Preventive Medicine Reports 2 (2015) 164–169

Contents lists available at ScienceDirect

Preventive Medicine Reports

journal homepage: http://ees.elsevier.com/pmedr

Examining food purchasing patterns from sales data at a full-service grocery store intervention in a former food desert

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ARTICLE INFO

Available online 2 March 2015

Keywords:
Food environment
Population health intervention
Sales data

ABSTRACT

Background. The Good Food Junction Grocery Store was opened in a former food desert in the inner city of Saskatoon, Canada.

Objective. The purpose of this research was to examine, using grocery store sales data, healthy and less healthful food purchasing over a one-year period beginning eight months after opening by shoppers' neighborhood of residence.

Design. A multilevel cross sectional design was used. The sample consisted of members of the Good Food Junction with a valid address in Saskatoon, Saskatchewan. All purchases made by members who reported their postal code of residence from May 15, 2013 to April 30, 2014 were analyzed. The outcome variable was the total amount spent on foods in 11 food groups. Linear random intercept models with three levels were fit to the data.

Results. Shoppers who were residents of former food desert neighborhoods spent $0.7 (95% CI: 0.2 to 1.2) more on vegetables, and $1.2 (95% CI: −1.8 to −0.6) less on meat, and $1.1 (95% CI: −2.0 to −0.3) less on prepared foods than shoppers who did not reside in those neighborhoods.

Conclusions. When given geographical access to healthy food, people living in disadvantaged former food desert neighborhoods will take advantage of that access.

Introduction

Presence and accessibility of supermarkets and grocery stores have been linked to improved fruit and vegetable consumption (Larson et al., 2009), general improvement in healthier food intake (Story et al., 2008), and lower body weight (Morland et al., 2006). Evidence is growing that suggests that food deserts are especially problematic when they coincide with public or private transportation deficiencies (Clifton, 2004; Bodor et al., 2008). Food deserts constrain decision-making around food purchase choices, influencing what become normative less healthful food choices (Mader and Busse, 2011; Gittelsohn et al., 2008; Walker et al., 2010). Awareness of the importance of the food environment in influencing positive or negative health outcomes has sparked interest in developing grocery stores and piloting various food-related interventions in deprived areas.

An emerging literature is leading a shift from merely description of food environments to the study of food environment interventions at various scales (Gittelsohn et al., 2012; Cummins et al., 2005; Wang et al., 2007). The literature examining the impact of a new grocery store on the surrounding community is limited. The Good Food Junction Cooperative Store (GFJ) is a full-service, 4900 square foot, not-for-profit grocery store that opened in September 2012 in a former food desert (Cushon et al., 2013) in the inner city of Saskatoon, Saskatchewan, Canada (city population 253,000). The store was opened with the mandate of providing healthy, affordable food, and a commitment to serving the needs of people in the surrounding neighborhoods where vegetables and fruit in particular, for an affordable price, have been challenging to access. The purpose of this research was to examine, using sales data, healthy and less healthful food purchasing over a one-year period at the store by shoppers' neighborhood of residence. Specifically, we examined if those who live within geographic proximity of the GFJ store (i.e. those people who are the target of the intervention) and who shop there, were more likely to purchase healthy foods (vegetables and fruit in particular) compared to those who live outside the target inner city neighborhoods.

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http://dx.doi.org/10.1016/j.pmedr.2015.02.012

Methods

A multilevel cross sectional design was used. The sample consisted of members of the GFJ with a valid address in Saskatoon, Saskatchewan. The GFJ provided the membership database and all purchases made in the store, regardless of membership status. All purchases made by members who reported their postal code of residence from May 15, 2013 to April 30, 2014 (beginning about eight months after the store's opening) were analyzed. We also compared purchases between members and non-members. Lifetime memberships can be purchased at any time during the year and cost five dollars (a nominal amount). In order to ensure that as many shoppers as possible were members for the purposes of our research, our study paid the membership fees for all members signing up between May 1, 2013 and September 30th, 2013.

Ethical approval was obtained from the behavioral ethics committee of the University of Saskatchewan.

