

Storing Empty Calories and Chronic Disease Risk: Snack-Food Products, Nutritive Content, and Manufacturers in Philadelphia Corner Stores

Sean C. Lucan, Allison Karpyn, and Sandy Sherman

ABSTRACT *Corner stores are part of the urban food environment that may contribute to obesity and diet-related diseases, particularly for low-income and minority children. The snack foods available in corner stores may be a particularly important aspect of an urban child's food environment. Unfortunately, there is little data on exactly what snack foods corner stores stock, or where these foods come from. We evaluated snack foods in 17 Philadelphia corner stores, located in three ethnically distinct, low-income school neighborhoods. We recorded the manufacturer, calories, fat, sugar, and sodium for all snack items, excluding candy and prepared foods. We then compared the nutritive content of assessed snack items to established dietary recommendations and a school nutrition standard. In total, stores stocked 452 kinds of snacks, with only 15% of items common between all three neighborhoods. Total and unique snacks and snack food manufacturers varied by neighborhood, but distributions in snack type varied negligibly: overall, there were no fruit snacks, no vegetable snacks, and only 3.6% of all snacks (by liberal definition) were whole grain. The remainder (96.4% of snacks) was highly processed foods. Five of 65 manufacturers supplied 73.4% of all kinds of snack foods. Depending on serving size definition, 80.0-91.5% of snack foods were "unhealthy" (by the school nutrition standard), including seven of 11 wholegrain products. A single snack item could supply 6-14% of a day's recommended calories, fat, sugar, and sodium on average (or 56-169% at the extreme) for a "typical" child. We conclude that corner store snack food inventories are almost entirely unhealthy, and we discuss possible implications and next steps for research and intervention.*

KEYWORDS *Corner stores, Food environment/built environment, Urban, Minority, Low income, Calories, Fat, Sugar, Sodium, Snacks, Food manufacturers, Dietary risk, Dietary guidelines*

INTRODUCTION

Diet-related diseases are leading causes of disability and premature death in the US.¹⁻³ These diseases—including heart disease, cancer, and stroke, as well as contributing conditions like obesity, diabetes, dyslipidemia, and hypertension—disproportionately affect urban,^{4,5} low income^{6,7}, and minority populations.^{6,8-14} High rates of such conditions in children are of particular concern. Chronic diseases that were once "adult onset" are appearing earlier in the lifecourse.^{8,15-19} And with dietary behaviors developing throughout childhood,^{20,21} increased incidence of

Lucan is with the Department of Family and Social Medicine, Montefiore Medical Center/Albert Einstein College of Medicine, Bronx, NY, USA; Karpyn and Sherman are with the The Food Trust, Philadelphia, PA, USA.

Correspondence: Sean C. Lucan, Department of Family and Social Medicine, Montefiore Medical Center/Albert Einstein College of Medicine, Bronx, NY, USA. (E-mail: slucan@yahoo.com)

obesity and chronic diseases for adults is all but guaranteed with the establishment of unhealthy dietary patterns in children.^{22,23}

Unhealthy dietary patterns include those that are high in total fat, sodium, and refined sugar—food constituents linked to obesity,^{24,25} diabetes,²⁵ cardiovascular disease,^{26–28} and cancer.²⁹ Healthy dietary patterns include those high in fruits, vegetables, and whole grains—dietary constituents associated with healthy weight,^{30,31} glucose control,^{31,32} cardiovascular health,^{27,31,33,34} and cancer prevention.^{33–35} Reducing dietary intakes of total fat, sugar, and/or sodium is consistent with established dietary recommendations^{36–42} which likewise call for greater consumption of fruits, vegetables, and whole grains.

