Influences of the neighbourhood food environment on adiposity of low-income preschool-aged children in Los Angeles County: a longitudinal study

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ABSTRACT

Background Few studies have examined the association between the food environment and adiposity in early childhood, a critical time for obesity prevention. The objective of this study was to examine the longitudinal association between neighbourhood food environment and adiposity among low-income preschool-aged children in a major metropolitan region in the USA.

Methods The study sample was 32 172 low-income preschool-aged children in Los Angeles County who had repeated weight and height measurements collected between ages 2 and 5 years through a federal nutrition assistance programme. We conducted multilevel longitudinal analyses to examine how spatial densities of healthy and unhealthy retail food outlets in the children's neighbourhoods were related to adiposity, as measured by weight-for-height z-score (WHZ), while controlling for neighbourhood-level income and education, family income, maternal education, and child's gender and race/ethnicity.

Results Density of healthy food outlets was associated with mean WHZ at age 3 in a non-linear fashion, with mean WHZ being lowest for those exposed to approximately 0.7 healthy food outlets per square mile and higher for lesser and greater densities. Density of unhealthy food outlets was not associated with child WHZ.

Conclusions We found a non-linear relationship between WHZ and density of healthy food outlets. Research aiming to understand the sociobehavioural mechanisms by which the retail food environment influences early childhood obesity development is complex and must consider contextual settings.

INTRODUCTION

The built environment influences healthy food accessibility and opportunities for exercise, and has been linked to obesity risk among adults.[1–3] However, its role in obesity development among children has been less studied. Findings from the few studies reporting associations between the food-related aspects of the built environment ('food environment') and child obesity are inconsistent.[4–11] Among school-aged children, several cross-sectional[4 5] and longitudinal[9 10] studies have found no associations between the food environment and adiposity, while others have found the availability of supermarkets and convenience stores to be associated with lower and higher body mass index (BMI), respectively.[6 7] Among preschool-aged children, even less is known about the role of the food environment in obesity development. To our knowledge, only three studies have looked at this association for preschool-aged children; all were cross-sectional and reported inconsistent findings.[8 11 12]

It could be argued that the family environment may be more important in influencing the food behaviours of children than the built environment, and that child obesity prevention efforts should focus on developing family interventions. However, it could also be argued that the neighbourhood environment may influence what parents feed their young children. Given the unclear role of the built environment in influencing child obesity risk and the increasing recognition of the need to prevent obesity early in life, the aim of this study was to assess the contribution of the food environment to obesity development among preschool-aged children. Our study population was over 30 000 low-income children aged 2–5 years in Los Angeles County (LAC), one of the most populated and diverse regions in the USA, whose mothers had all received nutrition education from the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), the second largest federal nutrition assistance programme in the USA. WIC participation reduced variation in parental nutrition education and repeated adiposity measurements on the children over time permitted longitudinal analysis.

METHODS

Child data

WIC provides food assistance and nutrition education to low-income pregnant and postpartum women and children up to age 5. Our study sample was children born in the USA in 2003 who participated in WIC in LAC between their second and fifth birthdays (2005–2008), had at least three weight and height measurements and lived in census tracts (CTs) with at least five WIC-enrolled children (N=32 172 children, or 96 888 observations). This cohort was chosen because the children turned age 5 and therefore left the programme before 2009 when a major change occurred in the WIC programme[13] that may have altered family behaviours and the neighbourhood food environment.[14 15]

Child data were obtained from the WIC Data Mining Project,[16] which has archived sociodemographic and anthropometric information on all children enrolled in WIC in LAC since 2002. Weight and height were measured for each child by WIC staff during recertification visits. A previous validation study comparing weight/height measurements collected by WIC staff in LAC to those collected by trained research staff found intraclass correlation coefficients of 0.93–0.99.[17] Sociodemographic information available for each child included age, gender, race/ethnicity (non-Hispanic White, Black, Asian, Hispanic), maternal language preference (English, Spanish, other), maternal educational level (less than high school, high school graduate or above), family size and family monthly income. WIC oversaw the geocoding of participant addresses and provided the authors with participant's residential CT rather than address to protect confidentiality. The outcome variable was weight-for-height z-score (WHZ), which was calculated from weight and height using age-specific and gender-specific Center for Disease Control growth curves.[18] BMI (expressed as percentiles or z-scores), a commonly used adiposity indicator, is problematic for studying children's longitudinal adiposity since BMI is correlated with height/length in children and dependent on body proportions, which change as a child grows.[19] In contrast, WHZ is independent of height at all ages and is therefore more appropriate for assessing adiposity trajectories in growing children.[20] Children with improbable WHZ (<-5 or >5) or health conditions that may have affected feeding practices were excluded from analyses (N=395).