Measures

The outcome variable was the total dollar amount spent on food. The number of items purchased was multiplied by the price per item to calculate the total spending per item. Items with no quantity and refunded items with a negative value for price were removed from further analysis.

The primary independent variables were distance from residence to the GFJ, distance from residence to the nearest full-service grocery store other than the GFJ, food category, residence status in the core neighborhoods, and level of deprivation in the dissemination area. Month of the year when food was purchased was included as a control variable in all analyses.

The 2013 City of Saskatoon road network file was used to calculate the road network distance between the centroid of each member's home postal code and the centroid of the GFJ postal code using ArcGIS. Distance to the nearest grocery store was calculated using a geolocated grocery store file developed by the research team in previous food environments' research (Engler-Stringer et al., 2014). This file includes all food stores and restaurants in Saskatoon as of March 2011, and has been updated to include any newly opened, or exclude closed grocery stores, as of July 2014. Grocery stores were defined as retail stores that contain a wide range of foods from all food groups. The network distance from the centroid of the member's home postal code to the centroid of the grocery store's postal code nearest to the member's home was calculated using the Closest Facility function in ArcGIS.

Two independent raters used Stock Keeping Unit codes and item descriptions to categorize all food items purchased into 11 categories; 1) fruit, 2) vegetables, 3) meat and alternatives, 4) dairy products, 5) grains, 6) sugar sweetened beverages, 7) non nutritive beverages, 8) snack foods, 9) prepared foods, 10) flavoring, and 11) non food items. The first five categories represent foods recommended in Canada's Food Guide (Health Canada, 2007a) and are considered healthy, while groups 6–11 are a combination of less healthful foods, non-food items and drinks. These categories were created from Canada's Food Guide (Health Canada, 2007a) and the Canadian Nutrient File (CNF) (Health Canada, 2007b) which is a food composition database that contains average values for nutrients in foods available in Canada. A large proportion of the data in the CNF is derived from the United States Department of Agriculture National Nutrient Database for Standard Reference, although foods not sold in Canada are omitted. Foods were considered fruit for example, if fruit was the primary ingredient; therefore 100% fruit juice and canned fruit in syrup were both considered fruit. Fruit beverages (containing less than 100% fruit juice) were considered sugar-sweetened beverages, and both water and diet sodas were considered non-nutritive beverages. The grain category was somewhat complex. Crackers were considered grains, cereals with 10 or fewer grams of sugar per serving were categorized as grains, whereas cereals with more than 10 grams were categorized as snacks. Snack foods were high-sugar cereals, and food items not considered part of one of the first five categories as listed above, usually due to their high sugar or fat content (e.g., potato chips). Prepared foods were those that required little more than heating for consumption as a meal (e.g., frozen pizza).

Postal code centroids were used to calculate a dichotomous variable indicating whether an individual resided or not in socioeconomically disadvantaged neighborhoods of Saskatoon. Neighborhood status was a proxy for individual socioeconomic status. The socioeconomically disadvantaged neighborhoods represent 6 contiguous neighborhoods (herein referred to as 'core neighborhoods'). The core neighborhoods have a high concentration of residents who are low income with an average household income of ~$40,000 compared to ~$84,000 for the city as a whole (City of S., 2013; Saskatoon Health Region, 2014). The core neighborhoods also have a large proportion of the population who are First Nations or recent immigrants with 15% having a mother tongue other than English compared to 7% for the city as a whole. Fig. 1 shows a map of Saskatoon, with GFJ members, and the core neighborhood area.

Material deprivation scores were calculated for neighborhoods in Saskatoon using the deprivation index developed by Pampalon et al. (2009). The material deprivation index is derived from the 2006 Canadian Census, and included the proportion of people aged 15 years and older without a high school diploma, employment/population ratio of people aged 15 years and older, and the average income of people aged 15 years and older in the neighborhood. The material deprivation index was entered into the models as a categorical variable representing 5 quintiles of deprivation.