A host of factors determines whether people eat according to dietary recommendations, and research on dietary pattern increasingly focuses on the food environment.^{43–49} An important aspect of a child's food environment is food stores. Food stores in urban communities tend to be small, with city supermarkets being scarce.^{50–52} Small stores located within residential neighborhoods—known regionally as *corner stores*, *convenience stores*, or *bodegas*—may be particularly important.^{50,53,54} These stores are generally less than 200 ft²⁵⁵ and offer a limited range of products.^{50,56} They are often located around schools,⁵⁴ are where children and caregivers shop for food,⁵⁵ and may offer less healthful food choices.^{50,57–59} In Philadelphia, such stores are called corner stores, the term we will use for all such stores for the remainder of this paper.

Past studies have evaluated some of the kinds of foods available in corner stores. These studies looked mainly at indicator foods (e.g., specific vegetables, wholegrain products, or low-fat dairy items as markers of healthful food inventory),^{50,59–72} or used food checklists or indices.^{56–58,73–85} However, no prior studies have looked more comprehensively at food offerings, and none have provided a detailed description of snack food inventories in corner stores despite evidence that children purchase and consume unhealthy snacks from corner stores,^{55,87} and corner stores provide a substantial number of total daily calories for young people.⁸⁸ Prior research has also not directly addressed the nutritional content of corner store snack foods, nor where these food come from. Failing to characterize corner store foods in this way may lead to misunderstandings of the local food environment, and misdirect strategies to improve community nutrition and downstream health.

Recognizing the need to better understand the snack foods available in corner stores, The Food Trust, a Philadelphia-based nonprofit organization, partnered with a university researcher to undertake a detailed evaluation. Investigators sought specifically to (1) generate item-by-item snack food inventories at corner stores in low income, minority neighborhoods in Philadelphia, (2) determine the manufacturers for pre-packaged snack food items, and (3) assess the nutritive content of available snack foods. Investigators also sought to understand how the availability of snack items could impact children's adherence to dietary recommendations and to suggest approaches to improve the healthfulness of corner store snack food offerings.

METHODS

Corner Store Project

During the school year of 2003–2004, study staff conducted multiple focus groups with sixth through eighth grade students at three Philadelphia public schools. As

shown in Table 1, these schools were in low income, minority neighborhoods having predominantly Asian and Black (school A), Latino (school B), or Black (school C) student bodies. Research involved asking students which, if any, of the neighborhood corner stores they patronized and what food items they typically purchased for snacks, observing stores to corroborate student reports, and recording snack food items at relevant stores. Research activities were part of a broader corner store campaign—funded through a grant from the Robert Wood Johnson Foundation (RWJF)—to promote healthier child snack purchases in urban neighborhoods. The University of Pennsylvania IRB approved the study.

Corner Store Sample

During focus groups, students identified 19 corner stores where they shopped (Table 1). Study staff observed these corner stores before and after school hours and confirmed student patronage. All stores were in residential neighborhoods within four blocks of students' schools. Only some stores were actually on street *corners*. Most stores stocked household convenience items in addition to food. None were part of national or regional chains. All were independently owned. One store owner declined to participate due to concerns about disrupting business. A second store owner did not participate due to a language barrier. Ultimately, study staff inventoried snack food items in 17 corner stores.

Recording Snack Foods

Staff at The Food Trust recorded unique snack foods within each of the 17 participating corner stores. *Snack foods* included all items that students reported purchasing for snacks with the exception of prepared foods and candy. Study staff did not record prepared foods due to non-standard constituents. Study staff did not record candy because the initial aim of the RWJF-funded corner store campaign was to assess healthy snacks and snacks that could be made healthier by criteria of the Comprehensive School Nutrition Policy standard (see below). Candy is categorically unhealthy by this standard, irrespective of would-be modifications.

