mediates any such associations. Last, we also assessed whether the number of FFR and other types of restaurant alone is associated with incident diabetes. This study represents one of the first investigations into the impact of the local restaurant environment on the risk of developing diabetes and the first study using Canadian data.

METHODS

Study cohort

Participant data for this retrospective cohort study came from Ontario respondents to three cycles of the Canadian Community Health Survey (CCHS)[15] who agreed to have their data linked with their personal health information (Share Files 2005, 2007/2008 and 2009/2010). We selected adult participants aged 20 to 84 years residing in urban, residential areas of four cities in southern Ontario: Toronto, Brampton, Mississauga and Hamilton. Eligible participants were those who were free of diabetes on the day of survey participation (according to their inclusion in the Ontario Diabetes Database (ODD) or self-report in the CCHS) and eligible for provincial health coverage for a minimum of 1 year at baseline. The final study cohort consisted of 7,079 participants who resided within walking distance of at least one restaurant.

Diabetes incidence

Cohort participants were followed forward in time from the date of CCHS interview until March 31, 2013. Incident diabetes was ascertained by linking individuals to the ODD, a validated and cumulative population-based registry of all patients with diabetes based on physician service claims and hospital discharge records since 1991.[16] The ODD's selection criteria have been demonstrated to have 86% sensitivity and 97% specificity in identifying patients with confirmed diabetes.[16] While the ODD does not differentiate between type 1 and 2 diabetes, the majority of people (90%–95%) with diabetes have type 2 diabetes.[17]

Restaurant environment

Data on restaurant locations were purchased from a commercial database (Dun & Bradstreet, Canada), which contained the geocoded locations of all restaurants in the study area in January 2008. After selecting the initial list of all eating establishments using North American Industry Classification System codes, we then conducted extensive cleaning of extracted records and additional reclassifying efforts consistent with a protocol adopted in previous studies.[18] We defined FFR as locally owned or chain limited-service restaurants (establishments without table service where patrons pay before receiving their meal) serving full meals. All remaining restaurants were classified as either full-service (establishments where patrons order and are served while seated, and pay after eating) or other restaurants (all other eating places such as cafes, coffee shops or snack-type outlets).

Restaurant exposure was derived for small residential parcels of land known as dissemination blocks (DBs) defined by Statistics Canada and assigned to individuals on the basis of their residential postal code (average of 2.4 study participants per block). For each participant, restaurant exposure was calculated as a buffer zone around the geometric centroid of the DB using network analysis tools in ArcGIS 9.3 software (ESRI, Redlands, CA). Although a wide range of buffer distances has been used in previous research, the majority of studies use buffer zones ranging from 500 to 1000 m to represent a neighbourhood environment accessible by walking.[19,20] In this study, we calculated the number of restaurants within a ~10-min walking distance (720 m) of DB centroids, based on an estimated speed of 1.2 m/sec and using an existing street network. This number represents the *absolute* availability of each restaurant type within a 10-min walk. *Relative* availability of FFR was calculated as the percentage of FFR relative to all restaurants within each buffer (absolute number of FFR/absolute number of total restaurants × 100%).

Baseline covariates

Baseline information on socio-demographic characteristics, smoking status and BMI of cohort participants was derived from the CCHS and is listed in Table 1. Household income adequacy was measured in quintiles and is a relative measure of participants' household income relative to all other Ontario respondents, adjusted for household and community size. Participants with missing values for household income were included in a separate category. BMI (kg/m^2) values were derived from self-reported height and weight data and were corrected for bias resulting from self-report using a validated error correction factor.[21]

Because of previously reported associations between the local retail food environment, area socio-economic composition, walkability and diabetes,[22–25] our analyses included composite indices of material deprivation and walkability at slightly larger geographic units than DBs – dissemination areas (small census areas with an average population of 400–700 people). Area material deprivation was measured using the Ontario Marginalization Index, a theoretically informed and empirically derived composite index of Canadian marginalization[26] previously shown to relate to the distribution of retail food outlets across this study's area.[23] Area walkability was assessed using a validated walkability index recently linked to levels of obesity and diabetes in Toronto.[22,24]

