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Authors

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Lai, Elaine S
Thompson, Jack
et al.

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Higher pricing of fresh produce is more likely in SNAP-Ed eligible neighborhoods when adjacent non-program eligible neighborhoods are mixed income

Mirna Ponce Jewell[a,*], Elaine S. Lai[a], Jack Thompson[a,1], Michael Fox[a], Tony Kuo[b,c,d]

[a] Division of Chronic Disease and Injury Prevention, Los Angeles County Department of Public Health, Los Angeles, CA 90010, USA
[b] Department of Epidemiology, UCLA Fielding School of Public Health, Los Angeles, CA 90095, USA
[c] Department of Family Medicine, David Geffen School of Medicine at UCLA, Los Angeles, CA 90024, USA
[d] Population Health Program, UCLA Clinical and Translational Science Institute, Los Angeles, CA 90095, USA

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ABSTRACT

This analysis describes the socioeconomic attributes of neighborhoods adjacent to low-income neighborhoods with ≥50% of households that are Supplemental Nutrition Assistance Program Education (SNAP-Ed) eligible. It compares the pricing, availability, and quality of fresh produce between these neighborhoods in Los Angeles County. The Los Angeles County Department of Public Health utilized 2013–2014 community-level data from the *Communities of Excellence in Nutrition, Physical Activity and Obesity Prevention* (CX3) Project to examine the geographic patterns of fresh produce purchases and accessibility in SNAP-Ed eligible census tracts. Community indicators collected by CX3 included information on pricing, availability, and quality of fruits and vegetables from grocery stores (n = 108) in these eligible neighborhoods (n = 21). Correlation statistics were generated to explore the effects of adjacent neighborhoods' socioeconomic status on fruit and vegetable pricing, availability, and quality in the selected neighborhoods ("CX3 neighborhoods"). Poverty data were obtained from the United States Census' American Community Survey. Residents of CX3 neighborhoods that were surrounded by mixed income neighborhoods paid 43% more for fresh produce than CX3 neighborhoods surrounded by other similarly low-income neighborhoods (median produce price, $1.50 versus $1.05). Study results suggest that while quality of produce remains an issue, it is the higher pricing of fresh produce in CX3 neighborhoods – i.e., in the presence of other surrounding mixed income neighborhoods (those with relatively higher income) – that appeared to potentiate food access barriers. Future SNAP-Ed efforts should take this pricing pattern under consideration when designing, planning, and/or implementing nutrition-related programs in these neighborhoods.

1. Introduction

Previous studies have shown that poor dietary behaviors and obesity are associated with neighborhood differences in socioeconomic status (Diez-Roux et al., 1999; Dubowitz et al., 2008; Rossen, 2014). Emerging evidence suggests limited access to fresh, affordable produce (fruits and vegetables) is a key barrier to healthy eating among underserved populations (Black et al., 2014; Morland et al., 2002; Powell et al., 2009; Powell et al., 2007). Some experts have argued that the effects of the food environment may be more important than the individual-level determinants of healthy eating (Beaulac et al., 2009; Story et al., 2008). For example, higher prices for fresh produce have been found in areas of concentrated poverty, as compared to more affluent geographic areas where higher income levels and lower prices are a norm (Gustafson et al., 2012). However, some studies have found no differences in produce pricing by area-level poverty (Gustafson et al., 2012; Leone et al., 2011; Rahkovsky and Snyder, 2015). Store type has been observed to be associated with produce pricing (Caspi et al., 2017; Gustafson et al., 2012; Martin et al., 2014), and with fruit and vegetable consumption (Aggarwal et al., 2014; Morland et al., 2002; Rose and Richards, 2004). Larger supermarkets, for instance, have been shown to have lower prices than smaller retail outlets (Caspi

Abbreviations: CX3, Communities of Excellence in Nutrition, Physical Activity and Obesity Prevention; DPH, Los Angeles County Department of Public Health; SES, socioeconomic status; SNAP-Ed, Supplemental Nutrition Assistance Program Education

* Corresponding author at: Division of Chronic Disease and Injury Prevention, Los Angeles County Department of Public Health, USA.
E-mail address: mponce@ph.lacounty.gov (M.P. Jewell).

[1] Affiliation at the time of the project.