TABLE 1 Characteristics of schools in Philadelphia corner store study, school year 2003-2004

School characteristic	School A	School B	School C
Region of Philadelphia	South	Northeast	South
Race-ethnicity of student body (%) ^a			
White	13.1	15.0	13.9
Black	36.7	22.5	59.0
Asian	38.6	6.6	14.1
Latino	11.6	55.7	13.0
Students receiving free or reduced-price lunch (%)	76.3	85.4	75.6
No. of inventoried corner stores around school (N) ^b	9	3	5

^aRace-ethnicity data per School District of Philadelphia website: <https://sdp-webprod.phila.k12.pa.us/OnlineDirectory/schools.jsp>

^bFewer stores were sampled in the neighborhood around school B because children reported shopping at fewer stores in this neighborhood. Two of the seven stores approached in the neighborhood around school C did not participate: one due to linguistic barrier, one due to logistical concerns. We did not collect data on the total number of stores in each neighborhood

The vast majority of reported snack items came in manufacturer-defined single-serving packages (e.g., a 1-oz bag of potato chips, or about 15 chips). However, children also reported purchasing items having multiple servings (e.g., a 6-oz bag of potato chips). *Snack foods* also included additional store items that study staff agreed could be consumed by children as snacks—e.g., fresh fruit (e.g., apples, not pineapples), fresh vegetables (e.g., baby carrots, not squash), and canned fruit (e.g., pop top single-serve fruit cocktail, not canned peaches requiring a can opener). Study staff recorded brand and manufacturer as well as nutritional information for all packaged items.

Categorizing Snack Foods

Study staff defined three broad categories for snack foods: fruits and vegetables, whole grains, and processed foods. Fruits and vegetables could have included whole (e.g., bananas) or cut-up fresh fruit (e.g., fruit salad) or vegetables (e.g., celery sticks), as well as some pre-packaged items with fruit or vegetables as the first ingredient: e.g., apple sauce, fruit cocktail, dried fruit (e.g., raisins), or vegetable dips (e.g., salsa, hummus). Fruits and vegetables excluded ingredients in baked items (e.g., raisins in cookies, blueberries in muffins, and carrots in cake) and potato items (e.g., potato chips) consistent with prior research.⁵⁶ Whole grains included any products having whole grain as the first ingredient, such as granola, trail mix, cereals, crackers, popcorn, or chips (e.g., “Sunchips”, not “Cheetos”, and granola bars, not oatmeal cream pies). *Processed foods* were pre-packaged items with principal ingredients of enriched flour, refined sugars, or hydrogenated oils. Processed foods were broadly divided into *salty snacks* (e.g., assorted chips and pretzels) or *refined sweets* (e.g., cakes, cookies, donuts, pastries, and brownies) based on consensus of study staff as to whether the predominant taste was salty or sweet.

Categorizing Food Manufacturers

We categorized prepackaged food manufacturers as either *single-brand* companies—having multiple possible product lines but only one brand name (e.g., Herr’s)—or *multi-brand* companies—having multiple products and brands (e.g., Frito-Lay; see footnote Table 3). We made determinations of single-brand vs. multi-brand by visiting company websites and through internet searches.

Assessing Nutritional Content

For pre-packaged snacks, study staff recorded the number of calories and the amount of fat, sugar, and sodium from package labels. For fresh items, staff used Nutritionist ProTM nutrition analysis software⁸⁸ to determine caloric, fat, sugar, and sodium content.

Researchers compared the ranges and medians of calories, fat, sugar, and sodium for snack foods to upper recommended limits by Daily References Intakes for children,⁸⁹ and to World Health Organization (WHO) guidelines for daily energy intake⁹⁰ (see footnote Table 4). Researchers also categorized all snack foods as “healthy” or “unhealthy” based on a standard developed by a Comprehensive School Nutrition Policy Task Force.⁹¹ This standard—adopted by the School District of Philadelphia to guide its snack food policy—defines “healthy” snacks as having less than 7 g of fat, 15 g of sugar, and 360 mg of sodium per serving.

Statistical Analyses

We used Microsoft Excel 2007 and Stata SE v.10 software for all statistical analyses. Statistics included frequency distributions for snack foods and manufacturers, chi squared tests for differences in snack foods and manufacturers by neighborhood, and Kruskal-Wallis tests for differences in snack food nutritive content between neighborhoods.

