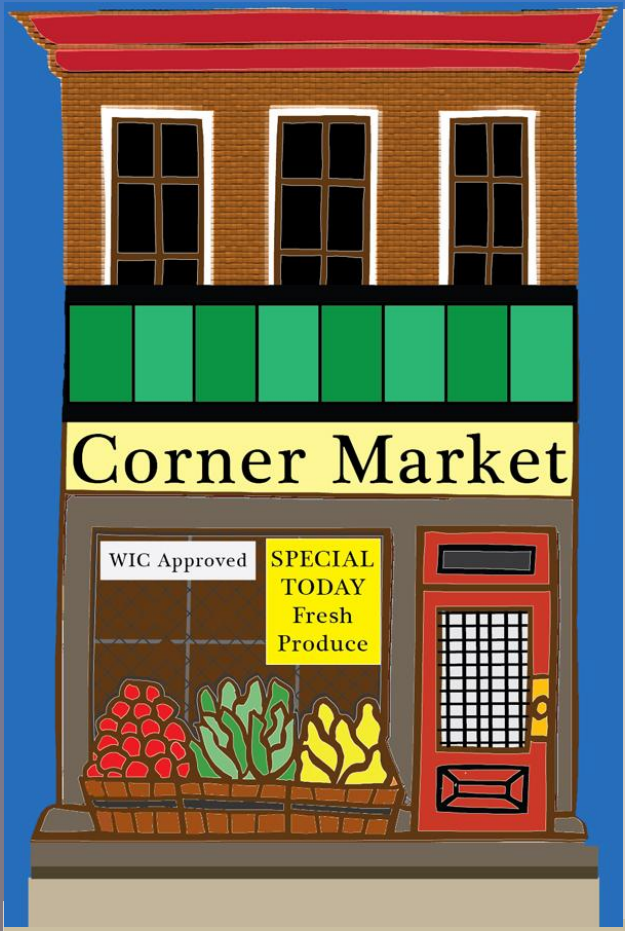
Healthy Food in Hartford:

Evaluating Changes to the Local Food Environment



2007-2010

Final Report

A study funded by the
The Patrick and Catherine Weldon
Donaghue Medical Research Foundation

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Donaghue Foundation Final Report

In 2007, members of the Donaghue Foundation took a leap of faith. They believed that a community-university partnership focusing on small corner stores could provide valuable information about food access in Hartford. Several major cities in the United States, most notably Philadelphia and Baltimore, have well publicized corner store initiatives with strong research and evaluation programs supporting their efforts Although almost 15 years older than the Philadelphia Food Trust, The Hartford Food System, one of the oldest organizations in the United States dedicated to the development of a sustainable urban food system, has no such support. This support from the Donaghue Foundation has spurred the expansion of the "Healthy Communities" group within CPHHP to build such a core, helped establish Katie Martin as a new investigator in the area, provided added policy research for the Women, Infant, and Children (WIC) Program, and expanded research initiatives to new areas to support market development in Connecticut. We greatly appreciate their commitment and are pleased to report on our findings and future directions.

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Background

Obesity, diabetes and food insecurity are chronic conditions that disproportionately affect low-income, minority populations. There are fewer supermarkets and less quality food in urban minority neighborhoods, which may have a significant impact on the ability of low-income residents to follow healthy dietary recommendations.[1-3] Small markets are common in urban neighborhoods and they can contribute to unhealthy eating habits and health disparities by providing easy access to inexpensive, non-nutritious foods.[4] Due to limited transportation, many low-income families must rely on these local stores for their food shopping needs. Lack of supermarkets paired with high poverty rates and health disparities in Hartford highlight the need to explore food availability and food purchasing habits among city residents.

Study Rationale

The city of Hartford, Connecticut is considered a food desert – an area with little or no access to foods needed to maintain a healthy diet. The poverty rate in Hartford in 2008 was 32.5%, and 46.1% among children.[5] The population is predominantly Hispanic (41%) and Black (37%). With a population of 124,060, Hartford has only one full-size supermarket, several medium-sized groceries, and over 130 corner markets. As supermarkets fled inner cities such as Hartford in the 1970s and 1980s, small corner markets filled the void and now are ubiquitous in urban neighborhoods.[6]

This food environment forces many low-income residents to rely on corner markets for their routine grocery needs, where junk food is in abundance but regular food staples and healthy food items are often in short supply. Therefore, improving the food inventory of small stores can potentially have a large impact on the food purchasing decisions of low-income residents in Hartford. The Hartford Food System (HFS), a non-profit organization, recognized the lack of healthy food in small Hartford markets, and in spring 2006 they created the "Healthy Food Retailer Initiative" (HFRI) to encourage small markets to offer healthier food items.