Statistical analysis

All statistical analyses were performed using SAS 9.3 (SAS Institute, Cary, NC) and applied standard sampling weights provided by Statistics Canada in order to maintain population representativeness. The SURVEY Cox proportional hazard

Table 1. Baseline characteristics of cohort participants (n = 7079)

Characteristic	Mean ± SD or *n* (%)
Age in years	43.4 ± 16.8
20–39	1244 (22.4)
30–64	4562 (65.9)
65–84	1273 (11.7)
Female	3881 (52.4)
Male	3198 (47.6)
Married/cohabiting	3461 (57.5)
Divorced/separated/widowed	1424 (12.9)
Single	2187 (29.6)
White	4911 (58.8)
Non-White	2139 (41.2)
Non-immigrant	3938 (47.7)
Immigrant	3126 (52.3)
High school or less	1968 (27.2)
Some post-secondary	2693 (38.1)
University or higher	2390 (34.7)
1 Lowest household income adequacy	1810 (23.8)
2 Medium-low	1446 (19.6)
3 Middle	1138 (14.8)
4 Medium-high	1105 (14.6)
5 Highest household income adequacy	1029 (13.6)
Missing	551 (13.6)
Toronto	4355 (72.7)
Brampton/Mississauga	1504 (19.1)
Hamilton	1220 (8.2)
Current smoker	1580 (21.8)
Former smoker	2630 (32.4)
Never smoked	2856 (45.8)
Survey cycle 2005	2170 (29.3)
Survey cycle 2007–2008	2622 (37.3)
Survey cycle 2009–2010	2287 (33.5)
Body mass index, kg/m^2	26.2 ± 4.9

Note: Frequencies presented in the table are unweighted counts, and percentages are weighted using survey sampling weights.

regression procedure was used to estimate hazard ratios (HRs) and associated 95% confidence intervals (CIs) for incident diabetes. Cohort participants were followed from the date of CCHS interview until diabetes diagnosis, death or end of study period (March 31, 2013), whichever occurred first. Each restaurant exposure measure was modeled separately, and all models accounted for the clustering of participants within DBs using the CLUSTER statement.

The main analyses comprised three models that examined the effect of relative restaurant availability on incident diabetes: Model 1 is an unadjusted model. Model 2 adjusted for all the individual-level socio-demographic baseline covariates shown in Table 1, as well as area-level material deprivation and walkability. Leisure-time physical activity and alcohol intake were also considered as possible confounders; however, adjustment for these variables did not change the final results, and they were therefore omitted for parsimony. Model 3 added a term for BMI in order to examine whether BMI may mediate the association between restaurant exposure and risk of diabetes.

In order to allow for greater comparability of effect sizes across variables with different distributions, each restaurant measure was rescaled by its interquartile range (IQR, difference between the 25th and 75th percentiles of each variable's distribution). Each HR unit thus represents the effect of one IQR increase of restaurant availability on the risk of incident diabetes. These IQRs corresponded to increases of 2 FFR, 4 full-service restaurants, 2 other restaurants, 8 total restaurants and 42.1% in the percentage of all restaurants that were FFR.

Because of a previously reported joint effect of relative and absolute FFR exposure on excess body weight,[11] we also assessed effect modification of relative FFR availability by the absolute number of FFR using interaction terms and stratified analyses. Analyses stratified by lower and higher volume of FFR were limited to 5,506 participants with 1 or more FFR within walking distance, because the relative number of FFR does not vary (i.e., can only equal 0%) when the absolute number of FFR = 0 but can have a value of up to 100% when the absolute number of FFR ≥1. Furthermore, because the effect of BMI on diabetes incidence is less pronounced among older adults[27] and because older Canadians tend to consume healthier diets and less fast food than younger adults,[5] we chose to stratify all analyses by age group (20–64 and 65–84 years).

