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Changes in Diet after Introduction of a Full Service Supermarket in a Food Desert

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3 **Changes in Diet after Introduction of a Full Service Supermarket**
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5 **in a Food Desert**
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10 **BACKGROUND**
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12 The obesity epidemic may partly be explained by geographic
13 differences in food availability within the United States.¹ To
14 address this, many policy solutions have focused on eliminating
15 "food deserts," or neighborhoods with limited access to healthy
16 food options.² Residence in a food desert has been associated
17 with the consumption of an unhealthy diet and increased risk of
18 obesity.^{3, 4} It has been argued that supermarkets provide access
19 to a variety of healthy, lower-calorie affordable foods and that
20 the absence of a nearby supermarket increases reliance on
21 convenience stores and fast food outlets⁵ thereby increasing
22 consumption of discretionary calories.
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38 Residents of low-income, minority, and rural neighborhoods
39 have limited spatial, or physical, access to grocery stores and
40 therefore less physical access to healthful food.^{1, 6-8} In fact,
41 African Americans are four times more likely to live in a
42 neighborhood without a full-service supermarket than are
43 Whites.^{1, 8-11} This finding has been proposed to explain why
44 African-American adults in particular are 1.5 times more likely
45 than White adults to be obese.¹²
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3 The Healthy Food Financing Initiative (HFFI), part of the
4 federal Farm Bill, aims to increase the availability of healthy
5 and affordable foods in U.S. neighborhoods that currently lack
6 such options. Since 2011, the federal government has invested
7 more than \$500 million through one-time financing assistance to
8 efforts that include the opening of full-service supermarkets
9 (FSS) in food deserts. Some public health experts have promoted
10 this strategy as a way to improve residents' food purchasing
11 behaviors and diet.¹³

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24 Few U.S. studies have actually examined the impact of
25 opening a full service supermarket in a food desert on food
26 purchasing and diet. One study in Philadelphia found no
27 significant change in fruit and vegetable intake or body mass
28 index (BMI) of residents after the opening of a supermarket.¹⁴
29 They did, however, find differences in perceived access to
30 healthy food options. In New York City, Elbel and colleagues
31 assessed the impact of a new supermarket on household food
32 availability and children's dietary intake and did not find any
33 consistent changes in either outcome.¹⁵ Both studies, however,
34 had small sample sizes, limited measures of dietary intake, and
35 few measures of contextual factors and additional outcomes that
36 might explain or illuminate their findings, for example, what
37 was sold at new markets, how people used them, and whether other
38 neighborhood stores changed.
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3 Given the large government investment to increase access to
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5 supermarkets, and no positive findings from existing
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7 evaluations, there is a need for more rigorous studies that can
8
9 inform whether such policies can address poor diets among food
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11 desert residents, and if so, how. This paper tests the impact of
12
13 a new HFFI-funded supermarket in a low-income food desert on
14
15 adult residents' diet, obesity (measured by BMI), and perceived
16
17 access to healthy food. We use comprehensive measures of dietary
18
19 intake, a large sample size, measures of shopping behavior and
20
21 perceived access to healthy food, and extensive data on changes
22
23 in the food environment.
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29 Prior studies may also have overlooked a key factor other
30
31 than shopping that might change with the introduction of a
32
33 supermarket: neighborhood satisfaction. Some research has found
34
35 an association between perceptions of one's neighborhood and
36
37 health,¹⁶⁻¹⁸ including atherosclerosis. We reasoned that a change
38
39 neighborhood satisfaction stemming from the opening of a
40
41 supermarket might explain changes in diet independent of changes
42
43 in shopping patterns or provide an indication of other potential
44
45 health benefits of the store apart from improved diet.
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52 **METHODS**

53 ***Study Design and Participants***

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3 The Pittsburgh Hill/Homewood Research on Eating, Shopping
4 and Health (PHRESH) study used a quasi-experimental longitudinal
5 design to investigate the effect of opening an HFFI-funded full-
6 service supermarket in an intervention neighborhood compared to
7 a comparison neighborhood with no plans to open a full-service
8 supermarket. Data collection efforts included extensive surveys
9 of a randomly selected cohort of residents that included
10 detailed 24-hour dietary recalls. The two neighborhoods were
11 socio-demographically and geographically matched and had similar
12 food environments at baseline: the intervention neighborhood
13 (Hill District) was approximately 1.37 square miles (population
14 of approximately 10,219), and the comparison neighborhood
15 (Homewood) was approximately 1.45 square miles (population of
16 approximately 8,300). The Hill District and Homewood were both
17 predominantly African-American (about 95 percent of the
18 population categorized themselves as African American), and
19 median household income was <\$15,000/household for both
20 neighborhoods. Prior to any changes, the nearest supermarket
21 was, on average, 1.7 miles (st dev. .351) away from Hill
22 District residents and 1.4 miles (st dev. .354) from residents
23 of Homewood. Distance was computed as the shortest network
24 driving distance from residents' homes to the closest full-
25 service supermarket (regardless of whether the resident reported
26 shopping there). Baseline data were collected from May through
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3 December, 2011; follow-up data collection was from May through
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5 December, 2014. In October 2013, the Hill District gained a
6
7 full-service supermarket.
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10 We drew our sample from a list of addresses generated by
11
12 the Pittsburgh Neighborhood and Community Information System
13
14 (PNCIS), with sampling in the intervention neighborhood
15
16 stratified by distance to the planned full-service supermarket.
17
18 Trained residents from each neighborhood were employed as
19
20 recruiters and data collectors, and went door-to-door to each
21
22 address to enroll the household's primary food shopper (this
23
24 person had to be over age 18 for the household to be eligible).
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28

