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Urban Farmers' Markets: accessibility, offerings, and produce variety, quality, and price compared to nearby stores

Sean C Lucan, MD, MPH, MS^a, Andrew Maroko, PhD^b, Omar Sanon^c, Rafael Frias, BA^d, and Clyde B. Schechter, MD^a

Sean C Lucan: slucan@yahoo.com

^aDepartment of Family and Social Medicine, Albert Einstein College of Medicine, Montefiore Medical Center, 1300 Morris Park Ave, Block Building, Room 410, Bronx, NY (USA) 10461. Tel: +1 (718) 430-3667, Fax: +1 (718) 430-8645

^bDepartment of Health Sciences, Lehman College, City University of New York, Bronx, NY, USA

^cCollege of Arts and Sciences: New York University, New York, NY, USA

^dAlbert Einstein College of Medicine, Bronx, NY, USA

Abstract

Most food-environment research has focused narrowly on select stores and restaurants. There has been comparatively less attention to non-storefront food sources like farmers' markets (FMs), particularly in urban communities. The objective of the present study was to assess FMs' potential contribution to an urban food environment in terms of specific foods offered, and compare FM accessibility as well as produce variety, quality, and price to that of nearby stores. Investigators conducted a detailed cross-sectional assessment of all FMs in Bronx County, NY, and of the nearest store(s) selling produce within a half-mile walking distance (up to two stores per FM). The study included 26 FMs and 44 stores. Investigators assessed *accessibility* (locations of FMs and stores relative to each other, and hours of operation for each), *variety* (the number and type of all food items offered at FMs and all fresh produce items offered at stores), *quality* (where produce items were grown and if they were organic), and *price* (including any sales prices or promotional discounts). Analyses included frequencies, proportions, and variable distributions, as well as mixed-effect regressions, paired t-tests, and signed rank tests to compare FMs to stores. Geographic information systems (GIS) allowed for mapping of FM and store locations and determining street-network distances between them. The mean distance between FMs and the nearest store selling fresh produce was 0.15 miles (range 0.02-0.36 miles). FMs were open substantially fewer months, days, and hours than stores. FMs offered 26.4 fewer fresh produce items on average than stores (p values <0.02). FM produce items were more frequently local and organic, but often tended towards less-common/more-exotic and heirloom varieties. FMs were more expensive on average (p values <0.001 for pairwise comparisons to stores)—even for more-

Correspondence to: Sean C Lucan, slucan@yahoo.com.

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commonplace and “conventional” produce—especially when discounts or sales prices were considered. Fully, 32.8% of what FMs offered was not fresh produce at all but refined or processed products (e.g., jams, pies, cakes, cookies, donuts, juice drinks). FMs may offer many items not optimal for good nutrition and health, and carry less-varied, less-common fresh produce in neighborhoods that already have access to stores with cheaper prices and overwhelmingly more hours of operation.

Keywords

Farmers' markets; Food environment; Food stores; Fruit; Vegetables; Processed foods; Accessibility; Variety; Quality; Price

Introduction

Most research on food environments has focused narrowly on storefront food sources: i.e., select stores and restaurants (Kirkpatrick, Reedy, & McKinnon, 2010; McKinnon, Reedy, Morrissette, Lytle, & Yaroch, 2009). There has been comparatively little attention to non-storefront food sources, particularly in urban communities (Lucan, 2014; Lucan, Maroko, Shanker, & Jordan, 2011; Lucan, et al., 2014).

One kind of non-storefront food source that may be important in urban communities is the farmers' market (FM). FMs are almost universally regarded and promoted as mechanisms to deliver fresh fruits and vegetables to areas lacking access (Bader, Purciel, Yousefzadeh, & Neckerman, 2010; Blanck, Thompson, Nebeling, & Yaroch, 2011; Cole, McNees, Kinney, Fisher, & Krieger, 2013; Foltz, Harris, & Blanck, 2012; Freedman, Bell, & Collins, 2011; George, Kraschewski, & Rovniak, 2011; Pearson & Wilson, 2013; Shinkle, 2011). However, there has been surprisingly little research on FMs with regard to how accessible they are (e.g., hours and locations), what kinds of foods they sell, or how their produce offerings compare to nearby storefront businesses in terms of variety, quality, and price.

A few prior studies have assessed FM accessibility, noting for instance that FMs tend to be located more often in higher-income areas (Lee, et al., 2010) and tend to have limited hours of operation (Evans, et al., 2012; Larsen & Gilliland, 2009; Lee, et al., 2010; Widener, Metcalf, & Bar-Yam, 2011). However, no prior studies have quantified the number of hours FMs operate or compared FM operating hours to those of nearby stores selling fresh produce.

At least two prior studies have considered the variety of produce offered at FMs. One study showed lower availability of 33 select produce items compared to supermarkets and produce stores (Millichamp & Gallegos, 2013). Another study showed FMs had the highest availability (along with supermarkets) of 16 select produce items among all measured food retailers (Lee, et al., 2010). No prior studies have comprehensively assessed all food items that FMs offer.

Two studies have formally assessed FM produce quality, suggesting the superiority of FM fruits and vegetables over the fruits and vegetables from produce stores and supermarkets

(Millichamp & Gallegos, 2013) and ethnic and convenience stores (Lee, et al., 2010)—at least based on visual appearance. However, no studies have directly assessed other quality dimensions that may be important to consumers (e.g., “freshness”, “purity”, and “naturalness” as suggested by (Park, et al., 2011)).

