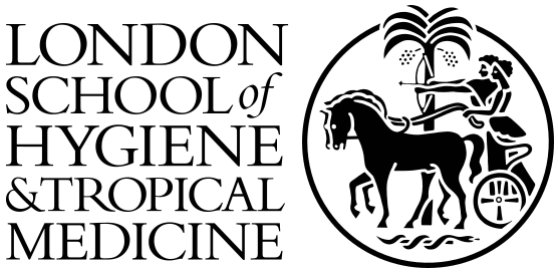

Published in final edited form as:
Health Aff (Millwood). 2014 February ; 33(2): 283–291. doi:10.1377/hlthaff.2013.0512.

New Neighborhood Grocery Store Increased Awareness Of Food Access But Did Not Alter Dietary Habits Or Obesity

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Abstract

Current national and local policies to improve diet in low-income US populations include increasing physical access to grocery stores and supermarkets in underserved neighbourhoods. Using a prospective controlled quasi-experimental design we evaluate the impact on Body Mass Index, fruit and vegetable intake and perceptions of food access, of increasing neighborhood supermarket provision in one community in Philadelphia. This increase in provision was one part of the wider public-private Pennsylvania Fresh Food Financing Initiative. The intervention moderately increased perceptions of food access, but did not lead to changes in fruit and vegetable intake or BMI. This suggests that a perception-action `gap' may exist. The effectiveness of interventions to improve physical access to food by encouraging supermarkets to locate in underserved areas therefore remains uncertain. Replication of findings in other settings is urgently required.

Background

Excess body weight is a major threat to health, driven primarily by associations with type 2 diabetes, cardiovascular disease and some cancers[1, 2]. The underlying cause for the recent and rapid increase in the population prevalence of obesity is thought to be environmental[3], with changes in the food system acting as one of the primary drivers for weight gain[4]. This suggests that population-level approaches to obesity prevention should include environmental interventions to reduce energy intake and improve diet quality as part of a wider population-level strategy to reduce overweight[5, 6].

Existing review evidence suggests that residing in African-American and low-income neighbourhoods, with poor access to healthy foods is an important risk factor for diet, particularly in the USA[7–10] thus food environment interventions are thought to hold potential as effective strategies for creating population-level improvements in eating

behaviour. On this basis, structural interventions to improve access to healthy foods in underserved areas form a major component of recent policy initiatives in the USA[11]. One major initiative is the $400 million Healthy Food Financing Initiative, a central component of a range of interventions promoted by the White House Task Force on Childhood Obesity *Lets Move!* campaign[12, 13]. Such interventions are based on the idea that encouraging supermarkets and grocery stores to open in underserved neighborhoods will translate into improvements in individual diet and lead to a reduction in diet-related health problems. These policy solutions are grounded in a long-standing and consistent observational American evidence base that suggests that lack of access to full-service grocery stores is associated with poor diet and an increased risk of chronic disease (including obesity)[8]. However evidence for the effectiveness of such built environment interventions is almost entirely absent[11, 14, 15], with no published formal experimental studies in the United States that directly test the impact of food retail development on food access, diet and diet-related diseases such as obesity. The only two published impact evaluations of food retail development interventions on fruit and vegetable intake were relatively small studies undertaken in low-income communities in Glasgow, Scotland and Leeds, England with mixed results[16–18]. The Leeds study reported an increase in fruit and vegetable consumption, especially for those with the lowest intakes at baseline, though this study lacked a control group. The Glasgow study, a controlled study, found no net increases in fruit and vegetable intake after allowing for changes in the control group.

The Healthy Food Financing Initiative is modelled on The Pennsylvania Fresh Food Financing Initiative, a similar public-private intervention aimed at encouraging the development of food supermarkets in underserved areas by providing grants and loans to defray the infrastructure costs of developing new grocery stores. This program has been viewed as a success, with 88 new or expanded fresh food retail projects developed, improving access to healthy food for an estimated 500 000 children and adults[19]. However, there has been no formal evaluation of its effectiveness in improving diet and reducing obesity.

This paper reports the results of a pilot study evaluating the impact of improving food access through increasing supermarket provision in a single low-income, predominately African-American community. The delivery of increased supermarket provision in this single community was part of the wider large-scale implementation of the Pennsylvania Fresh Food Financing Initiative which occurred in 88 locations cross the state. Effects on three outcomes were assessed; Body Mass Index (BMI), daily fruit and vegetable intake; and perceptions of food access.

METHODS

Study Design and Participants

A controlled before-and-after quasi-experimental longitudinal design was employed to collect data from a representative sample of residents of two Philadelphia neighborhoods. These neighborhoods - one intervention and one comparison - were matched on race/ethnicity, income and demographic profile and delineated by contiguous census tracts encompassing the main full-service food retail provision of each neighborhood.

