

Efficacy of a store-based environmental change intervention compared with a delayed treatment control condition on store customers' intake of fruits and vegetables

Guadalupe X Ayala^{1,*}, Barbara Baquero², Barbara A Laraia³, Ming Ji¹ and Laura Linnan⁴

¹Graduate School of Public Health, Institute for Behavioral and Community Health, San Diego State University, 9245 Sky Park Court, Suite 220, San Diego, CA 92123, USA: ²College of Public Health, Community & Behavioral Health, University of Iowa, Iowa City, IA, USA: ³School of Public Health, University of California at Berkeley, Berkeley, CA, USA: ⁴Gillings School of Global Public Health, Department of Health Behavior, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

Submitted 17 September 2012: Final revision received 14 February 2013: Accepted 7 March 2013: First published online 8 April 2013

Abstract

Objective: The present store-based intervention was designed to promote sales of fruits and vegetables (F&V) to increase intake among store customers – specifically customers of *tiendas*, small-to-medium-sized Latino food stores.

Design: Four *tiendas* were randomized to a 2-month environmental change intervention or a delayed treatment control condition. Employees and managers were trained to promote F&V sales, including how to implement a food marketing campaign and installing store equipment to promote fresh fruits and vegetables. The primary outcome was self-reported daily intake of F&V among a convenience sample of customers (at least forty per store) collected at baseline prior to randomization and then 4 months later. In addition, changes in availability of F&V in the *tiendas*, using unobtrusive observational methods, provided evidence of intervention fidelity.

Setting: *Tiendas* in central North Carolina.

Subjects: Participants included 179 customers who were recent immigrants from Mexico and Central America.

Results: A group-by-time interaction approached significance on daily servings of F&V; intervention customers reported an increase in F&V intake over time and as a function of the intervention ($P \leq 0.06$). Unexpectedly, self-efficacy for consuming more fruits ($P \leq 0.01$) and more vegetables ($P \leq 0.06$) decreased. In our store-level analyses, a group-by-time interaction was observed for availability of fresh and canned vegetables; the intervention increased availability of vegetables but not fruit.

Conclusions: Environmental change strategies to promote healthy eating are needed given the rates of obesity and diabetes in the Latino population. A store-based intervention was moderately effective at increasing customers' reported F&V intake. Such strategies can have a public health impact on underserved populations.

Keywords
Intervention
Fruits and vegetables
Grocery stores
Hispanics

Researchers have determined that unhealthy dietary patterns seen in many different populations are, in part, attributable to disparities in the built environment observed in lower-income and ethnic communities. For example, disparities in the built environment have been identified in access to healthy foods by neighbourhood deprivation⁽¹⁾, area-level wealth⁽²⁾ and ethnic composition⁽³⁾. Compared with higher-income and white communities, poorer and predominantly minority communities have significantly more small grocery stores and fewer produce markets and

natural food stores^(3,4). Small grocery stores in racial/ethnic minority neighbourhoods are far less likely to carry healthy food selections than those in predominantly white neighbourhoods (18% *v.* 58%)⁽⁵⁾. These disparities in access have been identified as important intervention targets, given evidence supporting the association between availability of certain food products and diet quality. A recent systematic review suggests that availability as defined by the presence or perceived presence of certain food products in a store is associated with

better diet quality⁽⁶⁾. However, evidence for the association of diet quality with availability defined as the presence of certain store types in a neighbourhood is mixed, due in part to potential inaccuracies introduced with using secondary data to define store type⁽⁷⁾. In addition, availability of fruits and vegetables (F&V) has not been consistently associated with consumption⁽⁸⁾. Nevertheless, given some evidence supporting the association between availability and use, as well as evidence from previous store-based interventions, one potentially viable approach to improve eating habits may be to increase the availability of F&V in small food stores.

Food environment interventions

Interventions in the food environment are defined as 'one[s] that affect availability, access, incentives, and information about foods at the point of purchase' (p. S109)⁽⁹⁾. The ultimate goal is to make healthy foods more available through convenience and/or by reducing costs⁽¹⁰⁾. In an older review of thirty-four nutrition environment interventions, information strategies were found to be ineffective at reaching their desired outcomes, be that sales, profit or intake⁽¹¹⁾. This suggests that other strategies are needed to increase intake and reduce health disparities⁽¹²⁾. In a more recent review of small food store interventions, Gittelsohn and colleagues concluded that multi-prong approaches are the most effective methods for achieving changes⁽¹³⁾. Yet despite this evidence, they also concluded that few studies assess change at the customer level. The present study sought to fill a gap in the current food environment intervention research by testing an intervention that involved increasing availability of F&V through social and physical changes to the store environment and evaluating changes in terms of the customers' F&V intake.