Regarding price, some studies have found FM produce to be cheaper than produce from supermarkets (Larsen & Gilliland, 2009; Lee, et al., 2010; J. McGuirt, Jilcott, Liu, & Ammerman, 2011), grocery stores (Lee, et al., 2010), and convenience stores (Larsen & Gilliland, 2009; Lee, et al., 2010). However, these studies did not consider differences in price by produce quality or production method (e.g., whether produce was organic or not), or differences in price factoring sales or promotional discounts.

The objective of the current study was to expand on the prior research of others and more fully assess FMs in an urban food environment. Specifically, the study sought to comprehensively assess all food items FMs offered and to compare FM accessibility and produce variety, quality, and price to that of nearby stores offering fresh fruits and vegetables. An aim of the research was to understand FMs' potential contribution to an urban food environment. The study included all FMs for an entire county, whereas previous studies have all used much smaller and more-restrictive samples.

Material and Methods

The current study involved a primary assessment of all FMs in Bronx County, NY (the Bronx). FMs were defined as periodic, stationary, open-air, public markets, primarily offering food items from local farms (i.e., farms in New York or any surrounding state). The study also involved assessment of the storefront sources of fresh fruits and vegetables nearest each FM (i.e., nearby supermarkets and other stores offering fresh produce).

FMs, stores, and the items they offered were the units of observation and analyses in this study. As such, the Albert Einstein College of Medicine institutional review board deemed the research exempt from human subjects review. The study considered FM and store accessibility, and the variety, quality, and price of food items. All assessments occurred June - September 2011.

Food-source accessibility

For FMs, directories of locations and hours of operation came from the New York State Department of Agriculture and Markets (a state agency), the New York City Department of Health and Mental Hygiene (a city agency), the Farmers' Market Federation of New York (a FM membership organization), and GrowNYC (a non-profit organization). Although there was substantial overlap between the directories, no single list was entirely complete. Combining information from all sources generated a final list of 26 Bronx FMs in total. Two investigators working together visited all 26 FMs (during advertised times), and confirmed locations as well as months, days, and hours of operation by speaking with FM staff.

For stores, the same two investigators expanded out systematically from FM locations along street grids, walking distances up to a ½ mile in all directions. The idea was to find nearby

alternative sources of fresh produce along pedestrian-friendly routes. In several cases, different FMs were close enough to each other that some of their nearby stores could have been compared to either FM (Figure 1). For analyses, only the one or two strictly closest stores were compared with any one FM, and investigators did not assess more than two stores per FM (even when there were additional, but more-distant, stores selling fresh produce within a ½ mile). Ultimately, investigators assessed 44 stores (two stores for each of 18 FMs, one store for each of the remaining 8 FMs). Investigators determined store hours from posted signs, and compared when stores were open to when FMs were open. Investigators also compared how far stores were from FMs along street-network walking routes.

Food-item variety

The two field investigators assessed all food items offered at FMs and all fresh-produce items offered at nearby stores using standard audit forms created specifically for the study (forms available from the authors upon request). Pilot testing showed complete agreement between investigators for form items, none of which were subjective.

To be conservative and to not inappropriately double count items at FMs and stores, investigators collapsed synonymous items potentially sold by different names (e.g., “yautia”, “malanga”, and “dasheen”) in analyses. Additionally, investigators ignored state distinctions for produce items (e.g., “California peaches” vs. “Georgia peaches”) unless the state distinction suggested a distinct commercial variety or cultivar (e.g., “Idaho potatoes” to imprecisely mean any Russet Burbank variety of spuds).

The study aimed to compare not just specific items between FMs and stores (e.g., Granny Smith apples to Granny Smith apples) but also item categories (e.g., apples of any variety to other apples of any variety). The produce category “apples”, for instance, was comprised of over 20 different cultivars. Investigators created grouped categories of cultivars for all produce varieties (e.g., “apples”, “potatoes”, “tomatoes”, “carrots”, etc. not otherwise specified), and made determinations about less-common/more-exotic varieties within categories based on: (a) display signage (e.g., “heirloom purple carrots”), (b) conversations with FM workers (who were often the farmers themselves), (c) overall availability of the specific variety among all the FMs and stores in the sample, and (d) group consensus considering all of these factors [please see Appendix Figure 1A for complete list of produce items characterized as less-common/more-exotic]. As an example, the produce category “apples” included less-common/more-exotic varieties like Crispin, Ginger Gold, Marshall, and Winesap, as well as more-common varieties like Granny Smith and Red Delicious.

Investigators also devised four broad food classifications to describe observed food items at FMs. These classifications included two categories of produce items (i.e., *Fruit* and *Vegetables*) and two categories of non-produce items (i.e., *Other whole foods* and *Refined or processed products*) [please see footnotes to Figure 2 for specific definitions and examples].

In addition to making observations, investigators asked FM workers about their offerings. Specifically, researchers inquired about best-selling items, whether FMs promoted any

particular items, and if they “tailored” the specific items they offered to the neighborhoods in which they were located.