Neighborhoods were 3 miles square and households were no more than 1.5 miles from existing full-service food retail provision in each area. Residents of the intervention neighborhood received new full-service food retail provision (one new 41,000 square foot grocery store) and were considered the intervention group. Residents of the comparison neighborhood did not receive new food retail provision from the scheme and were the comparison group. At baseline and follow-up the number of full-service grocery stores in the intervention and comparison neighbourhood were unchanged (full details are provided in Appendix 1[i]). The comparison neighborhood was located 3.2 miles from the intervention neighborhood to eliminate contamination.

The baseline consisted of a random directory-listed and random-digit dialled telephone survey of a representative sample of residents in each of the two neighborhoods. Baseline data collection occurred between June and September 2006, with individual follow-up June-November 2010. The supermarket was trading in December 2009, giving a minimum post-intervention period of 6 months before follow-up data were collected. To be eligible for the study at baseline households were required to be located in either of the two selected neighborhoods and to have one primary food shopper aged 18 or older residing within the home. Respondents received $20 for participation. The baseline sample comprised 1440 respondents, a response rate (RR) of 47.2 percent (intervention n=723, RR=47.4%; comparison n=717, RR=47%). At follow-up, 656 of the 1440 baseline residents across the two neighborhoods were present, a response rate of 45.5 percent (intervention n=311, RR 43.7%; comparison n=345, RR 48.9%). There were no significant differences in response rates and attrition between intervention and comparison neighbourhoods at both baseline and follow-up. Analyses presented here are based on sub-sets of the overall sample using a complete case approach for the outcomes and covariates of interest. Approval for the study was secured from Pennsylvania State University's Office of Research Protection (IRB #34283).

Outcome Measures and Covariates

Data on three primary outcomes were collected; BMI, fruit and vegetable intake and perceptions of food access. Body mass index was calculated using the standard equation (BMI; weight (kg)/height2 (m2)) based on self-reported height and weight, and used as a continuous measure. Mean fruit and vegetable intake was assessed using the Block Food Frequency Questionnaire[20, 21]. This tool captured the consumption of 10 fruits and 12 vegetables over the past month. Standardized algorithms were used to compute total daily fruit and vegetable intake[22]. The Block Food Frequency Questionnaire has good concurrent validity when compared with dietary records[23]. Consistent with past research, and to limit the influence of outliers, the tool was truncated at 15 items per day[24]. Perceptions of food access were assessed using a five-item scale capturing the extent to which the respondent considered grocery stores, and the fruit and vegetables sold in their neighborhood, to be expensive, of good quality, and of sufficient variety. Possible values ranged from 5 to 25, with higher values representing better access. Only respondents who completed all five items were received a summary score. The five individual scale items were also investigated as outcomes. See Appendix 1[i] for further details.

Covariates included age (in years), sex, self-identified race/ethnicity (white, black, Hispanic or other), presence of children under 12 in the household (yes/no), household income (greater/less than $40,000 per year), completed secondary education (yes/no), employment status (employed, unemployed, inactive) and mode of transport for food shopping (private/public transport).

Statistical analyses

Change between intervention and comparison conditions were estimated using difference-in-differences on an intention to treat and adopters versus non-adopters basis. Here intention-to-treat analyses suggest a community-level effect, whereas adopters versus non-adopters analyses focuses on the direct impact on those who used the new food retail provision. A statistically significant difference-in-differences value shows that the rate of change over time in the outcome variable is different between the intervention and control groups, indicating an intervention effect. Analyses were performed using the DIFF module[25] in Stata 12[26]. Results of three sets of analyses undertaken for each outcome (BMI, daily fruit and vegetable intake, and perceptions of food access) are reported. In the event of a statistically significant difference-in-differences value ($P<0.05$), we adjusted for age, sex, race/ethnicity, presence of children, household income, education, employment status, and mode of transport. Mean values and p-values for each outcome, for each of the three analyses, are reported. A full description of the enrolment procedures and analytical approach is provided in Appendix 1[i].

Limitations

The study has important limitations. It is a pilot study in one intervention community, with samples that were not large, and pre-dominantly African-American - though this group are considered the most at risk. However the sample was representative of the resident population, which has high proportions of university students and established older retired persons. The longitudinal design means the study sample will be older than the general population at follow-up as enroled study members will have lived in our study sites for four further years. The composition of the study sample means that generalizability of findings to other settings with different socio-demographic profiles may be limited. The study may underpowered, particularly for adopters versus non-adopters analyses (see Appendix 1[i] for further details) which lessens our ability to make robust statements about effectiveness. This has implications for the design of future studies - sample size calculations should *not* be undertaken on an intention-to-treat basis but should consider the likely rate of adoption of the intervention in the exposed community. Delays of three years with store construction generated a significant gap between baseline and follow-up. The influence of other unknown interventions that may be associated with our outcomes cannot be ruled out. Food buying habits and BMI may be slow to change, thus the short follow-up period may limit our ability to detect an intervention effect. The Block Food Frequency Questionnaire may not include all culturally relevant foods for the study population [36] and self-reported BMI may be prone to systematic error[37], though has been validated for use in adults[38, 39]. Future research should also investigate all components of diet, rather than just fruit and vegetable intake.