Statistical analysis

Linear random intercept models with three levels were fit to the data. The outcome variable at level 1 was total spending on food at the GFJ. Individual characteristics were entered at level 2, and area level characteristics were entered at level 3. Variables were entered using a step up approach. Model 0, which examined variability in the intercept, was sufficient to justify the modeling approach. Model 1 included the categorical food type variable and the core neighborhood residence variable. In Model 2, the interaction between food type and core neighborhood was included. If the interaction term between food type and core neighborhood was significant, stratified models by core neighborhood were created. In Model 3, all previous variables were retained, while distance to the GFJ and distance to the nearest grocery store were added. In Model 4, the fully adjusted model, categorical food type, core neighborhood residence, distance to the GFJ, distance to the nearest grocery store, other than the GFJ, neighborhood deprivation, and month of the year were included. ANOVA tests between model fit for each model examined differences in model fit.

To examine possible differences in purchasing between members and non-members we compared purchases by food types between membership types (see Online Appendix 1).

Results

The complete data set contained 72,587 purchases and 1109 GFJ members with valid geocoded addresses. The analysis dataset contained 38,190 purchases (52.6% of 72,587) made by 583 members (52.6% of 1109). Of the 1109 members 526 did not make a purchase at the GFJ during the study period. Purchases not made by GFJ members were excluded from the data. Of the 583 members, 361 lived in the core neighborhood.

Descriptive analysis of all variables is presented in Table 1. Members spent on average 4.8 (SD = 7.5) dollars per item at the GFJ. The average distance from home to the GFJ for all members was 0.6 km (SD = 0.3), while the average distance from home to the nearest grocery store (other than the GFJ) for all members was 0.5 km (SD = 0.3).