Produce quality

Assessments of produce quality were limited to considerations of “freshness” and “purity/naturalness”, which prior research has shown to be salient to urban consumers (Park, et al., 2011). At FMs, investigators assessed “freshness” by asking workers the number of days since harvest for each produce item. FM workers (again, often the farmers themselves) had no trouble providing this information. At stores, investigators could only note the state or country of origin for each produce item (which, while not providing the exact time it took to get from growing field to produce aisle, implied certain scenarios which could at least be used for comparisons to more precisely reported field-to-market times for FM produce). Regarding, “purity/naturalness”, investigators noted if items were labeled “organic” and, at FMs, asked workers directly if organic methods were used in the production of any items not specifically labeled.

Produce price

At both FMs and stores, the study's two field investigators recorded all listed prices for all fresh produce items, noting both regular and—when applicable—special, sales prices or promotional discounts. All items were priced by weight (e.g., by the lb.), by volume (e.g., by the pint), or by number (e.g., “each”, or by the “bunch”). As to not make assumptions about sizes and weights, price comparisons were only made between like items of like units (e.g., between two instances of apples sold by the lb., but not between an instance of apples sold by the lb. and an instance of apples sold by individual pieces).

Principal analyses focused on non-sale/non-discounted prices. And best values were used for all comparisons. For instance, if apples were regularly \$1.39 per lb. but also regularly sold in 3-lb. bags for \$3.99 (i.e., \$1.33 per lb.), the latter cheaper value would have been used for price comparisons. If there were two stores nearby to a given FM each offering the same item at different prices, the lower of the prices would have been used for comparisons.

Analysis

ArcGIS software (version 9.3.1, ESRI, Redlands, CA) allowed for mapping FM and store locations and for determining the distances between FMs and stores along street networks. Stata/SE version 12.1 (Stata Corp LP, College Station, TX) allowed for determining frequencies, proportions, and variable distributions, for the performance of significance tests, and for the calculation of confidence intervals and p values related to differences in FM and store attributes.

Investigators used mixed effects multilevel regression models for “overall comparisons” (comparing the aggregate of all FMs to the aggregate all assessed stores) and paired t-tests for “pairwise comparisons” (comparing each FM to its “paired” or nearby store(s)). To avoid distributional assumptions and to be conservative about p values, pairwise analyses were also run using the non-parametric Wilcoxon signed rank sum test.

For price comparisons between FM and store produce, investigators conducted three kinds of sensitivity analyses: (1) substituting any offered discount or sales prices for the lowest prices, (2) restricting price comparisons to more-commonplace produce by excluding items considered to be more-exotic or heirloom, and (3) restricting price comparisons to “conventional” produce by excluding items that were organic.

Results

Food-source accessibility

The 26 identified FMs in the Bronx were distributed unevenly across the 42 mi² of the county (Figure 1). All FMs were well within a half-mile walking distance of at least one store selling fresh produce (mean distance to nearest store 0.15 miles along street network, range 0.02 - 0.36 miles).

All stores were open year-round, seven days a week, offering fresh produce and other foods a mean of 98.5 hours per week (range 81-168 hours). In contrast, most FMs (20 out of 26) ran for just 4 months a year or fewer (range for all FMs: 3-6 months), were generally open just one day per week (only two FMs were open more than one day: on two weekdays), and generally operated for fewer than 8 hours on any day they were open (range 4-9.5 hours). Hours of operation were predominantly during the typical 9am-5pm workday; only three FMs were open on any weekdays more than an hour outside the 9am-5pm window, and only five FMs had any weekend hours.

Food-item variety

Investigators assessed a total of 4,923 food items, including 4,361 fresh produce items at FMs and nearby stores (430 distinct produce items, 3,931 duplicates). There were 96 fresh produce items offered only at FMs (e.g., yellow seeded watermelon, purple potatoes), 224 fresh produce items offered only at stores (e.g., pink seedless watermelon, Idaho potatoes), and 110 fresh produce items offered at both FMs and stores (e.g., pink seeded watermelon, sweet potatoes). While FMs offered a mean of 23.0 categories of fresh produce (e.g., “apples” not-otherwise-specified, “carrots” not-otherwise-specified), nearby stores offered a mean of 43.8 categories. Even if analyses were restricted to the nearby stores offering the fewest produce items (in cases where FMs were near two stores), FMs nonetheless consistently offered less produce (26.4 fewer fresh produce items than the comparison store on average, $p = 0.003$ for paired t-test, $p = 0.017$ for signed rank; 16.0 fewer fresh produce categories than the comparison store on average, $p < 0.001$ for paired t-test, $p = 0.002$ for signed rank).

Across all FMs, fruits and vegetables accounted for less than 2/3 of all food items overall, even if items like dried fruits and herb teas were included in the produce total (Figure 2). *Refined or processed products* like cakes, cookies, donuts, croissants, jams, and juice drinks accounted for nearly 1/3 of all food items (Figures 2 and 3).

Workers at stands of 10 FMs stated that some *Refined or processed products* were among their “best sellers”. At three of these FMs, and at four others (N=7), there were workers who reported promoting the sale of non-produce items (e.g., donuts, quiches, and juices). At

nearly 3/4 of all FMs (N=19), some workers described “tailoring” items to the neighborhood (e.g., bringing common herbs rather than heirloom vegetables to lower-income communities).

