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Veggie Van Pilot Study: Impact of a Mobile Produce Market for Underserved Communities on Fruit and Vegetable Access and Intake

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ABSTRACT

We conducted a pilot evaluation of the Veggie Van, a mobile produce market that brings weekly boxes of reduced-cost locally grown fruits and vegetables (F&V) to lower-income communities and offers cooking and nutrition education to customers. We conducted surveys just prior to starting Veggie Van at each of 3 sites and again at 2–3 months. F&V intake was measured with a 2-question item and a 10-item food frequency questionnaire (FFQ) in a subset of participants. At baseline, average servings/day of F&V was 4.9 (SD = 2.6, n = 60). At follow-up, individuals who reported shopping at Veggie Van frequently (n = 32) increased their F&V consumption by 0.41 servings/day compared with a decrease of –1.19 for those who rarely/never used Veggie Van (n = 27), a total difference of 1.6 servings/day (P = .01). There were no statistically significant differences in F&V consumption between groups based on the FFQ measure. Frequent shoppers reported additional health improvements and increases in their ability to buy enough F&V. We conclude that offering weekly boxes of affordable F&V paired with education in underserved communities may improve F&V consumption for frequent program users.

KEYWORDS

Mobile market; fruits and vegetables; lower-income; underserved; food access

Introduction

Diets rich in healthy foods—particularly those with higher levels of fruits and vegetables (F&V)—can help reduce the risk of chronic diseases.¹ Because F&V are naturally low in calories and high in fiber and water content, they are more filling than other foods and can help maintain a healthy weight.² However, most Americans do not consume enough F&V, and this is even more of an issue among lower-income and minority individuals.^{3,4} There are a number of factors that influence F&V

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consumption, including access, which involves both affordability and availability.^{5,6} Lower-income and communities of color tend to have less access to stores that sell F&V (grocery stores, supermarkets, farmers' markets) and greater access to stores or restaurants that sell nutrient-deficient foods.^{7,8} In addition to geographic proximity, individuals' perceptions of convenience of purchasing and preparing fresh F&V and affordability, quality, and variety of fresh F&V have been cited as influencing F&V access and consumption.^{5,9-12} Given this, it is important for studies to measure participants' perceptions of the food environment and usage of food outlets.

Surveys conducted in cooperation with North Carolina Department of Social Services found that lower-income families believed that having more opportunities for purchasing affordable, locally grown produce would facilitate consumption of more F&V. However, farmers' markets, which generally offer lower-cost local produce,¹³ are not easily accessed by this population.¹¹ The survey showed that participants had interest in other retail options, such as mobile markets, so we conducted formative research in several lower-income communities in North Carolina to help with the development of a program that could better serve the needs of this population.¹⁴ Focus group data suggested that a mobile produce market program delivering fresh F&V to conveniently located community sites was deemed highly acceptable to community members. That research informed the development of the "Veggie Van" program, which is a mobile produce market program that sells weekly boxes of fresh, locally grown produce at reduced cost. The purpose of this article is to (1) describe the 2 phases of pilot work that informed the Veggie Van model and (2) evaluate the Veggie Van's impact on lower-income individuals with limited access to fresh produce. Specifically, we sought to determine whether the Veggie Van program increased perceived access to fresh F&Vs among target populations and/or increased F&V consumption among people who shopped at the Veggie Van compared to those who did not.

Applied research methods

Veggie Van is run by the nonprofit organization Community Nutrition Partnership and is based in the Piedmont region of North Carolina. Researchers at the University of North Carolina at Chapel Hill partnered with Community Nutrition Partnership to develop and evaluate the Veggie Van program. Veggie Van works with community organizations that serve lower-income families and/or are located in areas that lack access to healthy food. Veggie Van staff and volunteers deliver weekly produce boxes to convenient locations within target communities (eg, lower-income housing developments, community centers, health care facilities, etc). Volunteers

also provide cooking demonstrations, nutrition information, and seasonal recipes. Customers are encouraged to order boxes in advance; they can choose a small (approximately \$8) or a large (approximately \$12) box, which are meant to feed 1–2 and 3–5 people per week, respectively. Customers can also choose to purchase individual pieces of produce, but the box is meant to be the best deal. Veggie Van operates year-round and accepts cash, checks, Supplemental Nutrition Assistance Program (SNAP), electronic benefits, and credit/debit cards. The Veggie Van purchases in bulk from local produce aggregators and passes the discount on to the customer. The Veggie Van program was made possible through grants from local foundations and businesses and from the sale of full-cost boxes to customers who could afford to pay market value for their boxes (approximately \$18 for a small and \$24 for a large).

For the evaluation of the Veggie Van program, we used a pre–post design and collected data in 2 phases:

Phase 1: September–December 2011 in Chapel Hill, North Carolina. We piloted the program in one lower-income housing community and conducted an evaluation using paper-and-pencil surveys collected from residents.

Phase 2: November 2012–August 2013 in Durham, North Carolina. We expanded the survey, made it telephone based, and tested the new methods as part of a pre–post evaluation of Veggie Van at 2 new sites, a health department (November–April) and community college (April–August). For phase 2, in order to increase awareness of Veggie Van program and encourage participation, all study participants received a weekly Veggie Van newsletter (via mail or e-mail), which included nutrition topics focused around monthly themes, produce information (e.g., Veggie of the Week), recipes, and information related to Veggie Van prices and policies. They also received a voucher to get their first box of produce free from Veggie Van.

