Neighbourhood immigrant acculturation and diet among Hispanic female residents of New York City

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Submitted 27 October 2010: Accepted 12 January 2011: First published online 18 March 2011

Abstract

Objective: To identify predominant dietary patterns among Hispanic women and to determine whether adherence to dietary patterns is predicted by neighbourhood-level factors: linguistic isolation, poverty rate and the retail food environment.

Design: Cross-sectional analyses of predictors of adherence to dietary patterns identified from principal component analysis of data collected using the Study of Women’s Health Across the Nation FFQ. Census data were used to measure poverty rates and the percentage of Spanish-speaking families in the neighbourhood in which no person aged ≥14 years spoke English very well (linguistic isolation) and the retail food environment was measured using business listings data.

Setting: New York City.

Subjects: A total of 345 Hispanic women.

Results: Two major dietary patterns were identified: a healthy dietary pattern loading high for vegetables, legumes, potatoes, fish and other seafood, which explained 17% of the variance in the FFQ data and an energy-dense dietary pattern loading high for red meat, poultry, pizza, french fries and high-energy drinks, which explained 9% of the variance in the FFQ data. Adherence to the healthy dietary pattern was positively associated with neighbourhood linguistic isolation and negatively associated with neighbourhood poverty. Presence of more fast-food restaurants per square kilometre in the neighbourhood was significantly associated with lower adherence to the healthy diet. Adherence to the energy-dense dietary pattern was inversely, but not significantly, associated with neighbourhood linguistic isolation.

Conclusions: These results are consistent with the hypothesis that living in immigrant enclaves is associated with healthy dietary patterns among Hispanics.

Racial and ethnic minority populations have been acutely affected by the epidemic of overweight and obesity in the USA. Hispanics, along with Black Americans and Native Americans, face a higher risk of obesity than Caucasians1. Multiple studies have shown that first-generation immigrants have a smaller body size compared with second- and third-generation immigrants and that the number of years since immigration is correlated with increased body size2–7. These studies have been interpreted to suggest that, over time, immigrants adapt to the ‘obesogenic’ environment of the USA, which promotes dietary and physical activity patterns favouring a positive energy balance, and thus gain weight8–10. Thus, acculturation, conceptualized as the process by which immigrants adopt the cultural norms of the host society (in this case dietary and physical activity patterns), has been identified as an important topic for studying body size among Hispanics4,8,9.

There is a growing volume of literature showing that, among Hispanics, increasing generation since immigration, duration of residence in the USA and other measures of increased acculturation are associated with diets that are lower in rice, beans and fruit and higher in sugar and sugar-sweetened drinks10. Much of the research has focused on individual-level measures of acculturation, such as the respondent’s use of English or years of residence in the USA. However, a few studies have shown that residence in primarily immigrant and co-ethnic neighbourhoods, areas likely to have groceries and restaurants selling familiar home country foods11, is linked to healthier diets12–14. Although presented as an indicator of neighbourhood-level acculturation status, foreign-born
composition is, conceptually, a less direct measure of
neighbourhood-level immigrant acculturation than are
measures of linguistic isolation\(^7\). Linguistic isolation is a
term used by the census to characterize households in
which no person aged \(\geq 14\) years speaks English ‘very well’
For example, neighbourhoods could have similar propor-
tions of immigrant residents, but the neighbourhoods could
differ in levels of linguistic isolation and thus the extent to
which they are isolated from obesogenic dietary norms and
practices prevalent in the USA. Neighbourhood linguistic
isolation has been found to be a stronger predictor of BMI
among Hispanics than neighbourhood foreign-born com-
position\(^7\). In addition, the association between nativity
and BMI was weaker among Hispanics living in neighbour-
hoods with higher levels of linguistic isolation than
among those living in neighbourhoods with lower levels of
linguistic isolation\(^7\).