29 At baseline, 4,002 addresses were randomly selected; data
30
31 collectors determined 2,900 of those addresses were inhabited.
32
33 Of the 1,956 addresses at which they were able to reach a
34
35 household member, 1,649 (84 percent) were eligible to
36
37 participate, and 1,434 (87 percent of those eligible) agreed to
38
39 do so. We eliminated 62 (4 percent) of the baseline surveys
40
41 because they were not sufficiently complete to be usable,
42
43 leaving a final baseline sample of 1,372. At follow-up, we were
44
45 able to re-interview 831 (65 percent) of the 1,273 individual
46
47 households that remained eligible to participate. Reasons for
48
49 ineligibility included death (n=52), physical or mental health
50
51 condition that prevented the resident from completing an
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3 interview (n=22), moved out of state (n=18), and moved within
4 the neighborhood, but the new address could not be found (n=6).
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8 At each timepoint, participants responded to a 60 minute
9 survey that included questions about healthy food access in
10 their residential neighborhood, food purchasing practices such
11 as where residents shopped and how often, transportation used
12 for food shopping trip, and socio-demographic characteristics.
13 Dietary intake was collected through a 24-hour recall
14 administered during the interview and then again 7 to 14 days
15 later. The interviewer measured height and weight of each
16 participant at the conclusion of each interview.
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29 Participants received \$25 for completion of the survey and
30 first dietary recall and an additional \$15 for completion of a
31 second dietary recall. Between baseline and follow-up,
32 participants received postcards, phone calls and invitations to
33 town hall meetings where findings from baseline data were
34 presented. All study protocols were approved by the
35 institution's Institutional Review Board (IRB).
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47 **Limitations to this study**

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49 This study was set in two low-income, racially isolated
50 urban neighborhoods; therefore, findings may not be
51 generalizable to other food deserts with residents who have
52 different socio-demographic profiles. In addition, because
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3 recruitment and enrollment into the study was done in-person,
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5 less mobile residents (i.e., households without children and
6
7 older residents) were more likely to respond and enroll in the
8
9 study. Furthermore, attrition among participants in our cohort
10
11 was relatively high; however, our analysis carefully adjusted
12
13 for observable characteristics associated with sample loss to
14
15 overcome this limitation. Finally, the timing of the follow up
16
17 may not have allowed for sufficient time to pass between the
18
19 opening of the store and changes in health outcomes such as BMI
20
21 or obesity status.
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29 **Measures**

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31 **Diet** was assessed diet with the automated self-administered
32
33 24-hour dietary recall (ASA-24), which collects data on all food
34
35 and beverages consumed in the 24 hours prior to completion.¹⁹
36
37 From the dietary recalls, we computed Healthy Eating Index-2010
38
39 (HEI-2010)²⁰ scores to measure *overall dietary quality* based upon
40
41 compliance with the United States Dietary Guidelines for
42
43 Americans. We calculated a single HEI-2010 score based on the
44
45 two days of intake, calculating per person scores.²¹ HEI can
46
47 range from 0 to 100, with higher scores indicating better diet
48
49 quality. We also calculated daily total kilocalories (Kcals/day)
50
51 *percent total fat intake* (percent of total fat Kcal/day); added
52
53 *sugar intake* (gram/day); intake of solid fats, alcoholic
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3 beverages and added sugars (SoFAAS) (percent of Kcal/day); fruit
4
5 and vegetable intake (servings/day); and whole grain intake
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7 (ounces/day).

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10 **Body mass index (BMI)** (or weight in kg/height in m²) was
11
12 calculated from interviewer-measured height and weight
13
14 (respondents were measured without shoes). Interviewers measured
15
16 height to the nearest eighth inch using a carpenter's square
17
18 (triangle) and an 8-foot folding wooden ruler marked in inches.
19
20 Weight was measured to the nearest tenth of a pound using the
21
22 SECA Robusta 813 digital scale.
23
24

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26
27 **Perceived access to healthy foods** was assessed through a
28
29 series of 10 questions on a 5-point (strongly agree-strongly
30
31 disagree) scale about the ease of buying, selection, quality,
32
33 and price of fruits, vegetables, whole grain foods and low-fat
34
35 items in their neighborhood.^{14, 22, 23}
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37

38
39 **Neighborhood satisfaction** was measured with the question,
40
41 "All things considered, would you say you are very satisfied,
42
43 satisfied, dissatisfied, very dissatisfied, or neutral - neither
44
45 satisfied or dissatisfied with your neighborhood as a place to
46
47 live?"²⁴
48