RESULTS

Corner Store Inventories

Overall, there were 452 snack foods available in the corner stores in the three neighborhoods (Table 2). Collectively, the stores in each individual neighborhood offered only one third to two thirds of this grand total, implying substantial variation in available snack foods between the demographically distinct neighborhoods. Indeed, each neighborhood offered unique snack foods not available in the other two neighborhoods, with only 15% of all snack items ($n=67$) being available in all three neighborhoods. Available snack foods varied within neighborhoods (between stores) as well, but most of the variation was due to store size, with larger stores offering more snack varieties than smaller stores.

The neighborhood around school A (see Table 1 for school characteristics) had stores with the greatest variety of snack foods, offering more snacks in general, and more kinds of snacks not found in the other two neighborhoods (Table 2). Correspondingly, this neighborhood drew on the greatest number of snack food manufacturers, including 15 manufacturers not supplying either of the other two neighborhoods. The neighborhood around school B drew on a comparable number of total and unique manufacturers, but had almost a third fewer kinds of total snack foods, and about half as many kinds of unique snack foods. The neighborhood around school C offered the least kinds of snack food, and had the fewest unique items and supplying manufacturers.

Snack Foods by Category

Despite substantial variation in the stocking of, and suppliers of, specific snack foods across and within neighborhoods, the distribution of snack food categories was remarkably constant (Table 2). Overall, there were no fruit or vegetable snacks, and snacks containing whole grains represented just 3.6% of snack food inventories. The remainder of snack food inventories (96.4%) was processed food. Processed food categories differed significantly by neighborhood. Salty snacks and refined sweets were available in roughly equal proportions in the neighborhood around school A. In the neighborhood around school C, salty snacks outnumbered refined sweets almost 2:1. The distribution in the neighborhood around school B also showed a predominance of salty snacks.

Manufacturers

Although there were 65 manufacturers in total, just five manufacturers accounted for nearly three quarters of all corner store snack food inventories (Table 3). The top two manufacturers were constant across all three neighborhoods, although they accounted for substantially different amounts of inventory in each neighborhood. The top two manufacturers were single-brand companies and overall, 55 manufacturers (85%) were single-brand companies.

TABLE 2 Unique snack foods available in corner stores of three Philadelphia school neighborhoods

Snack foods attribute	Neighborhood around school A	Neighborhood around school B	Neighborhood around school C	All 3 school neighborhoods
Total kinds of snack foods (<i>N</i>)	313	217	151	452
Range in total kinds of snack food per store (<i>N</i>)	33-192	92-126	5-75	5-192
Kinds of snack foods unique to neighborhood (<i>N</i>)	159	82	49	N/A ^a
Total number of snack food manufacturers (<i>N</i>)	44	40	26	65
Number of snack food manufacturers unique to neighborhood (<i>N</i>)	15	12	6	N/A ^b
Snack food categories (%)				
Fruits and vegetables	0.0%	0.0%	0.0%	0.0%
Whole grains ^c	3.7%	3.8%	3.1%	3.6%
Processed foods	96.3%	96.2%	96.9%	96.4%
<i>Salty snacks</i> ^d	49.9%	57.3%	62.4%	53.9%
<i>Refined sweets</i> ^e	50.1%	42.7%	37.6%	46.1%

Percentages for snack food categories and categories of processed foods are column percentages and may not sum to 100% due to rounding error. There were no statistically significant differences in the distributions of snack foods by category between neighborhoods (p value of $\chi^2=0.90$) or between stores within neighborhoods (p values of $\chi^2=0.38$, 0.50, and 0.35 for neighborhoods A, B, and C, respectively). There were statistically significant differences in the distribution of processed foods by category between neighborhoods (p value of $\chi^2=0.001$) and between stores within neighborhoods (p values of $\chi^2<0.01$, 0.05, and 0.01 for neighborhoods A, B, and C, respectively)

