Proximity of fast food restaurants to schools: Do neighborhood income and type of school matter?

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Abstract

Objectives. To investigate the proximity of fast food restaurants to public schools and examine proximity by neighborhood income and school level (elementary, middle, or high school).

Methods. Geocoded school and restaurant databases from 2005 and 2003, respectively, were used to determine the percentage of schools with one or more fast food restaurants within 400 m and 800 m of all public schools in Los Angeles County, California. Single-factor analysis of variance (ANOVA) models were run to examine fast food restaurant proximity to schools by median household income of the surrounding census tract and by school level. Two-factor ANOVA models were run to assess the additional influence of neighborhood level of commercialization.

Results. Overall, 23.3% and 64.8% of schools had one or more fast food restaurants located within 400 m and 800 m, respectively. Fast food restaurant proximity was greater for high schools than for middle and elementary schools, and was inversely related to neighborhood income for schools in the highest commercial areas. No association with income was observed in less commercial areas.

Conclusions. Fast food restaurants are located in close proximity to many schools in this large metropolitan area, especially high schools and schools located in low income highly commercial neighborhoods. Further research is needed to assess the relationship between fast food proximity and student dietary practices and obesity risk.

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Introduction

Over the past three decades, the epidemic of overweight among children in the United States has been accompanied by major changes in childhood patterns of food and beverage consumption (St-Onge et al., 2003). Prominent among these changes has been a significant increase in the consumption of foods from restaurants and fast food establishments (Nielsen et al., 2002a,b; Guthrie et al., 2002; Nielsen et al., 2002a,b). Among adolescents aged 12 to 18 years, the percentage of total energy intake from restaurant and fast foods consumption increased by nearly 300% from 1977 to 1996 (Nielsen et al., 2002a,b). Growth in fast food sales has been particularly rapid, outpacing growth in sales at table service restaurants by 45% between 1982 and 1997 (Jekanowski, 1999). Approximately 3 in 10 U.S. children now consume food from one or more fast food establishments on a typical day (Bowman et al., 2004).

Consumption of fast food is associated with increased caloric and total fat intake, more added sugar intake, less dietary fiber, fewer fruits and vegetables, and other indices of poor dietary quality in children and adolescents (Bowman et al., 2004; French et al., 2001; Schmidt et al., 2005). In addition, overweight adolescents have been found to be less likely than their lean counterparts to compensate for the energy intake from fast food by adjusting their energy intake from other sources (Ebbeling et al., 2004). Fast food consumption has also been associated with increased weight gain and insulin resistance among young adults in a recent longitudinal study, suggesting that frequent consumption may be an independent risk factor for obesity and type 2 diabetes (Pereira et al., 2005).

Strategies to address the childhood obesity epidemic include efforts to improve the food environment. An important focus of
these efforts has been on improving school environments by establishing more rigorous nutrition standards for school meals and regulating what is sold in vending machines (Institute of Medicine, 2007). However, the food environment immediately surrounding school campuses may also be important, especially at high schools where students have more freedom to leave school grounds and purchase food.

A recent study in Chicago found a statistically significant clustering of fast food restaurants within short walking distances of schools (Austin et al., 2005). Other studies have found higher concentrations of fast food restaurants in low income neighborhoods and, in one study (Block et al., 2004), in predominantly black neighborhoods (Block et al., 2004; Cummins et al., 2005; Reidpath et al., 2002; Pearce et al., 2007). However, these other studies did not examine fast food locations in relation to schools.

The objectives of the present study were to assess the proximity of fast food restaurants to public schools in a large metropolitan area and to address two primary questions: 1) Is there an association between fast food proximity to schools and neighborhood income? 2) If so, is this association affected by the level of commercialization of the area? The importance of these questions rests in the fact that the childhood obesity epidemic has disproportionately impacted those living in low income neighborhoods (Lee et al., 2006). Many of these neighborhoods are located in urban centers that are highly commercialized and densely packed with fast food restaurants (Block et al., 2004; Kipke et al., 2007). Given the greater independence and mobility of adolescents compared with younger children, our study also sought to examine the relationship between fast food restaurant proximity and school level (elementary, middle, or high school).

Methods

Data sources

We used 2005 data from the California Department of Education (CDE) to identify all public schools in Los Angeles County, the most populous county in the United States. All fast food restaurants in the county among 18 fast food chains (listed in Table 1) were ascertained using 2003 databases from the food inspection/permit and to receive periodic inspections. Though we did not formally validate completeness, we compared the total number of fast food outlets in our food inspection database with the total number in a commercial database (Dun & Bradstreet) for 17 of the 18 chains included in our study (one chain was not captured in the commercial database). We found 30% more outlets in the food inspection database (n=2648) than in the commercial database (n=1848).