Finally, we also tested the sensitivity of associations within a larger distance accessible by motorized transport by generating all analyses using larger, 3-km buffers (N = 10,135 participants). The study protocol was approved by the University of Toronto and Sunnybrook Health Sciences Centre research ethics boards.

RESULTS

Baseline characteristics of cohort participants are presented in Table 1. The majority of participants were adults of working age (<65 years, 88.3%) and resided in Toronto (72.7%). The average BMI placed participants in the overweight range (26.2 kg/m^2). During a median follow-up of 5 years (IQR 3.6–7.3 years), 347 participants developed diabetes (crude incidence of 4.6% or 9.1 per 10,000 person years).

In the overall sample, there was no significant association between the relative number of FFR (as the percentage of all restaurants within walking distance) and diabetes incidence (Table 2). However, because we identified a significant interaction between the relative share and the absolute number (i.e., volume) of FFR in relation to diabetes incidence, we generated analyses stratified by lower and higher volume of FFR. In areas with a high volume of FFR (3+ outlets), a greater relative share of FFR was related to higher risk of diabetes (HR = 1.76; 95% CI: 1.14–2.72, across the IQR) in the unadjusted analysis. However, this association was rendered non-significant after adjustment for individual and area-level covariates.

When analyses were further stratified by age, the heightened risk of diabetes related to a greater relative number of FFR persisted among younger adults aged 20–64 residing in areas with a high volumes of FFR (Table 2). In this group, a one IQR (42%) increase in the percentage of all restaurants that were FFR was related to a 79% higher risk of diabetes, after adjustment for covariates (Model 2; HR = 1.79; 95% CI: 1.03–3.12). Adjustment for BMI as a potential mediator attenuated this association by over 20%, rendering it non-significant (Model 3; HR = 1.40; 95% CI: 0.70–2.80, across the IQR). In contrast, the relative number of FFR was not significantly related to diabetes incidence among older adults or those of any age living in areas with low volumes of FFR.

Table 2. Relative number of fast-food restaurants (FFR) in relation to diabetes incidence in all areas and stratified by absolute number (volume) of FFR and age*

Relative number (%) of FFR	All areas			Low volume of FFR (1–2 outlets)‖			High volume of FFR (3+ outlets)‖		
	HR	(95% CI)	*p* value	HR	(95% CI)	*p* value	HR	(95% CI)	*p* value
All participants		*n* = 7079			*n* = 2837			*n* = 2669	
Model 1, unadjusted†	1.17	(0.91, 1.49)	0.218	1.11	(0.79, 1.55)	0.549	1.76	(1.14, 2.72)	0.011
Model 2, adjusted†	1.17	(0.89, 1.54)	0.264	1.16	(0.78, 1.72)	0.467	1.39	(0.82, 2.34)	0.222
Model 3, BMI as mediator§	1.10	(0.81, 1.48)	0.549	1.11	(0.72, 1.70)	0.648	1.27	(0.78, 2.06)	0.335
Age 20–64		*n* = 5806			*n* = 2330			*n* = 2219	
Model 1, unadjusted†	1.27	(0.96, 1.68)	0.096	1.29	(0.87, 1.90)	0.201	2.12	(1.29, 3.46)	0.003
Model 2, adjusted†	1.24	(0.89, 1.75)	0.205	1.32	(0.82, 2.12)	0.257	1.79	(1.03, 3.12)	0.039
Model 3, BMI as mediator§	1.12	(0.76, 1.65)	0.562	1.20	(0.69, 2.07)	0.517	1.40	(0.70, 2.80)	0.336
Age 65+		*n* = 1273			*n* = 507			*n* = 450	
Model 1, unadjusted†	0.83	(0.58, 1.20)	0.329	0.61	(0.32, 1.16)	0.131	0.62	(0.23, 1.71)	0.353
Model 2, adjusted†	0.96	(0.67, 1.38)	0.835	0.70	(0.40, 1.24)	0.222	0.56	(0.20, 1.59)	0.272
Model 3, BMI as mediator§	1.04	(0.72, 1.49)	0.843	0.76	(0.45, 1.30)	0.320	0.85	(0.35, 2.10)	0.725