To date, the vast majority of research on immigrant
acculturation and diet has focused on consumption of
individual or groups of nutrients, such as fats and sugars, or
on consumption of food groups, such as fruits and vege-
tables\(^10\). Referred to as ‘nutritionism’, this focus on nutrients
or food items high in specific nutrients as the predominant
outcome of interest has been critiqued as being overly
reductionist, failing to account for how foods are eaten in
combination as a part of meals and cuisines\(^15\). Since
nutrients and food items are commonly consumed as part
of a dietary pattern or preference, analyses of associations
between indicators of acculturation and single nutrients or
food items may be confounded by the effects of accultura-
ton on overall dietary preferences. Inter-individual variation
in dietary patterns, as opposed to variation in single nutri-
ents, may be a better indicator of the effects of individual-
and neighbourhood-level acculturation on diet\(^10\).

Using data from FFQ, we sought to identify major
dietary patterns among Hispanic women and to evaluate
the extent of individual women’s adherence to those
patterns. We then examined the association of adherence
to the dietary patterns with individual- and neighbourhood-
level acculturation and the neighbourhood retail food
environment.

**Experimental methods**

**Sample**

We analysed sociodemographic and FFQ data for the His-
panic female guardians (typically the mother; alternatively,
a grandmother) of children participating in the Head Start
Program who were enrolled in a study of risk factors for
asthma. The asthma study has been described extensively
elsewhere. Head Start, a federal programme that focuses on
the healthy development of children between the ages of
3 and 5 years, provides education, health, nutrition and
other services to low-income children and their families.

In brief, 1026 children were recruited from fifty Head Start
programmes conducted in northern Manhattan, Bronx and
Brooklyn; their guardians responded to a questionnaire on
asthma symptoms and risk factors\(^20\). Of these, 547 chil-
dren were enrolled into a substudy involving a home visit
during which further questionnaire data were collected
and environmental samples were taken\(^23\). Recruitment
and data collection occurred between November 2003 and
August 2006. The Columbia Presbyterian Medical Center
Institutional Review Board approved the study protocol
and all participants provided written informed consent.

**Individual-level data**

The parents of all the recruited children took part in an
extensive questionnaire-based interview and provided
sociodemographic information. Data from this questionnaire
that were assessed as potential individual-level predictors of
diet included Hispanic ethnicity (Mexican, Puerto Rican,
Dominican or other/mixed), age, nativity, language used at
home, whether the respondent currently attended school,
years of schooling completed and whether the respondent
worked outside the home. As part of the home visit protocol
that the subset of the families participated in, the children’s
guardians were asked to complete the Block ‘Study of
Women’s Health Across the Nation’ (SWAN) FFQ, the
Spanish language version of which includes the 103 core
SWAN FFQ items, plus nine additional questions on food
items common to Hispanic cuisine\(^22\).

**Neighbourhood-level data**

Home addresses were geocoded to the appropriate tax lot
using Geosupport software (City of New York, Depart-
ment of City Planning, New York City, NY, USA), and data
on neighbourhood food and social environment char-
acteristics were collected using aerial weighting methods
for 0–5 km radial buffers around each respondent’s home.
US Census 2000 Summary File 3 data were used to mea-
sure neighbourhood sociodemographic characteristics,
including: percentage of the population below the federal
poverty line, referred to here as ‘per cent poverty’; per-
centage of the population reporting Hispanic ethnicity,
referred to here as ‘per cent Hispanic’; and percentage of
Spanish-speaking households that were linguistically
isolated (defined by the Census Bureau as a household
in which no person aged \(\geq 14\) years speaks English only
or speaks a non-English language and speaks English
‘very well’) and referred to here as ‘per cent linguistically
isolated’. Data on the locations of supermarkets, grocery
stores, produce markets, convenience stores, bodegas,
meat stores, fish stores, candy and nut stores, bakeries,
fast-food restaurants and pizza parlours in 2005 were
obtained from a commercial database purchased from
Dun and Bradstreet\(^23\). Locations of farmers’ markets in
2006 were obtained from New York City Coalition Against
Hunger, the Council on the Environment of New York City
and the Farmer’s Market Federation of New York.
Statistical analyses

A modified version of the principal component analysis (PCA) approach described by Hu et al.\(^1\) for the Health Professionals Follow-up Study was used to identify dietary patterns with the SWAN FFQ data. Hu et al. grouped food items from the Willett FFQ into forty food groups and totalled the servings of each food per day in each group. The food groups used by Hu et al. were used along with the SWAN FFQ with a few modifications. Because the SWAN FFQ includes more soya-based items compared with the Willett FFQ, an additional food group for soya-based products was created. In addition, because participants reported very few servings of alcohol on the FFQ, the separate beer, wine and hard liquor groups used by Hu et al. were combined into one alcoholic beverage group.

