HHS Public Access

Author manuscript

J Community Health. Author manuscript; available in PMC 2019 October 01.

Published in final edited form as:

J Community Health. 2018 October ; 43(5): 886–895. doi:10.1007/s10900-018-0498-9.

Sources of foods that are ready-to-consume ('grazing environments') vs. requiring additional preparation ('grocery environments'): implications for food-environment research and community health

Sean C. Lucan, MD, MPH, MS[1], **Andrew R. Maroko, PhD**[2], **Jason L. Seitchik, MD**[3], **Don Yoon, MD**[3], **Luisa E. Sperry, BA**[4], and **Clyde B. Schechter, MD, MA**[5]

[1]Associate Professor, Department of Family and Social Medicine, Albert Einstein College of Medicine | Montefiore Health System, Bronx, NY

[2]Associate Professor, Department of Environmental, Occupational, and Geospatial Health Sciences, CUNY Graduate School of Public Health and Health Policy, New York, NY

[3]Medical Student, Albert Einstein College of Medicine, Bronx, NY

[4]Medical Student, Stony Brook School of Medicine, Stony Brook, NY

[5]Professor, Albert Einstein College of Medicine, Bronx, NY

Abstract

Local businesses that offer foods may create different 'grazing environments' (characterized by sources of ready-to-consume foods) and 'grocery environments' (characterized by sources of foods for later preparation). Such environments may be relevant to different populations at different times and may vary by neighborhood. In neighborhoods within two demographically distinct areas of the Bronx, NY (Area A [higher-poverty, greater minority representation, lesser vehicle ownership] versus Area B), researchers assessed all storefront businesses for food offerings. Food offerings could be ready-to-consume or require additional preparation. 'Healthful' offerings included fruits and vegetables, whole grains, and nuts; 'less-healthful' offerings included 'refined sweets' and 'salty/fatty fare.' 'Food businesses' (those primarily focused on selling food) were distinguished from 'other businesses' (not focused primarily on food selling). Area A had a higher percentage of street segments on which foods were available (28.6% vs. 6.9% in Area B; difference 21.7 percentage points [95% CI: 17.0, 26.5]) and a higher percentage of businesses offering foods (46.9% vs. 41.7% in Area B; difference 5.2 percentage points [95% CI: -2.0, 12.4]).

Corresponding author: Sean C. Lucan, MD, MPH, MS, Department of Family and Social Medicine, Albert Einstein College of Medicine | Montefiore Health System, 1300 Morris Park Ave, Block Building, Room 410, Bronx, NY 10461-1900, Tel: (718) 430-3667, Fax: (718) 430-8645, slucan@yahoo.com.

Conflict of interest: None of the other authors have any disclosures.

Authorship: SCL conceived the study, performed the literature review, designed the data collection protocol, oversaw primary data collection, performed all analyses, and drafted the manuscript, including tables and figures. ARM assisted with analyses and data interpretation, created the map, and helped revise the manuscript. JLS, DHY, and LES performed primary data collection, assisted with data analysis and interpretation, and helped revise the manuscript. CBS oversaw and assisted with data analysis and helped revise the manuscript.

Ethical Standards Disclosure: This study did not involve human subjects

‘Less-healthful’ items predominated in both ‘grazing environments’ and overall environments (‘grazing’ plus ‘grocery environments’; the environments researchers typically measure) in both Areas A and B. ‘Other businesses’ represented about 2/3 of all businesses and accounted for nearly 1/3 of all the businesses offering food in both geographic areas. The lower-income area with greater minority representation and less private transportation had more businesses offering foods on more streets. There was near-perfect overlap between ‘grazing environments’ and overall environments in both geographic areas. Future research should consider the extent of ‘grazing’ and ‘grocery environments,’ and when each might be most relevant to populations of interest.

Keywords

Food Environment; Community Nutrition; Public Health; Fruits; Vegetables; Whole Grains; Nuts; Processed Foods; Diet; Research

INTRODUCTION

There is increasing interest among researchers and policy makers as to how people’s dietary intake may relate to local sources of food.(1–4) Local food sources may influence people’s dietary choices, but research findings have been inconsistent(1–3) and studies do not generally distinguish sources of foods ready for consumption from sources of foods for later preparation. The distinction may be critical as the two categories of food can be relevant for different populations at different times. For instance, the availability of food ingredients may matter less for individuals seeking grab-and-go meals and snacks for immediate consumption (e.g., students traveling to or from school) compared to individuals stocking up for subsequent cooking and eating (i.e., those shopping for groceries).

Sources of foods ready for consumption include various storefront businesses,(5–8) fast food outlets, and take-away restaurants, all of which may be over-represented in lower-income and minority neighborhoods.(9–12) Other sources of ready-to-consume foods like convenience stores and grocery stores (also sources of foods for later preparation), might likewise be overrepresented in these communities.(9–11, 13) In contrast, larger chain supermarkets (sources of both foods for immediate consumption and later preparation) tend towards wealthier white communities(14, 15) having greater access to private transportation.(16)

Disparities in food availability between communities may be defined by differences in ‘grazing environments’ (characterized by sources of foods for immediate consumption) and ‘grocery environments’ (characterized by source of foods for later preparation). Failing to appreciate the distinction between these two types of environments may lead to miscategorization of food-source exposures and to false relationships in studies linking food availability to diet. For instance, in studies focused on adolescents, considering grocery-only retail as part of food-source exposures could potentially bias food-environment–diet associations if what adolescents largely consume is pre-prepared foods (as some evidence suggests is the case (17–19)). Misclassifying elements of a ‘grocery environment’ as part of the more-relevant ‘grazing environment’ may partly explain why food-environment research findings for adolescents have been mixed.(3)

The current study assessed ‘grazing environments’ and overall food environments (‘grazing’ plus ‘grocery environments’; the environments that studies typically assess) for communities within two demographically distinct urban areas. The areas differed in rates of poverty, racial/ethnic representation, and vehicle ownership. The areas also differed in rates of unhealthful dietary behaviors and diet-related diseases. Investigators considered how differences in sources of foods between the two areas (foods ready for consumption versus requiring additional preparation) could be important for food-environment research and community health. Specifically, investigators assessed how ‘grazing’ and overall food environments differed, and to what extent the distinction could matter for associations with diet in populations of interest.