49
50 **Food purchasing practices** were measured with several items.
51
52 **Store-type for food shopping.** We asked all participants at
53
54 baseline and at follow-up "When you want to buy food, how often
55
56 do you go to [the following types of stores]" with regard to a
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3 list of store types: dollar store, discount grocery store,
4
5 supercenter, wholesale club, specialty grocery store, full-
6
7 service supermarkets, meat or seafood market, fruit and
8
9 vegetable store or farm stands, and drug store. Examples of
10
11 local stores were provided for each. We chose these categories
12
13 based on definitions from the Food Marketing Institute (FMI) and
14
15 the North American Industry Classification System (NAICS), and
16
17 confirmed categories with our Community Advisory Boards, which
18
19 was comprised of key resident stakeholders within each
20
21 neighborhood. The response scale was never, occasionally,
22
23 sometimes, or often. We asked about their mode of transportation
24
25 for major food shopping trip, which was categorized as drive,
26
27 jitney (i.e., unregulated taxi), public transport, "get a ride",
28
29 or other (e.g., walk).
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36 We collected information on **frequency of major food**
37
38 **shopping** ("How many times did you visit the store you frequent
39
40 most for major food shopping in the past month?") and **weekly**
41
42 **food expenditures per person** using an open-ended item
43
44 ("Approximately how much do you spend on food each week?"),
45
46 which was adjusted by household size.
47
48

49 **Use of the new supermarket.** At the follow-up survey only,
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51 we asked Hill District residents how often they visited the new
52
53 supermarket since it opened. Response options were "more than
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55 once per week," "once per week," "2-3 times per month," "once
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3 per month," "a few times," "once or twice," "never." Those who
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5 reported shopping at the new store once per month or more were
6
7 classified as regular users.
8
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10 **Sociodemographic measures** included race/ethnicity, age,
11
12 gender, total household income, marital status, educational
13
14 attainment, children in the household, number of years lived in
15
16 the neighborhood.
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18

19 **Statistical Analyses**

20
21 We examined comparability of the two neighborhood cohorts
22
23 at baseline across a variety of measures. For our main analyses,
24
25 we computed for each outcome (i) the average difference between
26
27 baseline and follow-up values in the intervention group, (ii)
28
29 the average difference between baseline and follow-up values in
30
31 the comparison group, and (iii) a difference-in-difference
32
33 estimator indicating how the changes in the intervention group
34
35 over time compared with those in the comparison group. In these
36
37 analyses, we employed an *intention-to-treat* approach, comparing
38
39 differences in average outcomes for the entire intervention
40
41 group with those in the comparison group, regardless of whether
42
43 they used the new supermarket. Each value was tested to
44
45 determine if it was significantly different from zero.
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54 To help clarify the basis for our difference-in-difference
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56 results, within the intervention neighborhood cohort, we also
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3 compared changes among regular users of the new supermarket
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5 compared to others. Linear regression predicted, in turn, each
6
7 of the dietary outcomes of interest, BMI, perceived access to
8
9 healthy foods, and neighborhood satisfaction. To correct for
10
11 pre-existing differences between those who chose to use the new
12
13 supermarket and others in the neighborhood, we controlled for
14
15 linear and quadratic terms of age, gender, household income,
16
17 indicator of children of household with children, education
18
19 level ('high school', 'some college', 'college', with 'less than
20
21 high school' as reference category), and marital status
22
23 ('married', 'separated', with not married as reference category)
24
25 in these equations.
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31 For the same reason, we examined whether changes in weekly
32
33 food expenditures, frequency of major food shopping, and use of
34
35 different types of food stores were related to change in diet
36
37 across both neighborhoods. To do so, we conducted a series of
38
39 linear regressions to separately predict each dietary outcome
40
41 with significant change in intervention neighborhood compared to
42
43 its comparison, controlling for neighborhood.
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47 Analyses were performed using Proc SurveyReg and Proc
48
49 Surveyfreq in the statistical software SAS, version 9.2, with
50
51 analyses weighted to account for sample attrition between
52
53 baseline and follow-up to ensure that results generalize to the
54
55 baseline sample. Attrition weights were the inverse probability
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3 of response at follow-up estimated that included all of the
4 socio-demographic and additional baseline characteristics as
5 predictors.
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10 11 12 **RESULTS**

13 **Characteristics of Study Participants**

14
15 Study participants were predominantly female (75 percent),
16 non-Hispanic African American/Black (95.2 percent), not married
17 (82.7 percent), and low-income (median household income was
18 \$13,608) (Exhibit 1). Median age at baseline was 53.3 years; and
19 28.2 percent of the cohort had one or more children in the
20 household. Average BMI of the sample was 30.52 and 77.4 percent
21 of the sample met criteria for overweight (25-29.9 BMI) or obese
22 (30+ BMI).
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36 On average, the baseline HEI score was 48.4 (out of 100);
37 daily Kcal intake was 1796/day; percent of daily total fat
38 intake (as a percent of total Kcal) was 36.4 percent daily
39 teaspoons of added sugar was 14.6; SoFAAS consumption was 33
40 percent of daily calories; residents consumed 2.3 daily servings
41 of fruits and vegetables; and average whole grain consumption
42 was 0.58 oz per day.
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52 At baseline, nearly all residents (99 percent) said they
53 shopped at a full-service supermarket at least occasionally. Of
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3 all the different store types, the least frequented were
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5 specialty grocery stores and neighborhood stores.
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10 **Change in Diet, Body Mass Index, Neighborhood Satisfaction and** 11 **Perceived Access to Healthy Foods** 12 13