Forty markets joined the HFRI, agreeing to shift 5% of their shelf inventory away from "junk" food to healthier food items each year. Since the inception of the HFRI, the Center for Public Health and Health Policy (CPHHP) and the HFS developed a community-university partnership to conduct a multi-phase, mixed methods study to help evaluate the effectiveness and sustainability of the initiative. The goal of this study was to evaluate the HFRI by:

- measuring changes to the availability, quality and promotion of healthy food by comparing stores participating in the HFRI with control stores
- examining whether customer purchasing habits are related to healthy food availability within stores

Along with the Hartford Food System, advocates nationwide are embarking on initiatives to increase access to healthy food in corner stores. Prime examples include The Food Trust in Philadelphia, the Baltimore Healthy Stores Project in Baltimore, and The Good Neighbor Program in San Francisco.[7] However, there is a documented need for reliable measures of nutrition environments, and program evaluations to document the effectiveness of community-based initiatives.[8-10] This research is based on the ecological model which views health as a result of the interdependence between an individual and their surrounding ecosystem of family, community and culture.[11]

Study Methodology

Corner Stores

We obtained a list of all grocery stores in the city of Hartford from Dun & Bradstreet, a commercial marketing firm. We included CT Department of Public Health data on Hartford stores certified to accept coupons for the Special Supplemental Nutrition Program for Women, Infants and Children (WIC). We combined the two lists to generate a more complete list of grocery stores in Hartford. Out of a total of 154 groceries acquired from these lists, we excluded stores with annual sales over $500,000, and with more than five employees. The sampling frame included 123 grocery stores with average sales of $207,000 and an average of 2.5 employees.

Antonia Helena, above, displays some of the healthy foods available at her store, Williams Market in Hartford, one of 40 markets that are part of the Healthy Food Retailer Initiative, operated by the Hartford Food System.

Our initial sample size estimates called for a sample of 50 stores (25 in the HFRI and 25 controls), and we oversampled to account for attrition. We matched 28 stores participating in the HFRI with 28 control stores based on store size, WIC certification and zip code. After the baseline measurement, three of these stores closed and one refused to continue in the study. We conducted four complete inventories in 52 corner stores in Hartford, CT from January 2009 – January 2010.

Store Inventories

To measure availability, quality and promotion of healthy food in corner stores, we modified the Nutrition Environment Measures Survey in Stores (NEMS-S).[12] We included a measure of quality for fresh produce, and added items required by the WIC Program. The revised instrument includes:

- availability and quality of fruits and vegetables (including fresh, canned and frozen)
- low-fat proteins
- whole grains
- low-fat dairy
- other healthy staples
- healthy snacks
- promotion of healthy foods on store interior, exterior and at point of purchase

The inventory encompasses a variety of food items that can provide a healthy diet based on recommendations from the American Heart Association and the American Diabetes Association for the prevention of chronic diseases.[13, 14] We combined the inventory items to determine a Healthy Corner Store Score (HCSS) to describe the overall availability, quality and promotion of healthy foods in each store with a range of 0 – 50 points.

Figure 1: Summary of Healthy Corner Store Score (HCSS)

Category	Points	Category	Points
Fruits	**9**	**Grains**	**7**
Fresh Fruit Availability	3	Brown rice or oatmeal	1
Fresh Fruit Quality	3	Whole wheat bread	2
Canned Fruit (lite or 100% juice)	2	Whole wheat tortillas	1
Frozen Fruit	1	Low-sugar, whole grain cereal	3
Vegetables	**9**	**Proteins**	**8**
Fresh Vegetable Availability	3	Beans, canned *and* dry	4
Fresh Vegetable Quality	3	Tuna in water or peanut butter	1
Canned Vegetables	2	Fresh chicken	1
Frozen Vegetables	1	Ground turkey *and* beef	2
Dairy	**7**	**Snacks**	**5**
Low-fat milk	4	Healthy snacks	3
Low-fat cheese and yogurt	2	Fruit as a snack	1
Eggs	1	100% juice (≤16 oz.)	1
Other Staples/Misc	**2**	**Promotion**	**3**
Cooking spray	0.5	Produce Display	-1, +1
Low-sodium soup	0.5	Store Exterior Promotion	-1, +1
Large 100% Juice (>16 oz.)	1	Store Interior Promotion	-1, +1
TOTAL = Availability + Quality + Promotion = 50 points			

Data Collection

On average, the store inventories took 25 minutes to complete. Pairs of researchers conducted the inventories. Square footage was measured to determine store size with a laser distance measurer (Stanley FatMax Tru Laser). Each researcher measured store size twice, and the sizes were then averaged together. By collecting data in pairs, it was possible to increase the completeness of inventories and we found high inter-rater reliability (84% to 99%). The University of Connecticut Institutional Review Board approved the study protocol and consent forms (available in English and Spanish). Store owners were compensated $5 for each inventory.