Working with *tiendas* to promote healthy eating

In addition to our rigorous study design, the present study was conducted in a novel store setting – *tiendas*; one that may generalize to other small-to-medium food stores given the characteristics that they share. *Tiendas* are small Latino stores in US Mexican and Central American communities that serve as a gateway to new immigrants to the region⁽¹⁴⁾, and among immigrants, as a small business enterprise for economic independence⁽¹⁵⁾. *Tiendas* in these communities are usually family-owned businesses that are larger in size than a convenience store and have one or two additional service departments, including a butcher and a prepared food section, compared with traditional convenience stores. *Tiendas* are an ideal channel for promoting greater intake of F&V among customers given the greater odds of repeated exposure than a supermarket intervention because shopping in *tiendas* is a more frequent activity compared with shopping in supermarkets^(16,17). In addition, interventions delivered in *tiendas* are likely to reach a large population as most individuals' food basket includes items purchased

from *tiendas*^(16,17). Knowing more about how to design effective interventions for this setting and these customers has the potential to change our approach to population-level health promotion.

In the present study, we tested whether a *tienda*-based environmental change intervention (*Vida Sana: Hoy y Mañana*; Healthy Life: Today and Tomorrow) would result in changes in *tienda* customers' F&V intake compared with customers from control *tiendas*. In addition, we examined for changes in availability of F&V based on unobtrusive observations, to determine whether the intervention activities increased availability of fresh and canned F&V in the *tiendas*.

Methods

Study design

Tiendas in central North Carolina were randomly assigned to one of two conditions: (i) an environmental change intervention to promote store customers' intake of F&V; compared with (ii) a delayed treatment control condition, an intervention similar to the one described here but implemented after the follow-up assessment. The target population within the stores was Latino store customers. Census data indicate that the target population is comprised of relatively young families or young adult males who have lived in the USA for fewer than 10 years⁽¹⁸⁾. The majority does not have a high-school education, is of Mexican descent and is characterized as being linguistically isolated given their dominant use of the Spanish language. This population was targeted given strong and consistent evidence that more years of living in the USA is associated with less F&V consumption⁽¹⁹⁾. Changes were examined from baseline to immediate post-intervention (approximately 4 months from baseline). The San Diego State University's Institutional Review Board approved all study protocols.

Recruitment of *tiendas*

In a previous study, four counties were identified as having experienced a significant growth in the size of their Latino population⁽²⁰⁾. From within these counties, forty-three *tiendas* were identified; store audits were conducted in thirty-seven *tiendas* and customer and manager interviews in thirty of these *tiendas*. Among the stores audited, nine *tiendas* were identified that met the following inclusion criteria: availability of some F&V, presence of other food services (e.g. butcher, prepared foods) and more than one employee besides the manager. We sought to work with stores with some available produce as our goal was to increase their capacity to market and sell produce. Many of the excluded stores were smaller in size, did not have many additional services or mostly offered products other than food (e.g. boots, telephone cards and video rentals), and in

some cases, did not sell any produce. These nine stores were pair-matched on several characteristics (e.g. number of employees, types of products and services available) and then ordered, with those pairs located at the greatest distance from each other placed at the top of the selection list to minimize cross-contamination. The Principal Investigator and Project Manager visited each of these pair-matched *tiendas* to meet with the *tienda* managers to assess their interest in having their *tienda* participate. All *tienda* managers agreed to have their *tienda* participate, including being randomly assigned to treatment arm, by signing a consent form.

Intervention procedures

Intervention activities began after baseline assessments were completed with managers, employees and customers (as described in detail below) and were 4 months in duration, including 2 months for employee- and manager-directed activities followed by 2 months of a customer-directed intervention. The intervention did not subsidize wholesale food purchase. Rather, it focused on the business aspect of store management including employee training, point-of-purchase promotion and merchandising produce, all designed to promote sales of F&V. Prior to intervention implementation, all *tienda* managers and a majority of all employees completed a baseline interview (not presented in this paper) and then *tiendas* were randomly assigned to the intervention or delayed treatment control condition. The 4-month intervention involved: (i) employee and manager trainings; (ii) an 8-week food marketing campaign that included a point-of-purchase component, food demonstrations and an audio-based media campaign; and (iii) equipment to make structural changes.