14
15 Exhibit 2 provides the results of our main difference in
16
17 difference findings (see Appendix Table 1 for additional
18
19 details).²⁵ This analysis revealed positive differential effects
20
21 on several components of diet, perceived access to healthy
22
23 foods, and neighborhood satisfaction, but no change in BMI,
24
25 consumption of fruits and vegetables, or consumption of whole
26
27 grains. In the intervention neighborhood, we saw a decrease in
28
29 consumption of total Kilocalories (by 222 Kcal/day), added
30
31 sugars (-2.75 tsp/day) and SoFAAS (-1.38 percent/day). In
32
33 contrast, these either remained the same or increased in the
34
35 comparison neighborhood (difference-in-difference p -values <
36
37 .01). Unexpectedly, consumption of fruits and vegetables and
38
39 whole grain foods declined in both neighborhoods. These shifts
40
41 were statistically indistinguishable from one another
42
43 (difference-in-difference p -values = .36 and .51, respectively).
44
45 Consistent with these more specific findings, overall dietary
46
47 quality (i.e., HEI) declined in the comparison neighborhood but
48
49 not significantly so in the intervention neighborhood. The
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3 neighborhood difference in HEI scores was marginally significant
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5 ($p = .05$).
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8 BMI did not change in the intervention neighborhood, and
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10 increased slightly in the comparison neighborhood ($p=.02$)
11
12 although the difference-in-difference estimate was not
13
14 significant. We observed no significant changes in the rate of
15
16 overweight or obesity in either neighborhood, or any
17
18 differential change across the neighborhoods.
19
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21

22 There were substantial improvements in the intervention
23
24 neighborhood for all measures of perceived access to healthy
25
26 foods. While there were some small, occasionally significant
27
28 improvements among these measures in the comparison
29
30 neighborhood, all difference in differences were significantly
31
32 greater in the intervention neighborhood (all $p < .0001$).
33
34
35 Neighborhood satisfaction improved significantly in the
36
37 intervention neighborhood but not the comparison and the
38
39 difference in differences was significant.
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45 **Association between regular use of the new supermarket and**
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47 **outcomes.**
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49
50 If the observed relative improvements in diet, perceived
51
52 access to healthy foods, and neighborhood satisfaction among
53
54 residents of the intervention neighborhood were due to the new
55
56 supermarket, we might expect to see greater improvement among
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3 those who regularly used the store compared to those who did
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5 not. Among Hill District residents, 368 (68 percent) were
6
7 classified as regular users and 171 (32 percent) were either
8
9 nonusers or had visited only a few times since opening. Exhibit
10
11 3 compares changes in each outcome by store-user status findings
12
13 (see Appendix Table 2 for additional details).²⁵ Although changes
14
15 were in expected directions for total daily Kcal, added sugars,
16
17 SoFAAS, and neighborhood satisfaction, use of the supermarket
18
19 was not significantly associated with any of these outcomes. We
20
21 did, however, see significant differences between users and non-
22
23 users in terms of perceived access to healthy foods. For almost
24
25 all questions around access to fruits and vegetables, whole
26
27 grains and low-fat products, users of the store had a bigger
28
29 positive change over non-users. A series of sensitivity analyses
30
31 classifying store use differently (e.g., using an ordinal
32
33 measure of use or with other thresholds for "user") did not
34
35 change these findings appreciably.
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45 **Associations Between Changes in Food Purchasing Practices and** 46 47 **Changes in Diet** 48

49
50 Given that changes in diet did not appear to be associated
51
52 with use of the new supermarket, we sought other factors that
53
54 could potentially explain the observed differences by testing
55
56 for associations between pre-post change in a number of factors
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1
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3 and dietary change across both neighborhoods (Exhibit 4). We
4
5 examined changes in weekly food expenditures, major food
6
7 shopping frequency, and changes in types of food stores where
8
9 food is purchased. We found only one significant association; as
10
11 shown in Exhibit 4, increased shopping frequency at a discount
12
13 grocery store predicted an increase of .086 or about 1 percent
14
15 of daily percent of total fat intake ($p < .05$).
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19