Customers

Based on sample size estimates, our goal was to recruit 350 customers within at least 14 markets to measure purchasing habits of customers. We conducted a convenience sample of 372 customers shopping in 19 small corner stores in Hartford, CT. Inclusion criteria included being a resident of Hartford, and being the main food shopper for the family. Face-to-face interviews were conducted in the markets to measure household demographics, household food security and typical food shopping behavior. Household food security was measured using the USDA Food Security Module. The module consists of 18 questions that ask with increasing severity about a household's experiences with food insufficiency during the previous

12-month period. Food shopping behavior questions included where they shop for food and how often, whether they participate in SNAP (formerly food stamps) and the Women, Infants and Children Program (WIC) and specifically if they bought a list of items during the past month at the corner store, including fruit, vegetables, low-fat milk, whole grains, and snacks. Study participants were paid $5 for completing the survey.

Data Analyses

Data were analyzed using SPSS (version 18), SAS (version 9.1), and Hierarchical Linear Modeling (HLM) (version 6.0.4). Neighborhood demographic variables for each market were added to the store inventory database using data from the 2000 Census. Race, ethnicity and poverty level were populated using block group data. Reliability measures were calculated for the inventory and HCSS scale. Descriptive statistics were calculated for customer demographics and store characteristics. Bivariate analyses included chi-square tests for dichotomous variables and Spearman correlations for continuous variables.

Predicting Customer Purchasing Behavior

To estimate the probability of customers purchasing an item given the availability of that item in the store, multi-level logistic regression models were used. Possible predictors were considered to predict the probability of purchasing respective items. We started with a pool of variables including: household size, number of adults and children, car ownership, ethnicity, education, employment, income, gender, age, whether household receives SNAP (food stamps), diabetes in household, high blood pressure in household; and at the store-level, store size and WIC certification. We considered these as possible predictors for healthy food purchasing habits. To account for variability between markets, the markets were modeled with a random intercept.

Stepwise variable selection was performed using a logistic regression model with no random effects to look for a preliminary set of possible predictor variables. A random intercept for each market was added to the model and model selection continued manually until arriving at the final models. Specifically, we modeled the probability of purchasing:

- Fresh fruit given that a store does or does not offer counter fruit
- Fresh fruit related to the variety of fruit available in the store
- Fresh vegetables related to the variety of vegetables available in the store
- Two percent milk given that a store does or does not offer reduced fat milk

Measuring Changes in Stores

To measure changes to the store inventories over time, data were analyzed using restricted maximum likelihood in HLM. Time was measured as waves for Winter 2009, Spring 2009, Fall 2009 and Winter 2010. Demographic store variables included primary neighborhood race, neighborhood poverty rate, store square footage, years of store ownership, and were used as control variables in the modeling. Covariates were normalized with square root (store ownership) and natural log transformed (store square footage), and centered around their grand mean in order to aid in final model interpretation. The WIC status variable was left un-centered in order to interpret the effects of those stores that were WIC certified versus those that were not.

Modeling

Our approach to the modeling strategy was to first assess the Interclass Correlation Coefficients (ICC) of the unconditional models for the healthy food scores for Total HCSS, Fruit, Vegetable, Grain, Dairy and Protein outcome measures. Healthy food measures with ICCs demonstrating considerable variation that were attributable to differences among stores led to random effects models. Unconditional growth models estimating unadjusted rates of change in each healthy food score were calculated. We then investigated conditional growth models that looked at the fixed effects of baseline WIC status on healthy food measures over time, adjusting for demographic store characteristics. All control variables were entered into the model and a manual backward selection strategy was used to trim the model down. Significant covariates were retained in the final model.

To further assess the impact of the addition of the Revised Food Package (RFP) for WIC, a piecewise linear growth model was utilized. In order to assess if the slope prior to RFP implementation was significantly different from the slope post-RFP and whether there was a differential effect by WIC status, coding for time was distinguished in two pieces. Time 1 was modeled as the slope occurring prior to the RFP policy (time 1 = 0, 1, 2, 3) and Time 2 was modeled as the slope differential occurring post RFP policy change (time 2 = 0, 0, 1, 2). Constraints on the fixed effects for slope x WIC were placed in order to test whether there were significant overall slope differences by WIC store status.