Trainings

Three training sessions were developed, informed in part by our formative research, worksite studies⁽²¹⁾ and consultation with food industry experts. Given the target population's educational levels and dominance of the Spanish language, all trainings were designed at a sixth grade level and in Spanish. The training sessions were conducted in each of the two intervention *tiendas* with managers and employees. Manager trainings were separate from the employee trainings; however, they were both designed to occur during three 30-min sessions and focused on how to sharpen business skills key to promoting produce sales. In the first training, managers were introduced to the intervention components, their roles and responsibilities in the intervention, and the potential benefits of participation for their *tiendas*, their employees and their customers. During this training, managers were introduced to basic nutrition information about F&V and then participated in a *tienda* walk-through during which the managers and programme staff identified the most optimal locations for the intervention activities. The second

training involved presentation of an English-language video produced by the Food Marketing Institute (FMI; www.fmi.org) entitled 'Merchandising for Profit DVD', followed by a discussion on how to successfully market produce in their *tiendas*. The final training presented in-depth information on produce management, specifically how to work with produce distributors to ensure the purchase of high-quality produce, as well as methods for how to store and display produce to maximize sales and minimize waste. Food safety was an important component of this training. Although total manager training time was intended to be 90–135 min, this was exceeded in both intervention stores by approximately 200 min due to their interest in learning more about how to market F&V.

Employee trainings consisted of a slightly modified version of the first manager training; employees received more information regarding the benefits of F&V for their health and their pocketbooks/wallets. They did not participate in the walk-through. The second training included presentation of a Spanish-dubbed video produced by FMI, entitled 'The Power of Customer Service DVD – Spanish version', followed by an interactive discussion on suggestive selling techniques. A third training on becoming a produce specialist was initially planned but dropped because specialist training was not a priority of the managers. With support from the managers, all employee trainings occurred during the employees' work-time and total training time was exceeded by approximately 40 min due to activities and questions/answers.

Food marketing campaign

An 8-week food marketing campaign was conducted in each intervention *tienda* and consisted of food demonstrations, distribution of recipe and business cards with health promotion messages, and an audio novela. Each week two project staff conducted a food demonstration using commonly prepared Latino dishes but modified to include more fruits or vegetables, or new F&V dishes to spark the interest of individuals who may be more inclined to try something new. The food demonstration was accompanied by distribution of traditional recipe cards plus health promoting cards, the size of a business card and billed as such with the *tienda's* name. This latter intervention approach was used because the intervention was designed to reach men as well as women. In our formative research study, several of the men interviewed expressed similar opinions to health promotion materials as one man who said: '[it has to] fit in my wallet if I am going to take them with me'⁽²⁰⁾. The two *tiendas* also received posters, price tags, shelf tags, streamers (aka *papel picado*; a traditional Mexican form of art that consists of a long string of paper-cut designs, commonly used at celebrations such as birthdays), nutrient information tables for produce, and other point-of-purchase materials showcasing the fruit or vegetable promoted that week. Finally, to more fully capture the attention of customers,

the campaign included the airing of an audio novela over the store public announcement system that described the journey of eight fruit and vegetable characters from Mexico and Central America to the USA. Images of these characters were included in all print material developed for the campaign. With the exception of a few posters and fewer recipe cards distributed to customers, the food marketing campaign was implemented as planned.

Structural changes

To initiate structural changes to promote the sales of F&V, each of the intervention *tiendas* was allocated \$US 1000.00 to purchase equipment and other materials. The *tiendas* requested a buffet bar to display ready-to-eat F&V marketed as 'Pronto Paks'. The bar was equipped with freezable Coldmaster® bins that, once placed in the bar, would keep the packaged F&V at a temperature approved by the Food and Drug Administration for at least 8 h. With support from project staff, *tienda* employees prepared Pronto Paks, priced them at \$US 1.50 to \$US 1.99 depending on the size of the container, and placed them in the buffet bar which itself was stationed near the principal cash register. Implementation of the structural changes was delayed due to challenges with obtaining and setting up equipment; however, ultimately they were implemented as planned.

Recruitment and retention of participants

A minimum of forty customers per *tienda* were recruited to serve in the evaluation cohort. Customer eligibility criteria were: at least 18 years of age; lived in the community where the *tienda* was located; visited the *tienda* at least once weekly; purchased some produce at this *tienda* at least weekly (to ensure exposure to the intervention); did not visit any of the other participating *tiendas* to minimize contamination among control participants; was not on a doctor-prescribed diet; consumed less than eight cups of F&V per day to minimize the possibility of a ceiling effect; lived in the area for at least 1 year and planned to remain in the study area for at least 6 months.

Recruitment activities were conducted in the four *tiendas* concurrently and took 4 weeks, approximately 14 d per store. Bilingual-bicultural research assistants approached customers coming into the *tienda*, explained the study objectives and asked two quick eligibility questions (age, live in community). If the customer met these two eligibility criteria, then additional questions were asked to determine study eligibility. If the customer refused to speak with the research assistant or indicated that he/she did not have time, this contact and outcome were noted on a log sheet. To achieve the goal of forty customers per *tienda* (160 in total) needed for statistical power with a clustered design, nearly 1460 customers were approached for participation (see Fig. 1). The cohort maintenance strategies (postcards and reminder calls) and measurement incentives (\$US 10.00 at each assessment time point) helped to retain a sizeable cohort at immediate

post-intervention (M2). Participant cohort retention at M2 was moderate, ranging from 55 to 76% across the four *tiendas*. The majority were lost to follow-up (23 to 38%). Differences between completers and non-completers were minimal on both demographic and outcome variables; completers *v.* non-completers were more likely to be married and rated the stores more favourably at baseline.