HR = hazard ratio; 95% CI = 95% confidence interval; BMI = body mass index.
* Relative number of FFR was defined as the percentage of FFR relative to total restaurants within a 10-min walk of participants' residential areas. Results presented in the table are from separate Cox Proportional Hazard models. HRs represent the risk of incident diabetes estimated for 1 interquartile range increase in FFR proportion (42.1%).
† Model 1 is an unadjusted model.
‡ Model 2 is adjusted for age, sex, ethnoracial group, immigration status, education level, household income adequacy, smoking status, city of residence, area deprivation, area walkability and survey cycle.
§ Model 3 is adjusted for covariates in Model 2 and BMI, as a potential mediator.
‖ Stratified analyses by absolute number (volume) of FFR were restricted to 5506 participants.

Associations between absolute numbers of FFR and other restaurant types within walking distance are presented in Figure 1. Among younger adults, an increase of 4 full-service restaurants was related to a 9% lower risk of diabetes (HR = 0.91; 95% CI: 0.83–1.00). Associations for other restaurant types were similarly in the inverse direction, although failing to reach statistical significance. No significant associations were found for older adults aged 65–84, with all HRs near the null value.

The results of sensitivity analyses using the larger 3-km buffers yielded qualitatively similar results to the main analyses (data not shown).

DISCUSSION

This study represents one of the first investigations into the direct impact of the local retail food environment on incident diabetes and the first Canadian study of its kind. Using a population-based, urban cohort, we showed that exposure to a greater proportion of FFR relative to all restaurants within walking distance of participants' residential areas accelerated the risk of developing diabetes, but only among younger adults living in areas with high volumes of FFR (3+ outlets). In this subgroup, a ~40% increase in the percentage of all restaurants that were fast food was related to a 79% higher risk of developing diabetes, with adjustment for individual-level socio-economic covariates, area deprivation and walkability. Further adjustment for BMI attenuated this association. These findings suggest that the most adverse restaurant environment in relation to incident diabetes is one in which a high volume of FFR is poorly balanced by other types of dining options, and that this association may be mediated by higher body weight.

While the novel nature of these findings does not allow for direct comparisons with previous reports, our findings are consistent with the results of one recent study from Ontario, which demonstrated substantially elevated levels of obesity – a leading risk factor for diabetes – among adults residing in areas with both a high volume of FFR and low proportion of non-FFR.[11] Recent studies from Montreal and the US using similar measures of FFR availability have linked a higher relative concentration of FFR to lower quality diets and higher weight status among local residents.[12,28,29] Given experimental evidence demonstrating that the variety of available food options has a strong influence on food choices and the amount of food consumed,[30] it is possible that local exposure to the combination of a high volume and high share of FFR may similarly affect how individuals anchor their food purchasing decisions given the slate of available options, with less healthy options potentially competing with and "crowding out" healthier options.[31] Recurrent exposure to this type of restaurant environment may also contribute toward normalizing fast food, thereby influencing individuals' propensity for its consumption both within and outside residential settings. Additionally, given recent evidence that certain individuals (e.g., those who are highly reward sensitive) may be more susceptible to unhealthy environmental cues (including higher proportion of FFR near their home),[32] it is possible that exposure to a high volume of FFR that is poorly balanced by non-FFR may serve as an additional unique cue for vulnerable individuals to crave and consume fast food; this merits further investigation.