Results

Corner Store Characteristics

The corner markets in this sample reflect the geographic diversity of Hartford. The stores are located in six zip codes, 28 census tracts and 39 block groups. Store size ranges from 168 to 2,428 square feet (ft^2), with an average of 648 ft^2. Stores were located in neighborhoods that were predominantly Hispanic (47%) and Black (37%) with an average poverty rate of 37%. Six stores had new owners within the year, and on average stores were owned for 6.7 years (ranging from 6 months for the new owners to 26 years). Forty two percent of stores were certified to accept WIC, and WIC status was significantly correlated with store size (p=.02).

For the 53 stores with two pairs of data, we found high inter-rater reliability (84% to 99%) by dividing the number of discrepancies between the two researchers by the total number of inventory items. The HCSS had good internal consistency (Cronbach's alpha = .76).

Customer Characteristics

The average age of customers was 37.7 years, and 84% of the sample was female. Average household size was 3.4; 61% had kids and 32% had kids under age five. Demographic data is included in Table 1. The sample reflects the high level of poverty and poverty-related characteristics of the city of Hartford, CT. Only one in five customers owned a car, and 42% could borrow a car from a friend or relative. The majority (53%) was Black, and 40% were Hispanic. One third (35%) of customers had less than a high school degree, 43% had an adult who was currently employed, and 80% of the sample was single. Over two thirds (69.5%) of the sample were currently receiving SNAP (formerly food stamps). Among

households with a child under age 5, over half (56%) currently receive WIC.

The literature on urban food **environments focuses on large** supermarkets, or lack thereof. The majority of customers in this sample (52%) said they bought *most* of their food at medium-sized chain stores such as C-Town, Sav More, and Sav-A-Lot which are more prevalent in the city. Sixty-one percent of customers said they shop at large supermarket chains once a month or less, 25% shop twice a month, and 15% shop once a week or more. While low-income households often buy *most* of their food at grocery stores or supermarkets, they shop frequently at corner stores. One-third (34.1%) shop once or twice per month, another one-third (33.5%) shop once or twice per week, and 32.4% shop at corner stores nearly every day.

Customers from our sample had high levels of food insecurity. Sixty one percent of customers experienced food insecurity, including 26% with low food security and 35% with very low food security where adults often skip meals and cut back on the size and quality of their children's meals. This compares to the most recent national estimates showing that among households with incomes below poverty, 42.2% were food insecure. In addition, many customers self-reported that they or a member of their household has either diabetes (21%), or high blood pressure (32%).

Table 1: Customer Household Demographics

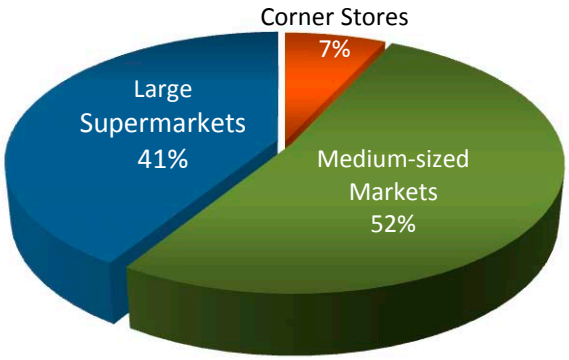
Characteristic	N	%
Total sample	372	100
Household demographics		
Female	312	84.1
Not married	294	79.9
Have children	228	61.3
Have children under age 5	119	32.0
Ethnicity		
Black	199	53.5
Hispanic	149	40.1
Other	24	6.4
Education		
Less than High School degree	130	35.0
High School degree / GED	157	42.4
Some college or higher	84	22.6
At least one adult employed	157	43.4
Own Car	73	20.0
Shopping Behavior		
Buy most of their food		
Large supermarket	148	40.8
Medium sized grocery	188	51.8
Small corner store	27	7.4
How often shop at corner store		
Once or twice per month	123	34.1
Once or twice per week	121	33.5
Every day	117	32.4
Receive SNAP / food stamps	258	69.5
Receive WIC (with children under 5)	66	55.5
Food Security		
Food secure	77	21.6
Marginal food secure	63	17.6
Low food security	93	26.1
Very low food security	124	34.7
Self-reported diabetes in household	78	21.0
Self-reported high blood pressure	119	32.2

Healthy Corner Store Scores

There was large variability in the total Healthy Corner Store Scores (HCSS) with scores ranging from 8.25 to 42.5, and an average score of 27 points at baseline. HCSS were significantly associated with WIC status ($p<.01$) and store size ($p<.01$).

We found significant differences comparing the HCSS of small, medium and large corner stores (see Table below). Larger corner stores scored higher on fruits, vegetables, grains and proteins compared to small-sized stores ($p<.01$). Large stores also scored higher for healthy staple items and more promotional items compared to small stores ($p=.01$ and .04 respectively). There were no significant differences in scores for low-fat dairy items or snack items based on store sizes.