RESULTS

A condensed description of the samples are provided in Exhibit 1 below, with a full description provided in the Appendix 2 Exhibit 1[i].

The samples were predominately female, black, educated to high-school level, and either unemployed or economically inactive with an annual household income of less than $40,000. No significant differences (z-tests) exist between the socioeconomic and demographic characteristics of the overall sample of respondents present at baseline and follow-up, and sub-samples of these respondents used to model each of the three outcomes. This suggests that imputation was unnecessary.

Forty-seven percent of the overall sample resided in the intervention area and this was mirrored across sub-samples. The proportion of intervention area residents who adopted the new supermarket provision was low, especially for those using the new provision as their food primary shopping destination (26.7%). Just over half of all intervention area residents used the new provision for any food shopping (51.4%). No resident of the comparison area reported using the new provision in the intervention area, that meaning that contamination of the comparison sample did not occur.

Intention-to-treat analyses

Difference-in-differences estimates for BMI, daily fruit and vegetable intake, and perceptions of food access, in intention to treat analyses, are shown in Exhibit 2.

There were no statistically significant difference in differences for BMI (DID=−0.46, P=0.56) and daily fruit and vegetable intake (DID=−0.05, P=0.84) in unadjusted analyses. For perceptions of food access a statistically significant improvement in the summary score (DID 1.47, P=0.004) and for each of the five individual scale items was found, which persisted after adjustment for covariates. For individual scale items there were improvements in perceptions of grocer choice (DID=0.58, P<0.001), grocer quality (DID=0.48, P=0.001), fruit and vegetable choice (DID=0.40, P=0.006), fruit and vegetable quality (DID=0.33, P=0.02) and a decrease in the perceived cost of fruit and vegetables (DID=−0.31, P=0.02).

Adopters versus non-adopters analysis

Exhibit 3 shows difference-in-difference estimates for the three outcomes in for those who adopted the new supermarket as their main food store versus those that did not.

For unadjusted analyses of primary adopters (those using the grocery store for their main food shopping) there were no statistically significant improvements as a result of the new supermarket for BMI (DID=−0.61, P=0.60), daily fruit and vegetable intake (DID=0.28, P=0.47) and for perceptions of food access (DID=1.31, P=0.98). For individual items in the scale only perceptions of fruit and vegetable choice showed a statistically significant improvement (DID=0.58, P=0.01), which was attenuated but remained significant after adjustment for covariates (DID=0.49, P=0.03).

Exhibit 4 shows difference-in-differences estimates for the three outcomes for those who adopted the new supermarket for any secondary or top-up shopping versus those who did not.

In unadjusted analyses of secondary adopters (those using the grocery store for any food shopping) there were no statistically significant improvements as a result of new supermarket provision for BMI (DID=−0.32, P=0.72) and daily fruit and vegetable intake (DID=0.23, P=0.45). Similar to the earlier intention to treat analysis, after adjustment for covariates, there was statistically significant improvement in overall perception of food access (DID=2.05, P=0.001) and for each of the scale items. For individual food access scale items there were improvements in perceptions of grocer choice (DID=0.67, P<0.001), grocer quality (DID=0.72, P<0.001), fruit and vegetable choice (DID=0.65, P<0.001), fruit and vegetable quality (DID=0.50, P=0.003) and a decrease in the perceived the cost of fruit and vegetables (DID=−0.49, P=0.002).

DISCUSSION

In summary, few residents adopted the new provision as their primary food shop, and exposure to increased provision had no statistically significant impact on BMI and daily fruit and vegetable intake at six-months. However, the increase in provision appeared to have a positive impact on perceptions of food access in the intervention neighborhood in intention-to-treat analyses, and for residents of the intervention neighborhood who reported adopting the new provision for any food purchasing. No impacts on perceptions of food access were detected for residents who reported using the new provision as their primary food shop. Though improvements in perceptions in food access were found, arguably the first step on the hypothesised causal pathway, these improvements did not translate into significant changes in daily fruit and vegetable intake or BMI.

Two UK studies have undertaken impact evaluations of similar interventions. One un-controlled before-and-after study in Leeds, reported improvements in fruit and vegetable intake, with the largest impacts seen amongst those with the lowest baseline intakes[16]. The second study, a controlled before and after quasi-experimental study undertaken in Glasgow, found no evidence for any effect on consumption patterns[17, 18, 32]. The findings reported here mirror the only previously reported controlled impact evaluations. The results presented here are somewhat at odds with early findings from observational US studies that reported strong links between poor access to supermarkets and grocery stores and poor diet[33]. Though current cross-sectional observational work continues to supports a role for the neighbourhood food environment on diet and obesity[34], a small but growing body of work using longitudinal designs and larger samples, suggests poor access to food retail environments may not necessarily be always associated with poor diet and obesity in children[35, 36] and adults[37, 38, 39, 40]. This latter work may provide support for the findings presented here.