This study failed to observe significant associations between incident diabetes and the absolute number (volume) of FFR and other restaurants, with the exception of a significant negative association for full-service restaurants among younger adults. These findings contrast with those of the only previously published investigation of diabetes risk related to FFR exposure, which observed an elevated risk of prevalent diabetes among adults living within walking distance of a greater number of FFR.[33] However, when excess weight is considered, our results are in line with several Canadian and US reports observing lower weight status among residents of areas with a greater volume of FFR, other restaurants and food retail in general.[11–13] Such findings reflect the common coexistence of higher volumes of food retail in areas that

	HR	(95% CI)	*p*-value
Fast-food restaurants			
All participants	0.95	(0.87, 1.04)	0.269
Aged 20-64	0.96	(0.86, 1.07)	0.413
Aged 65+	0.94	(0.79, 1.12)	0.499
Full-service restaurants			
All participants	0.93	(0.86, 1.01)	0.070
Aged 20-64	0.91	(0.83, 1.00)	0.039
Aged 65+	1.02	(0.92, 1.12)	0.749
Other restaurants			
All participants	0.96	(0.91, 1.02)	0.172
Aged 20-64	0.95	(0.89, 1.02)	0.163
Aged 65+	1.01	(0.92, 1.11)	0.843
Total restaurants			
All participants	0.92	(0.84, 1.01)	0.080
Aged 20-64	0.90	(0.81, 1.01)	0.064
Aged 65+	1.00	(0.87, 1.16)	0.965

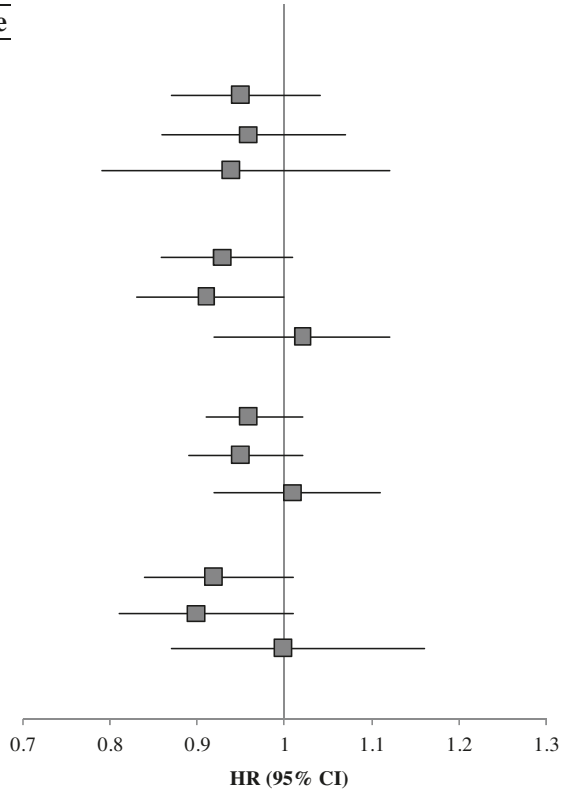

Figure 1. Absolute numbers of restaurants in relation to diabetes incidence*. HR = hazard ratio; 95% CI = 95% confidence interval. * Results of separate Cox proportional hazard models. HRs represent the risk of incident diabetes estimated for 1 interquartile range increase in the following absolute numbers of restaurants: 2 for fast-food restaurants; 4 for full-service restaurants; 1 for other restaurants; 8 for total restaurants. All models adjust for the following covariates: age, sex, ethnoracial group, immigration status, education level, household income adequacy, smoking status, city of residence, area deprivation, area walkability and survey cycle.

are more walkable (i.e., areas with a high diversity of land uses and many walkable destinations), a feature that has been repeatedly linked to higher rates of physical activity and lower rates of obesity and diabetes.[22,24] Thus, our adjustment for area walkability was intended to account for features of urban form that track with greater availability of restaurants, and represents an important improvement over previous studies on the topic.