Only restaurants with 10 or more outlets in Los Angeles County and with primarily counter and/or drive-through service were included in the analysis. Fast food restaurants located at major sports venues were excluded.

Data on census tract-level median household income were obtained from the Parcel Database maintained by the Los Angeles County Assessor.

Measures and data analysis

A total of 1684 public schools and 2712 restaurants were included in the analysis. We included schools classified by the CDE as elementary schools (n=1208), junior high/middle schools (n=259), or high schools (n=217). Schools were also classified by the median household income of the census tract in which the school was located. Schools were divided equally into four neighborhood income quartiles (i.e., quartile 1 included schools in the <25th percentile for census-tract median household income, quartile 2 included schools in the 25th–49th percentile, etc.).

Public schools and fast food restaurants were geocoded against Los Angeles County-specific street and parcel data using street addresses provided in the respective school directory and food safety databases. The 2005 CDE Public Schools Database included school addresses which were geocoded at the street-level using Thomas Brothers Transportation Lines (TRNL) reference data. From the geocoded schools, we created layers representing buffered areas around each school. At 400 m and 800 m in radius, with the circle buffers centered on the street match point. These distances were chosen based on research estimating that an average person can walk 400 m in 5 min and have been used in other studies (Austin et al., 2005; Western Australian Planning Commission, 2000; Pikora et al., 2002). We therefore considered both 400 m and 800 m to be reasonable thresholds for “close proximity”.

The mean number of fast food restaurants, and the percentage of schools with one or more fast food restaurants, within 400 m and 800 m of each school were calculated and examined by school type and neighborhood income quartile. Differences in percentages were assessed for statistical significance with the Chi-square test. Single-factor analysis of variance (ANOVA) models were run to examine whether the mean number of fast food restaurants within 400 m and 800 m of schools varied significantly by school type and neighborhood income.

To account for differences in population density across neighborhood income strata in assessing the relationship between mean number of fast food restaurants and neighborhood income, a single-factor analysis of covariance (ANCOVA) model was run using population density as the covariate.

To examine whether the level of commercialization in the neighborhood of the school affected the relationship between mean number of fast food restaurants and school type or neighborhood income, the level of commercialization surrounding the school was included as a second factor in two-factor ANOVA models. The hypothesis considered here is that relationships between fast food proximity to schools and neighborhood income or school type would be most apparent in highly commercial areas. The percent commercial area of the census tract within which the school was located was used as a proxy for level of commercialization and was calculated by dividing the total area of commercial use parcels by the total area of the census tract. Schools were then categorized as being located in an area of high, moderate, or low level of commercialization based on tertiles of percent commercial area.

Geographic analysis was performed using ArcGIS 9.1 software (ESRI; Redlands, CA), and subsequent statistical analyses were performed using SAS.
Mean number of restaurants and percent of schools with at least 1 restaurant within close proximity to schools, by school type and neighborhood income quartile, Los Angeles County, 2005

<table>
<thead>
<tr>
<th>School type</th>
<th>Overall</th>
<th>No. of schools</th>
<th>Mean number of fast food restaurants within 400 m</th>
<th>Range (min, max)</th>
<th>Percent of schools with 1 or more fast food restaurants within 400 m</th>
<th>Mean number of fast food restaurants within 800 m</th>
<th>Range (min, max)</th>
<th>Percent of schools with 1 or more fast food restaurants within 800 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>1684</td>
<td>0.42</td>
<td>(0, 8)</td>
<td>23.3</td>
<td>2.17</td>
<td>(0, 16)</td>
<td>64.8</td>
<td></td>
</tr>
<tr>
<td>School type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>217</td>
<td>0.65</td>
<td>(0, 8)</td>
<td>30.9**</td>
<td>2.71</td>
<td>(0, 16)</td>
<td>71.4</td>
<td></td>
</tr>
<tr>
<td>Middle/junior high school</td>
<td>259</td>
<td>0.42*</td>
<td>(0, 5)</td>
<td>24.3</td>
<td>2.10*</td>
<td>(0, 12)</td>
<td>64.5</td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>1208</td>
<td>0.38**</td>
<td>(0, 7)</td>
<td>21.7</td>
<td>2.09**</td>
<td>(0, 15)</td>
<td>63.7</td>
<td></td>
</tr>
<tr>
<td>Neighborhood income quartile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1 ($0–$32,832)</td>
<td>422</td>
<td>0.72***</td>
<td>(0, 8)</td>
<td>37.7***</td>
<td>2.90***</td>
<td>(0, 15)</td>
<td>76.8***</td>
<td></td>
</tr>
<tr>
<td>Q2 ($32,833–$44,416)</td>
<td>422</td>
<td>0.45</td>
<td>(0, 5)</td>
<td>24.4</td>
<td>2.44***</td>
<td>(0, 16)</td>
<td>69.7</td>
<td></td>
</tr>
<tr>
<td>Q3 ($44,417–$58,318)</td>
<td>419</td>
<td>0.31***</td>
<td>(0, 5)</td>
<td>18.9</td>
<td>2.07***</td>
<td>(0, 10)</td>
<td>65.6</td>
<td></td>
</tr>
<tr>
<td>Q4 ($58,319+)</td>
<td>421</td>
<td>0.21 b</td>
<td>(0, 6)</td>
<td>12.1</td>
<td>1.26</td>
<td>(0, 10)</td>
<td>47.3</td>
<td></td>
</tr>
</tbody>
</table>