Where customers buy *most* of their food



How often customers shop at Corner Store

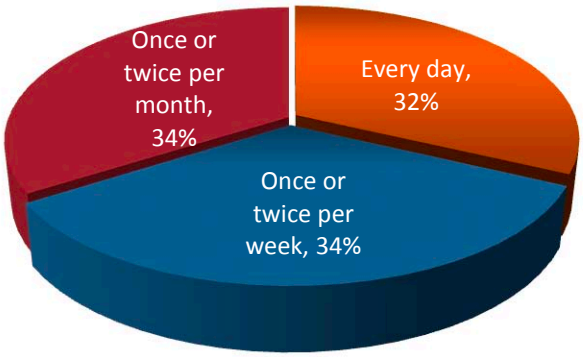


Table 2: Differences between Healthy Food Availability by Store Size

Food Category	Store Size - Mean (SD)					
	Small	Small vs. Med p value	Medium	Med vs. Large p value	Large	Large vs. Small p value
Fruit score	4.3 (2.4)	NS	5.6 (2.2)	NS	7.5 (1.2)	<.01
Vegetable	5.1 (2.4)	.01	6.9 (1.3)	NS	8.3 (0.9)	<.01
Healthy Grain	2.9 (0.8)	NS	2.9 (1.3)	<.01	4.5 (1.1)	<.01
Healthy Dairy	2.7 (1.7)	NS	3.9 (2.1)	NS	4.5 (2.1)	NS
Healthy	4.3 (1.1)	.05	5.0 (0.7)	.03	5.8 (0.9)	<.01
Healthy Snack	1.9 (0.7)	NS	2.2 (0.9)	NS	2.2 (0.6)	NS
Other healthy	1.0 (0.5)	NS	1.2 (0.5)	NS	1.6 (0.3)	.01
Healthy	-0.4 (0.9)	NS	0.0 (1.0)	NS	0.7 (1.0)	.04
Total HCSS	22 (6.8)	.01	27.6 (5.3)	.01	35 (6.2)	<.01

Using Analysis of Variance. NS = Not Significant at p<.05 level. SD = standard deviation

We used the overall Healthy Corner Store Scores to rank stores by those with the highest overall scores and most improved scores over the year, and to track changes over time. Based on a scale of 0 – 50 points, the average HCSS scores increased from 27 to 29 over the year, with an average percent change of 8.4%. The largest stores had the highest overall scores, but the small stores showed the greatest improvement over the year. Below are the highest achievements over one year based on store inventories:

Achievement	HCSS Score	Store Size	Location
Highest overall scores	45	Large	Central
Most improved scores	19 increased to 39	Small	North end
High scores	34 increased to 42	Medium	South end
High scores	41	Large	North end
High scores	41	Large	South end

Customer Purchases and Store Availability

There were significant correlations between the variety of fruit available in a store and whether customers buy fruit in the store ($p<.01$), and how many types of fruit they tend to buy ($p<.01$). Similarly, vegetable variety within a store is significantly associated with customers buying vegetables ($p<.01$), and how many types of vegetable they tend to buy ($p<.01$). However, most of these correlations are related to store size with larger stores carrying greater varieties of fruits and vegetables and, in general, customers shopping at larger stores being more likely to purchase produce. There were no significant associations between customers buying low-fat milk and stores stocking low-fat milk.

When controlling for confounding factors using a multi-level regression model to predict purchasing habits, neither offering counter fruit nor greater fruit variety increased the likelihood that customers would purchase fruit at the market. Women were more likely to purchase fruit than men ($p<.01$), and customers shopping at larger stores were more likely to purchase fruit ($p=.03$) than in smaller stores. Customers receiving SNAP were 1.6 times as likely to purchase fruit as those not receiving SNAP.

A similar regression model was used to estimate vegetable purchases within stores and a significant association was found. For a one unit increase in the number of vegetables available in the store, the odds of a customer purchasing vegetables increased by 15%. Women were 2.6 times as likely as men to purchase fresh vegetables. Older people had an increased probability of purchasing fresh vegetables ($p<.01$), while Black customers were less likely to purchase fresh vegetables ($p=.02$).

No significant relationship was found between stores carrying reduced fat milk and the probability of customers purchasing two percent milk, after controlling for potential covariates.

Variables which were significantly related to the probability of purchasing reduced fat milk included education, gender, and receiving SNAP. Women were twice as likely as men, and customers receiving SNAP were 1.7 times as likely as those not receiving SNAP to purchase reduced fat milk. Also, individuals who had graduated from high school were less likely to purchase reduced fat milk ($p=.02$).