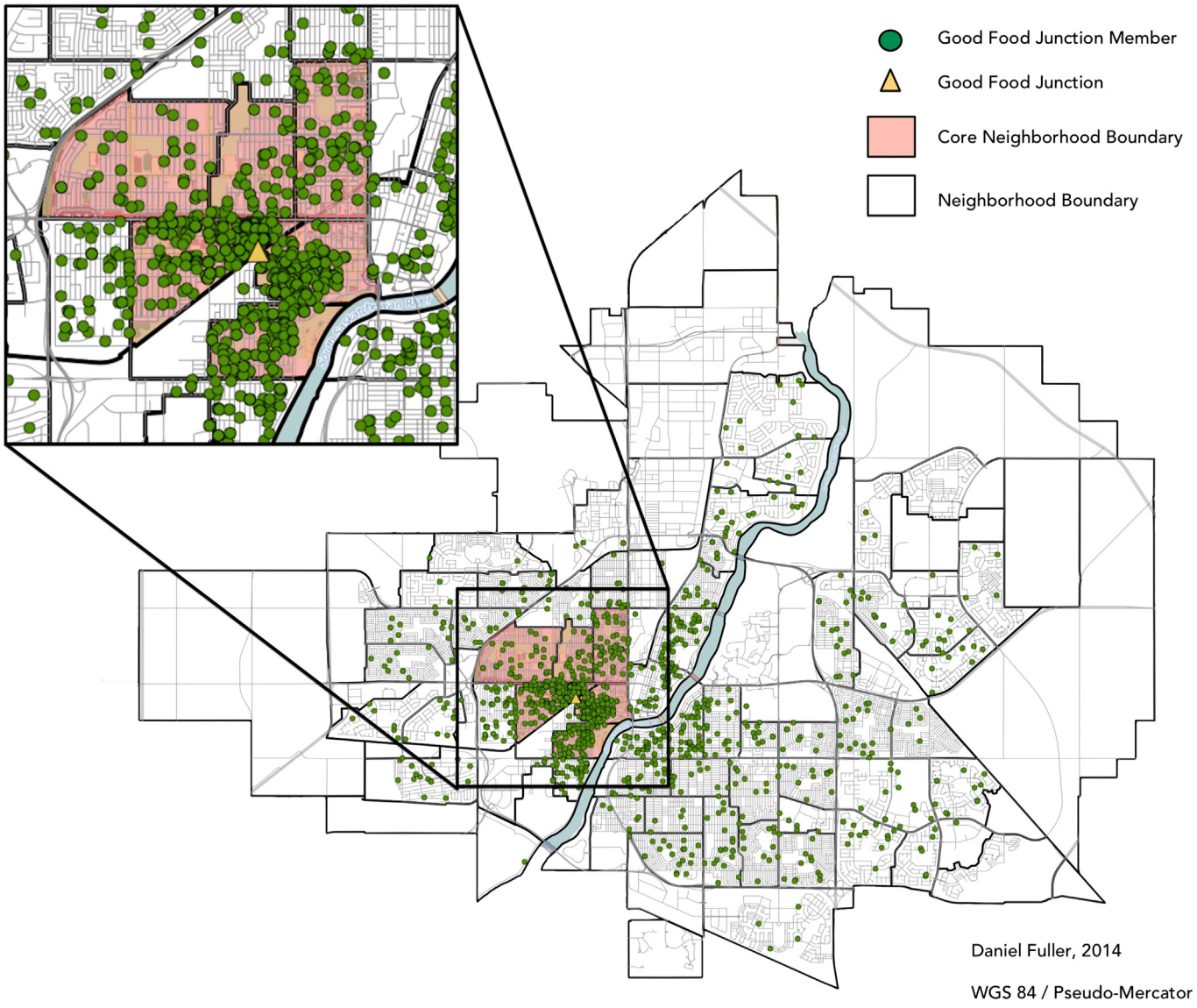

Fig. 1. Map of Good Food Junction members' home locations in relation to the grocery store.

Table 2 shows the results of Model 1 (null model), Model 2 (main effects model), and Model 3 (interaction between purchase category and core neighborhood residence). The null model showed significant variation in the intercept 4.8 (4.4 to 5.1), which justifies the use of multilevel modeling. Model 2 includes the categorical variable for food category and the core neighborhood residence dummy variable. For food purchases, compared to fruit, all members who shopped at the GFJ spent $−0.4 (95% CI: −0.6 to −0.1) less on vegetables, $3.9 (95% CI: 3.6 to 4.2) more on meat, $0.4 (95% CI: 0.1 to 0.7) more on dairy, $2.0 (95% CI: 1.5 to 2.6) more on non nutritive beverages, $2.3 (95% CI: 1.9 to 2.7) more on prepared foods, and $1.0 (95% CI: 0.7 to 1.4) more on non food items. There was no significant difference in spending between those residing in the core neighborhood compared to those residing outside the core neighborhood.

In Model 3, the interaction between food type and neighborhood residence of shoppers (core versus non-core) was included. The results show significant differences in type of food purchased (i.e., cost) between core and non-core neighborhood residents. Compared to the reference categories, fruit and non-core neighborhood residents, core neighborhood residents spent $0.7 (95% CI: 0.2 to 1.2) more on vegetables, $−1.2 (95% CI: −1.8 to −0.6) less on meat, and $−1.1 (95% CI: −2.0 to −0.3) less on prepared foods. We stratified the remaining analysis because many of the interaction terms between food type and core neighborhood residence were statistically significant.

Table 3 presents the results from analyses stratified by core or non-core neighborhood residents. In Model 3a (core neighborhood resident shoppers) and 3b (non-core neighborhood resident shoppers), all previous variables were retained, while two distance variables, to the GFJ and to the nearest grocery store, were added. In Model 3a, for each 1 km increase in distance from home to the GFJ there is non significant decrease of $0.1 (95% CI: −0.9 to 0.7) in spending. For each 1 km increase in distance from home to the nearest grocery store, not including the GFJ, there was a non-significant $0.7 (95% CI: −1.5 to 0.1) decrease in spending at the GFJ. In Model 3b, for each 1 km increase in distance from home to the GFJ there was a non-significant $1.3 (95% CI: −3.3 to 0.6) decrease in spending. For each 1 km increase in distance from home to the nearest grocery store there was a non-significant $1.4 (95% CI: −3.2 to 0.5) decrease in spending at the GFJ.

In model 4a and 4b, the neighborhood deprivation variable was not significantly associated with spending and did not change the

Table 1
Characteristics of members of the Good Food Junction Cooperative Grocery Store, in Saskatoon, Saskatchewan.