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et al., 2017; Gustafson et al., 2012), and are found more abundantly in higher income areas (Bower et al., 2014; Moore and Diez Roux, 2006; Powell et al., 2007).

The present study explores and describes the pricing, availability, and quality of fresh produce (while accounting for store type) to assess potential barriers to healthy eating in areas of high poverty in Los Angeles County. Identifying and understanding where these access gaps may exist has important uses for community planning and for providing support to low-income neighborhoods, especially as they relate to the equitable distribution of Supplemental Nutrition Assistance Program Education (SNAP-Ed) resources across the region. For example, SNAP-Ed supports are available in various forms, including classes that provide tips to families on how to stretch their food dollars to small market makeovers that improve the quality and availability of fresh produce in low-income neighborhoods.

To carry out the present study, the Los Angeles County Department of Public Health (DPH) cleaned and analyzed data from the California Department of Public Health's 2013–2014 *Communities of Excellence in Nutrition, Physical Activity and Obesity Prevention* (CX3) Project.

2. Methods

2.1. CX3 Project

The CX3 Project is based on a program planning framework used by the California Department of Public Health and its local health department partners to assist communities in determining how best to promote healthy diets and physical activity utilizing SNAP-Ed resources. Components of CX3 include information or data gathered from retail outlets and fast food outlets, walkability information for selected neighborhoods, and results from school and food environment scans. CX3 seeks to mobilize communities at every stage and to illustrate areas of improvement that will help prevent and manage obesity and other chronic diseases through gathering of data and management of neighborhood trends. Target communities of CX3 efforts ("CX3 neighborhoods") are low-income neighborhoods that are in SNAP-Ed eligible census tracts (CT). These census tracts are defined as tracts that have $\geq$50% of their populations living at or below 185% of the Federal Poverty Level (FPL).

2.2. Context of local health department partnerships and programming during the 2013–2016 SNAP-Ed grant cycle in Los Angeles County

During 2013–2016, DPH partnered with nearly 15 community-based organizations funded to implement SNAP-Ed services and interventions across Los Angeles County. One of the program's goals for these organizations was to reduce barriers to fresh produce (fruits and vegetables) access in low-income neighborhoods. The CX3 Project provided the necessary tools and resources (including scans of food environments) to assist with this process. Eleven agencies participated in the overall project. All eleven helped to define the neighborhood boundaries and represented sites where food environment surveys or scans were performed. The geographic coverage of the selected organizations was relatively extensive, representing 7 out of 8 large Service Planning Areas in Los Angeles County.

2.3. Neighborhood boundaries

Neighborhood boundaries used in the CX3 project and for the purposes of this study were defined by the SNAP-Ed partners as areas with clustered CTs containing 50% or more households at or below 185% the FPL. They must also have at least one elementary, middle, or high school within these boundaries to be eligible. The 185% FPL benchmark is the key criterion for determining household eligibility to receive SNAP-Ed services.

2.4. Food retailers assessments

For selected neighborhoods, food retailers were first identified through ArcGIS 10.1 using data from the California Food Retailers (CFR) database published by Dun & Bradstreet. DPH/SNAP-Ed personnel then went into each neighborhood to identify and verify any other retailers that were not included in the CFR. After retail outlets were identified, a random sample of 15 retailers was selected and surveyed using food environment scans of the neighborhood. If a neighborhood had 15 or fewer food retailers, then all food retailers were surveyed. The food environment surveys or scans were conducted by trained staff (including those from DPH) at each of the eleven agencies between October 2013 and October 2014.

2.5. Store characteristics and their assessments

The Food Availability and Marketing survey, a component of CX3, collected information regarding fruit and vegetable availability and pricing from grocery stores (n = 108) in twenty-one neighborhoods with at least 50% of the households living at or below 185% FPL. The content used in the survey was adapted from the Nutrition Environment Measures Survey in Stores instrument (Glanz et al., 2007).

Classification of stores utilized the Standard Industry Classification codes of business types. In the analyses, supermarkets were defined as chain stores that were larger than large grocery stores. Large grocery stores were those with > 4 cash registers and have 20 or more employees. Small markets were stores that have less than four cash registers. And convenience stores were establishments that primarily engage in retailing of a limited line of goods such as milk, bread, soda, and snacks (Census Industry Statistics Portal, n.d).