The few previously conducted studies that have used PCA with an FFQ designed for Hispanics provide little guidance on how to group Hispanic food items\(^2\)\(^,\)\(^3\). We tried two approaches and compared the dietary patterns they identified. Our first approach was to distribute the Hispanic food items into the food groups devised by Hu et al. on the basis of culinary usage (e.g. we placed flour tortillas in the refined grains group that includes white breads, muffins and bagels). Our second approach was to place all the Hispanic food items in their own food group. For each approach, we used PCA with orthogonal varimax rotation, retaining components that had eigenvalue >1 and were interpretable. A factor score was calculated as a measure of adherence to each component using the observed food group servings and the component loading scores\(^1\).

As in our past studies, because of the large number of types of retail outlets considered, retail food outlets were grouped into categories considered to be ‘BMI healthy’ (supermarkets, produce markets, farmers markets and health food stores), ‘BMI unhealthy’ (fast food, pizza, convenience stores, bodegas, meat markets, candy and nut stores) and ‘BMI neutral’ (restaurants excluding fast food and pizzerias, small grocery stores, fish markets and specialty stores)\(^2\)\(^,\)\(^3\). The identification and classification of retail outlets and the rationale for the grouping of outlets have been explained previously in an extensive manner. For the present analyses, we calculate the density (outlets per square kilometre of land area in the 0-5 km radial buffer) of BMI-healthy, BMI-unhealthy and BMI-neutral retail outlets. The density of BMI-healthy food outlets has been found to be inversely associated with maternal obesity and BMI in adults\(^2\)\(^,\)\(^3\). In addition, because of the interest among the policy makers of New York City (NYC) in the role of these particular food outlets, separate analyses examined whether the presence or density of fast-food restaurants, pizza parlours, supermarkets and bodegas in the participant’s neighbourhood predicted adherence to the dietary patterns.

Generalized estimating equation (GEE) analyses were used to evaluate the association between adherence to the identified dietary patterns and individual- and neighbourhood-level sociodemographic characteristics. Our GEE models used the respondent’s community district to designate larger neighbourhood areas in the calculation of robust standard errors\(^2\). Community districts represent named neighbourhoods in NYC such as Central Harlem or Washington Heights in which local community boards have influence over development, zoning and licensing. Analyses began with consideration of the individual-level sociodemographic characteristics; neighbourhood-level variables were subsequently added to the model. The individual-level variables, Hispanic ethnicity, USA or foreign place of birth, and use of English at home, proved to be highly inter-correlated and all three variables could not be entered into models simultaneously. Of the three variables, Hispanic ethnicity and language used at home proved to be the least inter-correlated, and analyses focused on these variables. Neighbourhood per cent Hispanic and per cent linguistically isolated were strongly correlated (\(r = 0.55\)); because linguistic isolation had greater face validity as a measure of acculturation status, analyses concentrated on this variable as a measure of neighbourhood-level acculturation status. Since neighbourhood-level socio-economic status may have an effect on diet above and beyond being just a proxy of individual-level socio-economic status and may also correlate with neighbourhood immigrant composition, we included neighbourhood per cent poverty in the model as a potential confounder. The neighbourhood retail food environment variables were added to the statistical model to evaluate whether differences in the density of retail outlets explained differences in diet by individual- and neighbourhood-level sociodemographic characteristics.

Results

From the 547 families who took part in the home visit portion of the study, a total of 355 female guardians, who self-reported their ethnicity as Hispanic, provided FFQ data. Of them, 345 provided the complete sociodemographic data required for the present analyses. Table 1 provides descriptive statistics for the study population.

The PCA of the FFQ data with Hispanic food items distributed across food groups identified two major components. The first component loaded high on vegetables, legumes, potatoes and fish and seafood and explained 17-28% of the variance in the data. This component was named the ‘Healthy diet’. The second component loaded high on processed meat, high-energy drinks, fries, poultry, pizza and red meat and explained 9-15% of the variance in the data. This component was named the ‘Energy-dense diet’. Table 2 shows the top ten loading items for the healthy diet and the energy-dense diet. The two approaches used to group the Hispanic food items in the FFQ produced almost identical results.
a 99% correlation for adherence to the healthy diet and a 94% correlation for adherence to the energy-dense diet. We therefore focused on the results from the PCA based on distributing the Hispanic food items among the existing food groups.