Produce quality

For quality, in terms of “freshness” local farms—in New York (87.6%), New Jersey (4.9%), or Pennsylvania (7.5%)—grew 100% of the fresh produce FMs offered. Almost all FM vegetables (97.6%) and 43.9% of FM fruits were picked within one or two days of being offered at FMs (69.0% of fruits were picked within one or two days if apples were excluded; apples are often placed in cold storage for yearly distribution after fall harvest). In terms of “purity/naturalness”, 3.1% of FMs' fresh fruit, and 7.9% of FMs' fresh vegetables were products of organic agriculture.

By contrast, at stores, 0.0% of the fruit and 0.8% of the vegetables came from farms in New York, New Jersey, or Pennsylvania. “Fresh” produce came from across the country (e.g., California), from Mexico and South America (e.g., Chile), or from more distant parts of the globe (e.g., New Zealand), suggesting substantially greater times since harvest in all cases, even under the most optimistic picking and shipping scenarios. Less than 1.3% of the fruits or vegetables offered at stores were organic.

Produce price

On average, any given produce item offered at FMs and assessed stores was cheaper at the stores; by pairwise comparison, the mean savings (\$0.24) was statistically significant; by overall comparison, the mean savings (\$0.16) was not (Table 1). Even in cases where two nearby stores had different prices for the same item, the more expensive store was still cheaper on average than the FM to which it was closest (p values < 0.001 for paired t-test and signed rank test).

Comparing “apples to apples” (regardless of whether those apples were Ginger Gold or Red Delicious, for instance) and likewise comparing other possibly different specific items within a shared produce-item category (e.g., comparing “potatoes” to “potatoes” regardless of whether they were Yukon Gold or Russet spuds), stores were also cheaper on average. The mean savings by pairwise comparison (\$0.43) was statistically significant; the mean savings by overall comparison (\$0.19) was not (Table 1).

In sensitivity analysis, mean savings were not substantively altered when discounts or sales prices were considered. However, sales prices—which investigators found only at stores—did at least minimally increase the savings one might achieve by store shopping (both overall and pairwise, both for any given produce item on average and for any item of a given produce category on average; in all cases, additional average savings amounted to about \$0.01).

In other sensitivity analysis, less-common/more-exotic or heirloom items appeared to drive some of the price differences between FMs and stores; restricting comparisons to “common produce only” reduced price differences, although not substantively (or even perceptibly to two decimal places) in pairwise comparisons (Table 1). Within specific produce categories

(e.g., “apples”, “potatoes”), more-exotic cultivars (e.g., Crispin apples, purple potatoes) generally cost more than more commonly cultivated varieties (e.g., Red Delicious apples, red potatoes), but even commonplace cultivars still tended to be more expensive at FMs—although price differences were not always statistically significant (Table 1 for select examples).

A final sensitivity analysis showed that organic items also drove some of the price difference between FMs and stores. Excluding organic items from consideration, FMs maintained their average expense but stores became cheaper, and overall price differences between FMs and stores became statistically significant (Table 1).

Discussion

This is the first study to provide a detailed assessment of food items offered at FMs, and compare FMs to nearby stores for an entire urban county. Produce at FMs tended to be fresher than at nearby stores, and a modestly higher proportion of FM produce items were organic. But if FMs offered better-quality produce, that better quality may have come at the cost of lower FM accessibility, more-restricted produce variety, and generally higher prices. FMs were open overwhelmingly fewer months, days, and hours than nearby stores, and they offered less than half as many varieties of fresh-produce items and fresh-produce categories on average. The produce they did offer often tended towards less-common/more-exotic and heirloom-type cultivars, but even comparatively commonplace produce was generally more expensive than when found in stores. A substantial portion of what FMs offered was not produce at all (fresh or otherwise), but rather refined and processed fare, often with fruits and vegetables only as minor ingredients (e.g., apple-cider donuts) or excluded from ingredient lists altogether (e.g., croissants). Given findings of the current study, it is not clear that FMs contribute positively to an urban food environment.

In terms of FM utilization, distance and transportation can be barriers (J. T. McGuirt, et al., 2014; Racine, Smith Vaughn, & Laditka, 2010). Although Bronx shoppers may not need to travel much further to get to FMs than they would to access nearby food stores, markedly limited hours of operation may discourage FM shopping (Jilcott Pitts, et al., 2014), and might particularly challenge those with 9am-5pm work days.

Moreover, FMs might not meet cultural expectations or offer preferred foods in diverse urban communities. Certainly some immigrants may appreciate the FM street-vending model and value the sourcing of fresh and natural foods (Park, et al., 2011). However, it seems unlikely that Bronx FMs' exclusive offering of produce from the Northeastern U.S. could completely meet the desires of individuals, for example, hailing from equatorial countries and desiring the tropical fruits and vegetables of their native homelands. It is also unclear if FMs' largely heirloom offerings can satisfy those looking for more-commonly cultivated produce varieties. While the current study did not assess customer desires, FMs would seem to be at a disadvantage to nearby stores with regard to their restricted produce offerings.

Beyond possible issues with FM accessibility and produce variety, produce cost may be another barrier to FM purchases (J. T. McGuirt, et al., 2014). FMs' more-exotic produce cost more. But even more-commonplace cultivars were consistently more expensive at FMs than at nearby stores in the current study (although not always by statistically significant margins). Several earlier studies likewise found FM produce to be substantially more expensive (sometimes by a factor of two or more) than produce from grocery stores (Wheeler & Chapman-Novakofski, 2014), supermarkets (Pearson, et al., 2014), or other fruit-and-vegetable markets (Pearson, et al., 2014).