Neighbourhood data

Neighbourhoods were defined by CT boundaries. While not a perfect definition of neighbourhood, CTs are useful for research purposes as they can be linked to census data on socioeconomic characteristics.[21] We used median annual household income and per cent of high school graduates from the American Community Survey (ACS) 2005–2009 to characterise neighbourhoods.[22]

Food environment data were obtained from business listings in the National Establishment Time-Series (NETS) from Walls and Associates,[23] which provided Standard Industrial Classification (SIC) codes, years the business was active and CT where the business was located. From this information we derived counts and densities (counts per square mile) of stores per CT per year for supermarkets, chain convenience stores, fruit and vegetable markets, liquor stores (which may sell convenience foods in addition to alcohol) and fast food outlets (including pizza establishments and sweets stores selling doughnuts, candy, nuts or confectionary items). In addition, to account for people travelling outside their CTs to purchase food, we created 0.5-mile and 1-mile buffers around the boundaries of each CT and obtained counts and densities per buffer per year for each establishment type. Supermarkets and fruit and vegetable markets were considered to be healthy food outlets because they carry significant amounts of fresh fruits and vegetables. Fast food outlets, liquor stores and chain convenience stores were considered to be unhealthy food outlets because they mostly carry non-perishable processed food.[24] Children's neighbourhood food environment was then characterised by the density of healthy and unhealthy food outlets that operated during the years 2005–2008 in the CTs where the children lived and in the expanded areas. Densities of healthy and unhealthy food outlets were allowed to be time varying (which accounted for changes in the food environment due to families moving or store openings and closures) and were top coded to the 95th centile to avoid unusual CTs from influencing results.

This study was approved by the University of California Los Angeles Office of the Human Research Protection Program.

Statistical analyses

Analyses were conducted using SAS V.9.2. Cross-sectional associations between WHZ and covariates at baseline (first measurement taken by WIC in 2005–2008) were examined using general linear models, adjusting for age. The longitudinal WHZ measurements were analysed using a multilevel linear growth model.[25] WHZ for child i at time t is modelled as

$$\mathrm{WHZ}_{ti} = \alpha_{0i} + \alpha_{1i}(\mathrm{age}_{ti} - 3) + e_{ti}$$

where α_{1i} is the growth rate for child i and represents change in WHZ per year, α_{0i} is the WHZ of child i at age 3 years and e_{ti} is random error. The WHZ growth-rate parameters were modelled as a function of individual-level and neighbourhood-level covariates:

$$\alpha_{0i} = \beta_0 + \beta_1 x_{1i} + \cdots + \beta_k x_{ki} + r_{0i}$$
$$\alpha_{1i} = \gamma_0 + \gamma_1 w_{1i} + \cdots + \gamma_l w_{li} + r_{1i}$$

where $x_{1i}, \ldots, x_{ki}$ are covariates affecting mean WHZ at age 3, $w_{1i}, \ldots, w_{li}$ are covariates affecting change in WHZ per year and r_{0i} and r_{1i} are random effects allowing each individual to have variation around the mean growth curve. This model gives two sets of parameter estimates: $\beta_1, \ldots, \beta_k$ estimate the effects of covariates on age 3 WHZ, and $\gamma_1, \ldots, \gamma_l$ estimate the effects of covariates on change in WHZ per year. This model is sometimes called an intercepts-as-outcomes and slopes-as-outcomes model.[25] We centred age at 3 years so that intercept terms could be interpreted as effect on mean WHZ at age 3 (mWHZ3). A random intercept was also included for CTs. Covariates for mWHZ3 and change in WHZ per year included child's age, gender and race/ethnicity;