Table 3 shows the results of GEE analyses of predictors of adherence to the healthy dietary pattern. Model 1 assessed associations between individual-level sociodemographic characteristics and adherence to the healthy dietary pattern. Compared with those reporting a Mexican ethnicity, those reporting a Puerto Rican ethnicity had lower adherence to the healthy dietary pattern. Adherence was also associated with being in school, increasing age and total estimated energy consumption, but was not associated with use of English at home. Model 2 included variables for individual and neighbourhood sociodemographic characteristics. Adherence to the healthy dietary pattern was significantly negatively associated with increasing neighbourhood poverty and significantly positively associated with linguistic isolation. Model 3 included all sociodemographic characteristics as well as characteristics of the neighbourhood food environment. As the densities of the three types of food outlets (BMI healthy, unhealthy and neutral) are strongly correlated (Spearman’s rank correlations between 0.60 and 0.82), initial analyses considered each of the three types of food outlets as predictors of adherence to the healthy dietary pattern separately and then a single model was fitted to consider all three types of outlets concurrently. The results were consistent regardless of modelling approach: the densities of BMI-healthy, BMI-unhealthy and BMI-neutral retail food outlets were not associated with adherence to the healthy dietary pattern, and inclusion of these variables in the model did not alter the associations between neighbourhood sociodemographic characteristics and adherence. In separate analyses (data not shown) considering fast-food restaurants, pizzerias, supermarkets and bodegas, the only association observed for these specific food outlets was an inverse association between the density of fast-food restaurants and adherence to the healthy diet ($\beta = -0.03$, $P = 0.02$). In these analyses, poverty rate and the proportion of Spanish-speaking households that were linguistically isolated remained significant predictors of adherence to the healthy diet.

Table 4 shows the results of GEE analyses of predictors of adherence to the energy-dense dietary pattern. Results for model 1 show that, compared with respondents who reported Mexican ethnicity, those reporting Puerto Rican ethnicity were more adherent to the energy-dense dietary pattern. Adherence was also associated with employment outside the home and with total energy consumption and inversely associated with increasing age. Model 2 showed that adherence to the energy-dense dietary pattern was significantly positively associated with increasing neighbourhood poverty. Model 3 includes additional variables for the characteristics of the neighbourhood food environment. Of the food environment variables, adherence to the energy-dense dietary pattern was positively associated with the density of BMI-neutral retail outlets. A large component of the BMI-neutral retail outlet category consists of restaurants other than fast food or pizzerias, and the association between adherence to the energy-dense dietary pattern and the density of BMI-neutral retail outlets was driven almost entirely by the association

### Table 1 Descriptive statistics of the full study population

<table>
<thead>
<tr>
<th>Categorical individual-level variables</th>
<th>Sample size (n 345)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic ethnicity</td>
<td>n  %</td>
</tr>
<tr>
<td>Mexican</td>
<td>141  41</td>
</tr>
<tr>
<td>Dominican</td>
<td>97  28</td>
</tr>
<tr>
<td>Puerto Rican</td>
<td>41  12</td>
</tr>
<tr>
<td>Other Hispanic</td>
<td>66  19</td>
</tr>
<tr>
<td>Current schooling</td>
<td></td>
</tr>
<tr>
<td>Not in school</td>
<td>261  76</td>
</tr>
<tr>
<td>In school</td>
<td>84  24</td>
</tr>
<tr>
<td>Work status</td>
<td></td>
</tr>
<tr>
<td>Not employed</td>
<td>261  76</td>
</tr>
<tr>
<td>Employed</td>
<td>84  24</td>
</tr>
<tr>
<td>Language used at home</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>83  24</td>
</tr>
<tr>
<td>Spanish</td>
<td>262  76</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Continuous individual-level variables</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Years of education</td>
<td>10.45  12.00</td>
</tr>
<tr>
<td>Age in years</td>
<td>32.35  31.22</td>
</tr>
</tbody>
</table>