Relatively few residents adopted the new provision as their primary food store. This indicates that simply providing new food retail infrastructure is insufficient to encourage the adoption of the new food supermarket as the main food shopping resource and

complementary initiatives to encourage the adoption of the new provision are therefore required. Previous work has identified barriers to change including preference for existing food retailing, worries about how increased choice would impact on household food budgets, community resistance, and access to informal credit for food shopping in existing provision[32]. Here the land on which the intervention is located is community owned and operated[41]. At planning and consultation stage the community actively indicated their preference for a new food supermarket indicating readiness to adopt the new provision and thus potentially ameliorating these barriers to change. Given the limited uptake of new provision in the intervention neighbourhood despite active community buy-in, further investigation of the factors that may facilitate community uptake of supermarket programmes should be undertaken.

The Philadelphia Food Financing Initiative is a relatively simple intervention, aimed at stimulating supermarket development in order to increase access to larger-scale full-service retail infrastructure. It is generally assumed that more provision is `better' and will automatically offer more choice, at a more reasonable cost, to local residents therefore providing an incentive to change purchasing and consumption habits[19]. However this assumption may be unrealistic if the price and availability of food *within* stores is not sufficiently different to stimulate a change in food shopping behaviour despite improvements in perceptions of food access. The implications for policy of the findings reported suggest that simply building new retail infrastructure, in itself, may not be sufficient to promote behaviour change related to diet. Rather, as Morland[42] suggests, a focus on business factors such as having a locally appropriate pricing structure, effective marketing and branding, and a clear stock policy are important if food retail interventions are to be successful. This suggests that the development of new food retail provision is unlikely to have an effect on food purchasing patterns unless combined with initiatives focused on price and availability that may help bridge this perception-action `gap'. Such actions may usefully be supported by local departments of health in order to increase the effectiveness of these interventions.

Though the effectiveness of an intervention aimed at increasing supermarket provision is uncertain in the present study, changes in outcomes in adopters versus non-adopters analyses reported here still show that the direction of change is positive indicating that these interventions may have some utility. Systematic reviews of intensive individually focused behavioral interventions to increase fruit and vegetable intake have reported mean increases of 0.6 to 1.13 portions per day[43, 44]. Though the observed changes of between 0.23–0.28 portions per day are lower than this, and not statistically significant, this may partly be attributable to the low study power available for these analyses. If such positive changes to fruit and vegetable consumption could be replicated at the population level this may have encouraging prospects for the prevention of disease[45]. For BMI, it is perhaps not unsurprising that we do not see significant changes due to issues of lag - the follow-up period may be too short to detect changes in BMI. Remaining uncertainties suggest that these findings urgently require confirmatory studies, with longer follow-ups, in other locations and populations.

CONCLUSION

Despite two decades of research describing the negative impact of poor quality neighborhood food environments on food access, diet, and obesity; experimental or quasi-experimental studies of interventions designed to address these environmental risks are still rare and have not been undertaken in the USA. Nevertheless, policymakers and non-governmental organisations have implemented policies and programs aimed at ameliorating the environmental determinants of diet despite this lack of evidence of effectiveness. In addition to the White House Task Force on Obesity's Healthy Food Financing Initiative (and the Pennsylvania Fresh Food Financing Initiative on which it is modelled) other schemes such as The New York City FRESH (Food Retail Expansion Health) program[46] continue to be rolled out in urban areas across the USA. The assumption is that by encouraging the location of commercial food retailing in low-income and underserved neighborhoods, health will improve by increasing access to, and therefore consumption of, components of a healthy diet. This study, the first controlled study undertaken in the USA, suggests that though such schemes may improve perceptions of food access, they may be less effective in changing diet and reducing obesity. Though replication of these findings in other settings is a priority, a consideration of complementary policies and interventions that may help consumers bridge the perception-action `gap' such as food shopping and cooking skills programs, price promotions, in-store stocking policies, food and drink taxes and subsidies, and increasing the availability of components of a healthy diet in commercial settings other than supermarkets, such as markets and community food programs, is also required.

TECHNICAL APPENDIX

Appendix 1: Methods

1. Food retail environment at baseline and follow-up

The number of full service stores in the comparison neighbourhood remained unchanged (n=3), though one store closed and another opened in another location, and the number of convenience stores reduced (baseline: n=56; follow-up: n=53). In the intervention neighborhood the number of full service grocery stores at baseline (n=2) increased by one (the intervention store) and the number of convenience stores increased by six (baseline n=55; follow-up n=61).

2. Study enrolment procedures

Respondents were initially contacted with a pre-notification letter along with a cash incentive of $1. Following the pre-notification letter, a computer assisted telephone interview (CATI) administered by the Penn State Survey Research Centre was completed by the primary household food shopper. A maximum of ten initial attempts to contact respondents were made. Once contact was established a maximum of twenty attempts were made to complete a scheduled interview.