*a p<0.05, **p<0.005, ***p<0.001.
*b School type: high school vs. middle or elementary school.
*b Neighborhood income: 4th income quartile vs. other quartiles.

Results

Overall, 23.3% and 64.8% of public schools had one or more fast food restaurants located within 400 m and 800 m, respectively (Table 2). The percentage with one or more fast food restaurants within 400 m was highest for high schools (30.9%), intermediate among middle schools (24.3%), and lowest among elementary schools (21.7%). A similar trend was seen with the 800 m buffer.

Fast food restaurant proximity to schools was inversely related to neighborhood income (Table 2). In the lowest income quartile, over three times more likely to have at least one fast food restaurant within 400 m than were schools in the highest income quartile (37.7% vs. 12.1%). This inverse relationship was also observed with the 800 m buffer. In the ANCOVA model, the inverse relationship between fast food restaurant proximity to schools and neighborhood income persisted after controlling for population density (p<0.001 for both the 400 and 800 m buffers).

Both school type and level of commercialization were significant effects in the two-factor ANOVA model. When the 400 m buffer was used, the estimated mean number of fast food restaurants in close proximity to high schools was significantly higher than the estimated mean for middle schools (p=0.042) and elementary schools (p=0.001). The estimated mean for middle schools did not differ from the estimated mean for elementary schools (p=0.81). The estimated mean number of fast food restaurants was significantly higher in areas of high commercialization compared to areas of low commercialization (p<0.001, Table 3).

Testing for interaction in the two-factor ANOVA model using the 400 m buffer revealed a significant interaction between neighborhood income and level of commercialization (p<0.001, Fig. 1). The effect of median household income was found to be significant only within the highest level of commercialization, with the estimated mean number of fast food restaurants in close proximity to schools being more than five times as high in areas of low income compared to areas of high income (1.1 vs. 0.2, respectively, p<0.001). No significant interaction was found between school type and level of commercialization. The results were similar when the 800 m buffer was used.

Discussion

We found that a large percentage of public schools in Los Angeles County have fast food establishments located within an easy walking distance. In addition, schools located in low income, highly commercial neighborhoods were more likely to have fast food restaurants in close proximity than more affluent neighborhoods with a comparable level of commercialization. This finding is consistent with those of other studies that have documented disproportionately high concentrations of fast food outlets in low income communities (Block et al., 2004; Cummins et al., 2005; Reidpath et al., 2002; Pearce et al., 2007).

Estimated mean number of fast food restaurants within 400 m and 800 m of schools, by school type and level of commercialization, Los Angeles County, 2005