### Table 2 Principal components identified in the FFQ data

<table>
<thead>
<tr>
<th>Component 1: Healthy diet</th>
<th>Loading weight</th>
<th>Component 2: Energy-dense diet</th>
<th>Loading weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cruciferous vegetables</td>
<td>0.75</td>
<td>Processed meat</td>
<td>0.67</td>
</tr>
<tr>
<td>Green leafy vegetables</td>
<td>0.74</td>
<td>High-energy drinks</td>
<td>0.61</td>
</tr>
<tr>
<td>Dark-yellow vegetables</td>
<td>0.68</td>
<td>Fries</td>
<td>0.58</td>
</tr>
<tr>
<td>Legumes</td>
<td>0.62</td>
<td>Poultry</td>
<td>0.50</td>
</tr>
<tr>
<td>Potatoes</td>
<td>0.55</td>
<td>Pizza</td>
<td>0.44</td>
</tr>
<tr>
<td>Fish and other seafood</td>
<td>0.52</td>
<td>Red meat</td>
<td>0.39</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.51</td>
<td>Eggs</td>
<td>0.38</td>
</tr>
<tr>
<td>Other vegetables</td>
<td>0.38</td>
<td>Fish and other seafood</td>
<td>0.35</td>
</tr>
<tr>
<td>Soup</td>
<td>0.32</td>
<td>Potatoes</td>
<td>0.29</td>
</tr>
</tbody>
</table>
between adherence to the energy-dense dietary pattern and the density of restaurants other than fast food or pizzerias (β = 0·006 per restaurant/km²,  P = 0·03). Density of other types of specific retail food outlets was not associated with adherence to the energy-dense dietary pattern. A comparison between models 2 and 3 shows that the inverse association between linguistic isolation and adherence to the energy-dense dietary pattern increases and reaches borderline statistical significance when the food environment variables are included in analyses.

### Discussion

In the present population of low-income Hispanic women, two major dietary patterns were identified: one that could be construed as being healthy, high in vegetables, fruit and legumes (Table 2); and a second that could be construed as being less healthy, comprised of energy-dense foods (Table 2). In our study, adherence to the healthy diet was strongly predicted by neighbourhood linguistic isolation, even after control for neighbourhood poverty. The association with neighbourhood linguistic isolation could not be accounted for by differences in the neighbourhood retail food environment. Adherence to the energy-dense dietary pattern was initially modestly inversely, but not significantly, associated with neighbourhood linguistic isolation, an association that increased after adjustment for measures of the neighbourhood retail food environment.

These results are consistent with the hypothesis that living in immigrant enclaves is associated with healthy
dietary patterns among Hispanic immigrants\(^{12,14}\). Past research among Hispanics has found associations between measures of acculturation and diet, but this work has focused mainly on specific nutrients or consumption of specific food groups such as fruits and vegetables, and individual-level measures of acculturation such as the participant’s use of English. However, nutrients and food items are not consumed in isolation; analyses that focus on isolated nutrients or food groups as the measure of diet may find associations between indicators of acculturation and diet that are not observed when the overall dietary pattern is considered as the outcome of interest\(^{17}\). For instance, past studies among immigrants have found associations between speaking English and the consumption of food items, but we did not observe an association between the participant’s use of English and overall dietary pattern\(^{10}\). In our analysis, neighbourhood-level acculturation is a major correlate of dietary patterns, appearing to promote one pattern of consumption while protecting a second pattern.

The nine additional food items included in the SWAN FFQ to reflect Hispanic cuisine did not, as a group, load highly on either the identified healthy or energy-dense dietary patterns. Since these ‘Hispanic’ FFQ items include not only foods that could be considered healthy (e.g. cassava or cooked green peppers) but also foods that could be considered energy dense (e.g. condensed milk or flan), the failure of this grouping to load highly on either pattern is not surprising. Thus, neighbourhood linguistic isolation does not appear to promote consumption of the ‘Hispanic’ food items added to the 103-item core SWAN FFQ but rather the consumption of an overall dietary pattern high in vegetables, legumes, fish, seafood and fruit, items that are part of the core FFQ. If, as literature suggests, the rise in obesity among immigrants results, at least in part, from the loss of home country diets and acquisition of obesogenic American diets, interventions that facilitate the maintenance of home country diets may make important contributions to obesity prevention\(^{10,26,29}\). Our results suggest, however, that such interventions should focus on the maintenance of patterns of home country dietary practices that are healthy (e.g. patterns that maintain higher levels of consumption of fruit, rice and legumes and lower sugar consumption) rather than on the consumption of specific food items or even types of cuisines considered to be ‘traditional’\(^{110}\).