The lack of associations seen among older adults (aged 65–84) in our study for both relative and absolute availability of FFR is consistent with our initial hypothesis that older adults may be less susceptible to any adverse effects of the retail food environment on diabetes risk. However, our sample of older adults was small, and so these results should be interpreted with caution. Other limitations of this analysis include a relatively short follow-up period (median of 5 years), which resulted in a small number of events. The transition from pre-diabetes states to diabetes spans many years, and so future studies with longer follow-up periods and those incorporating cumulative measures of food retail exposure are warranted. As with all observational research and despite our extensive control for individual- and area-level covariates, we cannot rule out the possibility that residual confounding by unmeasured or mismeasured characteristics may account for some of the observed results. Furthermore, our classification of restaurants into three broad categories may have introduced some degree of misclassification, and data on individuals' consumption of restaurant foods or detailed information on dietary intake were not available. This study focused on restaurant availability near the home and lacked data on restaurant exposure in other important settings of daily life (e.g., near the workplace), which may also influence diet and body weight.[12,34] Finally, the generalizability of our results is limited to urban or suburban areas with access to restaurants within walking distance.

CONCLUSION

This study documented an important interaction between the relative share and the volume of FFR in relation to incident diabetes, indicating that proximity to a high volume of FFR (3+ outlets) matters only if they are the predominant type of restaurant in the area. This association was limited to younger adults (<65 years), a group experiencing the most rapid rise in diabetes incidence,[3] likely a result of increasing levels of overweight and obesity. These findings are important as Canadian and US policy-makers increasingly target the local retail food environment with policies to restrict the number of FFR in certain areas as a means of promoting healthier food choices and reducing rates of obesity and associated health outcomes.[25,35] Findings from this

study suggest that policies merely targeting the volume of FFR or other retail food outlets may have limited effectiveness without a concurrent consideration of the overall balance of outlets within the local retail food landscape. Future studies should aim to replicate these findings in other settings, and additional evidence from longitudinal investigations and natural experiments to help define the optimal balance between outlets serving more and less healthful foods would be valuable for the design of effective health-promoting policies and interventions.

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RÉSUMÉ

OBJECTIFS : Déterminer si les résidents de secteurs comptant une proportion élevée de restaurants rapides (RR) par rapport à l'ensemble des restaurants sont plus susceptibles de contracter le diabète et si le risque varie selon le volume de RR.

MÉTHODE : Cette étude de cohorte comprenait les répondants adultes (20–84 ans) de l'Enquête sur la santé dans les collectivités canadiennes (cycles 2005, 2007–2008, 2009–2010) résidant à distance de marche (720 m) d'au moins un restaurant à Toronto, Brampton, Mississauga ou Hamilton (Ontario). Nous avons établi la survenue du diabète en reliant les participants à la base de données sur le diabète de l'Ontario. Nous avons utilisé des modèles à risques proportionnels de Cox pour estimer les coefficients de danger (QD) du diabète incident associés aux indicateurs relatifs et absolus de disponibilité des restaurants.

RÉSULTATS : Au cours d'un suivi médian de 5 ans, 347 des 7,079 participants (4.9 %) ont contracté le diabète. Chez les adultes les plus jeunes (20–65 ans, *n* = 5,806), une proportion plus élevée de restaurants rapides par rapport à l'ensemble des restaurants présentait une corrélation significative avec le diabète incident compte tenu d'une gamme de covariables individuelles et par secteur, mais seulement dans les secteurs ayant des volumes élevés de restaurants rapides (3 ou plus) (QD = 1.79, intervalle de confiance de 95 % : 1.03–3.12, dans tout l'écart interquartile). Si l'on tient compte de l'indice de masse corporelle, cette association devient non significative. Aucune association significative n'a été observée dans les secteurs ayant de faibles volumes de RR, ni chez les personnes âgées (65–84 ans, *n* = 1,273). La disponibilité absolue (le nombre) des restaurants rapides et des autres restaurants était en général sans rapport avec le diabète incident.

CONCLUSION : Les secteurs ayant un volume élevé de RR, mal équilibré par rapport aux autres types de restaurants, peuvent représenter un milieu défavorable pour ce qui est de la survenue du diabète.

MOTS CLÉS : diabète sucré; aliments de restauration rapide; restaurants; indice de masse corporelle; études de cohortes