3. Perceptions of food access question

Scale items were: quality of fruits and vegetables available in the neighborhood; choice of fruits and vegetables available in the neighborhood; expense of fruits and vegetables in the neighborhood; quality of local grocery stores in the neighborhood and choice of local grocery stores in the neighborhood. For each item, five possible responses were available (1=strongly agree, 2=agree; 3=neither agree nor disagree; 4=disagree, 5=strongly disagree). For ease of interpretation, these five variables were reverse-coded (with the exception of `expense') and summed to create a single continuous summary variable.

4. Analytical procedure

A difference-in-differences (DID) approach adjusts for underlying or secular trends affecting both intervention and control groups. Firstly, the difference between the mean values for the intervention and control groups at baseline is calculated. Secondly, the difference between the mean values for these groups at follow-up is calculated. Finally, the difference between these two differences is calculated. T-tests are performed to assess the statistical significance of these values.

Here we undertook three sets of analyses. Firstly, an intention-to-treat analysis compared mean outcome values between the intervention and control groups. Secondly, an adopters versus non-adopters analysis compared mean outcome values between the primary adopters (defined as those who switched to using the new grocery store for their main food shopping) and the rest of the sample. Finally, an adopters versus non-adopters analysis compared mean outcome values between secondary adopters (defined as those who switched to use the new grocery store for any food shopping) and the rest of the sample.

5. Limitations – study power

The study was originally powered to detect a ten percentage point change in daily fruit and vegetable consumption with 90 percent power to detect 95 percent significance, requiring a minimum n=437 per neighbourhood at follow-up. This was not achieved suggesting our study may be underpowered. However, with the sample available, the study is powered to detect, on an intention-to-treat basis, an eleven to twelve percentage point change with 80 percent power to detect 95 percent significance.

Appendix

Appendix 2

Exhibit 1 Full descriptive characteristic of analytical samples in the study

	All	Sub-samples (by outcome)		
		BMI	Fruit & Vegetable Intake	Perceptions of Food Access
Eligible Samples				
Sample size, n:	656	619	625	539

	All		Sub-samples (by outcome)					
			BMI		Fruit & Vegetable Intake		Perceptions of Food Access	
Resident in intervention area, n (%)	311 (47)		294 (47)		294 (47)		247 (46)	
Adopted intervention as main store, n (%)	83 (13)		80 (13)		79 (13)		64 (12)	
Adopted intervention as secondary store, n (%)	160 (24)		152 (25)		153 (24)		128 (24)	
Baseline sample characteristics	**Contr**	**Int**	**Contr**	**Int**	**Contr**	**Int**	**Contr**	**Int**
Gender (%)								
Male	67 (19)	67 (22)	67 (21)	65 (22)	63 (19)	60 (20)	60 (21)	55 (22)
Female	277 (80)	244 (78)	257 (79)	229 (78)	267 (81)	234 (80)	232 (79)	192 (78)
Missing	1 (0)	0 (0)	1 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)
Age in years								
Mean (SD)	52.7 (14)	54.2 (16)	53.6 (13)	54.9 (16)	52.7 (14)	54.2 (16)	52.0 (13)	53.5 (15)
Missing (%)	4 (1)	4 (1)	3 (1)	4 (1)	4 (1)	4 (1)	0 (0)	0 (0)
Race/Ethnicity (%)								
Black	283 (82)	268 (86)	269 (83)	253 (86)	270 (82)	254 (86)	242 (83)	219 (89)
White	43 (12)	13 (4)	41 (13)	13 (4)	42 (13)	12 (4)	37 (13)	12 (5)
Hispanic	7 (2)	6 (2)	6 (2)	5 (2)	7 (2)	6 (2)	6 (2)	4 (2)
Other	7 (2)	16 (5)	6 (2)	16 (5)	7 (2)	16 (5)	7 (2)	12 (5)
Missing	5 (1)	8 (3)	3 (1)	7 (2)	5 (2)	6 (2)	0 (0)	0 (0)
Household income (%)								
<$40,000 per year	210 (61)	207 (67)	197 (61)	196 (67)	199 (60)	195 (66)	188 (64)	172 (70)
>$40,000 per year	112 (32)	88 (28)	106 (33)	85 (29)	110 (33)	85 (29)	104 (36)	75 (30)
Missing	23 (7)	16 (5)	22 (7)	13 (4)	22 (7)	14 (5)	0 (0)	0 (0)
High school graduate (%)								
Yes	297 (86)	260 (84)	277 (85)	247 (84)	288 (87)	249 (85)	251 (86)	216 (87)
No	48 (14)	50 (16)	48 (15)	47 (16)	43 (13)	44 (15)	41 (14)	31 (13)
Missing	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Labour market status (%)								
Employed	164 (48)	134 (43)	155 (48)	127 (43)	160 (48)	131 (45)	144 (49)	119 (48)
Unemployed	35 (10)	34 (11)	30 (9)	33 (11)	34 (10)	33 (11)	33 (11)	26 (11)
Inactive	145 (42)	142 (46)	139 (43)	134 (46)	136 (41)	129 (44)	115 (39)	102 (41)
Missing	1 (0)	1 (0)	1 (0)	0 (0)	1 (0)	1 (0)	0 (0)	0 (0)
Children under 12 in household (%)								
Yes	80 (23)	68 (22)	73 (22)	66 (22)	79 (24)	68 (23)	74 (25)	61 (25)
No	265 (77)	243 (78)	252 (78)	228 (78)	252 (76)	226 (77)	218 (75)	186 (75)