	Analysis sample	Core neighborhoods	Non core neighborhoods
	Mean (SD) or percent (*N*)	Mean (SD) or percent (*N*)	Mean (SD) or percent (*N*)
Level 1			
Price per item (dollars)	4.8 (7.5)	4.9 (7.3)	4.7 (7.6)
n of food category purchases			
Fruit	5389 (14.1)	1695 (16.4)	3694 (13.3)
Vegetables	5132 (13.4)	1710 (16.5)	3422 (12.3)
Meat and alternatives	3743 (9.8)	973 (9.4)	2770 (10.0)
Dairy	5481 (14.4)	1555 (15.0)	3926 (14.1)
Grain	2666 (7.0)	776 (16.4)	1890 (6.8)
Sugar sweetened beverages	3674 (9.6)	900 (8.7)	2774 (10.0)
Non nutritive beverages	662 (1.7)	158 (1.5)	504 (1.8)
Snack foods	4667 (12.2)	917 (8.9)	3750 (13.5)
Prepared foods	1508 (3.9)	351 (3.4)	1157 (4.2)
Flavoring	2778 (7.3)	757 (7.3)	2021 (7.3)
Non food items	2490 (6.5)	567 (5.5)	1923 (6.9)
Level 2			
Distance to Good Food Junction (km)	0.6 (0.3)	0.6 (0.3)	0.6 (0.3)
Distance to nearest grocery store (km)	0.5 (0.3)	0.6 (0.3)	0.5 (0.3)
Level 3			
Core neighborhood residence			
No	222 (38.0)		
Yes	361 (62.0)		
Deprivation index			
Q1—least deprived	47 (8.1)	0 (0.0)	25 (11.1)
Q2	33 (5.7)	0 (0.0)	17 (7.8)
Q3	36 (6.2)	11 (3.1)	16 (7.4)
Q4	83 (14.2)	37 (10.2)	35 (15.7)
Q5—most deprived	383 (65.7)	313 (86.7)	129 (57.9)

associations between any of the other variables and spending. However, models 4a and 4b showed a significantly better model fit and were retained as the final models.

Discussion

The Good Food Junction Cooperative Grocery Store was opened in a former food desert in a cluster of socioeconomically disadvantaged neighborhoods in Saskatoon (Cushon et al., 2013; Engler-Stringer et al., 2014), in response to a lack of access to vegetables and fruit in this geographical area. Our findings indicate that those members who shop at the GFJ and who live in the socioeconomically disadvantaged neighborhoods targeted by the intervention show different food purchasing patterns than members who live outside the geographical area targeted by the intervention. GFJ members who reside in the targeted neighborhoods, spend more on vegetables, and less on meat and prepared foods, than shoppers who do not reside in those neighborhoods. The study is consistent with the work of Morland et al. who found that individuals' fruit and vegetable intake increased with each additional full-service grocery store in their home census tract (Morland et al., 2002). Poor food environments constrain decision-making around food purchasing, influencing what become normative less healthful food choices (Mader and Busse, 2011; Gittelsohn et al., 2008; Walker et al., 2010).

The small body of previous research on food store interventions has surveyed users about changes in their eating behaviors, and has shown mixed results (Wang et al., 2007; Cummins et al., 2008; Wrigley et al., 2003). Overall, few changes in eating behaviors have been found. Previous research suggests that other factors – such as self-efficacy, nutrition knowledge, social norms and food cost – may have more influence than physical access (Wang et al., 2007; Cummins et al., 2008; Cummins et al., 2005).

Literature also highlights misconceptions and partial understanding about the poor food choices made by low-income individuals (Travers, 1996; Travers, 1995; Alkon et al., 2013; Engler-Stringer, 2009). This literature argues that the high cost of healthy foods explains the choice of high energy-low nutrient density foods among the urban poor (Drewnowski, 2009; Drewnowski, 2010). Our results show that when given geographical access to healthy foods, compared to residents of higher income neighborhoods, low-income neighborhood residents will make healthy food purchases. This may support the argument

Table 2
Multilevel regression results examining the association between cost of food purchases, food purchase type, and residence in a disadvantaged neighborhood (core) in Saskatoon, Saskatchewan.