20 21 22 **DISCUSSION**

23
24 Using a rigorous design that accounted for potential
25
26 confounders and secular trends and included two 24-hour dietary
27
28 recalls, our study found a net positive change in some aspects
29
30 of diet, perceived access to healthy foods, and neighborhood
31
32 satisfaction among food desert residents whose neighborhood
33
34 acquired a new full-service supermarket. Although improvements
35
36 in perceived access to healthy foods were significantly greater
37
38 among regular users of the new supermarket compared to
39
40 infrequent and nonusers, changes in diet and neighborhood
41
42 satisfaction occurred in the intervention neighborhood
43
44 regardless of frequency of supermarket use. These improvements
45
46 were also unassociated with any observed changes in other food
47
48 purchasing practices.
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54 Also contrary to our hypothesis (and the intentions of
55
56 policy makers) that a supermarket would improve neighborhood
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3 residents' consumption of produce, consumption of fruits and
4
5 vegetables declined after the new supermarket opened, and did so
6
7 in equal measure to the comparison neighborhood. One potential
8
9 reason for this overall secular trend may be that almost all
10
11 residents of both neighborhoods shopped prior to *and* after the
12
13 new store's opening at food retail venues that do not
14
15 aggressively market or incentivize purchasing of produce. In
16
17 addition, because of time, knowledge and equipment needed to
18
19 prepare many fruits and vegetables - increasing produce intake
20
21 may be, practically-speaking, more difficult than making other
22
23 changes in diet.
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29 We saw significant differences in differences in total
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31 caloric intake, added sugars, and SoFAAS. Caloric intake, added
32
33 sugars and SoFAAS could potentially be easier components of diet
34
35 to change than fruit and vegetable consumption. For the most
36
37 part, they reflect decreases in food intake. Such changes take
38
39 less time and resources from daily activities. There have also
40
41 been recent public health campaigns focused on reducing sugar
42
43 intake and contact these may have influenced residents' choice
44
45 of strategies for improving their diets.²⁶
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49
50 Our study is the first to our knowledge to have found
51
52 significant improvements in multiple dietary outcomes and
53
54 neighborhood satisfaction among residents of a food desert
55
56 following the opening of a supermarket. Prior studies of
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2
3 supermarket effects have found improvements in perceptions of
4 healthy food access as well as economic impacts.^{14, 27} In their
5 study of a new supermarket opening in Philadelphia, Cummins et
6 al. found significant improvements in perceived access to
7 healthy foods.^{14, 27} The Reinvestment Fund reported on the role of
8 store openings in bringing employment opportunity, as well as
9 serving as an economic anchor for other new developments within
10 low food access neighborhoods.²⁷ Another longitudinal study of
11 the food environment similarly found mixed results regarding
12 changes in the food environment and diet: Boone-Heinonen and
13 colleagues, using 15 years of longitudinal data from the
14 Coronary Artery Risk Development in Young Adults (CARDIA) study,
15 found that greater supermarket availability was generally
16 unrelated to diet quality and fruit and vegetable intake.²⁸
17 Another recent analysis that used Nielsen data tracking food
18 purchasing found that only a small amount of food purchase
19 variation was explained by spatial differences in access to
20 healthful foods. Handbury et al. found that even after
21 controlling for spatial access, systematic socioeconomic
22 disparities in household purchases were the most important
23 factor in food purchasing practices. They found that even in the
24 same store, more educated households purchase more healthful
25 foods.²⁹
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3 In the absence of any direct associations between regular
4 use of the supermarket and other food access behaviors and the
5 change in diet, it is possible that other changes in the
6 intervention community (e.g., neighborhood improvements in
7 aesthetics) could explain changes in lifestyle of residents,
8 including dietary habits. Other research has found associations
9 between the perceived and objectively measured social and
10 physical environment of a neighborhood and residential
11 wellbeing,³⁰⁻³² although they have focused mostly on mental health
12 outcomes. Nonetheless, the largest change between the
13 intervention and comparison neighborhood was the opening of the
14 new supermarket, so it is the most likely cause of the changes
15 in diet we observed.
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33 It seems likely that the mechanism behind the improvements
34 in diet we observed is related to the changes in neighborhood
35 satisfaction and perceived access to healthy foods that are also
36 part of our results. Residents were actively involved in
37 bringing the market to their neighborhood, and there were public
38 discussions and marketing campaigns accompanying its opening,
39 focusing on the need for healthy foods in the community. These
40 may be necessary to influencing dietary choices through
41 supermarket introduction. The new supermarket may also have
42 stimulated economic development in the neighborhood and hope
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3 among community residents heartened by public and private
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5 investment in their neighborhood and their health.^{33, 34}
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10 **Conclusion**

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12 We obtained the first evidence that the introduction of
13
14 supermarkets can result in improvements in some components of
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16 diet among residents. Yet this change did not appear to be due
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18 to use of the market. Given this pattern of findings, policy
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20 makers should still consider placing markets in food deserts,
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22 but should move forward with greater caution until the
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24 mechanisms behind our observations are more firmly established.
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26 Resident buy-in, perhaps even advocacy, may be critical to new
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28 supermarket effects. And other policy levers related to hope and
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30 neighborhood satisfaction should also be considered as an
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32 alternative to markets, such as educational training and jobs-
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34 development. Addressing lack of opportunity may be as central to
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36 addressing obesity among low-income populations as is healthy-
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38 food access.
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EXHIBIT 1 (table)

Caption: Characteristics of PHRESH Study Participants at Baseline, May–December 2011

Source/Notes: Authors' calculations/ * $p < .05$; ** $p \leq .01$; *** $p \leq .001$; + Neighborhood store, Specialty grocery store, meat or seafood market. Adjusted for attrition weights (Neighborhood, Gender, Age, Income below the federal poverty limit, Education, Kids in the Household, Marital status, Disability, Home ownership, Access to a Car, Self-rated health, Years lived in neighborhood, BMI, HEI, and interactions of neighborhood with covariates).

EXHIBIT 2 (table)

Caption: Change In Diet, Body Mass Index, Neighborhood Satisfaction and Perceived Access to Healthy Foods for Residents of Intervention and Comparison Neighborhoods, and Difference in Differences

Source/Notes: Authors' calculations / * $p < 0.10$; ** $p < 0.05$; *** $p < 0.001$; + Change is computed as difference between follow up and baseline; the results on nutrient levels and types of foods describe mean reported daily intakes; HD = Hill District; HW = Homewood; F&V = fruits and vegetables, WGP = whole grain products, and LFP = low-fat products.

EXHIBIT 3 (table)

Caption: Comparison of Regular Users of the New Supermarket versus Others in the Intervention Neighborhood (Hill District)

Source/Notes: Authors' calculations / + Change is computed as difference between follow up and baseline; the results on nutrient levels and types of foods describe mean reported daily intakes; F&V = fruits and vegetables, WGP = whole grain products, and LFP = low-fat products.

EXHIBIT 4 (table)

Caption: Associations Between Changes in Select Food Purchasing Practices and Changes in Dietary Outcomes

Source/Notes: Authors' calculations / * $p < .05$; ** $p \leq .01$; *** $p \leq .001$.