METHODS

Sampling in two urban areas

The study focused on two large geographic divisions of the Bronx, NY—essentially the southwest and southeast quadrants of Bronx county (Figure 1).(20) Investigators purposely selected census tracts having the highest rates of poverty (and relatively high proportions of racial/ethnic-minorities), designated ‘Area A,’ and census tracts having the lowest poverty rates (and lower proportions of racial/ethnic-minorities), designated ‘Area B.’ Area A (15 census tracts) was more populous, so investigators included a greater number of census tracts in Area B (17 census tracts) for more comparable total populations (Figure 1). Area A had comparatively lower rates of vehicle ownership, a marker of mobility and potential access to distant food sources.(21) Area A (or, more precisely, the southwest division of the Bronx containing it) had higher rates of less-healthful eating (e.g., lower fruit-and-vegetable intake, higher sugary-drink consumption, poorer diet quality) and higher rates of diet-related chronic conditions (e.g., obesity, hypertension, diabetes).(22)

The study included all 398 ‘street segments’ (sections of a street between cross streets) in Area A and all 855 street segments in Area B. The goal was to assess all food sources to which individuals could be exposed in traveling along area streets.

Assessment for food sources

Investigators traveled the length of each side of each street segment, in each geographic area, to identify any storefront businesses offering foods (of note, ‘storefront businesses’ included free-standing vending machines). Assessments occurred during summer 2013. For each identified storefront business, investigators recorded the name, location, and type of business, and determined if any food was for sale using signage, menus/menu boards, product displays, and/or inquiries of staff. A distinction was made between ‘food businesses’ (i.e., outlets primarily focused on selling foods such as grocery stores, supermarkets, specialty food stores, restaurants, and free-standing vending machines) and ‘other businesses’ (i.e., all other storefronts such as auto shops, department stores, laundromats, beauty salons, and pawn shops).

Categorization of foods

Food items identified in assessments were classified as either ‘ready to consume’ or ‘requiring additional preparation.’ Additional preparation could include manipulation like opening with tools (e.g., a can opener), soaking, cooking, defrosting, heating, or chopping. Foods requiring additional preparation were felt to serve individuals seeking to eat at a later time. Sources of such foods defined a ‘grocery environment’. Foods that might be part of a ‘grocery environment’ included canned foods like peas, dried foods like beans, fresh vegetables like potatoes, microwave meals, and whole fruit like uncut pineapple or melon. Conversely, ready-to-consume foods would require no additional effort to eat other than perhaps opening a container (e.g., a box of raisins, a bag of chips, a jar of salsa) or hand peeling (e.g., oranges or bananas). Sources of food ready for consumption defined a ‘grazing environment,’ felt to serve individuals seeking to eat immediately (or at least open to eating presently, even if immediately obtaining food not the original objective or intent).

More details on ‘ready to consume’ and ‘requiring additional preparation’ appear in Table 1. Table 1 also shows food categorizations. Five food categories were developed through prior work in food-environment assessment.(8, 23–26) Categories included ‘fruits and vegetables,’ ‘whole grains,’ ‘nuts,’ ‘refined sweets,’ and ‘salty/fatty fare.’ Consistent with the Dietary Guidelines for Americans,(27) the three former categories were considered ‘healthful’ and the two latter categories were considered ‘less-healthful.’ Investigators assessed for the presence (yes/no) of any item in each category within all identified businesses.

Reliability in data collection

Using methods developed in earlier food-environment research,(8, 23–26) three investigators conducted assessments of 20 storefront businesses—first independently, then as a group. For the independent assessments, there was near-perfect agreement with regard to business name, business location, business type, and food offerings (agreement 98.7%). An example error was one investigator missing a vending machine at the back of a hair salon. For the group assessment, there was essentially perfect agreement with the gold standard of observations made independently by the principal investigator. The only differences were in the examples noted for available foods (e.g., the group noting “whole-wheat bagel” and the principal investigator noting “oatmeal” for the whole-grain item at a donut shop).

For data collection and management, the study used the web-based REDCap application. REDCap (Research Electronic Data Capture)(28) provides an intuitive interface for validated data entry, audit trails for tracking data manipulation, and automated export procedures for downloads to statistical packages.

Statistical Analyses

Investigators compared observations from Area A to those from Area B using two different and complementary units of analysis: (1) street segments and (2) storefront businesses. Of interest were the number and types of food sources that could be encountered traveling along the streets in both geographic areas. Comparisons between the Area A and Area B were by the five different types of food categories, first among ready-to-consume options (‘grazing

environments') and then including items requiring additional preparation ('grazing' plus 'grocery environments'—i.e., the 'overall environments' typical in food-environment research). Investigators used Stata version 12.1 (StataCorp, College Station, TX) for descriptive statistics and comparisons. Results include 95% confidence intervals as indicators of precision in measured differences.

RESULTS

Table 2 characterizes 'grazing environments' by showing sources of ready-to-consume-food offerings in Area A versus Area B by street segment and by storefront businesses. A footnote to the table characterizes 'overall food environments' by describing the comparative distributions for sources of all foods, including those requiring later preparation. Numbers and percentages detailed below come from the table or from calculations based on table values.

While there were fewer than half as many street segments in Area A (398 versus the 855 in Area B), there were more than twice as many businesses there (586 versus 266 in Area B). In other words, the lower-income area having greater minority representation and lesser vehicle ownership (Area A) had more than four times the proportion of street segments with storefront businesses (36.7% versus 8.7% in Area B; difference 28.0 percentage points [95% CI: 22.9, 33.1]). Area A also had more business per unit area and more business per capita than Area B (Figure 1).

