# Linking Childhood Obesity to the Built Environment: A Multi-level Analysis of Home and School Neighbourhood Factors Associated With Body Mass Index

Jason A. Gilliland, PhD,[1-3] Claudia Y. Rangel, MA,[1] Martin A. Healy, MSc,[1] Patricia Tucker, PhD,[4] Janet E. Loebach, MEDes,[1] Paul M. Hess, PhD,[5] Meizi He, PhD,[6] Jennifer D. Irwin, PhD,[7] Piotr Wilk, PhD[3,8]

## ABSTRACT

**Objectives:** This study examines environmental factors associated with BMI (body mass index) levels among adolescents with the aim of identifying potential interventions for reducing childhood obesity.

**Methods:** Students (n=1,048) aged 10-14 years at 28 schools in London, ON, completed a survey providing information on age, sex, height, weight, home address, etc., which was used to construct age-sex adjusted BMI z-scores. The presence of recreation opportunities, fast-food outlets and convenience stores was assessed using four areal units around each participant's home and school neighbourhood: "circular buffers" encompassing territory within a straight-line distance of 500 m and 1000 m; and "network buffers" of 500 m and 1000 m measured along the street network. School neighbourhoods were also assessed using school-specific "walksheds". Multilevel structural equation modeling techniques were employed to simultaneously test the effects of school-environment (Level 2) and home-environment (Level 1) predictors on BMI z-scores.

**Results:** Most participants (71%) had a normal BMI, 16.9% were overweight, 7.6% were obese, and 4.6% were considered underweight. Multilevel analyses indicated that built environment characteristics around children's homes and schools had a modest but significant effect on their BMI. The presence of public recreation opportunities within a 500 m network distance of home was associated with lower BMI z-scores ($p<0.05$), and fast-food outlets within the school walkshed was associated with higher BMI z-scores ($p<0.05$).

**Conclusion:** Interventions and policies that improve children's access to publicly provided recreation opportunities near home and that mitigate the concentration of fast-food outlets close to schools may be key to promoting healthy lifestyles and reducing childhood obesity.

**Key words:** Obesity; child; adolescent; environment; diet; recreation

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

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Childhood obesity has become a critical public health issue in Canada, as rates have tripled over the past three decades.[1] Over one in four Canadian children are either overweight or obese (17% and 9% respectively).[2] The increased prevalence of childhood obesity has been linked to the concurrent rise of physical health problems normally associated with adults, including Type 2 diabetes, hypertension, heart disease and pulmonary diseases, as well as socio-psychological afflictions such as discrimination, behavioural problems, negative self-esteem, anxiety and depression.[3-6] A rapidly expanding avenue of research suggests that rising rates of obesity are due not only to individual-level factors (i.e., genetics), but also to characteristics of our local built environments that may be encouraging or discouraging the healthy diets or active lifestyles associated with healthy body weights.[7-10]

Previous research has confirmed that obesity is linked to the consumption of energy-rich, fast foods.[11] Large-scale US studies have found that adult obesity rates are positively associated with the density of neighbourhood fast-food outlets[12] and convenience stores.[13] Much of the emphasis on the link between food and children's health focuses on advertising[14] or food policies within schools;[15-17] however, some policy-makers and public health professionals are shifting their focus to the food environments surrounding schools, as new research indicates that many children visit food retailers on their way to and from school, mostly filling up on high-sugar or high-fat, energy-dense foods.[18] Several studies have shown that fast-food outlets are more prevalent near schools[19,20] and in low-income neighbourhoods,[21,22] suggesting that these vulnerable populations may be at heightened risk of developing poor eating habits as a result of increased exposure to unhealthy foods. Furthermore, it has been shown in London, ON,

**Author Affiliations**

1. Human Environments Analysis Laboratory, Department of Geography, University of Western Ontario, London, ON
2. School of Health Studies and Department of Paediatrics, University of Western Ontario, London, ON
3. Scientist, Children's Health Research Institute & Lawson Health Research Institute, London, ON
4. School of Occupational Therapy, University of Western Ontario, London, ON
5. Department of Geography & Program in Planning, University of Toronto, Toronto, ON
6. Department of Health & Kinesiology, The University of Texas at San Antonio, San Antonio, TX
7. School of Health Studies, University of Western Ontario, London, ON
8. Department of Paediatrics and Department of Epidemiology & Biostatistics, University of Western Ontario, London, ON