Table 1 Characteristics of the study sample of children at their first WIC measurement (N=32 172)

Variable	Per cent	Mean (SD)
Child (individual) characteristics		
Child's gender		
Male	51.4	
Female	48.6	
Child's race/ethnicity		
Asian	3.8	
Black/African-American	5.2	
Hispanic	87.6	
White	3.2	
Other	0.2	
Obese (BMI for age >95th centile)	16.7	
Maternal education		
Less than high school	61.6	
High school education or higher	38.4	
Maternal language of preference		
English	34.8	
Spanish	63.2	
Other	2.0	
Age (years)		2.4 (0.3)
Family size		4.2 (1.4)
WHZ		0.7 (1.2)
Family monthly income ($)		1406 (718)
Neighbourhood characteristics		
Annual median household income ($)		50 326 (19 097)
High school graduates (%)		68.6 (18.0)
Density of healthy food outlets (count/mile^2)*		1.2 (1.9)
Density of unhealthy food outlets (count/mile^2)†		7.5 (6.4)

*Healthy food outlets include supermarkets and fruit and vegetable markets.
†Unhealthy food outlets include fast food outlets, chain convenience stores and liquor stores.
BMI, body mass index; WHZ, weight-for-height z-score; WIC, Special Supplemental Nutrition Program for Women, Infants and Children.

maternal education and language preference; and family monthly income, neighbourhood income and education, and densities of healthy and unhealthy food outlets. Family and neighbourhood income were categorised as low (<25th centile), middle (between the 25th and 75th centile) and high (>75th centile).

Separate models were fit for each geographical operationalisation (CT, CT plus 0.5-mile and 1-mile buffers). Density of healthy and unhealthy food outlets were included in models to estimate the effect of each controlling for the other. The potential for a non-linear association between adiposity and the food environment was assessed by fitting quadratic terms for healthy and unhealthy food outlets; quadratic terms found to be significant were included in the final models. Given the large sample size, a p value <0.01 was considered statistically significant.

RESULTS

The sample had similar proportions of boys and girls and was predominantly Hispanic (table 1). Most mothers had less than high school education and preferred to speak Spanish. Average family size was four with a mean monthly income of $1406. The median neighbourhood annual income averaged $50 326; on average, 69% of residents in these CTs had at least a high school diploma. The prevalence of obesity at baseline was 17%.

The food environment in the 1634 CTs where the WIC families lived during the years 2005–2008 was dominated by fast food outlets (annual average for 2005–2008=2762 outlets); the least common food outlets were fruit and vegetable markets (annual average 2005–2008=370 markets). On average, children lived in neighbourhoods with 1.2 and 7.5 healthy and unhealthy food outlets per square mile, respectively (table 1).

In cross-sectional associations at baseline, boys and Hispanic children had higher WHZ than girls and children of other ethnicities, respectively (table 2). Children whose mothers did not graduate from high school were heavier than their counterparts. WHZ at baseline was negatively associated with family and neighbourhood income and with neighbourhood education, and not associated with density of healthy or unhealthy food outlets (table 2).

In longitudinal analyses, when neighbourhood food environment was operationalised as density of food outlets in the child's CT, the food environment was not significantly associated with mWHZ3 or WHZ slope (change in WHZ with age; table 3). Quadratic terms for density of healthy and unhealthy food outlets were not significant and were omitted from the final model.

When food environment was operationalised as food outlets in the CT plus 0.5-mile and 1-mile buffers, associations between the food environment and adiposity emerged. In these models, the quadratic term for density of healthy food outlets on the intercept (mWHZ3) was significant and included in the final models. As shown in table 3, the association was non-linear: at lower densities, the association between density of healthy food outlets and mWHZ3 was negative; however, at higher densities, the association became positive. The point at which the relationship became positive is approximately 0.7 healthy food outlets/square mile (figures 1 and 2). In addition, density of healthy food outlets was negatively associated with WHZ slope in the CT plus 0.5-mile model. There was no significant association between the density of unhealthy food outlets and mWHZ3 or WHZ slope.