There were also more than twice as many street segments offering ready-to-consume foods in Area A than Area B (113 vs. 59). Stated differently, the 'grazing environment' that would be presented to an individual traveling through Area A was nearly twice as extensive the 'grazing environment' present in Area B. At least some ready-to-consume food could be found on more than one in four streets in Area A (28.4%). Conversely, ready-to-consume food was available in Area B on fewer than one in fourteen streets (6.9%, a difference of 21.5 percentage points [95% CI: 16.7, 26.2]). Considering 'grazing environments' by street segment, a potential consumer would find ready-to-consume items in each of the five food categories available proportionately more often in Area A.

In both geographic areas, but more markedly in Area A, less-healthful items predominated in 'grazing environments.' Walking through Area A, a potential consumer would find that nearly 1 in 10 street segments (9.8%) offered only less-healthful ready-to-consume foods without healthful alternative. In Area B, the proportion was closer to 1 in 30 (3.3%; a difference of 6.5 percentage points [95% CI: 3.4, 9.7]). 'Refined sweets' and 'salty/fatty fare' were available on 99.1% and 91.2% of the street segments offering food in Area A and on 89.8% and 88.1% of street segment offering food in Area B, respectively.

At the level of storefront businesses, Area A likewise had a 'grazing environment' more extensive than that of Area B. There were nearly 2.5 times more storefront businesses offering ready-to-consume foods in Area A (273 versus the 111 in Area B). The proportion of storefront businesses offering ready-to-consume foods was 46.6% in Area A versus 41.7% in Area B (difference 4.9 percentage points [95% CI: -2.3, 12.0]). The largest

business-level difference between the two areas was in the proportion offering nuts (8.9 percentage-point difference [95% CI 2.8, 15.0), contributed by differences in offerings from both ‘food businesses’ and ‘other businesses.’

‘Other businesses’ represented about 2/3 of all businesses in both geographic areas and accounted for nearly 1/3 of all the businesses defining ‘grazing environments.’ A higher percentage of ‘other businesses’ offered ready-to-consume foods in Area A than in Area B (20.7% vs. 17.1%; difference 3.6 percentage points [95% CI: -3.2, 10.3]). Although ready-to-consume items from all of the five food categories were more available from ‘other businesses’ in Area A, the numbers and proportions of foods from ‘less-healthful’ categories strongly predominated over those from ‘healthful’ categories—and to a degree that was greater than in Area B.

Considering ‘overall food environments’ (‘grazing environments’ plus sources of foods requiring additional preparation), the distributions of availability by street segment and by storefront businesses were similar to those seen in ‘grazing environments’ (see footnote to Table 2). In fact, there was near-complete overlap between overall and ‘grazing’ environments in both areas.

The most notable exceptions to the overlap between overall and ‘grazing environments’ were in Area A: 11 businesses sold only varieties of fruits/vegetables and whole grains that required additional preparation, and four businesses sold only varieties of ‘salty/fatty fare’ that required additional preparation. A potential consumer would, thus, not have ready-to-consume options for fruits/vegetables, whole grains, or ‘salty/fatty fare’ at 5.6%, 7.5%, and 1.8% of the businesses offering other varieties of these products, respectively. However, given placement of businesses on streets, a potential consumer could find ready-to-consume fruit/vegetable varieties on all street segments where any fruit/vegetable options were available. For whole grains and ‘salty/fatty fare,’ a potential consumer could find ready-to-consume varieties on all except 5.6% and 1.0% of the street segments where any varieties of these products were available, respectively.

Between the two geographic areas, by street segment, the overall food environment in Area A was 1.9 times more extensive than in Area B. By storefront business, the overall food environment in Area A was 2.5 times more extensive than in Area B.

DISCUSSION

The current study assessed sources of food to which individuals traveling in two demographically distinct urban areas might be exposed. Findings show differences in ‘grazing’ and overall food environments. Both environments were more extensive in the lower-income area with greater minority representation and less vehicle ownership, with more businesses offering food on more streets. This area had more food sources overall, including sources of ‘healthful’ and ‘less-healthful’ read-to-consume options.

Prior research on local food sources has not explicitly addressed the issue of foods ready for consumption as distinct from foods requiring additional preparation but has instead tended to conflate readiness with healthfulness: source of ready-to-consume items (e.g. fast-food

restaurants) have generally been categorized as ‘unhealthy’ while sources of items for later preparation (e.g., supermarkets) have generally been categorized as ‘healthy.’(29) This conflation is problematic because there are plenty of ‘healthful’ foods that are ready to consume (e.g., fresh fruits, nuts, prepared whole grain dishes) and ‘less-healthful’ foods requiring additional preparation (e.g., cake mixes, frozen pastries, microwave dinners). Moreover, fast -food outlets often sell healthful items (e.g., green salads, milk, sliced fruit) (30) and supermarkets may provide vast arrays of unhealthful fare.(31, 32)

Looking specifically at foods which happened to be ‘fast’ (i.e., ready-to-consume), and which also happened to be unhealthful (e.g., candy, salty snacks, frozen and baked sweets), a study of retail storefronts from 19 U.S. cities demonstrated greater availability in census tracts that were either in the highest tertiles for income and minority percentage or the lowest tertiles (however the sample sizes were small and differences were not statistically significant).(5) A study that focused only on drug stores in North Carolina showed no differences in availability of foods (including ready-to-consume items like cereal, cheese, and chips, and items requiring additional preparation like canned vegetables, dried pasta, and frozen meats) by neighborhood income.(33) Nonetheless, as in the present study, less-healthful items were available more frequently than healthier items.(33)

When less-healthful items are highly available, lower-income individuals may be more restricted to these options than those with higher incomes and/or greater mobility.(34) For instance, the potential influence of fast-food outlets on diet may be strongest among families with low vehicle access.(35) Indeed, prior research has shown that socioeconomic status, including car ownership, may influence distance traveled to obtain food,(34, 36) and the consequences for body weight of living in a ‘food swamp’ (an area with a high-density of fast food and junk food relative to healthier options) may be more pronounced in areas where residents are less mobile.(37)