^a67 snack food items were common to all three neighborhoods

^b13 snack food manufacturers were common to all three neighborhoods

^c3/9 stores in the neighborhood around school A and 2/5 stores in neighborhood around school C sold no wholegrain snacks. Popcorn and low fat chewy granola bars were available in all neighborhoods; wholegrain chips were available in the neighborhoods around schools A and B

^dProcessed salty snacks included assorted fried potato snacks (e.g., potato chips, potato skins, "Potato Stix", "Andy Capp's Hot Fries"), corn snacks (e.g., "Doritos", "Cheetos", "Cheese Curls", "Funyuns", "Fritos"), pork skins/rinds, refined flour crackers (e.g., "Cheese Nips", "Cheez-it", "Saltines", "Goldfish", "Combos", "Ritz"), and plantain chips

^eRefined bakery sweets included assorted cookies, cakes (e.g., "Ring Dings", "Kandy Kakes", "Honey Bun", "Yodels"), brownies, donuts, muffins, pastries (e.g., cinnamon rolls, honey buns), wafers (e.g., "Nilla wafers"), coconut bars, pies, corn bread, shortbread, "Rice Krispies Treats"

Potential Nutritional Implications

Table 4 shows median and maximum values of energy, fat, sugar, and sodium for the snack foods available in the corner stores. While differences between neighborhoods were statistically significant, actual values varied little. Table 4 also shows how nutritive values compared to recommended daily upper limits for a "typical" child—i.e., a hypothetical child with a total daily caloric requirement in the mid range for all children aged 4-18 (see footnote 4). On average, consuming a single

TABLE 3 Distribution of manufacturers supplying snacks to corner stores in three Philadelphia school neighborhoods

Manufacturer	Neighborhood A (%)	Neighborhood B (%)	Neighborhood C (%)	All 3 neighborhoods (%)
Herr's	23.4	17.2	40.3	25.1
Tastykake	21.4	9.4	18.2	18.1
Frito-Lay	15.9	15.7	6.6	14.1
McKee	13.4	8.5	0.0	9.8
Nabisco	4.8	8.8	8.1	6.3
Other	21.1	40.4	26.7	26.6

Percentages are column percentages and may not sum to 100% due to rounding error. There were statistically significant differences in the distribution of manufacturers supplying snack foods between neighborhoods (p value of $\chi^2 < 0.001$) and between stores within neighborhoods (p values of χ^2 all < 0.001). Herr's is a single-brand manufacturer. Tastykake is a single-brand manufacturer. Frito-Lay brands in the sample included Fritos, Doritos, Tostitos, Cheetos, SunChips, Cracker Jack, El Ileno, Funyuns, Grandma's, Lay's, Munchies, Munchos, Rold Gold, Ruffles, and Smartfood. McKee brands in the sample included Little Debbie and Sunbelt. Nabisco brands in the sample included Lorna Doone, Teddy Grahams, Chips Ahoy, Honey Maid, Nilla, Oreo, Ritz, Cheese Nips, Newtons, Nutter Butter, and Snackwells. Other manufactures included 60 companies: multi-brand companies like Bimbo (Bimbo, Entemann's, Marinela), Conagra (Andy Capp's, Crunch 'N Munch), General Mills (Dunkaroos), Kellogg (Nutrigrain, Austin, Cheez it, Famous Amos, Keebler, Pop Tart, Rice Krispies), Mars (Combos), Nestle (Cinnamon Toast Crunch bars), and Procter and Gamble (Pringles), and single-brand manufacturers like Aunt Hannah's, Bachman, Baker's Pride, Bud's Best, Chiffles, Cloverhill, Daddy Rays, Denise, Drake's, Duchess, Energy Club, Fernando's, Goya, Greg's, Home Girls, Hostess, Howard's, J.A.M., Jordan's, Knott's, Lady Linda, Lance, Mother's, Mr. G's, Ne-Mo's, Pepridge Farms, Planter's, Rap Snacks, Reismans, Robert's, Stauffer's, Stella D'Oro, Sunny, Torengo, Uncle Al's, Uncle Wally's, Uniled, Utz, Whoopee, and Wise.

snack food from a corner store could provide a typical child with about 6-14% of a day's recommended calories, fat, sugar, and sodium. And if the single snack food was a product having the most extreme values for recorded nutritive components, then a child would get more than half their day's calories, almost a full day's worth of fat, and greater than 1.5 times a day's limit of sugar and sodium. Due to lower typical daily calorie requirements for girls, any given snack would provide girls with a higher percentage of daily calories, fat, sugar, and sodium than boys on average.