In the CX3 assessments included in the present study, ten stores reported having fresh produce available, but no pricing information was displayed. Sensitivity of pricing of fruits and vegetables to seasonality were tested but the results were not statistically significant nor compelling. Prices were available per piece, pound, and package. Price per piece was converted to pound, assuming each fruit or vegetable was at least a medium size. Conversion (via Produce Converter, n.d) to price per package was not needed in the present analysis.

Produce availability was determined or verified using the question "Is produce sold? Yes/No" in the food environment scan. Produce quality was assessed as "All or most of fruit/vegetable is of poor quality (brown, bruised, overripe, wilted)", "Mixed quality; more poor than good", "Mixed quality; more good than poor", or "All or most of fruit/vegetable is of good quality (very fresh, no soft spots, excellent color)." For the purposes of this study, these categories were further dichotomized into (1) "poor" if fruits or vegetables were in the following response categories: "All or most of fruit/vegetable is of poor quality (brown, bruised, overripe, wilted)", "Mixed quality; more poor than good", or "Mixed quality; or "more good than poor"; or (2) "good" if both fruits and vegetables were in the following category: "All or most of fruit/vegetable is of good quality (very fresh, no soft spots, excellent color)." Staff responsible for these food environment scans were trained on the protocols to rate produce quality prior to deployment in to the field.

2.6. Describing the neighborhoods adjacent to the CX3 neighborhoods

Using ArcGIS 10.1, one-mile radii were drawn around the target neighborhoods (USDA Economic Research Service, n.d). CTs were defined as either urban or rural as defined by the Los Angeles County Fire Department, and/or based on research data presented here, either food deserts or not food deserts. A CT can be urban and be considered a food desert if there are no food retail outlets within a one-mile radius. Demographic data from any CT within or intersecting the perimeter were used to determine percentage of households who were living at or below 185% FPL. Guided by CX3 criteria, data of neighborhoods adjacent to each CX3 neighborhood were aggregated and dichotomized

into: (1) low-income neighborhoods where more than half of the total households were living at or below 185% FPL, or (2) mixed income neighborhoods (i.e., those with more households that were relatively higher socioeconomic status [SES]) where less than half of the total households were living at or below 185% FPL.

2.7. Neighborhood demographics and poverty data

The American Community Survey (ACS) is a random sample of American households that is administered by the United States (U.S.) Census Bureau every year and is pooled into 1-year, 3-year, and 5-year population estimates. Among the measures collected for the present study (analysis), the ACS calculates totals and percentages of households living in poverty, race/ethnicity, and gender. The California Department of Public Health provided the ACS estimates for households living at or below 185% FPL by CT, race/ethnicity, and gender. ACS 5-year estimates (2010–2014) and other demographic data used in the present analysis included race and the number of households living at or below 185% FPL. Similar ACS neighborhood-level estimates were tabulated for the neighborhoods adjacent to and surrounding each of the CX3 neighborhoods. The analysis utilized the 2010–2014 estimates because they aligned with the timeline of the CX3 data.

2.8. Primary outcomes of the analysis

The primary outcomes of the present study were: (1) pricing (continuous variable), (2) produce availability (dichotomous variable), and (3) produce quality (dichotomous variable). All correlation statistics and bivariate analyses were conducted using SAS 9.4 (SAS Institute, Inc., Cary, North Carolina). Since there were no active human research subjects, the present study and its analyses were considered exempt from a full Institutional Review Board review.

3. Results

Table 1 shows that a majority of store types found within the surveyed low-income neighborhoods of CX3 were convenience stores (51.9%). The highest prices were found in stores classified as "Other" (e.g., fish, produce, or health market) ($4.28, IQR = $6.44) and convenience stores ($1.49, IQR = $0.41). About half of the stores evaluated had fruits and vegetables available (56.5%). More than half of the produce available were "some poor to all poor" quality (55.7%). The median produce pricing per pound was $1.06 (IQR = $0.74). While not shown here, the mean produce pricing per pound was $1.42 with wide variation (SD = $1.29) across the stores. Table 2 shows that CX3 neighborhoods surrounded by mixed income neighborhoods (i.e., adjacent neighborhoods that included greater proportions of higher income households in the community) paid more for produce than CX3 neighborhoods surrounded by other lower income neighborhoods — i.e., $1.50 (IQR = $0.97) versus $1.05 (IQR = $0.63).