**Correspondence:** Jason A. Gilliland, Dept. of Geography, University of Western Ontario, 1151 Richmond St, London, ON N6A 5C2, Tel: 519-661-2111, ext. 81239, Fax: 519-661-3750; E-mail: jgillila@uwo.ca

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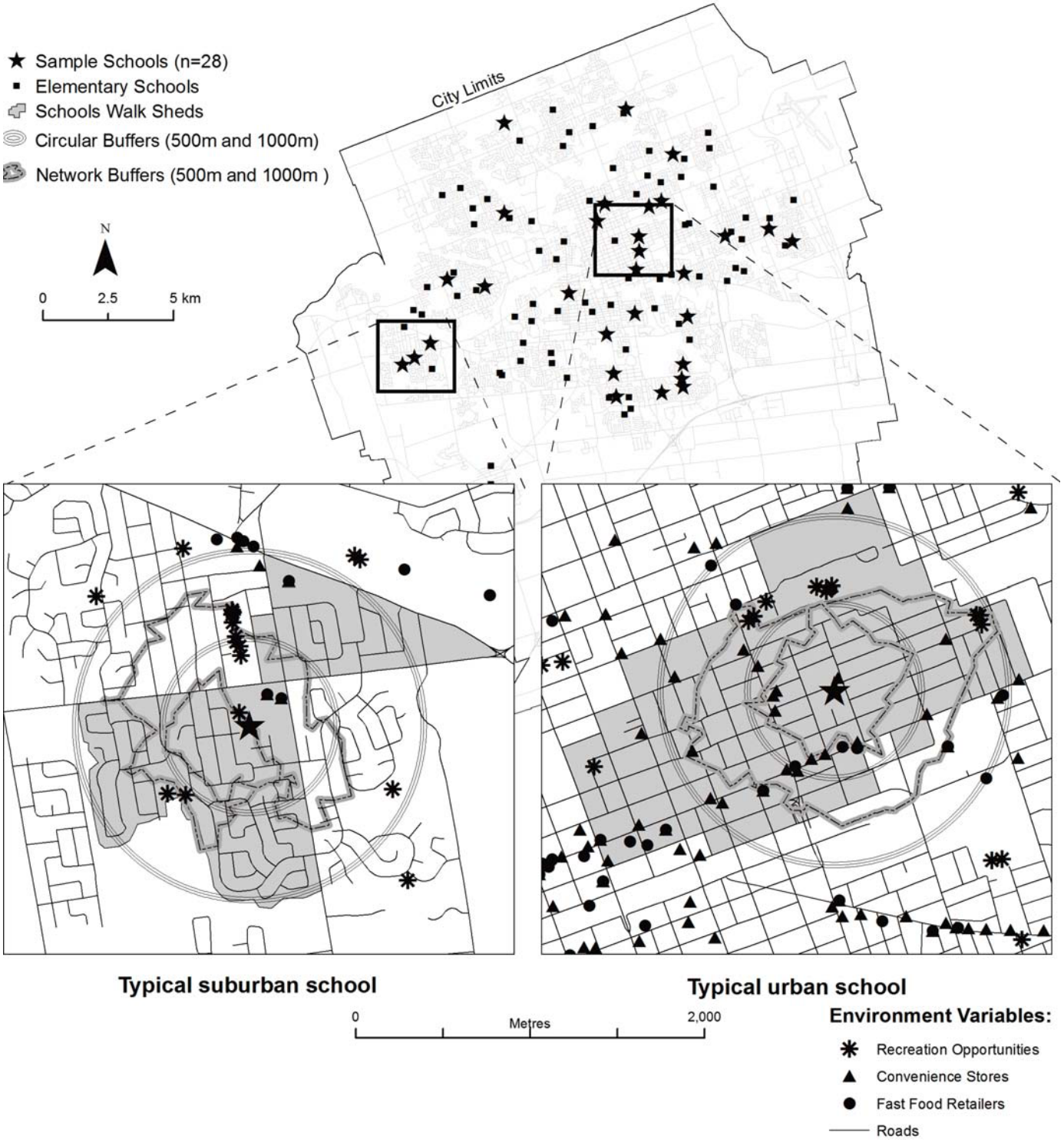
**Figure 1.** Illustration of different areal units used for characterizing neighbourhood environments