Using the Comprehensive School Nutrition Policy standard,⁹¹ and defining a "serving" as manufacturers do, 80.0% of snack foods available in the three neighborhoods were "unhealthy". Alternatively, defining "serving" as the entire product package, 91.5% of items were "unhealthy". Unhealthy snacks included 50% of products presumably designed to be "healthier" alternatives to "regular" products (e.g., Baked Cheese Curls and Sensables sugar-free cookies), and seven of 11 (63.6%) wholegrain products (i.e., six varieties of popcorn plus Slimfast Oatmeal Raisin Bar).

DISCUSSION

Our study provides a detailed evaluation of snack food inventories in corner stores in three distinct low income, minority neighborhoods of Philadelphia. Our findings confirm what other research^{50,55,57-88} has suggested for years: corner stores stock mostly unhealthful snack foods. In fact, we show that corner stores stock unhealthy snack foods almost to complete exclusion of healthy items. The stores in our sample offered no fruit or vegetables of varieties suitable for snacking. They exhibited few

TABLE 4 Medians and Maxima for select nutritional components of individual snack foods at Philadelphia corner stores, compared to recommended upper limits for a “typical” child and percentages of these limits achieved through two possible snack scenarios

Nutritive component ^a	Median per snack food ^b	Maximum per snack Food ^c	Recommended daily upper limit for “typical” child ^d	Percent daily upper limit from eating one food item (median scenario; %)	Percent daily upper limit from eating one food item (maximum scenario; %)
Energy (calories)	260	1,280	2,300	11	56
Fat (calories)	104	720	805	13	89
Sugar (calories)	33	980	575	6	170
Sodium (milligrams)	300	3,710	2,200	14	169

^a72% of snack foods was manufacturer-designated single serving. The remaining 28% of items had two to eight servings (with the exception of *Combos Nacho Cheese Pretzels* which had nine servings)

^bAll distributions were right skewed; Kruskal-Wallis tests revealed statistically significant differences by neighborhood, but these differences were not categorically meaningful (i.e., minima, medians, and maxima were similar or identical between neighborhoods)

^cMinima for nutritional components: energy=80 calories, fat=0 calories, sugar=0 calories, sodium=0 mg

^d“Typical” child = a hypothetical child with a total daily caloric requirement in the mid range for all children aged 4-18. Daily caloric needs of children aged 6-18 years range from 1,225-2,875 for girls and 1,350-3,925 for boys depending on age, weight, and activity level. (<http://www.fao.org/docrep/007/y5686e/y5686e06.htm>). Fats should be no more than 35% energy (children 4-18 years). Sugar should be no more than 25% of total energy (everyone). Sodium should be no more than 1,900 mg/day regardless of energy intake for children 4-8 years, no more than 2,200 mg/day for children for 9-13 years, and no more than 2,300 mg/day for children 14-18 years (<http://www.iom.edu/Object.File/Master/21/372/0.pdf>)

wholegrain items, and the kinds that were available were predominantly high in fat, sodium, and/or added sugar. Almost all other stocked snack foods were likewise “unhealthy”, being highly refined, pre-packaged products of either the salty or sweet variety. While there was marked variation in the number and kinds of snack foods offered across neighborhoods and between stores—and in the number and kinds of manufacturers from which these snacks came—the distributions in categories of snack foods were remarkably constant. Children, shopping at any of the corner stores in these Philadelphia neighborhoods, would have a similar exposure to unhealthy foods. Purchasing just one snack item could provide a child with more than half a day’s total recommended calories, and about 100% or greater the total recommended limits of fat, sugar, and sodium.