	All		Sub-samples (by outcome)					
			BMI		Fruit & Vegetable Intake		Perceptions of Food Access	
Missing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Public transport for food shopping (%)								
Yes	71 (21)	86 (28)	67 (21)	82 (28)	66 (20)	82 (28)	55 (19)	67 (27)
No	274 (79)	225 (72)	258 (79)	212 (72)	265 (80)	212 (72)	237 (81)	180 (73)
Missing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Has own car for food shopping (%)								
Yes	190 (55)	141 (45)	178 (55)	135 (46)	186 (56)	132 (45)	164 (56)	115 (47)
No	155 (45)	170 (55)	147 (45)	159 (54)	145 (44)	162 (55)	128 (44)	132 (53)
Missing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Walks for food shopping (%)								
Yes	47 (14)	36 (12)	45 (14)	33 (11)	45 (14)	34 (12)	42 (14)	32 (13)
No	298 (86)	275 (88)	280 (86)	261 (89)	286 (86)	260 (88)	250 (86)	215 (87)
Missing	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Outcomes at baseline and follow-up	**Contr**	**Int**	**Contr**	**Int**	**Contr**	**Int**	**Contr**	**Int**
BMI								
Baseline mean (SD)	29.2 (7)	30.1 (7)	29.1 (7)	30.1 (7)	29.2 (7)	30.1 (7)	29.2 (7)	30.4 (7)
Missing (%)	12 (4)	4 (1)	0 (0)	0 (0)	12 (4)	4 (1)	11 (4)	2 (1)
Follow-up mean (SD)	29.6 (7)	30.1 (7)	29.5 (7)	30.1 (7)	29.6 (7)	30.1 (7)	29.5 (7)	30.3 (7)
Missing (%)	11 (3)	12 (4)	0 (0)	0 (0)	11 (3)	12 (4)	9 (3)	8 (3)
Daily F&V Intake								
Baseline mean (SD)	3.7 (2)	3.5 (3)	3.7 (2)	3.5 (3)	3.7 (2)	3.5 (3)	3.7 (2)	3.6 (3)
Missing (%)	0 (0)	0 (0)	9 (3)	5 (2)	0 (0)	0 (0)	5 (2)	4 (2)
Follow-up mean (SD)	3.5 (2)	3.3 (2)	3.5 (2)	3.3 (2)	3.5 (2)	3.3 (2)	3.5 (2)	3.3 (2)
Missing (%)	0 (0)	0 (0)	4 (1)	8 (3)	0 (0)	0 (0)	2 (1)	4 (2)
Perceptions of food access (summary scale)								
Baseline mean (SD)								
Missing (%)	14.8 (4)	13.7 (4)	14.9 (4)	13.7 (4)	14.8 (4)	13.7 (4)	14.8 (4)	13.6 (4)
Follow-up mean (SD)	7 (2)	14 (5)	10 (3)	15 (5)	7 (2)	14 (5)	0 (0)	0 (0)
Missing (%)	15.6 (4)	15.9 (4)	15.7 (4)	15.9 (4)	15.6 (4)	15.9 (4)	15.5 (4)	16.0 (4)
	8 (2)	12 (4)	11 (3)	14 (5)	8 (2)	12 (4)	0 (0)	0 (0)
Perceptions of food access (separate dimensions):								
Good choice of different types of grocery stores in neighborhood								
Baseline mean (SD)	2.8 (1)	2.3 (1)	2.8 (1)	2.3 (1)	2.8 (1)	2.3 (1)	2.8 (1)	2.3 (1)