that the presence of fast-food outlets and convenience stores within 1 km of school is linked to increased junk food purchasing[23] and poorer diets.[24] However, a national study of Canadian students in grades 6-10 found that increased number of food retailers within 1 km of the school did not increase the likelihood of the students being overweight.[25] More research is needed to confirm the links between the local food environment and childhood obesity.

Increased physical activity is associated with reduced obesity and other health benefits for children and youth.[26] Unfortunately, Canadian children devote 62% of their free time (after school and weekends) to sedentary pursuits, and activity levels decline with age.[27] A growing body of research suggests that the layout and design of children's neighbourhood environments may be a key facilitator or barrier to physical activity.[28] Access to opportunities for physical activity, such as public parks and recreation facilities, has been repeatedly associated with higher rates of physical activity among children and adolescents.[8,28-30] Opportunities located within walking distance of home may be doubly important for

stimulating active behaviours, as both the route and the destination contribute to overall activity levels.[31] It has been argued that children from low-income households tend to have fewer opportunities for health-promoting activity because of a reduced ability to afford fee-based recreation programs as well as systemic socio-spatial inequities with respect to public resources.[32] However, previous research in London has shown that publicly provided recreation opportunities are equitably distributed with no obvious socio-spatial disparities.[33]

The purpose of this study is to identify built environment factors associated with high BMI levels among adolescents in London, ON, to help identify potential environmental interventions for reducing childhood obesity.

## METHODS

### Survey and outcome measure

Students in grades 6, 7 and 8 at 28 elementary schools within the city of London, ON, were invited to complete a questionnaire that asked for their home postal code, sex, age, height, weight and various health-related questions. The sampled schools were selected from neighbourhoods of varying built environments across the city (see Figure 1) to represent the full diversity of environmental factors that children experience around their homes and schools. Prior to school recruitment, ethics approval was obtained from University of Western Ontario's Research Ethics Board and the ethics boards at both the Thames Valley District School Board and the London District Catholic School Board. Informed written consent was obtained from 1,048 adolescents and their parents before data collection. A total of 966 out of 1,048 children aged 10-14 years who participated in the study provided the complete information on age, sex, height and weight - information needed to construct their age- and sex-adjusted BMI z-score - and 891 of those provided accurate address information for deriving measures of their home built environment.

Self-reported height and weight were used to estimate the body mass index (BMI) of participants by dividing weight in kilograms by height in metres squared; BMI z-scores were calculated to control for differences by age and sex. Following procedures established in previous studies,[34] we calculated age- and sex-specific BMI z-scores based on the World Health Organization growth curves, which in turn are based on large samples of children selected to represent optimal growth.[35]

### GIS analysis of environmental variables

Using ArcGIS 10.0 (Environmental Systems Research Institute Inc, Redlands, CA), survey data for participants were geocoded to the geographic centre of their home postal code. University of Western Ontario's Research Ethics Board did not allow us to collect the full address of students. Nevertheless, previous research indicates that Canadian postal codes are suitable proxies of home neighbourhoods in urban and suburban environments.[36,37] Since there is no agreed measure of "neighbourhood", we tested four different areal definitions around each participant's home postal code, including: circular "buffers" encompassing the territory within a distance of 1) 500 m and 2) 1000 m from the postal code centroid; and "network buffers", which encompass the territory reachable within distances of 1) 500 m and 2) 1000 m from home, as measured along the street network. To assess the built environment around the school, we used the same four circular and network buffers at 500 m and 1000 m from the school address, as well as an additional areal unit: the school "walkshed". The walkshed is the territory within a school's observed catchment area that encompasses only those students living within walking distance, as defined by the respective school boards (see Figure 1). School walksheds were generated for each school by: mapping the home postal code of every registered student not eligible for bussing according to school board data; selecting postal code centroids within the school board-mandated 1600 m walking distance of the specific school; and then merging all neighbouring city blocks that contained a selected postal code into a single walkshed polygon. We argue that this definition of unique walksheds based on the residential locations of students within walking distance of each school is a better representation of the local school neighbourhood than the standard buffers commonly used by researchers.