Evaluation procedures

Evaluation of the intervention was assessed at the customer and *tienda* levels. The primary aim of the study was to increase *tienda* customers' F&V intake. Additional customer changes were examined on behavioural and psychosocial variables; most scales had been used on several previous bilingual studies in which measurement equivalence was demonstrated in Spanish and English^(22,23). Bilingual-bicultural research assistants consented and then collected baseline data from customers during face-to-face interviews in the *tiendas*. Telephone interviews were used to complete the post-intervention assessment. All assessments occurred in Spanish although customers were given the option of completing it in English and required approximately 45 min to complete.

Primary aim

Fruit and vegetable intake. Our primary outcome was measured using the recently validated National Cancer Institute (NCI) Fruit and Vegetable All-Day Screener. The screener obtains an estimate of daily servings of F&V in the past month^(24,25). The instrument provided ten response options for each food item ranging from 'never' to 'five or more times a day'. The screener also included portion-size estimates for most food items, which have been shown to increase the accuracy of the estimates in predicting actual F&V intake⁽²⁵⁾. Food models were used to assist with portion estimations at baseline consistent with previous research⁽²⁶⁾; however, they were not used in the follow-up telephone assessment. This variation in administration between time points was consistent for both intervention and control participants. The screener yielded a final continuous score that reflected total daily servings of F&V.

Additional customer changes in behavioural and psychosocial variables

Fruit and vegetable variety. Respondents were shown a list of thirty-two fruits and forty-three vegetables and asked to report (yes or no) whether they had consumed these produce items during the past 30 d. The correlation between total F&V variety score and total intake score from the NCI Fruit and Vegetable All-Day Screener was small and only approached significance ($r=0.12$, $P=0.06$), suggesting that it may only be a moderately important independent dimension of overall intake.

Behavioural strategies for fibre and fat. This was a shorter version of a thirty-item scale used to assess

behavioural strategies to increase fibre and decrease fat. The scale was developed for use in Latinos and has acceptable construct and predictive validity⁽²³⁾. The internal consistency of the ten-item fibre subscale was $\alpha = 0.72$ and $\alpha = 0.66$ for the nine-item fat subscale.

Psychosocial factors. Perceived barriers were measured with a twelve-item scale that assessed personal, social and environmental barriers to healthy eating ($\alpha = 0.85$)⁽²³⁾. Higher scores indicated greater perceived barriers using response options that ranged from 1 = 'strongly disagree' to 5 = 'strongly agree'. Self-efficacy for purchasing and consuming more fruits and vegetables were measured separately with six items each (e.g. 'How sure are you that you can select fresh fruit that won't go bad before you plan to use it?'; fruits: $\alpha = 0.67$; vegetables: $\alpha = 0.63$). Response options ranged from 1 = 'I'm sure I cannot' to 5 = 'I'm sure I can', with higher score indicating greater self-efficacy for purchasing and consuming more F&V.

Store-level effects

To determine whether the number of F&V available increased in the intervention *v.* the control *tiendas*, weekly observations were conducted on randomly selected days and times in all four *tiendas* over a 13-week period: 3 weeks pre-intervention, 8 weeks during the customer-directed intervention and 2 weeks post-intervention. A blinded observer visited the *tiendas* and captured information on the number of F&V available using a *tienda* audit tool with a predetermined set of items based on formative research⁽²⁷⁾. The tool was designed to capture the presence of F&V in three forms: fresh, frozen and canned, the latter without any type of syrup. Frozen was excluded from the analyses due to limited availability in these stores. The tool yielded a final number representing the total number of fresh fruits, canned fruits, fresh vegetables and canned vegetables. Inter-rater reliability (= 0.95) on a 25% sub-sample provided evidence of the reliability of this approach. In addition to *tienda* observations, inventory data were obtained from the managers to determine whether the manager purchased more F&V during this same 13-week period. The managers were asked to provide us, either weekly or monthly, hard copies of the inventory sheets that they received from all their produce distributors. This provided a measure of how much of each produce item the stores received during each week of the study.