Table 2 Cross-sectional associations between weight-for-height z-score (WHZ)* and individual-level and neighbourhood-level variables (adjusted for age; N=32 172 children)

	WHZ at 1st measurement			
	Adjusted means (SE)†	p Value	Regression estimates (SE)	p Value‡
Child's gender		<0.0001		
Female	0.660 (0.010)			
Male	0.772 (0.009)			
Child's race/ethnicity		<0.0001		
Asian	0.370 (0.034)[a]			
Black/African-American	0.438 (0.290)[b]			
Hispanic	0.759 (0.007)[a,b,c]			
Non-Hispanic White	0.470 (0.037)[c]			
Maternal language of preference		<0.0001		
English	0.685 (0.011)[a]			
Spanish	0.746 (0.008)[a]			
Other	0.386 (0.046)[a]			
Maternal education		<0.0001		
Less than high school	0.753 (0.008)			
High school graduate or higher	0.661 (0.011)			
Family size			0.002 (0.005)	0.7326
Family monthly income			−0.040 (0.009)	<0.0001
Neighbourhood median income			−0.004 (0.001)	<0.0001
Neighbourhood % high school graduates			−0.008 (0.001)	<0.0001
Density of healthy outlets (stores/mile^2)			0.006 (0.003)	0.0469
Density of unhealthy outlets (stores/mile^2)			−0.001 (0.001)	0.1541

*First measurement recorded by WIC, 2005–2008.
†Same superscripts mean that groups are significantly different from each other (Tukey's test, p<0.0001).
‡p Values obtained using separate general linear models for each variable, adjusting for age.
The significance for all the subscripts in Table 2 (a,b,c for race/ethnicity and a for language) is <0.0001.
WIC, Special Supplemental Nutrition Program for Women, Infants and Children.

Table 3 Multilevel longitudinal growth models predicting mean weight-for-height z-score (WHZ) at age 3 (intercept) and change in WHZ (slope) among preschool-aged children participating in WIC in Los Angeles County (N=32 172 children)

Variable	Census tract		CT +0.5 mile buffer		CT +1 mile buffer	
	B	p Value	B	p Value	B	p Value
Predictors of mean WHZ at age 3						
Child's gender (ref=male)	−0.119	<0.0001	−0.118	<.0001	−0.118	<0.0001
Child's race/ethnicity (ref=white)						
Asian	−0.083	0.0518	−0.084	0.0489	−0.087	0.0419
Black/African-American	−0.078	0.0398	−0.073	0.0555	−0.072	0.0565
Hispanic	0.234	<0.0001	0.236	<.0001	0.236	<0.0001
Maternal language preference (ref=English)						
Spanish	−0.020	0.1160	−0.022	0.0906	−0.022	0.0853
Other	−0.060	0.1997	−0.063	0.1777	−0.065	0.1631
Maternal schooling (ref=≥high school)	0.030	0.0086	0.030	0.0083	0.030	0.0090
Family monthly income (ref=high [>$1800])						
Low (<$958)	0.035	0.0002	0.035	0.0002	0.034	0.0002
Middle ($958–1800)	0.016	0.0246	0.016	0.0280	0.016	0.0284
Neighbourhood median income (ref=high[>$50 557])						
Low (<$32 460)	0.044	0.0226	0.026	0.1827	0.024	0.2094
Middle ($32 460–50 557)	0.019	0.2122	0.009	0.5516	0.011	0.4806
Per cent High school graduates in neighbourhood	−0.002	0.0003	−0.002	0.0002	−0.002	0.0001
Density of healthy food outlets*	0.002	0.4187	−0.026	0.1141	−0.030	0.2746
Squared density of healthy food outlets			0.021	0.0014	0.045	0.0014
Density of unhealthy outlets†	−0.001	0.1047	0.001	0.6552	−0.001	0.8458
Predictors of change in WHZ with age (slope)						
Child's age (years)	−0.007	0.7607	0.003	0.8968	0.003	0.8902
Gender (ref=male)	−0.001	0.8763	−0.001	0.8636	−0.001	0.8729
Race/ethnicity (ref=white)						
Asian	−0.028	0.1966	−0.027	0.2078	−0.026	0.2168
Black/African-American	−0.002	0.9183	−0.005	0.7991	−0.005	0.8010
Hispanic	−0.041	0.0124	−0.042	0.0095	−0.042	0.0106
Maternal language (ref=English)						
Spanish	0.041	<0.0001	0.041	<.0001	0.041	<0.0001
Other	0.018	0.4302	0.021	0.3645	0.023	0.3247
Maternal schooling (ref=≥high school)	−0.005	0.3848	−0.005	0.3742	−0.005	0.3817
Family monthly income (ref=high [>$1800])						
Low (<$958)	−0.023	0.0045	−0.023	0.0051	−0.023	0.0054
Middle ($958–1800)	−0.009	0.1821	−0.008	0.2088	−0.009	0.1998
Neighbourhood median income (ref=high[>$50 557])						
Low (<$32 460)	−0.003	0.7697	0.004	0.6649	0.002	0.8097
Middle ($32 460–50 557)	−0.021	0.0067	−0.016	0.0419	−0.016	0.0326
Per cent High school graduates in neighbourhood	<0.001	0.1077	<0.001	0.1034	<0.001	0.0842
Density healthy food outlets	<0.001	0.9767	−0.014	0.0035	−0.022	0.0102
Density unhealthy food outlets	0.001	0.1592	<0.001	0.8841	<0.001	0.9052