EXHIBIT 1

Characteristics of PHRESH Study Participants at Baseline, May–December 2011

Characteristic	All Percent, Mean (SE) (n=831)	Intervention Percent, Mean (SE) (n=571)	Comparison Percent, Mean (SE) (n=260)
Race/Ethnicity (%)			
African American/black	95.2	94.7	96.1
Other	4.8	5.3	3.9
Mean age in years	53.3 (0.7)	53.1 (0.9)	53.7 (1.3)
Gender* (%)			
Female	75.0	77.4	69.8
Mean annual household income (USD)	13,608 (473)	13,147 (567)	14,620 (855)
Marital status (%)			
Married/living with partner	17.7	16.3	20.7
Never married	44.0	45.5	40.6
Widowed/divorced/separated	38.3	38.2	38.6
Educational attainment (%)			
Less than high school	13.4	14.7	10.8
High school diploma	36.5	38.2	32.7
Some college /technical school	35.4	33.5	39.5
College degree	14.7	13.7	17.0
Any children in household (%)	28.2	28.1	28.6
Mean years lived in the neighborhood ***	27.0 (0.8)	31.2 (1.1)	17.8 (1.1)
When buying food, how often go to: (%)			
Convenience stores	54.0	52.1	58.0
Neighborhood stores	45.1	44.7	45.9
Dollar stores	75.3	74.3	77.4
Discount grocery stores ***	59.9	52.9	75.3
Supercenters	78.2	77.8	79.1
Wholesale clubs	51.2	50.6	52.5
Specialty grocery stores	30.3	28.5	34.4
Full service supermarkets ***	99.1	99.8	97.3
Meat or seafood markets	75.5	76.5	73.1
Fruit and vegetable stores/farm stands	64.8	65.2	63.8
Drug stores**	47.5	51.2	39.2
Type of store for major food shopping (%)			
Full service supermarket **	74.1	77.2	67.3
Supercenter	12.2	11.5	13.8
Fruit and vegetable store/farm stand	0.5	0.4	0.6
Discount grocery store **	4.9	3.3	8.4
Wholesale club	3.1	2.7	3.9
Other ⁺	5.2	4.8	6.0
Transport to and from major food shopping store (%)			
Drive	38.9	37.0	43.0
Jitney	25.6	26.5	23.7
Public transportation	17.4	18.5	15.0
Get a ride	16.7	16.8	16.4
Other	1.5	1.2	2.0

SOURCE Authors' calculations. **NOTES** * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ⁺ Neighborhood store, Specialty grocery store, meat or seafood market.

Adjusted for attrition weights (Neighborhood, Gender, Age, Income below the federal poverty limit, Education, Kids in the Household, Marital status, Disability, Home ownership, Access to a Car, Self-rated health, Years lived in neighborhood, BMI, HEI, and interactions of neighborhood with covariates).

EXHIBIT 2

Change In Diet, Body Mass Index, Neighborhood Satisfaction and Perceived Access to Healthy Foods for Residents of Intervention and Comparison Neighborhoods, and Difference in Differences

Outcome	Intervention Neighborhood (Hill District)		Comparison Neighborhood (Homewood)		Difference-in-Differences
	Baseline (n=571)	Change ⁺ Mean (n=571)	Baseline (n=260)	Change ⁺ Mean (n=260)	Change ⁺ in HD - Change ⁺ in HW (n=831)
Dietary Quality (Healthy Eating Index-2010)	48.3	-0.39	48.6	-2.59**	2.20*
Total kilocalories	1727	-222***	1861	-44	-178**
Total fat as a percentage of total kilocalories (%)	36.3	0.35	36.6	0.51	-0.16
Added sugars in grams	14.3	-2.75***	15.1	0.58	-3.34**
Solid Fats, Alcohol and Added Sugars (SoFAAS) as a percentage of total kilocalories (%)	33.2	-1.38**	32.8	1.72**	-3.11**
Fruits and vegetables in servings	2.3	-0.27***	2.4	-0.13	-0.14
Whole grains in ounces	0.62	-0.08**	0.50	-0.03	-0.05
Body Mass Index	30.4	0.13	30.8	0.44**	-0.31
Overweight (%)	77.0	0.08	78.2	-1.42	1.50
Obese (%)	47.9	-1.52	49.3	0.34	-1.86
Neighborhood satisfaction (%)	66.6	13.8***	55.9	2.64	11.1**
Perceived access to healthy foods (%)					
F&V easily accessible	16.4	55.9***	22.3	5.1*	50.8***
F&V choice	10.2	56.2***	15.4	7.9**	48.4***
F&V quality	15.6	44.6***	19.3	5.4*	39.3***
F&V cost	17.2	31.0***	19.3	7.3**	23.6***
WGP easily accessible	18.5	52.6***	27.3	11.0**	41.6***
WGP choice	12.0	47.6***	14.5	12.1***	35.5***
WGP cost	16.4	37.2***	18.1	9.8**	27.4***
LFP easily accessible	17.2	54.6***	21.9	15.7***	38.8***
LFP choice	12.9	47.3***	13.4	14.0***	33.2***
LFP cost	14.0	38.8***	15.8	11.7***	27.1***

SOURCE Authors' calculations. **NOTES** * $p < 0.10$; ** $p < 0.05$; *** $p < 0.001$; ⁺ Change is computed as difference between follow up and baseline; the results on nutrient levels and types of foods describe mean reported daily intakes; HD = Hill District; HW = Homewood; F&V = fruits and vegetables, WGP = whole grain products, and LFP = low-fat products