Part of the difference in price between FMs and stores may reflect different agricultural practices used to grow the produce. Both the current study and prior work (Pearson, et al., 2014) suggest that FMs may offer more organic produce than nearby food stores. A study that included an organic FM noted that prices were highest at this FM over all others, and that prices were higher at FMs (offering some organic produce) in general over neighboring supermarket and produce stores (presumably offering less or none) (Millichamp & Gallegos, 2013). The current study shows that FM produce may be comparably expensive whether organic or not, but that store produce is considerably more expensive when organic.

There are also non-produce items to consider. In some locales, farmers must be directly involved in the growing or production of any foods they offer at FMs (Pearson & Wilson, 2013), with pre-packaged foods being expressly prohibited (Ruelas, Iverson, Kiekel, & Peters, 2012). But even when such rules exist, they still allow FMs to sell items that are not fresh produce and that are less than ideal for good health (e.g., pies, cakes, cookies, and donuts as long as they are “freshly made”). The present study showed that refined and processed products were sometimes both promoted items and big sellers at FMs, and represented nearly 1/3 of all FM offerings overall. Other research has shown that even when not available, customers may express desire for such non-produce foods at FMs (Ruelas, et al., 2012).

The current study had notable strengths. First, it considered all FMs in an urban county rather than a more select sample in a smaller area. Second, investigators performed a comprehensive assessment of all foods offered at all FMs, as opposed to focusing on just select produce items (Larsen & Gilliland, 2009; Lee, et al., 2010; Millichamp & Gallegos, 2013; Pearson, et al., 2014; Wheeler & Chapman-Novakofski, 2014) or predominant produce varieties (J. McGuirt, et al., 2011); analyses in the current study included almost twice as many distinct fresh-produce items as the next largest study to date (430 items vs. 230 items) (J. McGuirt, et al., 2011). Third, analyses compared FMs to the one or two nearest stores selling fresh produce within walking distance, and considered separately the dimensions of accessibility, variety, quality, and price. Fourth, investigators compared like units in item-specific price analyses (e.g., apples by the lb. to apples by the lb.) rather than using an alternative method that others have used, which makes assumptions about average weights for items sold (Millichamp & Gallegos, 2013; Pearson, et al., 2014; Wheeler & Chapman-Novakofski, 2014). Fifth, investigators conducted price comparisons both overall and pairwise; conducted sensitivity analyses that considered sales prices, produce commonness, and organic status; and confirmed robustness of pairwise findings using non-parametric statistical tests.

The current study also had limitations. For instance, in considering differences between FMs and nearby food stores, the research did not assess other potentially important differences that might matter to shoppers, like familiarity of the shopping experience or alignment with cultural values or personal desires. Another limitation was that all data were cross-sectional. Food inventories and prices (and even FM and store locations) could change over time. Also, while retaining sales units (e.g., items by the lb.) for price comparisons was a strength of the analyses, the combination of units (i.e., items by the lb. along with items by the pint and by number) for overall summary statistics makes such summary statistics difficult to interpret. To aid in interpretation, purchasing a single lb., pint, or bunch of 10 produce items not-otherwise-specified from a nearby store as opposed to a FM could result in an average savings of \$2.40 (i.e., $10 \times \$0.24$). That savings might be as much as \$4.30 ($10 \times \0.43) if the potential customer considers all produce in a given category to be equivalent and does not favor less-common/more-exotic and more-expensive cultivars that might only be found at FMs. Still, investigators did not assess actual produce purchasing in the current study and this is a limitation.

Other studies have assessed produce purchasing—and even produce consumption (at least through self report). For instance, studies evaluating financial incentive programs (e.g., coupons or vouchers), demonstrate at least modestly greater intent to purchase or consume—or reportedly increased purchasing or consumption—of fruits and vegetables among FM incentive recipients (Baronberg, Dunn, Nonas, Dannefer, & Sacks, 2013; Freedman, et al., 2011; Freedman, Choi, Hurley, Anadu, & Hebert, 2013; Jones & Bhatia, 2011; Kropf, Holben, Holcomb, & Anderson, 2007; Lindsay, et al., 2013; McCormack, Laska, Larson, & Story, 2010; Racine, et al., 2010; Webber, Balsam, & Oehlke, 1995; Weinstein, Galindo, Fried, Rucker, & Davis, 2014; Wheeler & Chapman-Novakofski, 2014; Young, et al., 2013). Other studies suggest that living near a FM is associated with greater produce intake (Gustafson, et al., 2013; Park, et al., 2011; Ruelas, et al., 2012) and that introducing FMs to communities may minimally increase reported consumption of select fruits and vegetables (Evans, et al., 2012). FMs may offer other benefits for community nutrition as well, like improving the provision and price of healthy items at surrounding convenience stores (Larsen & Gilliland, 2009).

Perhaps for these reasons, there seems to be much enthusiasm for using FMs to improve food environments in communities challenged by healthy-food access (Davis, Cook, & Cohen, 2005; Hood, Martinez-Donate, & Meinen, 2012; McCormack, et al., 2010). However, given the results and implications of the current study, it is hard for us to share this enthusiasm.