Previously validated databases of every fast-food outlet and convenience store in the city and surrounding county were provided by the Middlesex-London Health Unit, which is mandated to keep a current inventory of all food retailers for the purpose of licensing and annual health inspections. Using a master address database provided by the City of London, every food retailer was geocoded to its correct building. To "ground truth" the database, trained research assistants performed on-site environmental audits within a 1000 m buffer around six of the sample schools during the same period as the surveys and confirmed 100% accuracy of the database: all food premises listed in the health unit inventory for those test neighbourhoods were still in business and no new food retailers were found. Fast-food outlets were defined as restaurants with food ordered at a counter and paid for in advance. Convenience stores were classified as small food retailers with a floor area of less than 1000 m. Data on school locations and public recreation opportunities (including parks, playgrounds, arenas and recreation centres, and sports fields/facilities) were obtained from the City of London Planning & Development Division and had been previously validated using orthoimagery with a 30 cm ground pixel resolution.[33,37] These data were used to calculate accessibility measures for each participant using GIS (geographic information systems), including the number of public recreation opportunities, fast-food outlets and convenience stores within all defined home and school neighbourhoods.

### Statistical analyses

Attribute tables containing the built environment variables by school and by home postal code for each participant were linked to questionnaire data on each student within ArcGIS 10.0 and exported for statistical analysis. The model was tested using multilevel structural equation techniques for complex survey data. This technique allows for simultaneous testing of the effects of school-environment (Level 2) and home-environment (Level 1) predictors on a child's BMI z-scores. The constructs representing built environment – presence of public recreation opportunities, presence of fast-food outlets, and presence of convenience stores – were operationalized at both levels. The two sets of measurement instruments are independent, as they refer to different geographic environments and different units of analysis. The model was estimated using Mplus 6.0 program (Muthén and Muthén).[38]

**Table 1.** Demographic Characteristics of Study Participants

| | All | | Underweight | | Normal | | Overweight | | Obese | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % | n | % |
| All | 966 | 100.0 | 44 | 4.6 | 686 | 71.0 | 163 | 16.9 | 73 | 7.6 |
| Sex | | | | | | | | | | |
| Boys | 458 | 47.4 | 16 | 3.5 | 285 | 62.2 | 112 | 24.4 | 45 | 9.8 |
| Girls | 508 | 52.6 | 28 | 5.5 | 401 | 78.9 | 51 | 10.0 | 28 | 5.5 |
| Age, years | | | | | | | | | | |
| 10 | 66 | 6.8 | 3 | 4.6 | 44 | 66.7 | 10 | 15.2 | 9 | 13.6 |
| 11 | 105 | 10.9 | 9 | 8.6 | 72 | 68.6 | 10 | 9.5 | 14 | 13.3 |
| 12 | 319 | 33.0 | 14 | 4.4 | 224 | 70.2 | 54 | 16.9 | 27 | 8.5 |
| 13 | 418 | 43.3 | 17 | 4.1 | 305 | 73.0 | 78 | 18.7 | 18 | 4.3 |
| 14 | 58 | 6.0 | 1 | 1.7 | 41 | 70.7 | 11 | 19.0 | 5 | 8.6 |