Data analyses

All analyses were based on the intention-to-treat approach. Descriptive statistics were performed on all variables to ensure they met statistical assumptions. Primary and other customer outcomes were examined using mixed effects models. Models accounted for repeated measures from baseline to 4-months post-baseline. All available data were utilized; no data imputations were

performed for missing data. Terms were included in the model to account for time between baseline and the intended 4-month post-baseline, as well as store clustering. To determine whether the intervention *tiendas'* environment changed, we examined the relative change in the observed number of available fresh and canned F&V between the first and last observation.

Results

The study recruited 179 customers across the four *tiendas* (see Fig. 1) and 119 (66%) were available for outcome analyses. Most of the study participants were females (66%), young adults (mean age 32 (sd 9) years) and married or living as married (75%). A majority (83%) reported living with family in households of approximately four individuals. Over a third had 6 years of education or less. The majority was employed (71%), including 36% as labourers, and the average household monthly income was approximately \$US 1500.00. Most rented their home or apartment (74%) and nearly a quarter were on some sort of food assistance programme. All of the participants were born outside the USA, and specifically 84% were of Mexican origin. On average respondents had lived in the USA for 8 (sd 5) years.

Primary aim and other customer changes

The intervention condition participants reported consuming nearly an additional daily serving of F&V as measured by the NCI F&V screener ($P \leq 0.06$; see Table 1). The same was not observed among the delayed treatment condition participants. Contrary to what was expected, self-efficacy for purchasing and consuming F&V decreased in the intervention condition and increased in the delayed treatment condition (fruits: $P \leq 0.01$; vegetables: $P \leq 0.06$). No other significant group-by-time interactions were observed on the other outcomes including fruit variety, vegetable variety, behavioural strategies for fat, behavioural strategies for fibre and perceived barriers.

Store-level effects

The total number of fresh and canned F&V observed in the intervention and control *tiendas* was examined over time. Table 2 contains the relative change (in percentage) of the four variables for each condition. There were larger increases in the availability of fresh and canned vegetables in the intervention *v.* the control *tiendas*. There were similar decreases in fresh fruits in both study conditions, and similar increases in canned fruits. These findings suggest that changes occurred at the *tienda* level, with important changes observed in the availability of fresh and canned vegetables.

A second source of *tienda* data collected was produce distributor receipts. Weekly for 12 weeks, we requested produce distributor receipts from *tienda* managers/owners,

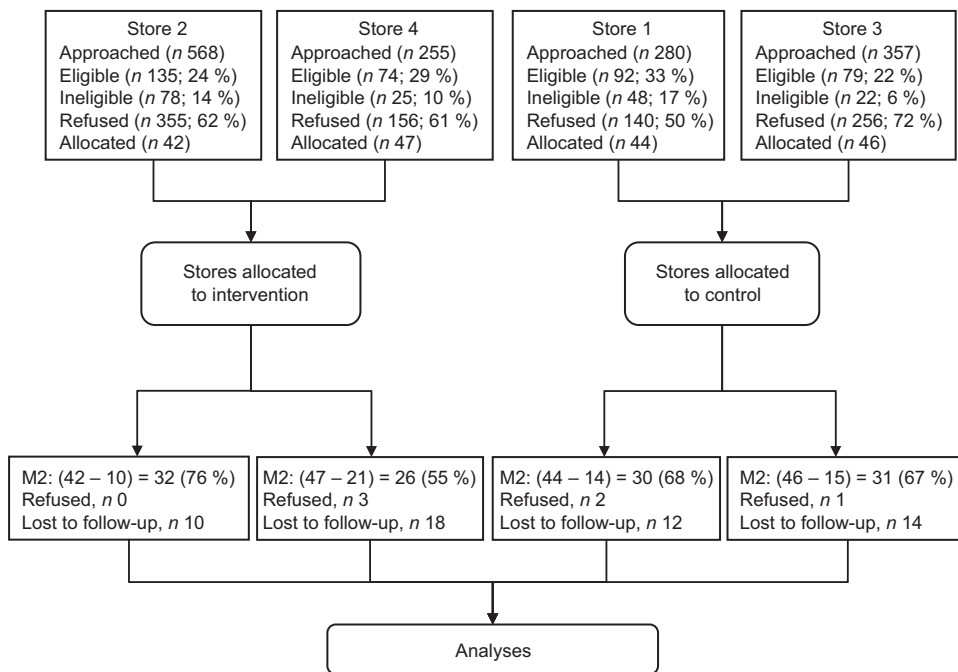


Fig. 1 CONSORT (Consolidated Standards of Reporting Trials) figure with recruitment and cohort maintenance outcomes

Table 1 Results of mixed effects models on changes in primary and other customer outcomes; *Vida Sana: Hoy y Mañana* (Healthy Life: Today and Tomorrow) *tienda*-based environmental change intervention, central North Carolina, USA