In the current study, the area defined by greater poverty and less vehicle ownership had greater food availability—both items ready-to-consume and overall. There were more opportunities for ‘grazing’ or snacking, and for purchasing food in general. Those living in the area would not have to travel far to obtain something to eat. The fact that most available items in both ‘grazing’ and overall environments were ‘less-healthful’ might help explain why the division of the Bronx containing the area has higher rates of less-healthful eating and of diet-related chronic diseases.(22)

The greater availability of food in the geographic area with less vehicle ownership was attributable mostly to the greater retail density there. In both geographic areas though, food items were available from a wide variety of retail sources beyond expected ‘food businesses.’ Indeed, ‘other businesses’ (including auto shops, department stores, laundromats, and pawn shops) represented about 2/3 of all businesses and 1/3 of all the food sources in both geographic areas (in which they offered predominantly less-healthful items).

The current study has several strengths. First, investigators sampled in two demographically distinct urban areas, including all businesses on over 1,250 street segments. Second, data collection included sources of both healthful and less-healthful food categories. Third,

investigators distinguished between items that were ready-to-consume from food items overall—a novel and important distinction for food environments relevant to different groups (e.g., those amenable to eating now versus those intending to eat later). Fourth, food availability was assessed using two different, complementary units of analysis: street segments (what's available on a given street) and businesses (what's available from a given storefront). Fifth, for businesses, the study considered contributions of 'other business' (overlooked in most food-environment research)(29) in addition to contributions of 'food businesses.'

One limitation of the present study is its cross-sectional design. Other research by our group suggests local food environments may change over time in a direction of increasing food availability. For instance, we found that on a sample of streets across the Bronx, nearly 30% more businesses offered food in 2015 than in 2010, with the number of streets on which foods were available increasing by more than 20% over the five-year period. (*Authors, paper under review*) Thus the findings of the current study with regard to food availability are likely conservative. Additionally, the current study utilized generous criteria for healthfulness (e.g., counting foods like fruit cocktail, trail mix, and popcorn as 'healthful' and likewise counting relatively minor components like sandwich toppings). The study also did not measure the relative amounts of 'healthful' versus 'less-healthful' food items. Anecdotally, there were greater quantities and varieties of less-healthful foods even when healthful options were present (e.g., the token bananas near the register at a donut shop). An additional limitation is the exclusive focus on foods without considering beverages. This choice related to the fact that virtually all beverages (with the rare exception of powdered drink mixes, canned milk, and frozen juices) are ready-to-consume and cannot help distinguish 'grazing' from 'grocery environments.' With regard to distinguishing environments, there may have been food sources that offered ready-to-consume items but not items for later preparation and our data did not allow us to make this determination. Future research should. For now, it is sufficient to note differences between 'grazing environments' and 'overall environments.' Finally, While we cannot say if our findings apply in other cities, the availability of ready-to-consume less-healthful items from a wide variety of storefront retailers is consistent with prior literature looking at cities across the U.S.(5)

Conclusion

The current study is the first to our knowledge to explicitly consider sources of food ready for consumption ('grazing environments') as distinct from sources of food overall (including grocery items for later preparation). 'Grazing' and 'grocery environments' might be relevant to different populations at different times, and future research should consider this nuance. For instance, in the current study, there were some storefronts that only offered whole grains and fruits and vegetables that would require additional preparation. These businesses might not be so relevant to children looking for snacks(38), for example, and probably should not be included as potential food-source 'exposures' for children making their own purchasing and consumption decisions.

We found that the overall food environment was more substantial in the lower-income area having greater-minority representation, lesser vehicle ownership, and more businesses on streets. Less-healthful items predominated and were substantially more numerous (and proportionally more present) than in the wealthier area with greater vehicle ownership. Because lower vehicle ownership might hinder travel for distant groceries,(21) the predominance of less-healthful offerings in an immediate vicinity is concerning for community health—particularly with regard to ready-to-consume items. Such items might lure people into impulse purchases (and impulse consumption) they did not intend.

To promote healthier choices and better health, some research has focused on ready-to-consume meals.(39) However, ready-to-consume foods extend beyond meals and include wide varieties of snacks across spectrums of healthfulness and processing. Preliminary evidence suggests that modifying ready-to-consume foods near the checkouts at various storefront retailers (e.g., to include fresh and dried fruits, granola bars, and/or nuts) could result in more-healthful purchases.(40) Also, store owners might work with distributors to stock more healthier ready-to-consume items in addition to, or in place of, less-healthful fare.(41)

Regardless, conceptualizations of food environments should extend beyond limited arrays grocers and restaurants. ‘Grazing’ and ‘grocery environments’ may include many ‘other businesses.’ Researchers and communities should recognize the substantial availability of foods (both ready-to-consume and for later preparation) from a wide variety of storefronts, and the substantial potential to modify offerings towards improved community health.

Acknowledgments

The authors would like to thank Geohaira Sosa for her help with data cleaning and analysis, and Aixin Chen, Charles Pan, and Aurora Jin, for reviewing drafts of the manuscript and for their insightful comments and contributions.

Financial support: SCL is supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health under award K23HD079606. The content of this manuscript is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. Student stipends through the Albert Einstein College of Medicine supported data collection. For data collection and management, the study used REDCap electronic data capture tools hosted through the Harold and Muriel Block Institute for Clinical and Translational Research at Einstein and Montefiore under grant UL1 TR001073.