4. Discussion

According to the United States Department of Agriculture, the intersection between produce access, availability, and demand by low-income households is multi-faceted and complex (Rahkovsky and Snyder, 2015). Apart from individual and neighborhood characteristics, other external market forces have been shown to affect the availability of produce (Black et al., 2014; Powell et al., 2007). The present study's analysis demonstrated heterogeneity of economic environments in Los Angeles County and its association with produce pricing in low-income neighborhoods. In the selected CX3 neighborhoods, for example, three of them did not have produce available in the retail outlets that were scanned and two were surrounded by mixed income neighborhoods. In addition, no differences were found in the availability and/or the quality of the produce when low-income and mixed income neighborhoods were compared. However, a general review of CX3 information did suggest that the quality of fresh produce in low-income neighborhoods was still a concern, especially since a little more than half of the stores assessed by CX3 contained poor quality produce. Ideally, a majority of accessible produce should have been of good quality and affordable across all store types, and across all geographic locations.

Produce pricing was generally inconsistent among the selected CX3 neighborhoods. This inconsistency or heterogeneity may have

Table 1
Store, produce, and demographic characteristics in and around 21 low-income CX3 neighborhoods in Los Angeles County, 2013–2014[a].

	% (n) or % (IQR)[b]	Median produce price, $ (IQR)	*p*-Value[d]
Total number of neighborhoods	n = 21		
Total number of stores	n = 108	n = 49[c]	
Store type			
Supermarket chain	1.9 (2)	1.26 (0.73)	$p < 0.01$
Large grocery store	6.5 (7)	0.64 (0.28)	
Small market	37.0 (40)	0.89 (0.67)	
Convenience store	51.9 (56)	1.49 (0.41)	
Other (e.g., fish, produce or health market)	2.8 (3)	4.28 (6.44)	
Store produce characteristics[e,f]			
Produce is available	56.5 (61)	1.06 (0.74)	
"Most to all good" quality produce available	44.3 (27)	0.89 (0.79)	$p = 0.18$
"Some poor to all poor" quality produce available	55.7 (34)	1.18 (0.63)	
Total number of census tracts	n = 710		
Census tract demographic characteristics[g]			
Median percentage of Hispanic households, % (IQR)	59.0 (24.0)		
Median percentage of black households, % (IQR)	7.8 (17.2)		
Median percentage of households ≤185% FPL, % (IQR)	51.6 (9.6)		

[a] The outcome for all statistical tests in Table 1 is median produce price.
[b] IQR = interquartile range.
[c] Produce pricing was posted in 49 of the 61 stores where produce was available.
[d] Kruskal-Wallis non-parametric test.
[e] Produce characteristics were determined by observational assessment. Evaluation of price of produce across site visits showed no seasonal variation in pricing. Converting price per piece to price per pound assumed available produce were medium in size. http://www.howmuchisin.com/produce_converters. Oranges were excluded due to the wide variability in size and weight available.
[f] Produce observed included apples, bananas, tomatoes, carrots, cabbage, and broccoli.
[g] Data were derived from the American Community Survey. The 2010–2014 5-year estimates were used to align with the corresponding timeline of the CX3 data.

Table 2
Store, produce, and demographic characteristics by neighborhood income status in and around 21 low-income CX3 neighborhoods in Los Angeles County, 2013–2014.