	Intervention				Control				F and P values
	Baseline		Post-test		Baseline		Post-test		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Daily servings of fruits & vegetables	2.04	1.19	2.88	2.01	2.61	1.53	2.84	2.35	F = 3.41, P = 0.06
Past month variety of fruits	20.50	5.75	20.93	5.74	20.12	5.49	19.13	6.16	NS
Past month variety of vegetables	25.93	5.90	26.86	7.77	26.42	6.24	25.53	7.54	NS
Behavioural strategies to increase fibre	2.37	0.56	2.60	0.63	2.54	0.57	2.61	0.64	NS
Behavioural strategies to decrease fat	2.47	0.59	2.53	0.59	2.57	0.57	2.72	0.61	NS
Perceived barriers	1.84	0.59	2.09	0.45	1.80	0.67	2.16	0.49	NS
Self-efficacy for fruits	3.87	0.56	3.61	0.49	3.87	0.50	3.95	0.44	F = 5.52, P = 0.01
Self-efficacy for vegetables	3.97	0.47	3.67	0.50	3.89	0.51	3.87	0.45	F = 3.55, P = 0.06

with three of the four *tiendas* providing two to three receipts from each of one to two distributors. One of the control *tiendas* was unable to provide more than four distributor receipts for the entire period, suggesting that this method may not provide a reliable comparison between *tiendas*. No analyses were conducted with these data.

Discussion and conclusions

Disparities in access to healthy foods are evident to researchers and community residents alike, the former who recognize the influence of these disparities on eating habits⁽²⁸⁾. Previous research suggests that targeting increases in availability of healthy foods may be a relevant approach to improving eating habits⁽¹³⁾. The present study contributed to this literature by testing a store-based intervention promoting F&V in order to increase intake

Table 2 Percentage change in availability of fresh and canned fruits and vegetables by study condition: *Vida Sana: Hoy y Mañana* (Healthy Life: Today and Tomorrow) *tienda*-based environmental change intervention, central North Carolina, USA

	Fruits		Vegetables	
	Fresh	Canned	Fresh	Canned
Intervention	↓ 19%	↑ 8%	↑ 26%	↑ 30%
Control	↓ 13%	↑ 9%	↑ 9%	↓ 9%

among store customers. The study was conducted in *tiendas*, small Latino stores in US Mexican and Central American communities that serve an important role in the community⁽²⁰⁾. *Vida Sana, Hoy y Mañana*, a *tienda*-based intervention, was moderately effective at increasing F&V intake among store customers. Daily servings of

F&V increased by +0.84 among intervention customers compared with +0.23 in the control customers. This is consistent with previous research which found small positive changes as a result of an in-store intervention⁽²⁹⁾. Considering the limitations noted below, these findings would suggest that it is possible to intervene at the environmental level in this setting and achieve changes in customers' eating habits.

Changes were also found in self-efficacy; however, the changes were in the opposite direction to that hypothesized. The intervention customers reported decreases in self-efficacy for F&V, while control customers reported increases. Did the presence of the intervention in the *tiendas* evoke feelings of inadequacy in terms of ability to make dietary changes? By making F&V more 'available', did *tienda* customers feel unable to make the corresponding changes in their purchasing and eating habits? This finding requires further study, particularly given that previous evidence suggests self-efficacy may not be an appropriate construct for a Latino population⁽³⁰⁾. Finally, in the present study we observed significant increases in the availability of fresh and canned vegetables. This is an important finding because it suggests that it is possible to see concurrent changes in the environment along with changes in *tienda* customer intake. This is consistent with other food environment interventions (e.g. Working Well Trial⁽³¹⁾), providing additional support for environmental change strategies.

Limitations

Several limitations are important to consider. First, F&V intake was measured via self-report. It is possible that intervention customers were biased to report greater intake of F&V given their greater visibility in the stores. Related, given the limited space available in the stores to conduct the follow-up interviews and no funding to conduct home visits, follow-up interviews were conducted by telephone. As such, a second limitation of the study is the lack of food models to assist with dietary data collection at follow-up. This may have led to over- or under-reporting; however, this source of variability was equally distributed across conditions. Third, the retention rate was moderate compared with previous studies we have completed (*Secretos*: 79% at 1-year follow-up⁽³²⁾; *Sembrando Salud*: 81% at 2-year follow-up⁽³³⁾). Stronger efforts are needed to retain a sample recruited through food stores. Similarly, more resources are needed to recruit a sample through food stores as evidenced by the refusal rate at initial approach (ranged from 50 to 72%; see Fig. 1). Fourth, the study was conducted only in four *tiendas*. The extent to which results generalize to *tiendas* in other communities and to other types of small food stores is not known. Fifth, our measure of self-efficacy may not have been understood well given the educational level of participants, and thus our counterintuitive findings should be interpreted with caution.