	All		Sub-samples (by outcome)					
			BMI		Fruit & Vegetable Intake		Perceptions of Food Access	
Missing (%)	1 (0)	0 (0)	1 (0)	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)
Follow-up mean (SD)	3.1 (1)	3.0 (1)	3.1 (1)	3.0 (1)	3.1 (1)	3.1 (1)	3.1 (1)	3.1 (1)
Missing (%)	2 (1)	6 (2)	1 (0)	4 (1)	1 (0)	3 (1)	0 (0)	0 (0)
Quality of grocery stores in neighborhood is good								
Baseline mean (SD)	3.0 (1)	2.8 (1)	3.0 (1)	2.8 (1)	3.0 (1)	2.8 (1)	3.0 (1)	2.8 (1)
Missing (%)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	0 (0)	0 (0)
Follow-up mean (SD)	3.3 (1)	3.5 (1)	3.3 (1)	3.5 (1)	3.3 (1)	3.5 (1)	3.3 (1)	3.5 (1)
Missing (%)	5 (1)	5 (2)	4 (1)	3 (1)	2 (1)	3 (1)	0 (0)	0 (0)
Choice of fresh fruit and vegetables to purchase in neighbourhood is good								
Baseline mean (SD)	3.3 (1)	3.0 (1)	3.3 (1)	2.9 (1)	3.3 (1)	2.9 (1)	3.3 (1)	3.0 (1)
Missing (%)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	0 (0)	0 (0)
Follow-up mean (SD)	3.4 (1)	3.5 (1)	3.4 (1)	3.5 (1)	3.1 (1)	3.5 (1)	3.4 (1)	3.5 (1)
Missing (%)	6 (2)	2 (1)	5 (2)	1 (0)	3 (1)	1 (0)	0 (0)	0 (0)
Quality of fresh fruit and vegetables to purchase in neighbourhood is good								
Baseline mean (SD)	3.3 (1)	3.0 (1)	3.3 (1)	3.0 (1)	3.3 (1)	3.0 (1)	3.3 (1)	3.0 (1)
Missing (%)	3 (1)	4 (1)	3 (1)	3 (1)	1 (0)	2 (1)	0 (0)	0 (0)
Follow-up mean (SD)	3.4 (1)	3.5 (1)	3.4 (1)	3.5 (1)	3.5 (1)	3.5 (1)	3.4 (1)	3.5 (1)
Missing (%)	3 (1)	2 (1)	2 (1)	1 (0)	1 (0)	1 (0)	0 (0)	0 (0)
Fresh fruit and vegetables in neighbourhood are expensive								
Baseline mean (SD)	2.4 (1)	2.6 (1)	2.4 (1)	2.6 (1)	2.4 (1)	2.6 (1)	2.4 (1)	2.6 (1)
Missing (%)	6 (2)	13 (4)	6 (2)	13 (4)	5 (2)	12 (4)	0 (0)	0 (0)
Follow-up mean (SD)	2.3 (1)	2.3 (1)	2.4 (1)	2.3 (1)	2.4 (1)	2.3 (1)	2.4 (1)	2.3 (1)
Missing (%)	8 (2)	10 (3)	7 (2)	8 (3)	7 (2)	7 (2)	0 (0)	0 (0)

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Exhibit 1

Characteristics of analytical samples in the study by all participants and by outcome specific sub-samples

	All	Sub-samples (by outcome)		
		BMI	Fruit & Vegetable Intake	Perceptions of Food Access
Eligible Samples				
Sample size, n:	656	619	625	539
Resident in area with new supermarket, n (%)	311 (47)	294 (47)	294 (47)	247 (46)
Adopted new supermarket as main store, n (%)	83 (13)	80 (13)	79 (13)	64 (12)
Adopted new supermarket as secondary store, n (%)	160 (24)	152 (25)	153 (24)	128 (24)
Baseline sample characteristics				
Gender (%)				
Male	134 (20)	132 (21)	123 (20)	115 (21)
Female	521 (79)	486 (79)	501 (80)	424 (79)
Missing	1 (0)	1 (0)	1 (0)	0 (0)
Age in years				
Mean (SD)	54 (14.8)	54 (14.5)	53 (14.5)	53 (14.2)
Missing (%)	8 (1)	7 (1)	8 (1)	0 (0)
Race/Ethnicity (%)				
Black	551 (84)	522 (84)	524 (84)	461 (86)
White	56 (9)	54 (9)	54 (9)	49 (9)
Hispanic	13 (2)	11 (2)	13 (2)	10 (2)
Other	23 (4)	22 (4)	23 (4)	19 (4)
Missing	13 (2)	10 (2)	11 (2)	0 (0)
Household income %				
	417 (64)	393 (63)	394 (63)	360 (67)
<$40,000 per year	200 (30)	191 (31)	195 (31)	179 (33)
>$40,000 per year	39 (6)	35 (6)	36 (6)	0 (0)
Missing				
High school graduate (%)				
Yes	557 (85)	524 (85)	537 (86)	467 (87)
No	98 (15)	95 (15)	87 (14)	72 (13)
Missing	1 (0)	0 (0)	1 (0)	0 (0)
Labour market status (%)				
Employed	298 (45)	282 (46)	291 (47)	263 (49)
Unemployed	69 (11)	63 (10)	67 (11)	59 (11)