<table>
<thead>
<tr>
<th>School Type</th>
<th>Estimated mean no. of fast food restaurants within 400 m radius</th>
<th>Estimated mean no. of fast food restaurants within 800 m radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>High school (ref)</td>
<td>0.65</td>
<td>2.71</td>
</tr>
<tr>
<td>Middle school</td>
<td>0.45*</td>
<td>2.20*</td>
</tr>
<tr>
<td>Elementary school</td>
<td>0.41**</td>
<td>2.19**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of commercialization</th>
<th>Estimated mean no. of fast food restaurants within 400 m radius</th>
<th>Estimated mean no. of fast food restaurants within 800 m radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (ref)</td>
<td>0.22</td>
<td>1.21</td>
</tr>
<tr>
<td>Medium</td>
<td>0.45***</td>
<td>2.19***</td>
</tr>
<tr>
<td>High</td>
<td>0.83***</td>
<td>3.70***</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.005, ***p<0.001.
We also found a greater proximity of fast food restaurants to high schools than middle or elementary schools, a finding that has at least several possible explanations. Given the large market segment represented by teens, it is plausible that fast food chains may preferentially site outlets near high schools because of the flexibility these students have to visit these sites before, during, and after the school day. However, the finding may also reflect preferential sighting of high schools on major thoroughfares and, therefore, in closer proximity to fast food establishments compared with middle and elementary schools that may more often be sited in largely residential areas. Regardless of the underlying mechanism, the issue of fast food proximity is likely of particular importance for high schools, where students are often free to leave campus during lunchtime and have greater independence before and after school.

An important limitation of our study is that we focused solely on fast food establishments and did not assess other aspects of the food environment. One recent study found that comprehensive assessments of local food environments are important because concentrations of unhealthy food outlets can sometimes be accompanied by the presence of healthier food options in the same community (Pearce et al., 2007). However, other studies have found that the high density of fast food establishments found in low income communities are often associated with more general evidence of unhealthy food environments, including a paucity of supermarkets, limited access to fresh produce, and an abundance of convenience stores offering few healthy food options (Baker et al., 2006; Kipke et al., 2007, Morland et al., 2002).

We also did not address in our study the availability of commercial fast food products sold on school campuses. Though we could not quantify the percentage of schools that offer these products on site, such practices have been phased out over the past several years across Los Angeles County as a result of new school district-level policies and, more recently, state legislation mandating more rigorous nutrition standards for foods and beverages sold at schools.

Our study did not assess the degree to which fast food proximity to schools influenced dietary patterns among students, including the fact that fast food establishments offer a range of menu items, some of which are less obesigenic than others. We also did not assess the relationship between fast food proximity and childhood obesity rates. Although fast food consumption has been associated with excess weight gain (Pereira et al., 2005; Duffey et al., 2007; Thompson et al., 2004), limited information is available on the influences of fast food proximity and accessibility on dietary practices and weight status. Several studies have evaluated geographic associations between fast food density and obesity rates with mixed results (Maddock, 2004; Jeffrey et al., 2006). However, these ecologic studies are limited because they do not account for the many other factors that contribute to obesity at both the community and individual levels. Further research is needed to better define the relationships between fast food proximity and weight status as well as dietary practices.

An additional limitation is that we could not identify in the restaurant database fast food establishments that were not part of a recognizable chain. Therefore, we do not know the degree to which the geographic distribution of all fast food restaurants may have differed from those included in our analysis. In addition, we assessed the proximity of fast food restaurants to schools using a straight line radius approach rather than incorporating road or path network distances, resulting in potential overestimation of fast food proximity.

These limitations notwithstanding, our findings raise a concern that the significant efforts made in recent years to improve nutrition environments within schools, including policies mandating more rigorous nutrition standards for school meals and restrictions on foods and beverages sold in vending machines, may potentially be diminished if attention is not given to fast
food outlets directly surrounding schools, especially in low income communities. These efforts are particularly important given the disproportionately high rates of childhood obesity in low income communities (Lee et al., 2006). In addition, the findings underscore the need for further research to assess the relationship between fast food proximity to schools and student dietary practices and obesity risk.

While strategies to curb the childhood obesity epidemic must include more effective education of children and their parents on nutrition and portion control, these efforts will likely fall far short without concurrent environmental change efforts that tip the balance in favor of healthier food purchases. Municipalities have much control over how land is used and developed in their jurisdictions (Ashe et al., 2003). Increasingly, public health authorities are working with city planners to promote zoning and other land use policies that incorporate health as a consideration. Much of this work most recently has focused on physical activity promotion through, for example, the design of more walkable neighborhoods and allocation of space for parks, jogging trails, and bicycle paths (Powell, 2005).

Efforts are needed to expand this focus to food environments. Potential areas of intervention include regulating the density of fast food establishments and creating economic and other incentives for markets that offer affordable fresh produce and for restaurants that offer healthier fare and smaller portions. The results of this study suggest that consideration in these efforts should be given to the types of food establishments located near schools, especially in low income communities with high commercial densities.

Conclusions

Fast food restaurants are located in close proximity to many schools in this large metropolitan area, especially high schools and schools located in low income highly commercial neighborhoods. Further research is needed to assess the relationship between fast food proximity and student dietary practices and obesity risk.

References