Conclusion

The results of the current study demonstrate that urban FMs may offer and promote many items that are less-than-ideal for good nutrition and health. Moreover, FMs may carry less-varied, less-common, more-expensive produce in neighborhoods that already have stores with overwhelmingly more hours of operation. Although FMs might increase access to organic produce, and produce that is fresher, their lower accessibility, restricted variety, and

higher cost, might provide little net benefit to food environments in urban communities, especially when so much of their inventory is refined and processed non-produce fare.

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Appendix

apple:cameo	lamb's quarter
apple:cortland	mustard greens:red
apple:crispin	nectarine:white ^c
apple:empire ^b	onion:sweet red italian
apple:ginger gold	peach-a-rine ^c
apple:ida red	peach:saturn ^b
apple:jonagold	peach:white ^b
apple:marshall	pepper:hungarian
apple:winesap	pipicha
beet:golden	plum:golden
beet:orange	plum:green shiro
beet:white	plum:white ^b
carrot:purple	plum:wishi washi
carrot:red ^b	potato:purple
carrot:white	purslane
carrot:yellow	radish:french breakfast
cauliflower:cheddar	rue(ruda)
cauliflower:violet queen	scallion:red
cherry:sour	sorrel
cherry:white	spilanthes
eggplant:neon	squash blossom
eggplant:spanish	squash:gray ^c
eggplant:zebra	squash:lita
epazote ^b	squash:patty pan
garlic scape	sumac
garlic:elephant	swiss chard:rainbow
garlic:green	swiss chard:red ^b
gooseberry	swiss chard:white
grape:ribier ^c	swiss chard:yellow
hierba mora	tomato:yellow
kale:red	travisio
kale:red russian	watermelon:yellow
kale:tuscan	

Figure 1A. List of less-common/more-exotic fresh produce varieties offered at farmers' markets and nearby stores in the Bronx^a

^aAll items available at farmers' markets unless otherwise indicated

^bItems also offered by at least one store in the sample

^cItems available at store(s) in the sample; not offered at any of the farmers' markets

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Abbreviations

FM	Farmers' Market
lb.	pound (unit of weight)

Highlights

- Farmers' markets (FMs) may offer a means to get fresh produce into needy communities
- But FMs operate overwhelming fewer months, days, and hours than nearby stores
- FMs carry less-varied, less-common, more-expensive produce than nearby stores
- FMs offer many items not optimal for good health (e.g., jams, pies, juice drinks)
- FMs might provide little net benefit to food environments in urban communities

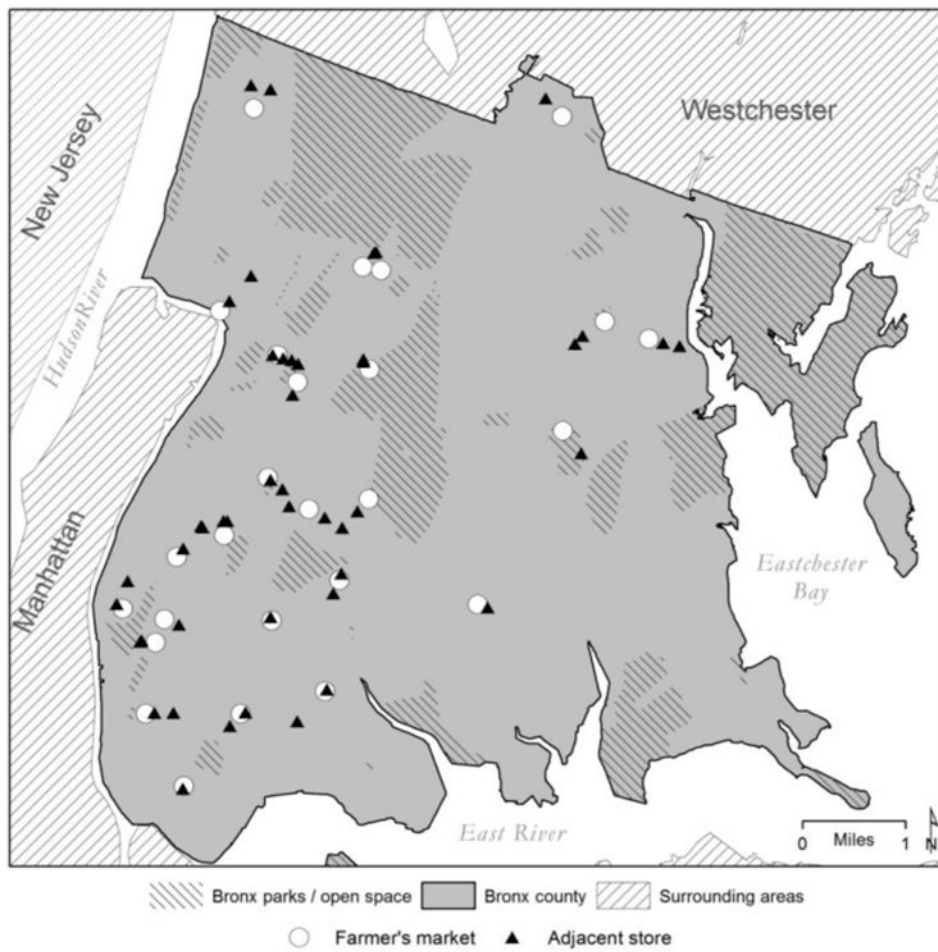


Figure 1. Bronx Farmers' Markets (FMs) and nearby stores selling fresh produce
 There were 26 FMs across the 42 mi² of the Bronx. All FMs were well within a half mile of at least one store selling fresh produce (mean distance to nearest store 0.15 miles, range 0.02 - 0.36 miles). The map shows 44 stores (two stores for each of 18 FMs, one store for each of the remaining 8 FMs).