Implications for future research and practice

Those interested in working with similar small grocery and ethnic food stores, to improve the food environment or to deliver a healthy eating campaign, should consider a number of factors prior to implementation. Previous research suggests implementation of an in-store intervention must recognize that: (i) strategies be consistent with store needs; (ii) managers are motivated primarily by profit; and (iii) strategies cannot be overly complex but should fit the context^(10,12). The first implication of the present study is that the managers appreciated customer service training for their employees. Managers in our formative research study indicated that they have few resources to invest in customer service training and yet they understand its importance⁽²⁰⁾. Although the Spanish-dubbed video was vetted by a non-participating *tienda* manager, due to insufficient resources to produce one of our own, future studies should consider developing trainings that are more relevant to a small store environment. Second, selling packaged ready-to-eat F&V (Pronto Paks) was perceived the most relevant intervention strategy given *tienda* customer characteristics (i.e. young adult males; women with young children). However, the Pronto Paks were initially sold at a price ranging from \$US 2.00 to \$US 2.50, making it difficult to compete with other ready-to-eat snack options. Fortunately the price was successfully lowered after project staff calculated that the *tienda* would still make a profit if Pronto Paks were sold for \$US 1.50 each. Third, when suggesting physical changes to the *tienda* environment, we initially limited our discussion with managers to items that fit the research budget. However, one *tienda* manager offered to contribute \$500.00 of his own funds to purchase a buffet bar that was larger and fit better in his *tienda*. Thus, it is important to discuss a variety of possibilities and the pros and cons of each selection and to tailor the structural change to the unique needs and interests of the manager and physical layout of the *tienda*.

The current study was conducted in central North Carolina, a state that experienced a significant growth in the size of its Latino immigrant population. *Tiendas* are a product of this migration⁽¹⁵⁾ and the introduction of small ethnic food stores with the arrival of new immigrants helps shape the food environment for everyone. This is a phenomenon that has received little study despite suggestions about a reverse acculturation process that happens in communities with new immigrants⁽³⁴⁾. More research is needed on how the food environment for everyone changes with new immigrants and its implications on eating habits and health outcomes.

Acknowledgements

Sources of funding: The work was supported by the National Cancer Institute (R21 CA120929-01). *Conflicts of*

interest: There are no conflicts of interest. *Authors' contributions:* All authors were involved in the conceptualization of the study and selection of measurement and intervention activities. M.J. conducted the analyses. G.X.A. prepared a first draft of the paper with assistance from B.B. B.A.L., L.L. and M.J. edited several drafts of the paper and approved the final version.