A relative or complete lack of fresh produce and wholegrain products is a consistent theme in research on corner stores, particularly for stores in low income, minority, or disadvantaged neighborhoods.^{50,56–60,63,65,67,68,74,75,79,83–85} While most past research on store inventories has focused predominantly—though not exclusively^{57,85}—on produce that is fresh, dietary guidelines are not generally specific about recommending fruits and vegetables in this form.^{37–41,92,93} In our study, we also considered shelf stable produce varieties such as dried (e.g., raisins), canned (e.g., pop top, single-serving fruit cocktail), and jarred (e.g., salsa) items to show complete exclusion from corner store shelves.

The vast majority of snack products available on corner store shelves (>95%) were highly processed foods. Healthy snack foods could scarcely be found. Similarly, Bovell-Benjamin et al. reported that while healthy foods were less available in corner stores, sugary items were universally present.⁵⁷ Likewise, Glanz and colleagues demonstrated that corner stores tend to carry the higher fat, higher sugar varieties of common foods.

Although we designed our study to measure corner store inventories only, other researchers have linked store offerings to dietary pattern. Franco et al. showed that lower healthy food availability within a neighborhood or at the closest store was associated with consuming a less healthy diet.⁷³ And Pearce et al.,⁹⁴ showed that individuals in neighborhoods with the best access to corner stores had lower odds of meeting recommendations for vegetable intake. These findings are not surprising in light of our corner store inventory results.

Looking specifically at school children’s snack purchases from corner stores (in another study from Philadelphia), Borradaile and colleagues showed that children purchased no fruits or vegetables and only bought refined sweets and salty snacks.⁵⁵ In this study, authors reported that children bought an average of 1.6 food items per purchase, with the majority of children shopping at corner stores everyday and 42% shopping at corner stores twice daily. Applying these purchasing patterns to the inventory findings from our study, a child’s two shopping trips to a corner store in a day could supply 18–44% of day’s calories, fat, sugar, and sodium under a *median scenario* and 178–545% under a *maximum scenario* (see Table 4 for median and maximum scenarios). And these values are likely gross underestimations given that most urban children—particularly minorities and those with low income—are less physically active (and therefore require fewer daily calories) than we have assumed in our hypothetical scenarios for a “typical” child.^{96,97} Also, by more rigorous international guidelines from the WHO, the recommended upper daily limit of sugar should be only 10% of total calories⁹⁷ (not the 25% we consider from the US Dietary Reference Intakes⁸⁹). Moreover, very young children (ages 4–8) should have no more than 1,900 mg of sodium per day, almost 14% less than the 2,200 mg we set as our conservative upper limit.⁸⁹

When considering our corner store inventory findings along with Borradaile et al's data on children's purchasing patterns, we set up somewhat of a *chicken-and-egg* dilemma: it is impossible to know which precedes the other. In fact, the relationship between food availability and dietary pattern is likely bidirectional.⁷³ In our study, there were striking differences in snack product offerings between neighborhoods, which may suggest different consumer preferences or vendor priorities (or both) in ethnically distinct areas of the city. Our findings are consistent with prior work showing varying availability of specific foods across the same type of stores located in different neighborhoods.⁷⁴

Assuming that food availability does in fact influence what consumers purchase, then we agree with other authors that corner stores can play a critical role in helping curb rates of obesity and diet-related diseases by providing healthful food.^{50,53,54,98} Certainly, the food industry can be a partner in fulfilling this role. In our study, the majority of the more than 450 different snack foods came from just three manufacturers. All three companies have already attempted to make healthier alternative snacks that were available in our sample (although clearly there is room for improvement as half of these products were not actually "healthy" even by our liberal definition). Other companies could attempt to develop healthier products as well, and also gradually modify their "regular" products to reduce the amounts of fat, sugar, and sodium. Multi-brand manufacturers might be better able to experiment with such modifications, creating whole new brands (e.g., "Sunchips") before tinkering with tested favorites (e.g., "Cheetos"). Changing consumer preferences (the other side of the "chicken-and-egg" issue) could encourage and accelerate such change. Or change could come through direct government intervention (e.g., New York City's campaign to regulate the amount of sodium in processed foods).⁹⁹