*Healthy outlets include supermarkets, and fruit and vegetable markets.
†Unhealthy outlets include fast food outlets, chain convenience stores and liquor stores.
CT, census tract; WIC, Special Supplemental Nutrition Program for Women, Infants and Children.

DISCUSSION

In this study of largely Hispanic, low-income preschool-aged children participating in WIC in LAC, the food environment and in particular the density of healthy food outlets in the child's neighbourhood, was associated with adiposity. The association appeared when our broader definition of neighbourhood (CT plus 0.5-mile or 1-mile buffer) was used, and indicated a non-linear association of mean WHZ at age 3 with density of healthy food outlets.

While a large proportion of studies looking at food environments and obesity define neighbourhood based on CT boundaries, our findings support the results of other studies suggesting that a less circumscribed definition should be considered.[26–28] For example, Hillier *et al*[26] studied shopping patterns among WIC recipients in Northern Philadelphia and found that, on average, participants travelled 1–1.6 miles for their food shopping, with only 1.5% of participants conducting most food shopping within their own CT. It is difficult to make comparisons between studies as there is substantial heterogeneity between different geographic areas. However, an effort should be made to develop food environment measures that are conceptually and empirically valid.[29] Given our findings, we suggest that CTs may be too small of an area to determine an effect of the food environment on children's adiposity. On the other hand, it may be less convenient for families with very small children to travel outside of their immediate neighbourhoods.