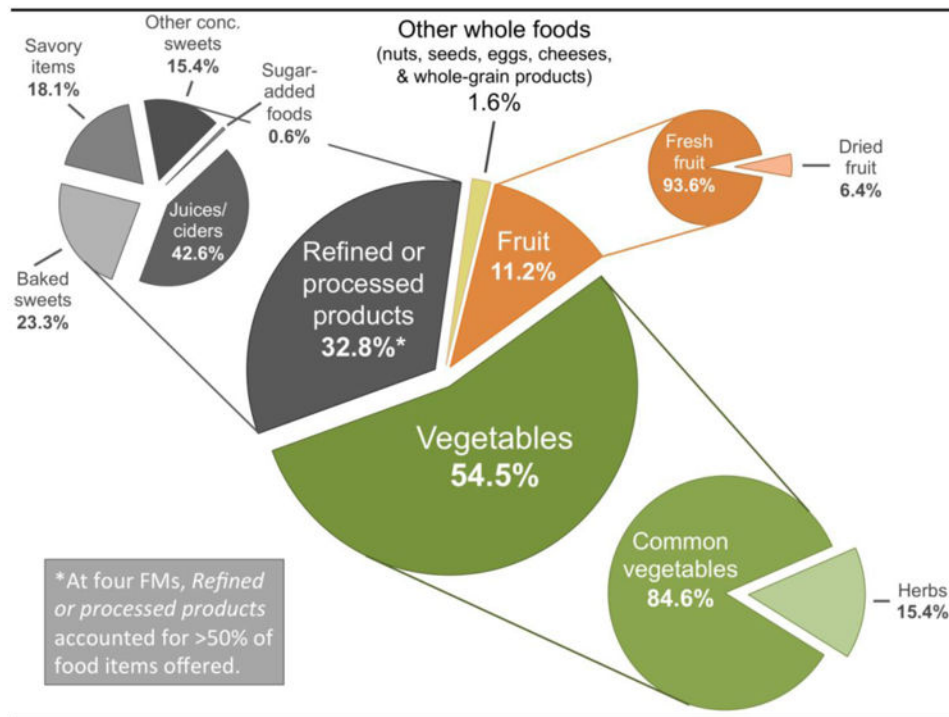


Figure 2. Broad food classifications of items available across all 26 Bronx FMs

Fruit included fresh and dried varieties of generally-sweet, seed-bearing, whole produce (e.g., apples, berries, melons, cherries, plums/prunes, grapes/raisins, fresh and dried apricots, etc.).

Vegetables included more-savory, seed-bearing, whole produce, which—while arguably “fruit” by strict botanical definition—many people think of as vegetables (e.g., tomatoes, squashes, peppers, cucumbers, eggplants, corn, bean pods). *Vegetables* also included true vegetables like shoots (e.g., asparagus), leaves (e.g., lettuces), flower buds (e.g., broccoli), tubers (e.g., potatoes), roots (e.g., carrots), and bulbs (e.g., onions) as well as mushrooms and herbs (e.g., basil, chives, mint, cilantro, and various teas like nettle and sumac).

Other whole foods included nuts, seeds, eggs, cheeses, and whole-grain products (e.g., granolas, whole-grain breads, oatmeal bars).

Refined or processed products included non-whole-grain baked sweets (e.g., cakes, cookies, scones, pastries, pies, donuts), savory items (e.g., quiches, croissants, empanadas, tiropitas, hot-dog sliders), juices/ciders (e.g., juice mixes, nectars, and juice drinks), sugar-added items (e.g., sugared coconut flakes, sweetened dried banana, sugared peanuts, apricots in syrup), and other concentrated sweets (e.g., molasses, jellies, jams, syrups, and honey).



Figure 3. Images from a Bronx farmers' market

Left panel: Large display of various juices, nectars, juice mixes, and ciders leading up to a sign for “PIES”. A small display of fresh vegetables can be seen just beyond the “PIES” sign.

Right Panel: Farmers'-market sign advertising baked sweets and savory items over a table displaying these goods.

Table 1
Fresh produce available at FMs and nearby stores and price comparisons by unit, both overall and pairwise^a