**Table 2.** Built Environment Characteristics of Study Participants

| | Circular Buffer | | | | Network Buffer | | | | School Walkshed | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 500 m | | 1000 m | | 500 m | | 1000 m | | | |
| | n | % | n | % | n | % | n | % | n | % |
| Home Neighbourhood Environment | | | | | | | | | | |
| Number of public recreation opportunities | | | | | | | | | | |
| 0 | 291 | 30.9 | 89 | 9.4 | 634 | 67.2 | 252 | 26.7 | | |
| 1 | 147 | 15.6 | 57 | 6.0 | 175 | 18.6 | 164 | 17.4 | | |
| 2 or more | 505 | 53.6 | 797 | 84.5 | 134 | 14.2 | 527 | 55.9 | | |
| Number of fast-food outlets | | | | | | | | | | |
| 0 | 505 | 53.6 | 181 | 19.2 | 694 | 73.6 | 378 | 40.1 | | |
| 1 | 104 | 11.0 | 66 | 7.0 | 92 | 9.8 | 117 | 12.4 | | |
| 2 or more | 334 | 35.4 | 696 | 73.8 | 157 | 16.7 | 448 | 47.5 | | |
| Number of convenience stores | | | | | | | | | | |
| 0 | 435 | 46.1 | 177 | 18.8 | 652 | 69.1 | 344 | 36.5 | | |
| 1 | 134 | 14.2 | 55 | 5.8 | 122 | 12.9 | 108 | 11.5 | | |
| 2 or more | 374 | 39.7 | 711 | 75.4 | 169 | 18.0 | 491 | 52.1 | | |
| School Neighbourhood Environment | | | | | | | | | | |
| Number of public recreation opportunities | | | | | | | | | | |
| 0 | 125 | 12.9 | 77 | 8.0 | 277 | 28.7 | 185 | 19.2 | 38 | 3.9 |
| 1 | 103 | 10.7 | 20 | 2.1 | 307 | 31.8 | 71 | 7.4 | 47 | 4.9 |
| 2 or more | 738 | 76.4 | 869 | 90.0 | 382 | 39.6 | 710 | 73.5 | 881 | 91.2 |
| Number of fast-food outlets | | | | | | | | | | |
| 0 | 471 | 48.8 | 84 | 8.7 | 682 | 70.6 | 271 | 28.1 | 54 | 5.6 |
| 1 | 49 | 5.1 | 58 | 6.0 | 15 | 1.6 | 20 | 2.1 | 118 | 12.2 |
| 2 or more | 446 | 46.2 | 824 | 85.3 | 269 | 27.9 | 675 | 69.9 | 794 | 82.2 |
| Number of convenience stores | | | | | | | | | | |
| 0 | 304 | 31.5 | 20 | 2.1 | 473 | 49.0 | 187 | 19.4 | 108 | 11.2 |
| 1 | 254 | 26.3 | 162 | 16.8 | 281 | 29.1 | 104 | 10.8 | 27 | 2.8 |
| 2 or more | 408 | 42.2 | 784 | 81.2 | 212 | 22.0 | 675 | 69.9 | 831 | 86.0 |

## RESULTS

Nearly three quarters (71.0%) of participants were categorized as having a normal BMI, 16.9% were overweight, 7.6% were obese, and 4.6% were considered underweight (Table 1). Boys were much more likely to be overweight or obese than girls; however, BMI did not vary greatly according to age.

Table 2 provides descriptive statistics for the environmental variables used in this study. It presents the number and percentage of participants who have 0, 1, or 2 or more of the selected environmental features nearby, depending on which method is used to define home and school neighbourhoods. Two key findings are clear from the results presented: 1) a large percentage of children have at least one public recreation opportunity, convenience store and fast-food restaurant within a short walk of their home and school; and 2) the way in which neighbourhoods are delineated, in terms of distance from home or school and how distance is measured, has a major influence on whether the selected environmental factors appear to be accessible or not.