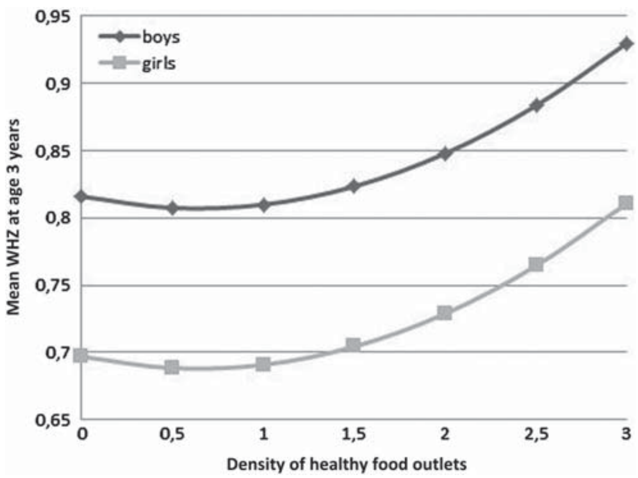


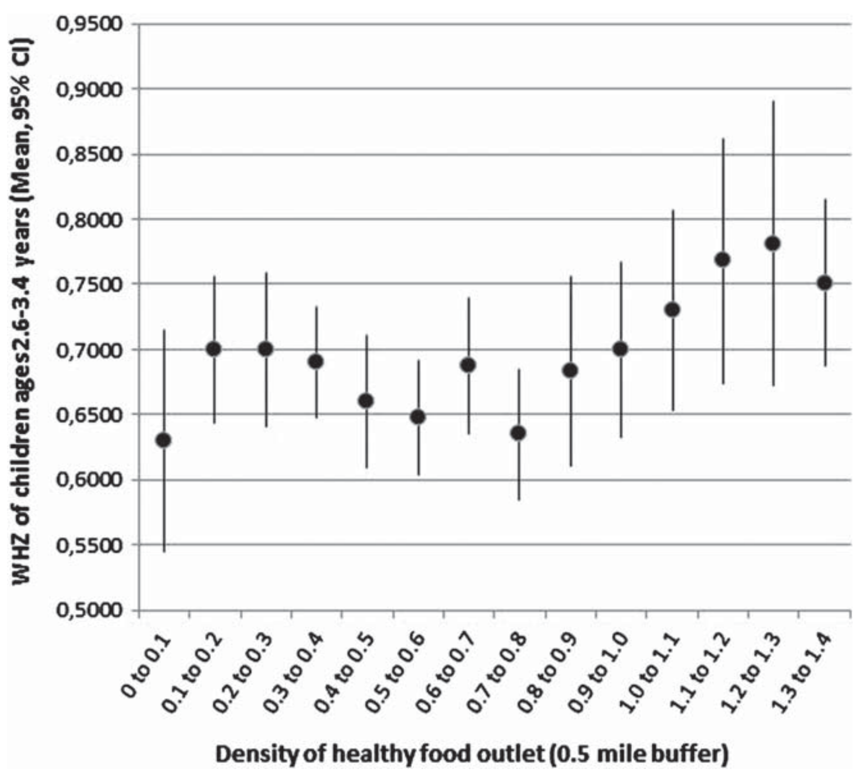
Figure 1 Relationship between mean WHZ at age 3 years and density of healthy food outlets in a 0.5-mile buffer around the borders of the census tracts where the child lived (2005–2008). Equation estimated for Hispanic children (when compared to white children) whose mothers speak Spanish, have at least a high school education, have an average family income ($1402) and live in an average neighbourhood (neighbourhood annual income = $50 326; % high school graduates=69%; density of unhealthy food outlets=7.5) WHZ, weight-for-height z-scores.

Two recent longitudinal, nationally representative studies among school-aged children found null associations between the food environment and BMI, regardless of the food environment measure used.[9 10] Their use of CTs to define food environment may have contributed to the null findings. In addition, these studies used BMI, which is a problematic measure of adiposity for growing children.[20]

To our knowledge, no published study to-date has examined the longitudinal association between the food environment and adiposity in preschool-aged children. Cross-sectional findings, however, partially agree with ours. Burdette and Whitaker[8] reported no associations between BMI z-score and distance to fast food restaurants among 3–5-year-old WIC participants in Ohio. We also found no associations between WHZ and density of unhealthy food outlets. Fiechtner *et al*[12] found a positive association between BMI and living ≤1 mile from a large supermarket (vs those living >2 miles away) in a small convenience sample of already overweight/obese preschool-aged children in Boston. Our study suggests that density of healthy food outlets is positively associated with mean WHZ but only at higher densities of healthy food outlets; at lower densities the association is negative, as hypothesised.

Our finding of a non-linear association between adiposity and density of healthy food outlets should be further explored. Even though we, as others before us, classified supermarkets as ‘healthy outlets’, supermarkets also carry a large variety of high-fat, high-sugar foods and drinks in addition to fresh produce. Miller *et al*[30] reported that when compared to convenience and other small food stores in New Orleans, supermarkets had a much greater display of energy-dense snack foods and these were always within a metre of the cash registries. In contrast, fruit and vegetable displays (which were also greater in supermarkets when compared to convenience stores) were never within a metre of the cash register.[30] Therefore, referring to supermarkets as the ‘best’ food outlet for healthy food purchases may be misleading. Our results suggest that there may be a threshold effect in which ~0.7 healthy stores per square mile is associated with lowest mean adiposity. We speculate that a lower density of healthy stores may translate into a lack of access to fresh healthy foods but >0.7 stores per square mile may increase the availability of healthy and unhealthy foods. In this population of low-income families receiving nutrition