Produce-item category (or specific produce item)	Unit ^b (per)	Price at Farmers' Markets (mean)	Price at nearby stores (mean)	Savings at nearby stores overall (mean and 95% CI)	p value for mixed-effect regression	Pairwise savings at nearby store(s) (mean and 95% CI)	p value for paired t-test	p value for signed rank
All Fresh Produce								
Any given produce item on average	Any	\$1.95	\$1.79	\$0.16 ^c (\$-0.13 – \$0.46)	0.293	\$0.24 ^c (\$0.15 – \$0.33)	<0.001	<0.001
Any item of a given produce category on average	Any	\$2.02	\$1.83	\$0.18 ^c (\$-0.23 – \$0.60)	0.388	\$0.43 ^c (\$0.30 – \$0.55)	<0.001	<0.001
“Common” Produce Only^d								
Any given produce item on average	Any	\$1.85	\$1.79	\$0.06 (\$-0.26 – \$0.38)	0.717	\$0.24 (\$0.15 – \$0.33)	<0.001	<0.001
Any item of a given produce category on average	Any	\$1.90	\$1.83	\$0.07 (\$-0.36 – \$0.49)	0.760	\$0.41 (\$0.28 – \$0.54)	<0.001	<0.001
“Conventional” Produce Only^e								
Any given produce item on average	Any	\$1.95	\$1.69	\$0.26 (\$0.03 – \$0.49)	0.025	\$0.25 (\$0.16 – \$0.34)	<0.001	<0.001
Any item of a given produce category on average	Any	\$2.02	\$1.68	\$0.34 (\$0.03 – \$0.65)	0.034	\$0.44 (\$0.31 – \$0.57)	<0.001	<0.001
Select Produce^f								
Any apples	lb.	\$1.38	\$1.24	\$0.14 (\$-0.09 – \$0.37)	0.247	\$0.16 (\$-0.25 – \$0.56)	0.408	0.534
<i>Red Delicious apples</i>	lb.	\$1.47	\$1.33	\$0.14 (\$-0.08 – \$0.36)	0.222	\$0.27 (\$-0.25 – \$0.79)	0.255	0.176
Any potatoes	lb.	\$1.15	\$0.52	\$0.63 (\$0.44 – \$0.83)	<0.001	\$0.58 (\$0.32 – \$0.84)	<0.001	<0.001
<i>Red potatoes</i>	lb.	\$1.26	\$0.86	\$0.40 (\$0.14 – \$0.65)	0.002	\$0.37 (\$-0.30 – \$1.03)	0.212	0.344
Any onions	lb.	\$1.24	\$0.70	\$0.54 (\$0.35 – \$0.73)	<0.001	\$0.51 (\$0.25 – \$0.78)	<0.001	0.006
<i>Red onions</i>	lb.	\$1.20	\$0.86	\$0.34 (\$0.08 – \$0.59)	0.010	\$0.38 (\$-0.26 – 1.01)	0.175	0.057
Any peppers	lb.	\$1.58	\$1.35	\$0.23 (\$-0.27 – \$0.49)	0.080	\$0.33 (\$0.02 – \$0.65)	0.042	0.028
Any tomatoes	lb.	\$1.93	\$1.29	\$0.63 (\$0.38 – \$0.89)	<0.001	\$0.69 (\$0.39 – \$0.99)	<0.001	0.001
Any blueberries	pint	\$6.00	\$3.24	\$2.75 (\$1.94 – \$3.57)	<0.001	\$1.51 (\$-4.84 – \$7.86)	0.204	0.180
Any raspberries ^g	pint	\$6.25	\$2.99	\$3.26 (Not applicable)	-	Not applicable	-	-
Any parsley	bunch	\$1.66	\$1.11	\$0.55 (\$0.37 – \$0.73)	<0.001	\$0.57 (\$0.33 – \$0.81)	<0.001	0.008
Any cilantro	bunch	\$1.58	\$0.99	\$0.59 (\$0.42 – \$0.77)	<0.001	\$0.60 (\$0.34 – \$0.86)	<0.001	<0.001
Any garlic	bulb	\$1.55	\$0.27	\$1.27 (\$1.02 – \$1.52)	<0.001	\$1.46 (\$1.02 – \$1.90)	<0.001	0.012
Any carrots	bunch	\$2.03	\$1.23	\$0.80 (\$0.60 – \$0.99)	<0.001	\$0.86 (\$-0.99 – \$2.70)	0.107	0.180

Produce-item category (or specific produce item)	Unit ^d (per)	Price at Farmers' Markets (mean)	Price at nearby stores (mean)	Savings at nearby stores overall (mean and 95% CI)	p value for mixed-effect regression	Pairwise savings at nearby store(s) (mean and 95% CI)	p value for paired t-test	p value for signed rank
Any cucumbers	one	\$0.61	\$0.57	\$0.05 (\$-0.12 – \$0.22)	0.554	\$0.11 (\$-0.24 – \$0.47)	0.475	0.524

^aThe table is a comparison of the lowest offered prices, excluding sales prices, discounts, or promotions. “Overall” = comparing the aggregate of all FMs to the aggregate all assessed stores, “pairwise” = comparing each FM to its “paired” or nearby store(s).

^bAll items were priced by unit of weight (e.g., by the lb.), by volume (e.g., by the pint), or by number (e.g., “each” or by the “bunch”). “Any” is a unitless notional concept, conveying the average cost of items priced by weight, volume, and number together in their native units.

^cWhen sales, discounts, and promotions were considered, an additional \$0.01 savings could be achieved by shopping at stores (both overall and pairwise, both for any given produce item on average and for any item of a given produce category on average). This additional saving resulted from sales prices being available at some stores for some items but at no FMs for any item.

^d“Common” Produce Only included all fresh produce items except for those categorized as “less-common/more-exotic”. Please see Appendix Figure 1A for complete list of produce items characterized as less-common/more-exotic

^e“Conventional” Produce Only included all fresh produce items not categorized as organic.

^fSelect Produce items/item categories were among the most common types of fresh produce offered at both FMs and stores by lb, by pint, or by each.

^gRaspberries were not available at any matched FM-store combinations and were only available at one of the assessed stores in the whole sample, precluding significance testing of mean differences. Other fresh produce items offered by volume units (e.g., by the pint) were likewise essentially only offered at stores (e.g., grape tomatoes) or FMs (e.g., strawberries), not both.