References

- Cubbin C, Hadden WC & Winkleby MA (2001) Neighborhood context and cardiovascular disease risk factors: the contribution of material deprivation. *Ethn Dis* **11**, 687–700.
- Reidpath DD, Burns C, Garrard J *et al.* (2002) An ecological study of the relationship between social and environmental determinants of obesity. *Health Place* **8**, 141–145.
- Moore LV & Diez Roux AV (2006) Associations of neighborhood characteristics with the location and type of food stores. *Am J Public Health* **96**, 325–331.
- Dubowitz T, Heron M, Bird CE *et al.* (2008) Neighborhood socioeconomic status and fruit and vegetable intake among whites, blacks, and Mexican Americans in the United States. *Am J Clin Nutr* **87**, 1883–1891.
- Horowitz CR, Colson KA, Hebert PL *et al.* (2004) Barriers to buying healthy foods for people with diabetes: evidence of environmental disparities. *Am J Public Health* **94**, 1549–1554.
- Caspi CE, Sorensen G, Subramanian SV *et al.* (2012) The local food environment and diet: a systematic review. *Health Place* **18**, 1172–1187.
- Walker RE, Keane CR & Burke JG (2010) Disparities and access to healthy food in the United States: a review of food deserts literature. *Health Place* **16**, 876–884.
- Gustafson A, Hankins S & Jilcott S (2012) Measures of the consumer food store environment: a systematic review of the evidence 2000–2011. *J Community Health* **37**, 897–911.
- Seymour JD, Yaroch AL, Serdula M *et al.* (2004) Impact of nutrition environmental interventions on point-of-purchase behavior in adults: a review. *Prev Med* **39**, Suppl. 2, S108–S136.
- Steenhuis I, van Assema P, Reubsaet A *et al.* (2004) Process evaluation of two environmental nutrition programmes and an educational nutrition programme conducted at supermarkets and worksite cafeterias in the Netherlands. *J Hum Nutr Diet* **17**, 107–115.
- Holdsworth M & Haslam C (1998) A review of point-of-choice nutrition labelling schemes in the workplace, public eating places, and universities. *J Hum Nutr Diet* **11**, 423–445.
- Glanz K & Yaroch AL (2004) Strategies for increasing fruit and vegetable intake in grocery stores and communities: policy, pricing, and environmental change. *Prev Med* **39**, Suppl. 2, S75–S80.
- Gittelsohn J, Rowan M & Gadhoke P (2012) Interventions in small food stores to change the food environment, improve diet, and reduce risk of chronic disease. *Prev Chronic Dis* **9**, E59.
- Ayala GX, Maty S, Cravey A *et al.* (2005) Mapping social and environmental influences on health: a community perspective. In *Methods in Community-Based Participatory Research for Health*, pp. 188–209 [BA Israel, E Eng, AJ Schulz *et al.*, editors]. San Francisco, CA: Jossey-Bass.
- Johnson JH, Johnson-Webb KD & Farrell WC (1999) A profile of Hispanic newcomers to North Carolina. *Popular Government* Fall issue, 2–12.
- Food Marketing Institute (2010) *Supermarket Facts, Industry Overview 2009*. Arlington, VA: Food Marketing Institute; available at http://www.fmi.org/facts_figs/?fuseaction=superfact
- Food Marketing Institute (2005) *El Mercado 2004: A Perspective on US Hispanic Shopping Behavior*. Arlington, VA: Food Marketing Institute; available at http://www.fmi.org/news_releases/index.cfm?fuseaction=mediatext&id=737
- US Census Bureau (2000) American Community Survey. <http://www.census.gov/acs/www/> (accessed January 2013).
- Ayala GX, Baquero B & Klinger S (2008) A systematic review of the relationship between acculturation and diet among Latinos in the United States: implications for future research. *J Am Diet Assoc* **108**, 1330–1344.
- Ayala GX, Laraia B, Kepka D *et al.* (2005) Evidence supporting tiendas as a setting for health promotion: characteristics of tiendas and tienda managers. Paper presented at the *133rd Annual Meeting of the American Public Health Association*, Philadelphia, PA, USA, 10–14 December 2005.
- Linnan L, Weiner B, Graham A *et al.* (2007) Manager beliefs regarding worksite health promotion: results from the Working Healthy Project 2. *Am J Health Promot* **21**, 521–528.
- Ayala GX, Ornelas I, Rhodes SD *et al.* (2009) Correlates of dietary intake among men involved in the MAN for Health study. *Am J Mens Health* **3**, 201–213.
- Elder JP, Ayala GX, Slymen DJ *et al.* (2009) Evaluating psychosocial and behavioral mechanisms of change in a tailored communication intervention. *Health Educ Behav* **36**, 366–380.
- Greene GW, Resnicow K, Thompson FE *et al.* (2008) Correspondence of the NCI Fruit and Vegetable Screener to repeat 24-H recalls and serum carotenoids in behavioral intervention trials. *J Nutr* **138**, issue 1, 200S–204S.
- Thompson FE, Midhune D, Subar AF *et al.* (2004) Performance of a short tool to assess dietary intakes of fruits and vegetables, percentage energy from fat and fibre. *Public Health Nutr* **7**, 1097–1105.
- Ayala GX (2006) An experimental evaluation of a group- versus computer-based intervention to improve food portion size estimation skills. *Health Educ Res* **21**, 133–145.
- Emond JA, Madanat HN & Ayala GX (2012) Do Latino and non-Latino grocery stores differ in availability and affordability of healthy food items in a low-income, metropolitan region? *Public Health Nutr* **15**, 360–369.
- Cannuscio CC, Weiss EE & Asch DA (2010) The contribution of urban foodways to health disparities. *J Urban Health* **87**, 381–393.
- Wrigley N, Warm D & Margetts B (2003) Deprivation, diet, and food-retail access: findings from the Leeds 'food deserts' study. *Environ Plann* **A35**, 151–188.
- Elder JP, Ayala GX, Parra-Medina D *et al.* (2009) Health communication in the Latino community: issues and approaches. *Annu Rev Public Health* **30**, 227–251.
- Biener LB, Glanz K, McLerren D *et al.* (1999) Impact of the Working Well Trial on the worksite health environment. *Health Educ Behav* **26**, 478–494.
- Elder JP, Ayala GX, Campbell NR *et al.* (2006) Long-term effects of a communication intervention for Spanish-dominant Latinas. *Am J Prev Med* **31**, 159–166.
- Campbell NR, Ayala GX, Litrownik AJ *et al.* (2001) Evaluation of a first aid and home safety program for Hispanic migrant adolescents. *Am J Prev Med* **20**, 258–265.
- Millman J & Pinkston W (2001) Mexicans transform a town in Georgia and an entire industry. *Wall Street Journal*, 30 August 2001.