EXHIBIT 3

Comparison of Regular Users of the New Supermarket versus Others in the Intervention Neighborhood (Hill District)

Outcome	Change⁺ Among Supermarket Users Mean (n=368)	Change⁺ Among Supermarket Non-Users Mean (n=171)	Significance Level
Dietary quality (Healthy Eating Index-2010)	-0.45	-0.20	
Total kilocalories	-260	-201	
Total fat as a percentage of total kilocalories (%)	0.00	1.08	
Added sugars in grams	-3.17	-2.37	
Solid fats, alcohol and added sugars (SoFAAS) as a percentage of total kilocalories (%)	-1.63	-2.04	
Fruits and vegetables in servings	-0.32	-0.11	
Whole grains in ounces	-0.06	-0.09	
Body Mass Index	0.01	0.16	
Overweight (%)	-0.28	0.73	
Obese (%)	-1.96	-2.98	
Neighborhood satisfaction (%)	13.86	5.14	
Perceived access to healthy foods (%)			
F&V easily accessible	59.8	48.5	*
F&V choice	59.4	48.7	*
F&V quality	47.1	41.2	
F&V cost	34.8	18.9	**
WGP easily accessible	57.8	47.0	*
WGP choice	50.7	43.7	
WGP cost	42.1	27.5	**
LFP easily accessible	63.0	44.7	**
LFP choice	54.5	38.2	**
LFP cost	43.4	28.4	**

SOURCE Authors' calculations. **NOTES** * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ⁺ Change is computed as difference between follow up and baseline; the results on nutrient levels and types of foods describe mean reported daily intakes; F&V = fruits and vegetables, WGP = whole grain products, and LFP = low-fat products.

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EXHIBIT 4

Associations Between Changes in Select Food Purchasing Practices and Changes in Dietary Outcomes

Survey Question	Change in HEI-2010 (Dietary Quality)	Change in Total Kcal	Change in Total Fat (percent of total Kcal)	Change in Added Sugars (grams)	Change in SoFAAS (percent of total Kcal)
	Beta	Beta	Beta	Beta	Beta
How often you shop for food	0.002	-0.067	0.004	-0.083	-0.041
Weekly per person expenditures for food	-0.010	0.054	0.001	0.003	0.012
When buying food, how often go to:					
Convenience stores	-0.011	-0.065	-0.002	0.024	0.032
Neighborhood stores	-0.011	0.010	0.028	-0.010	0.004
Dollar stores	-0.017	-0.006	0.086*	-0.022	-0.031
Discount grocery stores	0.066	0.062	0.014	0.009	-0.041
Supercenters	-0.004	-0.027	0.020	-0.052	-0.040
Wholesale clubs	-0.014	-0.001	0.059	-0.047	-0.004
Specialty grocery stores	-0.033	0.027	0.020	0.012	0.025
Full-service supermarket	-0.013	0.016	-0.028	0.041	-0.025
Meat or seafood markets	-0.018	0.023	0.012	0.027	0.022
Fruit and vegetable stores/farm stands	0.000	0.044	-0.023	-0.020	0.001
Drug stores	-0.024	0.005	-0.041	-0.017	-0.037

SOURCE Authors' calculations. NOTES *p < 0.05; ** p < 0.01; *** p < 0.001.

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3 APPENDIX EXHIBIT 1 (table)

4 Caption: Change In Diet, Body Mass Index, Neighborhood Satisfaction and Perceived Access to Healthy
5 Foods for Residents of Intervention and Comparison Neighborhoods, and Difference in Differences

6 Source/Notes: Authors' calculations / * $p < 0.10$; ** $p < 0.05$; *** $p < 0.001$; + Change is computed as
7 difference between follow up and baseline; the results on nutrient levels and types of foods describe
8 mean reported daily intakes; HD = Hill District; HW = Homewood; F&V = fruits and vegetables, WGP =
9 whole grain products, and LFP = low-fat products.
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12 APPENDIX EXHIBIT 2 (table)

13 Caption: Comparison of Regular Users of the New Supermarket versus Others in the Intervention
14 Neighborhood (Hill District)

15 Source/Notes: Authors' calculations / + Change is computed as difference between follow up and
16 baseline; the results on nutrient levels and types of foods describe mean reported daily intakes; F&V =
17 fruits and vegetables, WGP = whole grain products, and LFP = low-fat products.
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For Review Only

APPENDIX EXHIBIT 1

Change In Diet, Body Mass Index, Neighborhood Satisfaction and Perceived Access to Healthy Foods for Residents of Intervention and Comparison Neighborhoods, and Difference in Differences