We employed univariate regression to determine which of the built environment variables to include in the models on the basis of statistically significant associations with BMI z-scores (Table 3). The final multi-level models included the following variables for the home environment: presence of recreation opportunities, presence of fast-food restaurants, and presence of convenience stores, all within the 500 m network distance of home. For the school environment, the final models included: presence of recreation opportunities, presence of fast-food restaurants, and presence of convenience stores, all within the school-specific walkshed. Table 4 displays the results of the multi-level analysis of the influence of the school and home built environment on children's BMI z-score. Prior to testing the hypothesized model, we examined the between-school variability in BMI z-scores. The interclass correlation coefficient of 0.039 ($p<0.05$) indicated that there were statistically significant differences in BMI z-scores across school neighbourhoods. As predicted, the results from the multi-level models show that the home-environment predictor "presence of public recreation opportunities within 500 m network distance" had a significant negative (i.e., reducing) effect on BMI z-scores (-0.203; $p<0.05$). The indicators for "presence of fast-food outlets" and "presence of convenience stores" in the home environment, however, had no significant effect on the outcome variable (0.012 and 0.190, respectively; $p>0.05$). The effect of only one of the school-environment (Level 2) predictors, presence of fast-food outlets within the school walkshed, was statistically significant (0.073; $p<0.05$), after controlling for home-environment variables.

## DISCUSSION

This study of children aged 10-14 years in London, ON, found that nearly three out of four participants (71.0%) were categorized as having a normal BMI, 16.9% were overweight, 7.6% were obese,

**Table 3.** Results of the Univariate Multi-level Regression Analyses Examining the Relationship Between School and Home Built Environment and Children's BMI Z-Scores

| | Circular Buffer | | Network Buffer | | School Walkshed |
|---|---|---|---|---|---|
| | 500 m Estimate (SE) | 1000 m Estimate (SE) | 500 m Estimate (SE) | 1000 m Estimate (SE) | Estimate (SE) |
| Home Neighbourhood Environment | | | | | |
| Number of public recreation opportunities | -0.109 (0.10) | 0.043 (0.03) | -0.182* (0.09) | 0.017 (0.03) | |
| Number of fast-food outlets | 0.204* (0.09) | 0.032 (0.02) | 0.139 (0.10) | 0.026 (0.02) | |
| Number of convenience stores | 0.076 (0.10) | 0.044* (0.02) | 0.219* (0.10) | 0.026 (0.02) | |
| School Neighbourhood Environment | | | | | |
| Number of public recreation opportunities | -0.136 (0.26) | -0.097* (0.04) | 0.305 (0.25) | 0.389 (0.24) | -0.017 (0.05) |
| Number of fast-food outlets | 0.028 (0.13) | 0.044 (0.02) | 0.166 (0.26) | -0.005 (0.02) | 0.095* (0.03) |
| Number of convenience stores | 0.138 (0.14) | 0.048* (0.02) | 0.18 (0.13) | 0.021 (0.02) | 0.057* (0.02) |

* Significant at p=0.05

**Table 4.** Results of the Multivariate Multi-level Regression Analysis Assessing the Influence of the School and Home Built Environment on Children's BMI Z-Scores

| Fixed Effect | Estimate | SE | Est./SE | p-value |
|---|---|---|---|---|
| Home environment (500 m network buffer) | | | | |
| Recreation opportunities | -0.203 | 0.093 | -2.183 | 0.03 |
| Fast-food outlets | 0.012 | 0.121 | 0.099 | 0.92 |
| Convenience stores | 0.190 | 0.122 | 1.559 | 0.12 |
| School environment (walkshed) | | | | |
| Recreation opportunities | -0.019 | 0.041 | -0.471 | 0.64 |
| Fast-food outlets | 0.073 | 0.034 | 2.160 | 0.03 |
| Convenience stores | 0.020 | 0.021 | 0.947 | 0.34 |
| **Random effects** | **Estimate** | **SE** | **Est./SE** | **p-value** |
| Child-level residual variance | 1.673 | 0.080 | 20.821 | 0.00 |
| School-level residual variance | 0.021 | 0.019 | 1.074 | 0.28 |

Intraclass correlation coefficient for BMI z-score=0.039 (p=0.041).
Number of children=891; number of clusters=28.

and 4.6% were considered underweight. These findings are very similar to reported rates of overweight (17%) and obesity (9%) among children aged 6-14 years across Canada.[2] Also consistent with previous Canadian studies[2,39] is the finding that boys were more likely to be overweight than girls; but, unlike previous studies,[39] we did not see any discernible trend in BMI by age within the limited age range of our sample.