References

1. Caspi CE, Sorensen G, Subramanian SV, Kawachi I. The local food environment and diet: a systematic review. Health Place. 2012; 18(5):1172–87. DOI: 10.1016/j.healthplace.2012.05.006 [PubMed: 22717379]
2. Rahmanian E, Gasevic D, Vukmirovich I, Lear SA. The association between the built environment and dietary intake - a systematic review. Asia Pac J Clin Nutr. 2014; 23(2):183–96. DOI: 10.6133/apjcn.2014.23.2.08 [PubMed: 24901086]
3. Engler-Stringer R, Le H, Gerrard A, Muhajarine N. The community and consumer food environment and children’s diet: a systematic review. BMC Public Health. 2014; 14:522.doi: 10.1186/1471-2458-14-522 [PubMed: 24884443]
4. Sisnowski J, Street JM, Merlin T. Improving food environments and tackling obesity: A realist systematic review of the policy success of regulatory interventions targeting population nutrition. PLoS One. 2017; 12(8):e0182581.doi: 10.1371/journal.pone.0182581 [PubMed: 28783757]

5. Farley TA, Baker ET, Futrell L, Rice JC. The ubiquity of energy-dense snack foods: a national multicity study. Am J Public Health. 2010; 100(2):306–11. DOI: 10.2105/AJPH.2009.178681 [PubMed: 20019297]
6. Basch CH, Kernan WD, Menafro A. Presence of Candy and Snack Food at Checkout in Chain Stores: Results of a Pilot Study. J Community Health. 2016; 41(5):1090–3. DOI: 10.1007/s10900-016-0193-7 [PubMed: 27101366]
7. Wright J, Kamp E, White M, Adams J, Sowden S. Food at checkouts in non-food stores: a cross-sectional study of a large indoor shopping mall. Public Health Nutr. 2015; 18(15):2786–93. DOI: 10.1017/S1368980015000178 [PubMed: 25712753]
8. Lucan SC, Maroko AR, Seitchik JL, Yoon DH, Sperry LE, Schechter CB. Surprising neighborhood sources of food & drink: implications for research and community health. Am J Prev Med. In Press.
9. Hilmers A, Hilmers DC, Dave J. Neighborhood disparities in access to healthy foods and their effects on environmental justice. Am J Public Health. 2012; 102(9):1644–54. DOI: 10.2105/AJPH.2012.300865 [PubMed: 22813465]
10. Neckerman KM, Bader MD, Richards CA, et al. Disparities in the Food Environments of New York City Public Schools. Am J Prev Med. 2010; 39(3):195–202. doi:S0749-3797(10)00346-6[pii]10.1016/j.amepre.2010.05.004. [PubMed: 20709250]
11. Rummo PE, Guilkey DK, Ng SW, Popkin BM, Evenson KR, Gordon-Larsen P. Beyond Supermarkets: Food Outlet Location Selection in Four U.S. Cities Over Time. Am J Prev Med. 2017; 52(3):300–10. DOI: 10.1016/j.amepre.2016.08.042 [PubMed: 27865651]
12. Maguire ER, Burgoine T, Penney TL, Forouhi NG, Monsivais P. Does exposure to the food environment differ by socioeconomic position? Comparing area-based and person-centred metrics in the Fenland Study, UK. Int J Health Geogr. 2017; 16(1):33.doi: 10.1186/s12942-017-0106-8 [PubMed: 28877706]
13. Moore LV, Diez Roux AV. Associations of neighborhood characteristics with the location and type of food stores. Am J Public Health. 2006; 96(2):325–31. doi:AJPH.2004.058040[pii]10.2105/AJPH.2004.058040. [PubMed: 16380567]
14. Powell LM, Slater S, Mirtcheva D, Bao Y, Chaloupka FJ. Food store availability and neighborhood characteristics in the United States. Prev Med. 2007; 44(3):189–95. doi:S0091-7435(06)00334-3[pii]10.1016/j.ypmed.2006.08.008. [PubMed: 16997358]
15. Zenk SN, Schulz AJ, Israel BA, James SA, Bao S, Wilson ML. Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in metropolitan Detroit. Am J Public Health. 2005; 95(4):660–7. doi:95/4/660[pii]10.2105/AJPH.2004.042150. [PubMed: 15798127]
16. Bader MD, Purciel M, Yousefzadeh P, Neckerman KM. Disparities in Neighborhood Food Environments: Implications of Measurement Strategies. Econ Geogr. 2010; 86(4):409–30. [PubMed: 21117330]
17. Poti JM, Popkin BM. Trends in energy intake among US children by eating location and food source, 1977-2006. J Am Diet Assoc. 2011; 111(8):1156–64. DOI: 10.1016/j.jada.2011.05.007 [PubMed: 21802561]
18. Slining MM, Mathias KC, Popkin BM. Trends in food and beverage sources among US children and adolescents: 1989-2010. J Acad Nutr Diet. 2013; 113(12):1683–94. DOI: 10.1016/j.jand.2013.06.001 [PubMed: 23916972]
19. Tyrrell RL, Greenhalgh F, Hodgson S, et al. Food environments of young people: linking individual behaviour to environmental context. J Public Health (Oxf). 2016; doi: 10.1093/pubmed/fdw019
20. New York City Department of Health and Mental Hygiene. NYC UHF 34 Neighborhoods. http://a816-dohbesp.nyc.gov/IndicatorPublic/EPHTPDF/uhf34.pdfhttps://www.ncbi.nlm.nih.gov/pmc/articles/PMC2642661/pdf/zpq3455.pdf. Accessed February 22 2018
21. Widener MJ, Metcalf SS, Bar-Yam Y. Developing a mobile produce distribution system for low-income urban residents in food deserts. J Urban Health. 2012; 89(5):733–45. DOI: 10.1007/s11524-012-9677-7 [PubMed: 22648452]
22. Buchholz N, Resnick S, Konty K. The New York City Community Health Survey Atlas, 2010. The New York City Department of Health and Mental Hygiene; 2012. https://www1.nyc.gov/assets/doh/downloads/pdf/epi/nyc_comhealth_atlas10.pdf. Accessed June 13 2013