	Model 1	Model 2	Model 3
	Beta (95% CI)	Beta (95% CI)	Beta (95% CI)
Intercept	4.8 (4.4 to 5.1)	4.5(3.9 to 5.0)	4.4(3.8 to 5.0)
Food category			
Fruit		–	–
Vegetables		−0.4(−0.6 to −0.1)	−0.8 (−1.2 to −0.1)
Meat and alternatives		3.9 (3.6 to 4.2)	4.6 (4.2 to 4.2)
Dairy		0.4 (0.1 to 0.7)	0.4 (0.0 to 0.7)
Grain		−0.1 (−0.4 to 0.3)	−0.1 (−0.6 to 0.3)
Sugar sweetened beverages		0.1 (−0.2 to 0.4)	0.3 (−0.2 to 0.4)
Non nutritive beverages		2.0 (1.5 to 2.6)	2.5 (1.7 to 2.6)
Snack foods		0.0 (−0.3 to 0.2)	0.2 (−0.3 to 0.2)
Prepared foods		2.3 (1.9 to 2.7)	3.0 (2.4 to 2.7)
Flavoring		0.3 (0.0 to 0.6)	0.3 (−0.2 to 0.6)
Non food items		1.0 (0.7 to 1.4)	1.2 (0.6 to 1.4)
Core neighborhood residence		−0.6 (−1.3 to 0.1)	−0.4 (−1.2 to 0.1)
Food category*core neighborhood			
Fruit*core			–
Vegetables*core			0.7 (0.2 to 1.2)
Meat and alternatives*core			−1.2 (−1.8 to −0.6)
Dairy*core			0.0 (−0.6 to 0.5)
Grain*core			0.0 (−0.7 to 0.6)
Sugar sweetened beverages*core			−0.4 (−1.0 to 0.3)
Non nutritive beverages*core			−0.9 (−2.0 to 0.3)
Snack foods*core			−0.4 (−1.0 to 0.2)
Prepared foods*core			−1.1 (−2.0 to −0.3)
Flavoring*core			−0.1 (−0.7 to 0.6)
Non food items*core			−0.3 (−1.0 to 0.4)

Table 3
Multilevel regression results examining the association between cost of food purchases, food purchase type, and distance to the Good Food Junction stratified by neighborhood disadvantage (core) in Saskatoon, Saskatchewan.

	Model 3a	Model 3b	Model 4a	Model 4b
	Core neighborhood	Non core neighborhood	Core neighborhood	Non core neighborhood
	Beta (95% CI)	Beta (95% CI)	Beta (95% CI)	Beta (95% CI)
Intercept	4.5 (3.7 to 5.3)	5.9 (4.1 to 7.7)	4.0 (2.4 to 5.6)	5.1 (2.8 to 7.4)
Food category				
Fruit	–	–	–	–
Vegetables	−0.1 (−0.4 to 0.3)	−0.8 (−1.2 to −0.3)	−0.1 (−0.4 to 0.3)	−0.8 (−1.2 to −0.3)
Meat and alternatives	3.4 (3.1 to 3.8)	4.6 (4.1 to 5.1)	3.4 (3.1 to 3.8)	4.6 (4.1 to 5.1)
Dairy	0.4 (0.1 to 0.7)	0.4 (−0.1 to 0.9)	0.4 (0.1 to 0.7)	0.4 (−0.1 to 0.9)
Grain	−0.1 (−0.5 to 0.3)	−0.1 (−0.6 to 0.5)	−0.1 (−0.5 to 0.3)	−0.1 (−0.6 to 0.5)
Sugar sweetened beverages	−0.1 (−0.4 to 0.3)	0.3 (−0.3 to 0.9)	−0.1 (−0.4 to 0.3)	0.3 (−0.3 to 0.9)
Non nutritive beverages	1.6 (0.9 to 2.3)	2.5 (1.6 to 3.5)	1.6 (0.9 to 2.3)	2.5 (1.6 to 3.5)
Snack foods	−0.2 (−0.5 to 0.1)	0.2 (−0.3 to 0.7)	−0.2 (−0.5 to 0.1)	0.2 (−0.3 to 0.7)
Prepared foods	1.9 (1.4 to 2.4)	3.0 (2.3 to 3.8)	1.9 (1.4 to 2.4)	3.0 (2.3 to 3.7)
Flavoring	0.2 (−0.1 to 0.6)	0.3 (−0.2 to 0.9)	0.3 (−0.1 to 0.6)	0.3 (−0.2 to 0.9)
Non food items	0.9 (0.5 to 1.3)	1.2 (0.5 to 1.8)	0.9 (0.5 to 1.3)	1.1 (0.5 to 1.8)
Distance to Good Food Junction	−0.1 (−0.9 to 0.7)	−1.3 (−3.3 to 0.6)	−0.1 (−0.9 to 0.7)	−1.3 (−3.3 to 0.6)
Distance to nearest grocery store	−0.7 (−1.5 to 0.1)	−1.4 (−3.2 to 0.5)	−0.8 (−1.6 to 0.0)	−1.4 (−3.2 to 0.5)
Area deprivation index				
Q1—least deprived			–	–
Q2			Omitted	1.0 (−1.2 to 3.2)
Q3			Omitted	−0.1 (−2.1 to 2.0)
Q4			1.2 (−0.6 to 2.9)	0.9 (−1.0 to 2.9)
Q5—most deprived			0.4 (−1.1 to 1.8)	1.6 (−0.5 to 3.7)