People's Market

Romny Mini Mart

Carlos Supermarket

People's Plaza

We intended to examine customer purchasing habits longitudinally over one year, in tandem with the store inventory data. We contracted with Telesage, a company specializing in interactive voice response (IVR) telephone surveys. We sent letters asking customers to call into the IVR system to complete their 3-month follow-up survey, and the system automatically called customers on their 3-month date. However, we had a very low response rate (approximately 25%) at the 3-month follow-up survey with customers. We sent reminder

letters (many of which were returned due to addresses no longer being current), and did personalized phone calls to ask people to complete the survey (many of the phones were no longer in service). After additional efforts to increase responses, we had a 25% response rate at the 6-month follow-up and decided to stop the customer portion of the study.

Comparing HFRI stores with control stores

There were no significant differences between stores participating in the HFRI and control stores related to store size, ownership, neighborhood ethnicity or poverty. There were also no significant differences between HFRI and control stores at baseline with regard to availability of healthy food (chi-square tests for dichotomous variables; t-tests for continuous). Availability between stores at baseline is listed in Table 2.

Throughout the study, there were no significant differences between stores participating in the HFRI and the control stores, on any indicator. HFRI stores did make some improvements over the course of the year, but they were not significantly different from the control stores.

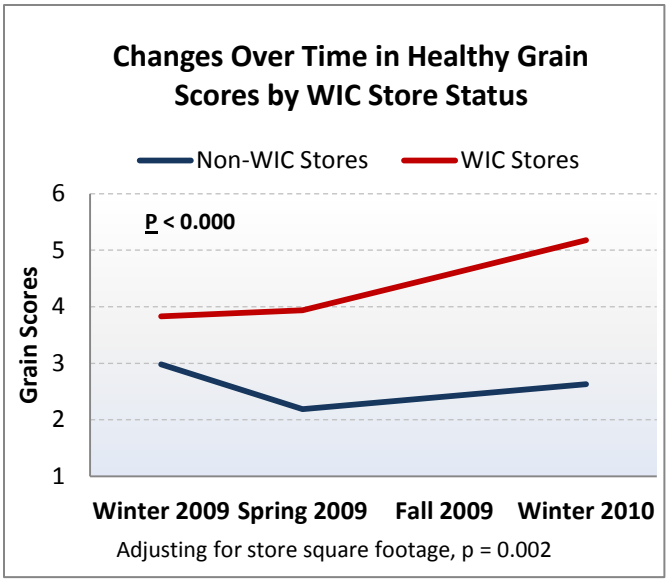
Table 3: Baseline Healthy Food Availability *

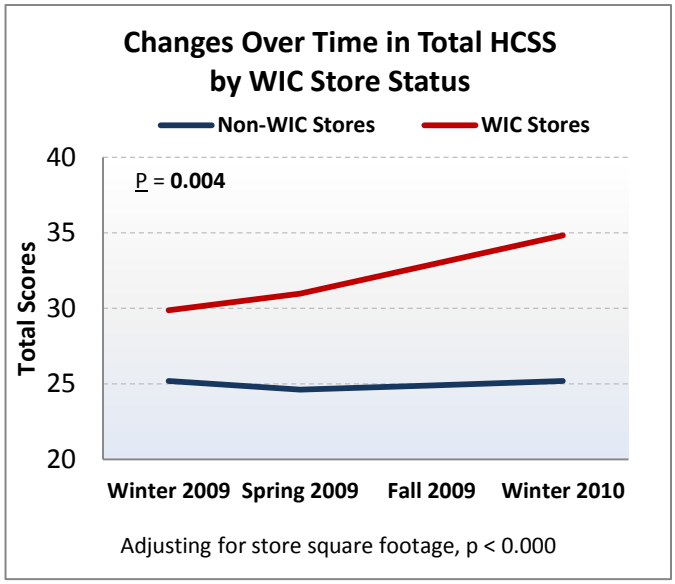
Baseline	Average all	HFRI Stores	Control Stores
Total N	**52**	**28**	**24**
Number	**#**	**#**	**#**
Total	27.2	28.1	26.1
Fresh fruit	3.5	3.9	3.0
Fresh	5.0	6.0	3.9
Percentage	**%**	**%**	**%**
Fresh fruit	42	46	38
Reduced	69	68	71
Whole	13	18	8
High fiber	77	71	83