23. Lucan SC, Maroko A, Shanker R, Jordan WB. Green Carts (mobile produce vendors) in the Bronx–optimally positioned to meet neighborhood fruit-and-vegetable needs? J Urban Health. 2011; 88(5):977–81. DOI: 10.1007/s11524-011-9593-2 [PubMed: 21691925]
24. Lucan SC, Varona M, Maroko AR, Bumol J, Torrens L, Wylie-Rosett J. Assessing mobile food vendors (a.k.a. street food vendors)–methods, challenges, and lessons learned for future food-environment research. Public Health. 2013; 127(8):766–76. DOI: 10.1016/j.puhe.2013.05.006 [PubMed: 23891280]
25. Lucan SC, Maroko AR, Bumol J, Varona M, Torrens L, Schechter CB. Mobile food vendors in urban neighborhoods-implications for diet and diet-related health by weather and season. Health Place. 2014; 27:171–5. DOI: 10.1016/j.healthplace.2014.02.009 [PubMed: 24631725]
26. Lucan SC, Maroko AR, Sanon O, Frias R, Schechter CB. Urban farmers' markets: accessibility, offerings, and produce variety, quality, and price compared to nearby stores. Appetite. 2015; 90:23–30. DOI: 10.1016/j.appet.2015.02.034 [PubMed: 25733377]
27. Dietary Guidelines for Americans 2015–2020. EighthMar, 2016. For Professionals: Recommendations At-A-Glancehttps://health.gov/dietaryguidelines/2015/resources/DGA_Recommendations-At-A-Glance.pdf. Accessed February 22 2018
28. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009; 42(2):377–81. [PubMed: 18929686]
29. Lucan SC. Concerning limitations of food-environment research: a narrative review and commentary framed around obesity and diet-related diseases in youth. J Acad Nutr Diet. 2015; 115(2):205–12. DOI: 10.1016/j.jand.2014.08.019 [PubMed: 25443565]
30. Neckerman KM, Lovasi L, Yousefzadeh P, et al. Comparing nutrition environments in bodegas and fast-food restaurants. J Acad Nutr Diet. 2014; 114(4):595–602. DOI: 10.1016/j.jand.2013.07.007 [PubMed: 24035459]
31. Vaughan CA, Cohen DA, Ghosh-Dastidar M, Hunter GP, Dubowitz T. Where do food desert residents buy most of their junk food? Supermarkets. Public Health Nutr. 2017; 20(14):2608–16. DOI: 10.1017/S136898001600269X [PubMed: 27702412]
32. Vernez Moudon A, Drewnowski A, Duncan GE, Hurvitz PM, Saelens BE, Scharnhorst E. Characterizing the food environment: pitfalls and future directions. Public Health Nutr. 2013; 16(7):1238–43. DOI: 10.1017/S1368980013000773 [PubMed: 23570695]
33. Racine EF, Kennedy A, Batada A, Story M. Foods and Beverages Available at SNAP-Authorized Drugstores in Sections of North Carolina. J Nutr Educ Behav. 2017; 49(8):674–83 e1. DOI: 10.1016/j.jneb.2017.05.360 [PubMed: 28889856]
34. Eckert J, Vojnovic I. Fast food landscapes: Exploring restaurant choice and travel behavior for residents living in lower eastside Detroit neighborhoods. Applied Geography. 2017; 89:41–51.
35. Longacre MR, Drake KM, MacKenzie TA, et al. Fast-food environments and family fast-food intake in nonmetropolitan areas. Am J Prev Med. 2012; 42(6):579–87. DOI: 10.1016/j.amepre.2012.02.017 [PubMed: 22608373]
36. Hirsch JA, Hillier A. Exploring the role of the food environment on food shopping patterns in Philadelphia, PA, USA: a semiquantitative comparison of two matched neighborhood groups. Int J Environ Res Public Health. 2013; 10(1):295–313. DOI: 10.3390/ijerph10010295 [PubMed: 23343984]
37. Cooksey-Stowers K, Schwartz MB, Brownell KD. Food Swamps Predict Obesity Rates Better Than Food Deserts in the United States. Int J Environ Res Public Health. 2017; 14(11)doi: 10.3390/ijerph14111366
38. Engler-Stringer R, Schaefer J, Ridalls T. An examination of the roles played by early adolescent children in interactions with their local food environment. Can J Public Health. 2016; 107(0): 5296.doi: 10.17269/cjph.107.5296 [PubMed: 27281514]
39. Hillier-Brown FC, Summerbell CD, Moore HJ, et al. The impact of interventions to promote healthier ready-to-eat meals (to eat in, to take away or to be delivered) sold by specific food outlets open to the general public: a systematic review. Obes Rev. 2017; 18(2):227–46. DOI: 10.1111/obr.12479 [PubMed: 27899007]

40. Adjoian T, Dannefer R, Willingham C, Brathwaite C, Franklin S. Healthy Checkout Lines: A Study in Urban Supermarkets. J Nutr Educ Behav. 2017; 49(8):615–22 e1. DOI: 10.1016/j.jneb.2017.02.004 [PubMed: 28889850]

41. Lucan SC, Karpyn A, Sherman S. Storing empty calories and chronic disease risk: snack-food products, nutritive content, and manufacturers in Philadelphia corner stores. J Urban Health. 2010; 87(3):394–409. DOI: 10.1007/s11524-010-9453-5 [PubMed: 20405225]