	All	Sub-samples (by outcome)		
		BMI	Fruit & Vegetable Intake	Perceptions of Food Access
Inactive	287 (44)	273 (44)	265 (42)	217 (40)
Missing	2 (0)	1 (0)	2 (0)	0 (0)
Children under 12 in household (%)				
Yes	148 (23)	139 (22)	147 (24)	135 (25)
No	508 (77)	480 (78)	478 (76)	404 (75)
Missing	0 (0)	0 (0)	0 (0)	0 (0)
Public transport for food shopping (%)				
Yes	157 (24)	149	148	122
No	499 (76)	470 (76)	477 (76)	417 (77)
Missing	0 (0)	0 (0)	0 (0)	0 (0)
Outcomes				
BMI[a], Daily F&V Intake[b], Perceptions of food access:, baseline mean value (SD)	-	29.5 (6.9)	3.6 (2.4)	14.2 (4.2)

Authors calculations based on analytical data

[a] Body Mass Index,

[b] Daily Fruit & Vegetable Intake;

Exhibit 2

Intention-to-treat analyses for BMI, fruit and vegetable intake, perceptions of food access

	Baseline	Follow-up	Difference-in-Difference (Unadjusted)	
	Difference between New Supermarket Neighborhood and Non New Supermarket Neighborhood (Unadjusted)	**Difference between New Supermarket Neighborhood and Non New Supermarket Neighborhood (Unadjusted)**	**Unadjusted**	**Adjusted**
BMI[a]	1.00	0.54	−0.46[ns]	-
Fruit and vegetable intake	−0.16	−0.21	−0.05[ns]	-
Perceptions of food access	−1.12	0.40	1.52[**]	1.47[**]
Grocer Choice	−0.57	0.004	0.58[***]	0.57[***]
Grocer Quality	−0.21	0.28	0.49[***]	0.48[***]
F&V Choice[b]	−0.30	0.12	0.42[***]	0.40[**]
F&V Quality[b]	−0.25	0.09	0.34[*]	0.33[*]
F&V Expense[b]	0.21	−0.09	−0.30[*]	−0.31[*]

[ns]not statistically significant

Authors calculation based on analytical data. Adjusted analyses controlled for: age, sex, race/ethnicity, presence of children, household income, education, employment status, and mode of transport

[a]Body Mass Index,

[b]Fruit & Vegetable

[***]$P \leq 0.001$

[**]$P \leq 0.01$

[*]$P \leq 0.05$

Exhibit 3

Primary adopters versus non-adopters analysis for BMI, fruit and vegetable intake, perceptions of food access

	Baseline	Follow-up	Difference-in-Difference	
	Difference between adopters of the new supermarket as their primary store and non adopters (Unadjusted)	Difference between adopters of the new supermarket as their primary store and non adopters (Unadjusted)	Unadjusted	Adjusted
BMI[a]	1.34	0.72	−0.61[ns]	-
Fruit and vegetable intake	−0.58	−0.30	0.28[ns]	-
Perceptions of food access	−0.38	0.93	1.31[ns]	1.00[ns]
Grocer Choice	−0.46	−0.19	0.27[ns]	0.22[ns]
Grocer Quality	0.02	0.41	0.39[ns]	0.31[ns]
F&V Choice[b]	−0.20	0.38	0.58[**]	0.49[*]
F&V Quality[b]	−0.08	0.27	0.34[ns]	0.25[ns]
F&V Expense[b]	0.33	0.07	−0.27[ns]	−0.27[ns]

[ns]not statistically significant

Authors calculation based on analytical data. Adjusted analyses controlled for: age, sex race/ethnicity, presence of children, household income, education, employment status, and mode of transport

[a]Body Mass Index,

[b]Fruit & Vegetable

[***] $P \leq 0.001$

[**] $P \leq 0.01$

[*] $P \leq 0.05$

Table 4

Secondary adopters versus non-adopters analysis for BMI, fruit and vegetable intake, perceptions of food access

	Baseline	Follow-up	Difference-in-Difference	
	Difference between those who adopted the new supermarket as their secondary store and non-adopters (Unadjusted)	Difference between those who adopted the new supermarket as their secondary store and non-adopters (Unadjusted)	Unadjusted	Adjusted
BMI[a]	1.07	0.75	-0.32^{ns}	-
Fruit and vegetable intake	−0.32	−0.10	0.23^{ns}	-
Perceptions of food access	−0.81	1.24	2.22^{***}	2.05^{***}
Grocer Choice	−0.64	0.06	0.70^{***}	0.67^{***}
Grocer Quality	−0.24	0.515	0.76^{***}	0.72^{***}
F&V Choice[b]	−0.27	0.429	0.70^{***}	0.65^{***}
F&V Quality[b]	−0.20	0.35	0.55^{***}	0.50^{**}
F&V Expense[b]	0.32	−0.16	-0.48^{**}	-0.49^{**}

Authors calculation based on analytical data. Adjusted analyses controlled for: age, sex, race/ethnicity, presence of children, household income, education, employment status, and mode of transport

[a] Body Mass Index,

[b] Fruit & Vegetable

*** $P \leq 0.001$

** $P \leq 0.01$

* $P \leq 0.05$ ns not statistically significant