* Chi-square tests for dichotomous variables; t-tests for continuous

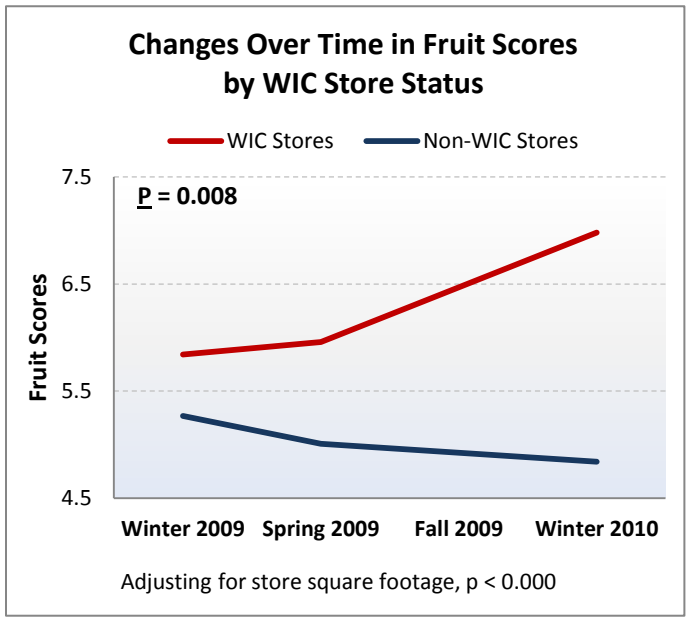
Changes to the WIC Program

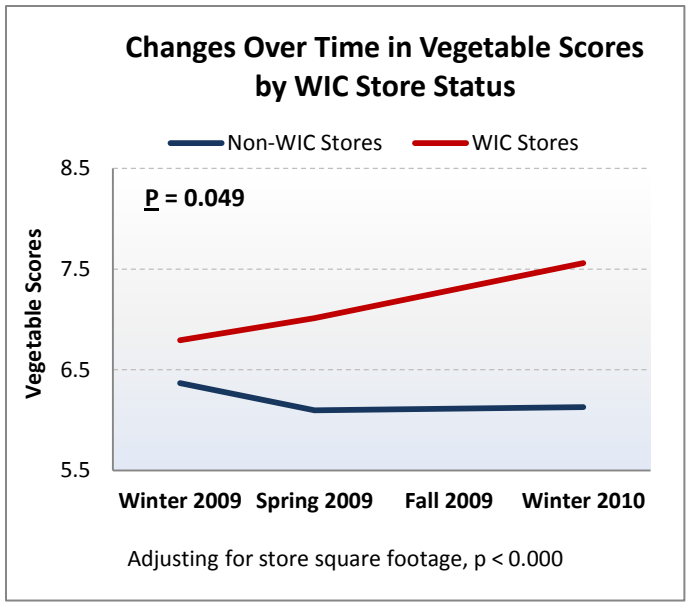
During our evaluation, a federal policy change to the Women, Infants and Children Program (WIC) took effect in October 2009 which impacted stores in our study. Stores that accept WIC coupons were required to stock fruits and vegetables (either fresh, frozen or canned), whole grains (including brown rice and whole wheat tortillas) and low-fat milk (2% or less fat). This enabled us to conduct an opportunistic study to evaluate changes to stores based on WIC certification. We saw significant changes in the availability of healthy food items after the policy change took effect.





Following the WIC policy change, WIC certified stores had significantly greater availability of fruit, vegetables, whole grains, and overall HCSS scores (p<.01) compared to non-WIC stores. In these models, store size was a significant predictor of increased scores, but even when controlling for store size, WIC certification made a significant difference.

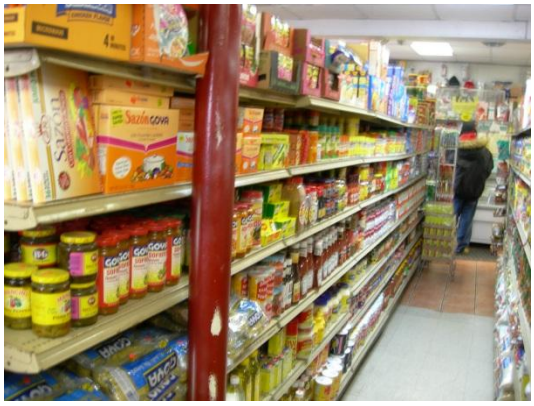




Implications

While the common assumption is that corner stores carry limited healthy food, results for individual items and the overall Healthy Corner Store Scores show this is a mixed picture. The HCSS reflect that stores carry a variety of healthy foods, but most stores have substantial room for improvement. A close look at individual foods shows that the majority of corner stores do carry produce, yet with fewer fruits than vegetables. Even when healthy foods are available, they are seldom promoted through attractive displays, signage or placement at the register. In general, WIC certified stores and larger markets stock a wider availability of healthy foods, but even small stores can be considered healthy markets.

While measuring individual food items within stores is instructive, the HCSS summary score provides a useful tool for comparing overall availability, quality and promotion of key healthy foods. The HCSS can also be used to rank stores within a community, to target stores with low scores, and to track changes over time. Among



corner stores in this sample, there was wide variability in the HCSS scores, yet only one store scored above 40 (out of 50) points on the overall HCSS in the baseline. Over one year, scores improved by 8%. The scores reflect that stores carry a variety of healthy foods, but substantial room for improvement exists for most stores regardless of their size.