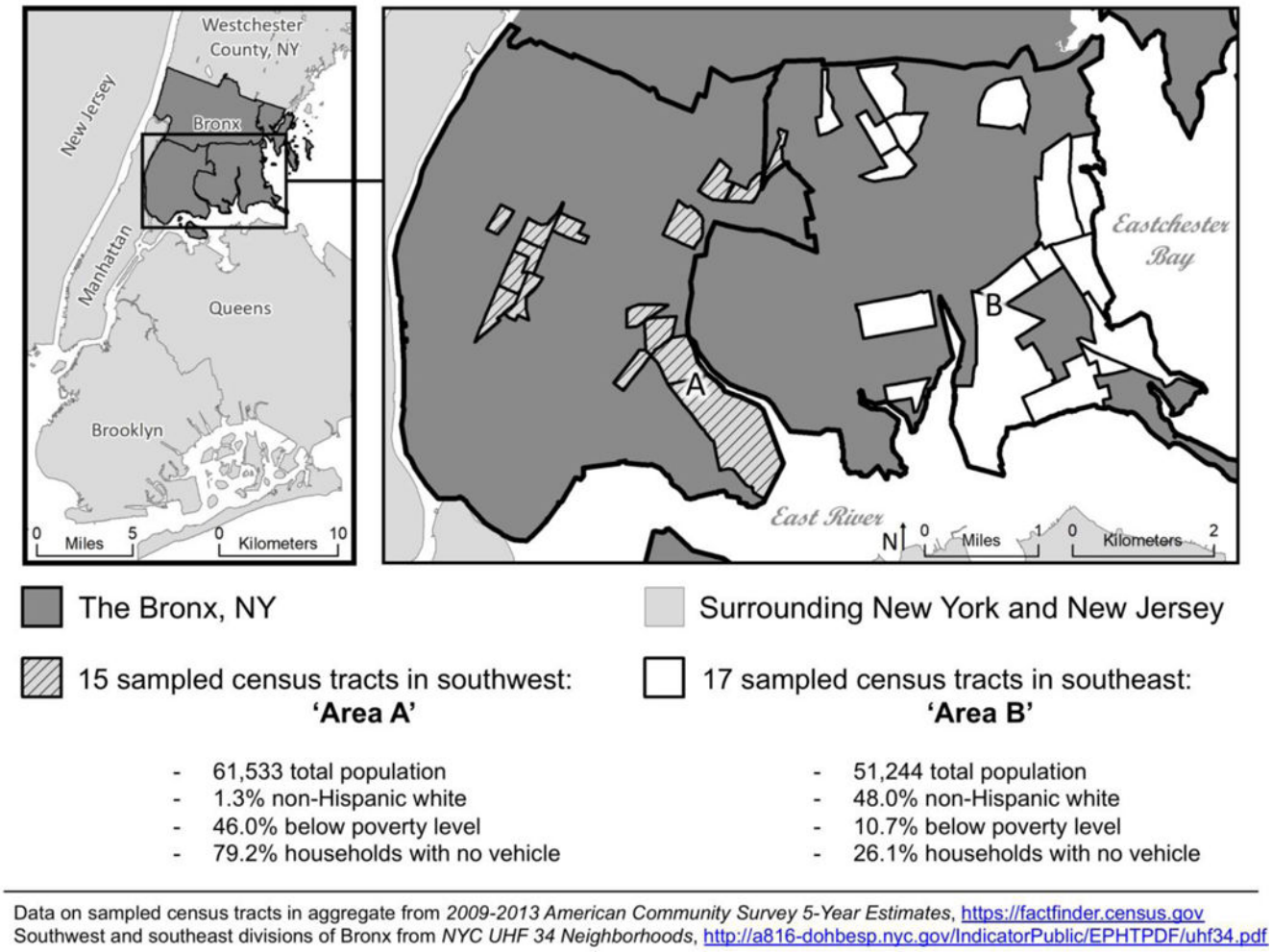

Figure 1.
Sampled census tracts in two large geographic divisions of the Bronx, NY

Table 1

Food categories and healthfulness for ready-to-consume foods (contributing to a 'grazing environment') and foods requiring additional preparation (contributing to a 'grocery environment')

Food Category *(healthfulness)*	**Examples of ready-to-consume foods**	**Examples of foods requiring additional preparation**
Fruits and Vegetables *(healthful)*	• Pieces of fresh fruit requiring no cutlery to peal or cooking to eat (e.g., apples, oranges, bananas, berries) • Prepared fruit salads, green salads, or vegetable dishes • Pop-top, peal-top, or screw-top fruit/ vegetable items (e.g., fruit cocktail, humus, jars of salsa) • Dried fruit (e.g., raisins, prunes, apricots) • Toppings (e.g., lettuce and tomato for sandwiches, peppers and onions for pizza)	• Uncut, thick-skinned fruit requiring cutlery (e.g., melons, pineapple, durian) • Fresh fruits/vegetables requiring cooking (e.g., plantain, potatoes, winter squash, eggplant) • Canned fruits/vegetables requiring an opener (e.g., canned peas, canned peaches) • Dried fruits/vegetables requiring cooking (e.g., split peas, beans, lentils) • Frozen items requiring defrosting or heating (e.g., frozen berries, frozen spinach)
Whole Grains *(healthful)*	• Cooked rice or other cooked whole grains • Prepared whole-grain pastas and baked good • Whole-grain crackers and chips • Whole-corn tortillas • Baked whole-wheat pizza crust • Granola bars and trail mixes • Popped popcorn	• Uncooked brown rice or other whole grains • Unpopped popcorn • Frozen tortillas and breads • Unbaked whole-wheat bread or pizza dough
Nuts *(healthful)*	• Shelled nuts, seeds, and peanuts • Trail mixes • Peanut butter and nut butters	• Nuts still in their shells (except for "cracked" pistachios that could be opened manually or peanuts in their soft dried pods)
Refined Sweets *(less-healthful)*	• Baked goods (e.g., cookies, cakes, brownies, donuts, muffins, pastries, pies) • Candy bars and other candies • Frozen novelties (e.g., ice creams, sherbets, sorbets, ices) • Sugary breakfast cereals	• Items requiring heating or baking (e.g., frozen pastries, frozen pies, cookie dough) • Items requiring additional ingredients plus baking (e.g., brownie mix, cake mix)
Salty/Fatty Fare *(less-healthful)*	• Bagged snacks that are not whole-grain (e.g., potato chips, corn chips, pork rinds) • Processed meats and fast-food meats (e.g., hotdogs, hamburgers, sausages, cheese steaks, cold cuts/deli meats, jerky, bacon) • Fried foods (French fries, fried chicken),	• Items requiring baking/warming (e.g., frozen pizzas, frozen burritos, microwave dinners, etc. • Items requiring cooking (e.g., dried ramen, boxed mac and cheese, chopped frozen cheesesteak, etc.)