We further agree with other authors that corner stores, non-profits, and government can work together to encourage networks between store owners and local producers, bringing healthy food from local farms and bakeries into the corner store product mix.^{50,100} Corner store/non-profit/government collaboration can also make possible the acquisition of refrigeration and other equipment that would better enable stores to stock healthy food.^{50,98} Also, broad government policies (e.g., national changes to the Women, Infants, and Children program)¹⁰¹ may incentivize corner store owners to make healthy changes to their inventories. And new government initiatives (like the USDA's Healthy Urban Food Enterprise Development Center, created in the 2008 Farm Bill¹⁰²) can create national infrastructure to help establish local and regional food systems for sourcing healthy foods to corner stores.

Our study makes several important contributions to the literature on local food environments. Ours is the first study to provide a comprehensive, detailed evaluation of snack food inventories in corner stores, describing the range in scope of offerings. We separately considered multiple stores near three ethnically distinct, low income schools, showing important differences across neighborhoods and between stores. We provide the first ever data in the medical or public health literature about food manufacturers and the industrial origins of corner store snack foods. We used established dietary recommendations and food policy to guide our food categorizations and showed both the near absence of recommended foods, and a glut of foods associated with promoting obesity and chronic disease. Finally, we evaluated the theoretical impact of corner store snack food environments on a "typical" child's diet, showing impressive potential detriment.

Despite notable strengths, our study also had limitations. First, the stores we inventoried represent a select sample. Although we are reassured by consistencies with related past research, local and regional variations may prevent broad generalization of our findings. Second, we evaluated snack products only and did not conduct a broader assessment of foods sold in stores. For intentional reasons, we did not count candies—which were available in all stores—nor prepared food—which were available in some. These items would have likely increased not only the proportions of unhealthy food we found, but also the media and maxima for calories, fat, sugar, and sodium given the high sugar (\pm fat) content of most candy and the high fat and sodium content of most prepared foods (e.g., hot dogs, nachos, and fried cheese). We did not count beverages, but prior research has shown that beverages account for less than 20% of snack items purchased from corner stores.⁵⁵ We limited our product counts to unique items, not total items, and thus can only report on item variety, not abundance. We did not collect information on the placement or prominence of products in stores; nor promotions or pricing which are important considerations as well.¹⁰⁴ We conducted our inventories at a single point in time, thus, findings represent only a cross-sectional snapshot. Finally, we only collected limited nutritive information, although data on other relevant constituents (e.g., *trans*-fat, saturated fat, and fiber) would likely only make our findings more striking given the preponderance of highly processed foods we found.

CONCLUSION

Our study suggests that urban corner stores overwhelmingly stock unhealthy pre-packaged snack foods. While there was some variability in specific snack offerings and manufacturing sources by store and by neighborhood, nutritive quality of snacks varied little: most snacks were high in calories, fat, added sugar, and/or sodium. If what is available in stores reflects what is purchased and consumed by children, then corner stores may have a substantial unhealthy impact on community nutrition and downstream health.

To further clarify the chain from product manufacture and distribution, to corner store supply, to consumer purchases and consumption, future work might link distributor delivery invoices with corner store sales receipts and consumer dietary assessments. Equally important will be studies to determine to what extent consumer demand, vendor priority, and/or manufacturer/distributor influence drive what type of snack foods are available in urban corner stores. In the interim, our data suggests that there is much room for improvement in the healthfulness of corner store snack food inventories in low income and minority communities.

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