Lee et al.\(^{30}\) suggest that, in the face of increasing market penetration of processed foods and US chain restaurants in Korea, a multi-pronged national campaign to promote retention of the vegetable-centred traditional Korean diet resulted in significant positive health effects. A similar approach that acknowledges the healthy dietary patterns and their practices that many immigrants bring from their countries of origin, and encouragement of the retention of the best elements of those practices, an approach Yeh et al. refer to as ‘selective acculturation’\(^{29,31,32}\), may be of use among immigrant groups in the USA.

In these analyses, our construct of ‘BMI-healthy’ retail outlets, which has previously been shown to predict lower BMI in adults and lower risk of maternal obesity\(^{25,24}\), did not predict adherence to either of the identified dietary patterns. Whereas adherence to the healthy dietary pattern might be expected to be associated with lower energy intake and the energy-dense dietary pattern to be associated with higher energy intake, higher energy intake was positively associated with higher adherence to both dietary patterns. Since our previous research has found an association between the density of BMI-healthy outlets and lower BMI, we considered that control for energy intake in models that include food environment variables might represent over-adjustment for a potential intervening variable. However, the results for the food environment variables were not materially different in analyses that did not control for energy intake. The only association between our previously defined food environment measures and diet was between a higher density of BMI-neutral outlets and higher adherence to the energy-dense dietary pattern, an association primarily driven by the density of restaurants other than fast food or pizza. It is likely that an abundance of restaurants is linked to higher consumption of restaurant meals and exposure to non-home country cuisines and higher levels of acculturation. In addition, meals consumed outside the home are less healthy than meals prepared at home\(^{35,34}\). In the analyses examining specific retail outlets, the only association observed was between higher density of fast-food restaurants and lower adherence to the healthy dietary pattern. Although prior work has not found strong links between the presence of fast-food outlets and diet or obesity, it is possible that in this population an abundance of fast-food restaurants is linked to more meals being consumed in these restaurants\(^{24,35–37}\). Such restaurants are not major sources of the vegetables, legumes and fruit associated with the healthy dietary pattern. Although there were a few associations between the dietary pattern data and aspects of the retail food environment, the food environment measures did not explain the association between neighbourhood Spanish language linguistic isolation and adherence to the healthy dietary pattern.

In conclusion, these analyses suggest that measures of neighbourhood-level immigrant acculturation may predict differences in dietary patterns among Hispanic women that cannot be explained by variation in the neighbourhood retail food environment. The present study contributes to a small but growing literature that considers how neighbourhood contexts may moderate the influence of individual ethnicity or acculturation on health behaviour. Strengths of the study include the representation of several Hispanic ethnicities in the study sample, the use of objective measures of the food environment and the use of dietary pattern analysis to characterize the food intake of participants. The primary limitation is the use of a sample that includes only women. Interventions and nutritional
counselling that focus on preserving and promoting the home country diets of immigrants may be effective in preventing the weight gain that is commonly seen among immigrants with longer duration of residence in the USA and among successive generations of immigrants.

Acknowledgements

The research was funded by grants from the National Institutes of Health (R01ES014229 and R01HL068236). The authors have no conflict of interest to declare. Y.P. conceptualized the research questions, directed the analyses and drafted the manuscript; K.N. helped design the neighbourhood health effects study and co-authored the manuscript; J.Q. developed the Geographic Information System measures of neighbourhood characteristics; C.W. helped design the neighbourhood health effects study, developed the statistical analytical plan and co-authored the manuscript; J.J. designed the asthma study and oversaw participant recruitment/data collection; A.R. designed the neighbourhood effects study, co-authored the manuscript; J.Q. developed the Geographic Information System measures of neighbourhood characteristics; C.W. helped design the neighbourhood health effects study, conducted the statistical analyses and co-authored the manuscript.

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