Food Category *(healthfulness)*	Examples of ready-to-consume foods	Examples of foods requiring additional preparation
	• Ethnic fast foods (e.g., tacos, empanadas, pizza slices, fried rice, fried dumpling's, ramen, egg rolls)	

Table 2

Ready-to-consume-food offerings ('grazing environments)[a] in the Bronx by street segment and by storefront business

Sample characteristic	Area A census tracts n	(%)	Area B census tracts n	(%)	Difference in %, Area A - Area B (%age points)	[95% CI]
STREET SEGMENTS	398	(100.0)	855	(100.0)		
with ≥ 1 business	146	(36.7)	74	(8.7)	(28.0)	[22.9, 33.1]
offering any food	**113**	(28.4)	59	(6.9)	(21.5)	[16.7, 26.2]
offering any fruits or vegetables	97	(24.4)	47	(5.5)	(18.9)	[14.4, 23.4]
offering any whole grains	**85**	(21.4)	40	(4.7)	(16.7)	[12.4, 20.9]
offering any nuts	97	(24.4)	38	(4.4)	(19.9)	[15.5, 24.4]
offering any refined sweets	112	(28.1)	53	(6.2)	(21.9)	[17.2, 26.6]
offering any salty/fatty fare	**103**	(25.9)	52	(6.1)	(19.8)	[15.2, 24.4]
offering only less-healthful foods[b]	39	(9.8)	28	(3.3)	(6.5)	[3.4, 9.7]
ALL BUSINESSES	586	(100.0)	266	(100.0)		
offering any food	**273**	(46.6)	111	(41.7)	(4.9)	[−2.3, 12.0]
offering any fruits or vegetables	**185**	(31.6)	**76**	(29.3)	(3.0)	[−3.6, 9.6]
offering any whole grains	**135**	(23.0)	60	(22.6)	(0.5)	[−5.6, 6.6]
offering any nuts	171	(29.2)	54	(20.3)	(8.9)	[2.8, 15.0]
offering any refined sweets	257	(43.9)	105	(39.5)	(4.4)	[−2.7, 11.5]
offering any salty/fatty fare	**215**	(36.7)	84	(31.6)	(5.1)	[−1.7, 11.9]
offering only less-healthful foods[b]	53	(9.0)	28	(10.5)	−(1.5)	[−5.8, 2.9]
'FOOD BUSINESSES'[c]	194	(100.0)	79	(100.0)		
offering any food	**192**	(99.0)	79	(100.0)	−(1.0)	[−2.5, 0.4]
offering any fruits or vegetables	**170**	(87.6)	73	(92.4)	−(4.8)	[−12.2, 2.7]
offering any whole grains	**114**	(58.8)	56	(70.9)	−(12.1)	[−24.3, 0.1]
offering any nuts	136	(70.1)	46	(58.2)	(11.9)	[−0.8, 24.5]
offering any refined sweets	178	(91.8)	73	(92.4)	−(0.7)	[−7.7, 6.4]
offering any salty/fatty fare	**182**	(93.8)	76	(96.2)	−(2.4)	[−7.8, 3.0]
offering only less-healthful foods[b]	10	(5.2)	4	(5.1)	−(0.1)	[−5.7, 5.8]
'OTHER BUSINESSES'[d]	392	(100.0)	187	(100.0)		

J Community Health. Author manuscript; available in PMC 2019 October 01.

Sample characteristic	Area A census tracts n	(%)	Area B census tracts n	(%)	Difference in %, Area A - Area B (%age points)	[95% CI]
offering any food[e]	81	(20.7)	32	(17.1)	(3.6)	[−3.2, 10.3]
offering any fruits or vegetables	**15**	(3.8)	**3**	(1.6)	(2.2)	[−0.4, 4.8]
offering any whole grains	21	(5.4)	4	(2.1)	(3.2)	[0.2, 6.3]
offering any nuts	35	(8.9)	8	(4.3)	(4.7)	[0.6, 8.7]
offering any refined sweets	79	(20.2)	32	(17.1)	(3.0)	[−3.7, 9.7]
offering any salty/fatty fare	**33**	(8.4)	8	(4.3)	(4.1)	[0.1, 8.1]
offering only less-healthful foods[b]	43	(11.0)	24	(12.8)	−(1.9)	[−7.6, 3.8]

[a]Table values define ‘grazing environments.’ **Bold typeface** indicates when values would be greater if additionally considering ‘grocery environments’ (i.e., sources of food items requiring additional preparation); the only differences of > 2 street segments or > 2 businesses considering overall food environments (‘grazing’ plus ‘grocery environments) as opposed to ‘grazing environments’ alone were in Area A (street segments offering whole grains: 90 vs. 85, businesses offering fruits or vegetables: 196 vs. 185, all businesses offering whole grains: 146 vs. 135, all businesses offering salty/fatty fare: 219 vs. 215, ‘food businesses’ offering fruits or vegetables: 179 vs. 170, ‘food businesses’ offering whole grains: 125 vs. 114)

[b]‘only less-healthful foods’ = only ‘refined sweets’ and/or ‘salty/fatty fare’ (i.e., no ‘healthful’ food options like fruits, vegetables, whole grains, or nuts)

[c]‘food businesses’ = various grocery stores, supermarkets, specialty food stores, restaurants, and free-standing vending machines (businesses focused primarily on selling food)

[d]‘other businesses’ = all other storefronts (businesses not primarily focused on selling food).

[e]Among ‘other businesses’ offering food were: auto repair and auto sales shops; banks and check cashing outlets; clothing, shoe, apparel, and jewelry stores; department stores; dollar stores and discount stores; electronics stores, gas stations, gift shops; laundromat and dry cleaners; newsstand; nutritional-supplement store; pawn shops, pet shops, pharmacies; professional offices (medical, legal, real estate, etc.); salons and barber shops; sporting goods; tobacco shops.