Even when healthy foods are available, they are seldom promoted through attractive displays, signage or placement at the point of purchase. For example, even though most stores carry foods that could be bought as healthy snacks, they are often in the back of the store rather than at the point of purchase. Results can be used to develop future interventions. Potential remedies could include working with owners to relocate already available healthy snack options (such as pretzels, raisins and 100% juice) closer to the register, or using inventory results to identify unavailable foods (such as low-fat milk and whole grain bread) and encouraging store owners to stock them.

Even though increasing access to larger supermarkets is mentioned as a potential remedy for limited healthy food availability[15] this is often not feasible in urban, densely populated cities such as Hartford. Promoting stores with high HCSS, and working within existing stores to improve their availability and promotion of healthy items may be more feasible in urban food environments, compared to advocating for a full-size supermarket or recruiting an existing chain to fill retail space.[16] Recent attempts by Common Ground, a non-profit organization, to locate a new grocery chain in downtown Hartford, even with tax abatements and incentives from the city, have not been fruitful.

We did not see significant differences based on the Healthy Food Retailer Initiative. We believe this is largely due to the fact that staffing for the program was underutilized and resources were under-committed to achieve the goals set forth by the program. At the beginning of the program there were two full-time staff positions committed to the program, and this diminished to one part-time staff member. With a leadership change at the Hartford Food System, there is new direction and momentum for the next phase of the Healthy Food Retailer Initiative. Based on our work in the markets we suggest focusing on a small number of stores, particularly WIC certified stores, and providing hands-on interactions. In discussions with the new staff at HFS, we are optimistic that the research findings are being utilized and translated back into the project. The current goals are to:

- build on the foundations of the program
- use the study results to target specific stores
- target specific food items in participating stores

Most research on food environments utilizes aggregate data on number and type of stores per geographic area and the aggregate health outcomes for that geographic area. Very few studies have combined store food availability data with actual purchasing behavior in corner stores. The strength of this research is the direct information collected from customers and the stores in which they shop. Similarly, most of the food environment literature compares number of supermarkets to corner stores, and lumps corner stores into one category. Our results show wide variability even among small markets. For corner store evaluations and interventions, size measurements are important. Similarly, within the food environment

literature, there is little discussion of WIC certification as a key factor for healthy food availability. Within our sample of corner stores, store size and WIC certification were significant predictors of healthy food availability and quality. Corner store evaluations and interventions need to take these factors into consideration.

Limitations

While this study has strengths, there are some notable limitations. This study was conducted in a sample of markets in one medium sized city and therefore results are limited to the study area. The city of Hartford is predominantly minority with very high poverty rates, even compared to other urban locations. Results may be different when comparing this sample to other more diverse locals. Shopping behavior is based on self-report rather than direct observations or sales data. While this is not a representative sample, it may have practical benefits for organizations or municipalities working with corner markets in other urban environments to conduct store inventories or create interventions in stores.

The store inventory did not measure price or affordability of foods, even though they are important aspects of food access. Collecting this information would have added additional burden on the store owners (prices are often not listed on food items in corner stores) and substantially increased data collection time while extending beyond the scope of the HFRI evaluation. The instrument we used was easy to administer, taking approximately 25 minutes per store, with high inter-rater reliability when used by different data collectors.

We had intended to measure customer purchasing habits over one year to compare with the availability of healthy food within stores. Our response rates were very low and we had to discontinue this part of the study. Because we are focusing on low-income neighborhoods, the study population is inherently very transient and difficult to reach. Since the customer data is from the baseline measure and is cross-sectional, we cannot infer causation.

Conclusions

This study contributes to the growing field of research exploring urban food environments. In order to translate nutrition information into practice, it is necessary to understand and work within the local food environment. Small steps to improve dietary intake can significantly prevent or delay the onset of diabetes [15] and other chronic conditions. However, major barriers related to accessing healthy food in low-income urban populations exist.[1, 2,16] Encouraging those most at risk for obesity and diabetes to "eat healthy food" will be hampered if these foods are not locally available.

We have continued to partner with the Hartford Food System to translate this information and our lessons learned. Our findings highlight areas of improvement in corner stores and areas for future interventions. Results are actively being translated back into the community. Under new leadership, the Hartford Food System is using the study results to inform the next phase of their project. Specifically, they are targeting a small group of markets that have strong relationships and willingness to make changes.

Once again, we sincerely thank the Donaghue Foundation for their generous support, encouragement and belief in our research.

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