	CX3 neighborhoods	Adjacent neighborhoods (mixed income)	
Total number of neighborhoods	n = 10	n = 11	
Total number of stores	n = 61	n = 47	
Store type, % (n)[a]			
Supermarket chain	–	4.3 (2)	$p = 0.43$
Large grocery store	6.6 (4)	6.4 (3)	
Small market	41.0 (25)	31.9 (15)	
Convenience store	50.8 (31)	53.2 (25)	
Other (e.g., fish, produce or health market)	1.6 (1)	4.3 (2)	
Store produce characteristics, % (n)[a]			
Produce is available	54.1 (33)	59.6 (28)	$p = 0.57$
"Most to all good" quality produce available	45.5 (15)	42.9 (12)	$p = 0.84$
"Some poor to all poor" quality produce available	54.6 (18)	57.1 (16)	
Median produce price, $ (IQR)[b,c,d]	1.05 (0.63)	1.50 (0.97)	$p = 0.06$
Total number of census tracts	n = 415	n = 295	
Census tract demographic characteristics[e]			
Median percentage of Hispanic households, % (IQR)[b,c]	59.1 (18.0%)	59.0 (24.8%)	$p = 0.23$
Median percentage of black households, % (IQR)[b,c]	7.9 (28.1%)	4.4 (16.0%)	$p = 0.40$
Median percentage of households ≤185% FPL, % (IQR)[b,c]	58.2 (6.9%)	46.8 (7.1%)	$p < 0.01$

[a] χ^2 was performed for expected cell values > 5; Fisher's Exact Test was performed when 25% of cells had expected values < 5.
[b] IQR = interquartile range.
[c] Kruskal-Wallis non-parametric test.
[d] Produce pricing was posted in 49 of the 61 stores where produce was available.
[e] Data were derived from the American Community Survey. The 2010–2014 5-year estimates were used to align with the corresponding timeline of the CX3 data.

contributed to the more pronounced food insecurity prevalence in these neighborhoods. Interestingly, the present study found that produce pricing was higher in low-income neighborhoods when they were surrounded by mixed income neighborhoods (i.e., these adjacent neighborhoods included higher income households). Previous research has found that different factors may help explain some of these disparities or pricing patterns, including race/ethnicity and neighborhood deprivation (Powell et al., 2007; Rahkovsky and Snyder, 2015); albeit the present study analysis did not find any significant association(s) between racial composition and higher pricing (data not shown).

In addition to reducing residents' ability to acquire fresh produce (Wedick et al., 2015), higher produce pricing in mixed neighborhoods could have disproportionately trickled down to and hindered the potential impact of nutrition education interventions in the lower income CX3 neighborhoods (i.e., the higher pricing may have inhibited the use of the knowledge gained through the nutrition education to purchase healthier food). Because of this latter influence or effects (likely unintended), future SNAP-Ed efforts should consider these study results as lessons learned that can help inform future program planning and implementation.

4.1. Limitations

The analysis plan for the present study has several limitations. First, the number of neighborhoods analyzed was relatively small for a county of 88 cities and about 140 unincorporated communities, thus limiting generalizability of the results. Second, a majority of the data presented in the study represented urban, high poverty communities and may not necessarily reflect other settings in the region or across the United States. Third, in the analysis sample, there were several urban neighborhoods that were surrounded by pockets of rural CTs, which may have affected the interpretation of the strength of relationships between the impact or effects of adjacent neighborhoods on smaller, population-dense neighborhoods. Fourth, residents may have shopped in retail outlets outside of their neighborhood (Dubowitz et al., 2015), thereby complicating data interpretation; albeit neighborhood boundaries have been known to predict shopping patterns (Gustafson, 2017). Finally, data from the present study's analysis were aggregated to the neighborhood level without accounting for *within* neighborhood variation. However, even if this was the case, this study represents one of the first to look at the potential impact or unintended influence of adjacent neighborhoods' socioeconomic status on fresh produce pricing, availability, and quality in low-income neighborhoods that were the target communities of federal programs such as SNAP and SNAP-Ed.

5. Conclusions

Results from the present study suggest that while quality of produce (fruits and vegetables) remains an issue, it is the higher pricing of fresh produce in CX3 neighborhoods when the adjacent neighborhoods are mixed income (relatively higher income) that appeared to potentiate food access barriers. Future SNAP-Ed efforts to increase fresh produce access should be mindful of this pricing phenomenon, and should use the results to inform future program planning and implementation in low-income, SNAP-Ed eligible neighborhoods across the U.S. These and other food assistance program efforts should be supported by further research that describes how other factors, such as transportation access, distribution of food store types, and the frequency by which residents shop outside of their neighborhood, can collectively impact produce pricing and influence the quality of fruits and vegetables that are available in different geographic areas comprising mixed proportions of low, middle, and high income populations.

Disclosure

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