Outcome	Intervention Neighborhood (Hill District)		Comparison Neighborhood (Homewood)		Difference-in-Differences
	Baseline (n=571)	Change ⁺ Mean (SE) (n=571)	Baseline (n=260)	Change ⁺ Mean (SE) (n=260)	Change ⁺ in HD - Change ⁺ in HW (n=831)
Dietary Quality (Healthy Eating Index-2010)	48.3 (0.59)	-0.39 (0.64)	48.6 (0.84)	-2.59 (0.92)**	2.20*
Total kilocalories	1727 (31)	-222 (32)***	1861 (53)	- 44 (51)	-178**
Total fat as a percentage of total kilocalories (%)	36.3 (0.36)	0.35 (0.44)	36.6 (0.51)	0.51 (0.67)	-0.16
Added sugars in grams	14.3 (0.47)	-2.75 (0.49)***	15.1 (0.82)	0.58 (0.92)	-3.34**
Solid Fats, Alcohol and Added Sugars (SoFAAS) as a percentage of total kilocalories (%)	33.2 (0.46)	-1.38 (0.56)**	32.8 (0.63)	1.72 (0.79)**	-3.11**
Fruits and vegetables in servings	2.3 (0.07)	-0.27 (0.08)***	2.4 (0.11)	-0.13 (0.12)	-0.14
Whole grains in ounces	0.62 (1.03)	-0.08 (0.04)**	0.50 (0.05)	-0.03 (0.06)	-0.05
Body Mass Index	30.4 (0.30)	0.13 (0.14)	30.8 (0.49)	0.44 (0.19)**	-0.31
Overweight (%)	77.0 (1.89)	0.08 (1.17)	78.2 (2.88)	-1.42 (1.44)	1.50
Obese (%)	47.9 (2.18)	-1.52 (1.53)	49.3 (3.33)	0.34 (2.14)	-1.86
Neighborhood satisfaction (%)	66.6 (0.02)	13.8 (2.3)***	55.9 (3.26)	2.64 (3.60)	11.1**
Perceived access to healthy foods (%)					
F&V easily accessible	16.4 (1.64)	55.9 (2.5)***	22.3 (2.81)	5.1 (3.0) *	50.8***
F&V choice	10.2 (1.27)	56.2 (2.4)***	15.4 (2.31)	7.9 (3.2)**	48.4***
F&V quality	15.6 (1.6)	44.6 (2.5)***	19.3 (2.57)	5.4 (3.1) *	39.3***
F&V cost	17.2 (1.66)	31.0 (2.8)***	19.3 (2.67)	7.3 (3.3)**	23.6***
WGP easily accessible	18.5 (1.74)	52.6 (2.4)***	27.3 (3.02)	11.0 (3.7)**	41.6***
WGP choice	12.0 (1.47)	47.6 (2.5)***	14.5 (2.35)	12.1 (3.2)***	35.5***
WGP cost	16.4 (1.67)	37.2 (2.5)***	18.1 (2.60)	9.8 (3.4)**	27.4***
LFP easily accessible	17.2 (1.71)	54.6 (2.45)***	21.9 (2.75)	15.7 (3.5)***	38.8***
LFP choice	12.9 (1.52)	47.3 (2.5)***	13.4 (2.22)	14.0 (3.1)***	33.2***
LFP cost	14.0 (1.55)	38.8 (2.45)***	15.8 (2.40)	11.7 (3.0)***	27.1***

SOURCE Authors' calculations. **NOTES** * $p < 0.10$; ** $p < 0.05$; *** $p < 0.001$; ⁺ Change is computed as difference between follow up and baseline; the results on nutrient levels and types of foods describe mean reported daily intakes; HD = Hill District; HW = Homewood; F&V = fruits and vegetables, WGP = whole grain products, and LFP = low-fat products

APPENDIX EXHIBIT 2

Comparison of Regular Users of the New Supermarket versus Others in the Intervention Neighborhood (Hill District)

Outcome	Change⁺ Among Supermarket Users Mean (SE) (n=368)	Change⁺ Among Supermarket Non-Users Mean (SE) (n=171)	Significance Level
Dietary quality (Healthy Eating Index-2010)	-0.45 (0.73)	-0.20 (1.17)	
Total kilocalories	-260 (38.82)	-201 (58.46)	
Total fat as a percentage of total kilocalories (%)	0.00 (0.55)	1.08 (0.84)	
Added sugars in grams	-3.17 (0.60)	-2.37 (0.95)	
Solid Fats, Alcohol and Added Sugars (SoFAAS) as a percentage of total kilocalories (%)	-1.63	-2.04 (1.08)	
Fruits and vegetables in servings	-0.32 (0.09)	-0.11 (0.24)	
Whole grains in ounces	-0.06 (0.05)	-0.09 (0.07)	
Body Mass Index	0.01 (0.16)	0.16 (0.27)	
Overweight (%)	-0.28 (1.61)	0.73 (2.39)	
Obese (%)	-1.96 (1.83)	-2.98 (2.68)	
Neighborhood satisfaction (%)	13.86 (2.55)	5.14 (4.60)	
Perceived access to healthy foods (%)			
F&V easily accessible	59.8 (2.94)	48.5 (4.75)	*
F&V choice	59.4 (2.94)	48.7 (4.27)	*
F&V quality	47.1 (3.11)	41.2 (4.30)	
F&V cost	34.8 (3.25)	18.9 (4.60)	**
WGP easily accessible	57.8 (2.94)	47.0 (4.44)	*
WGP choice	50.7 (3.07)	43.7 (4.32)	
WGP cost	42.1 (3.14)	27.5 (4.22)	**
LFP easily accessible	63.0 (2.72)	44.7 (4.61)	**
LFP choice	54.5 (2.93)	38.2 (4.50)	**
LFP cost	43.4 (2.93)	28.4 (4.47)	**

SOURCE Authors' calculations. **NOTES** * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ⁺ Change is computed as difference between follow up and baseline; the results on nutrient levels and types of foods describe mean reported daily intakes; F&V = fruits and vegetables, WGP = whole grain products, and LFP = low-fat products.