This study makes an important empirical contribution to knowledge about the determinants of childhood obesity in Canada, as the results of multi-level statistical analyses indicate that characteristics of the built environment around children's homes and schools have a modest but significant effect on their BMI. As expected from previous studies, the presence of recreation opportunities in the home neighbourhood had a significant effect on BMI z-scores: children who had at least one public recreation opportunity within a 500 m walk of their home were likely to have lower BMI z-scores than their counterparts without a recreation opportunity nearby. Presumably, children and youth are more likely to use parks and recreation facilities if they are located within close walking distance of their home, and lower observed BMIs may therefore be due to increased physical activity levels associated with greater accessibility. Indeed, this finding follows previous research on children 11-13 year olds in London, which revealed that those who have two or more public recreation facilities within 500 m of their home engaged in 16.5 more minutes of physical activity per day than children with fewer facilities in their home neighbourhood.[28] On the other hand, the presence of public recreation opportunities in the school neighbourhood did not have a significant effect on children's BMI z-scores. This finding fits with qualitative studies based on interviews and/or focus groups with children that suggest they are likely to spend more of their free time, especially on weekends, playing in the neighbourhood around the home rather than around the school;[40,41] moreover, during school hours, children are likely to play on the school grounds rather than leave the campus to play.

Easy access to retailers of "junk food", such as fast-food restaurants and convenience stores around children's homes and schools, appeared to contribute to higher obesity levels; however, the presence of fast-food restaurants within the school walkshed was the only food environment variable that had a statistically significant association with higher BMI z-scores among our sample children. This finding follows recent research on grade 7-8 students in London, which revealed that the presence of fast-food outlets within 1 km of school is linked to increased purchasing of junk food by students[23] and poorer-quality diets (i.e., lower "healthy eating index" scores).[24] The findings are also supported by qualitative research indicating that children who purchase junk food are likely to do it near the school, during the lunch break and the journey to and from school, whether or not a parent may be present to evaluate their purchase.[40,41] On the other hand, a study of grade 6-10 students in 178 schools across Canada did not find any statistically significant relation between the characteristics of the local food environment around each school and the likelihood of children being overweight; however, the study did not account for the presence/absence of recreation facilities or other opportunities for physical activity in the local environment.[25]

This paper has a number of methodological strengths and weaknesses that are worth noting. It makes a methodological contribution by applying multiple areal units of different shapes and sizes (i.e., circular buffers, network buffers and school-specific walksheds) to categorize the home and school environments of children. This approach recognizes and attempts to account for the modifiable

areal unit problem that is inherent in most environment and health studies.[42] The school-specific walkshed is a particular innovation of this study that also proved to be the most significant method for delineating school neighbourhoods. Another methodological improvement is that the geodatabases of environmental variables used were locally generated by municipal organizations and validated through rigorous processes to achieve ground-truth. Most previous studies of this kind have relied on commercial databases, which are often incomplete and spatially inaccurate,[43,44] to identify the locations of food retailers and recreation opportunities.[39,45,46]

Although BMI is a widely accepted measure for comparing body weight status at the population level, there are limitations to using BMI for identifying overweight/obesity among children. We used age- and sex-adjusted BMI z-scores to determine differences by age and sex, but accuracy can be affected by factors such as ethnicity, frame size, level of physical fitness and biologic maturation.[47] Ideally, any assessment of body weight status should be calculated using direct measurements, as self-reported heights and weights for youth tend to underestimate the prevalence of overweight and obesity.[48] Nevertheless, as reported above, rates of overweight and obesity in our sample population were not dramatically different from rates reported for children in a recent nationwide study based on directly measured BMI.[2] Self-report measures are much less intrusive and more feasible to collect for large samples, but as an absolute value, the BMI should be interpreted with caution.