Figure 2 Means and 95% CIs for WHZ for children around age 3 years (ages 2.6–3.4 years) by density of healthy food outlets in the census tract plus 0.5-mile buffer. WHZ, weight-for-height z-scores.



education through the second largest federally funded nutrition assistance programme, it is likely that the lack of neighbourhood access to healthy fresh foods would have influenced food purchasing decisions. It is also possible that the positive association observed between WHZ and the density of healthy food outlets is spurious—neighbourhoods that attract several supermarkets may be more urbanised and differ in other environmental aspects that may increase child obesity risk, such as having more traffic and fewer parks, affecting physical activity. Our study did not have access to data on traffic patterns or parks year by year. However, a separate analysis of land use data for LAC obtained for 2000 showed minimal variation in the per cent of land that is occupied by green space (an indicator of park availability) in lower income CTs (personal communication, Kara MacLeod, 2014).

This study demonstrates the complexity involved in studying the relationship between the food environment and obesity risk, with results varying depending on the definition of neighbourhood boundaries (ie, CTs vs buffers surrounding CTs), the measure of food environment used ('unhealthy' vs 'healthy' food outlets), the contextual setting (eg, urban vs suburban vs rural) and the outcome examined (adiposity vs change in adiposity with age).

Strengths of this study include its longitudinal nature and large sample size; exposure of all WIC families to nutrition education, which reduces the likelihood that effects of the food environment are confounded by lack of parental nutrition knowledge; and high validity of its weight and height measurements.[17] A limitation, which is common to most studies using food store data, is the lack of assessment of the validity of the classification of food stores as healthy or unhealthy. In addition, using CTs to define neighbourhoods may be problematic since they are solely administrative units with no real-life significance for residents. Using such artificial boundaries could result into some misclassification bias, which we believe we have minimised by the use of the 0.5-mile and 1-mile buffers. Finally, our results are not necessarily representative of low-income preschool-aged children nor of all WIC participants as children included in this study were different from those excluded (those with 1 or 2 weight/height measures only), with those included more likely to be younger Hispanic children with Spanish speaking mothers and overall less advantaged (not shown). This is reflective of the fact that Spanish-speaking Hispanics are more likely to stay in WIC longer and, therefore, more likely to have been included in this longitudinal analysis. If we restrict our analyses to Hispanic children only, our non-linear relationship between mWHZ3 and density of healthy food outlets in our buffer models remains. However, a negative association between density of unhealthy food outlets and mWHZ3 surfaces in the CT-only model, again suggesting that the association between the food environment and adiposity needs to be interpreted within specific contexts and with consideration for the measures used.

CONCLUSION

Despite the latest evidence showing a slowing down of the obesity epidemic in preschool-aged children in the US,[31] there is an ongoing need to prevent obesity early in life. Our study contributes to our understanding of the role of the food environment in obesity development among preschool-aged children. To our knowledge, this is the first study to document a non-linear relationship between adiposity and the density of healthy food outlets, and one of just a few to longitudinally examine the contribution of the food environment to obesity early in life. This non-linear relationship suggests a threshold effect which warrants further investigation. Understanding the impact of the neighbourhood food environment on obesity development has important implications for social and economic policies.

What is already known on this subject?

- The neighborhood built environment can affect health status.
- Food-related aspects of the built environment have been linked to obesity risk among adults.
- Little is known about this association among preschool-aged children.

What does this study add?

- We found a non-linear association between child adiposity and neighbourhood density of healthy food outlets.
- Lowest adiposity was observed at ~0.7 healthy food outlets per square mile.
- This threshold effect warrants further research and may have important implications for social and economic research and policy.

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Contributors MPC participated in the design of the study, carried out the data management and analysis, and drafted the manuscript. SEW participated in the design of the study, was in charge of data collection and edited the manuscript. CMC participated in the design of the study, supervised the statistical analyses and edited the manuscript. MK and ES aided in data collection and management, and edited the manuscript. TZN aided in data management and analysis, and edited the manuscript. MCW participated in the design of the study, aided in data management and analyses, and edited the manuscript.

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Competing interests None.

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