Note. Model 4 includes a dummy variable for each month.

that both the cost of healthy foods, and lack of access to these foods, work together as disincentives to healthy food purchasing for low-income neighborhood residents.

The result provides preliminary evidence to support the argument that when given geographical access to healthy food, people living in disadvantaged neighborhoods will take advantage of that access. This study contributes to the literature by studying a large scale community based food store intervention, and having access to its sales data over an extended period of time soon after its opening.

Limitations

Limitations of the current study include, the membership database not containing any individual characteristics. We used area level deprivation as a proxy for individual socioeconomic status, which has known limitations (Oakes, 2006; Hanley and Morgan, 2008). Individual level socioeconomic, transportation, and workplace data would have allowed a more detailed subgroup analysis. Second, the analysis includes only purchases made at the GFJ. Food purchasing patterns are complex and occur at multiple locations. Results should not be generalized to purchases made at other grocery stores. We can also not compare purchasing patterns prior to the opening of the GFJ nor estimate the change in purchasing patterns due to the store opening. In addition, our analyses only included purchases made by GFJ members, which accounted for slightly more than half of all purchases. We could not reliably collect the postal code of residence of all shoppers.

Previous research looking at coupon programs aimed at increasing vegetable and fruit consumption has suggested that these programs may primarily attract users who would already make vegetable and fruit purchases (Balsam et al., 1994; Anliker et al., 1992), and we wonder if the same situation is at play in this study.

Conclusion

Our examination of a food store intervention's sales data has found that shoppers who are residents of the former food desert neighborhood spend more on vegetables, and less on meat and prepared foods than shoppers who do not reside in those targeted neighborhoods. Residents of the former food desert appeared to be accessing the new grocery store for healthy food purchases more than their non-resident counterparts.

Funding statement

Funding for this research was provided by a grant from the Canadian Institutes for Health Research (#127084).

Conflict of interest statement

The authors report to conflicts of interest.

Acknowledgments

The authors would like to acknowledge the staff and Board of Directors of the Good Food Junction Cooperative Grocery Store for allowing access to their sales data, as well as the work of all of the Good Food, Healthy Families research staff. This study was funded by the Canadian Institutes for Health Research (#127084). D. Fuller helped conceptualize the research and conducted the data analysis and wrote the results. R Engler-Stringer helped conceptualize the research and wrote the introduction, discussion and conclusions. N. Muhajarine helped conceptualize the research and edited the entire article. The authors have no conflicts of interest to report.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.pmedr.2015.02.012.

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