Another potential criticism of this research might be directed at the fact that, because of University of Western Ontario's Research Ethics Board directives, we used children's home postal codes as the centre of their neighbourhoods rather than their actual dwelling. Although previous research has shown that this is a common strategy in epidemiological studies and that postal codes are adequate proxies for addresses in Canadian cities,[36,37] the potential limitations of this approach must be acknowledged: if the positional discrepancy between exact location and proxy location is large for a given case, it may lead to the misclassification of the presence or absence of certain environmental features.[36,37] Positional discrepancy is not a significant problem in this study, however, as it has been estimated that the majority of residential dwellings in urban and suburban London are located within 100 m of their respective postal code centroid.[37,49]

It could be argued that another limitation of the study is that it does not examine the full range of environmental variables that have appeared in previous literature. We limited our model to the selected variables for two reasons: 1) previous research in the same city with children of the same age group indicated that these were the most significant predictors of physical activity levels, junk food purchasing and dietary quality; and 2) the statistical test for school-level effects revealed that the school-level built environment accounted for only a small percentage of the variance, and therefore adding more variables would not be efficient.

This is one of the first Canadian studies to empirically establish a relation between neighbourhood environmental factors and children's BMI. It is also one of the only studies of its kind to focus on a typical mid-sized North American city, as the small but growing literature on the environment-obesity link is still dominated by studies set in larger cities. While causal relations cannot be inferred from these cross-sectional data and the results are not necessarily generalizable, the study has potentially important implications for planners, school board officials and other decision-makers involved in the construction and management of children's environments. Interventions, policies and programs that increase children's access to high-quality, publicly provided recreation opportunities within a short walk of home may be a key to promoting active lifestyles and reducing obesity levels among children and youth. In addition, the study highlights the need for municipalities to consider bylaws and policies aimed at regulating the concentration of fast-food outlets close to schools, where children are heavily exposed, and to create incentives that encourage more healthy food options on local menus. Given the problems associated with rising childhood obesity rates, it is imperative that further research be conducted into how environmental factors influence physical activity levels and dietary habits among children and youth, particularly if we are to develop interventions that promote lifelong healthy behaviours.

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## RÉSUMÉ


**Objectifs :** Notre étude porte sur les facteurs environnementaux associés à l'IMC (indice de masse corporelle) d'adolescents en vue de cerner des interventions possibles pour réduire l'obésité infantile.

**Méthode :** Des élèves (n=1 048) de 10 à 14 ans fréquentant 28 écoles de London, en Ontario, ont rempli un questionnaire sur leur âge, leur sexe, leur taille, leur poids, leur adresse personnelle, etc., lequel a servi à construire des écarts Z ajustés selon l'âge et le sexe pour l'IMC. La présence de possibilités de loisir, d'établissements de restauration rapide et de dépanneurs a été évaluée à l'aide de quatre unités de surface autour du domicile et du quartier scolaire de chaque participant : des « zones tampons circulaires » englobant le territoire sur une distance entre 500 et 1000 m en ligne droite; et des « zones tampon de réseau » de 500 à 1000 m mesurées le long du réseau des rues. Les quartiers scolaires ont aussi été évalués à l'aide des « bassins de marche » propres à l'école. Une modélisation multiniveaux par équations structurelles a servi à évaluer simultanément les effets de prédicteurs des écarts Z de l'IMC liés à l'environnement scolaire (niveau 2) et au milieu de vie (niveau 1).

**Résultats :** La plupart des participants (71 %) avaient un IMC normal, 16,9 % étaient en surpoids, 7,6 % étaient obèses, et 4,6 % étaient considérés comme étant de poids insuffisant. Des analyses multiniveaux ont montré que les caractéristiques du milieu bâti autour du domicile et de l'école des enfants avaient un effet mineur mais significatif sur leur IMC. La présence d'installations de loisir publiques dans un réseau de 500 m du domicile était associée à des écarts Z d'IMC inférieurs ($p<0,05$), et la présence d'établissements de restauration rapide dans le bassin de marche de l'école était associée à des écarts Z d'IMC supérieurs ($p<0,05$).

**Conclusion :** Les interventions et les politiques qui améliorent l'accès des enfants à des installations de loisir publiques près de chez eux et qui atténuent la concentration des établissements de restauration rapide près des écoles pourraient être la clé du succès pour promouvoir les modes de vie sains et réduire l'obésité infantile.



**Mots clés :** obésité; enfant; adolescent; environnement; régime alimentaire; loisir