Recruitment and data collection

All participants for both phases of the pilot had to be at least 18 years old and able to read and write in English. We also asked that the survey respondent be the one who did the majority of grocery shopping for his or her household.

Phase 1

All units of the selected housing community received a recruitment letter, study information sheet, and baseline survey placed under their door by the

property manager approximately 1 week before the Veggie Van pilot program started. Interested residents had 2 weeks to complete the 10- to 20-minute survey and return it in a sealed envelope to the property office. Participants who completed the survey were contacted after the 8-week pilot to complete a follow-up survey, which was delivered to them by mail. Participants who did not complete and return the follow-up survey within 1 week received up to 3 reminder calls from the study team. They also had the option to complete the follow-up survey over the phone. We mailed participants a \$15 gift card (to Wal-Mart or Food Lion, a local grocery store chain) after they completed the follow-up survey.

Phase 2

For phase 2, we recruited individuals at a community college and local health department. For these sites, the Veggie Van and research teams worked with employees who served as community liaisons at each site and asked them to identify people who might be interested in using Veggie Van from among students, staff, and faculty (at the community college) or employees and patients (at the health department). These potential customers were asked to complete an interest form (paper or web based) indicating their likelihood of using Veggie Van. The interest form also asked whether or not they would like to be contacted with more information about a research study. The research team called individuals who were interested in Veggie Van and agreed to be contacted by the research team. During that call, a research team member screened participants and scheduled a 30-minute telephone-administered survey for eligible participants. Prior to being called to complete the survey, potential participants received a consent document. After completing the baseline survey, participants were contacted 3 months later and asked to complete a follow-up survey. Participants received a \$15 gift card (to Wal-Mart or Food Lion) for completing the baseline survey and an additional \$15 for completing the follow-up survey.

Measures

For this study, we looked at 2 main outcome variables: perceived access to F&V and F&V intake. The perceived access variable was meant to measure the impact of Veggie Van on access to fresh F&V in the target communities and thus we compared changes from baseline to follow-up for all participants regardless of whether or not they shopped at Veggie Van. For the F&V intake measure, we were interested in whether shopping at Veggie Van had a direct impact on diet and thus we compared changes from baseline to follow-up for study participants who used Veggie Van to those who did not. In addition to the main outcomes, we asked anyone who reported on the follow-up survey

that they had used Veggie Van at least once (i.e., Veggie Van shoppers) whether they had made any changes as a result of using Veggie Van.

Perceived access to fruits and vegetables

Self-reported perceived F&V access was measured using the following 4 questions: (1) It is easy to buy fresh fruits and vegetables in my neighborhood; (2) There is a large selection of fresh fruits and vegetables in my neighborhood; (3) The fresh fruits and vegetables in my neighborhood are high quality; (4) I can afford to buy enough fresh fruits and vegetables for my family. Participants chose responses from a 5-point Likert scale ranging from *strongly agree* = 1 to *strongly disagree* = 5. Participants were asked to think about their neighborhood as the area within a 20-minute walk or about a mile from their home. The first 3 items were selected from previously tested scales^{15,16} and were summed to create a perceived access score. The affordability measure (item 4) was used as a single item because it was not originally part of the scale.

Fruit and vegetable intake

F&V servings/day was computed using 2 measures. In both phases we used a 2-question item (2QS) asking, “How many servings of [fruits /vegetables] did you usually eat each day” over the last month.¹⁷ Participants were asked to include all fresh, frozen, or canned F&V, but not juice, in their response. Responses were then summed to create the F&V outcome variable. For phase 2 only, we used the National Cancer Institute’s F&V Screener,¹⁸ a 12-item food frequency questionnaire (FFQ) asking about consumption of fruit, juice, lettuce salad, french fries/fried potatoes, other white potatoes, cooked dried beans, tomato sauce, vegetable soups, mixtures that included vegetables, and other vegetables. Participants had the option to report frequency of consumption on a per month, week, or day basis for each food. We calculated average servings/day over the past month by converting all answers to servings per day. To create the FFQ measure, we summed the responses (in servings/day) for all of the items with the exception of juice so that the final number would be comparable to the 2QS, which excluded juice.

Process measures

Participants reported how often they usually bought produce from the Veggie Van. Frequent shoppers were defined as those who bought produce one or more times per month. Rare/nonusers included individuals who never shopped at Veggie Van or who reported purchasing produce at Veggie Van

less than once a month. During phase 2, we asked participants whether they recalled receiving any newsletters from Veggie Van, how often they received them, what topics they remembered, how much of the newsletters they read, and how often they read them. We used previously developed measures to assess newsletter relevance (“How much did the information in the newsletters apply to your life?”), trust (“How much did you trust that the information in the newsletters was true?”), and whether or not the information helped participants eat more F&V.¹⁹

Self-reported behavior changes

In phase 2, as part of the follow-up survey, we asked everyone who reported ever using Veggie Van (regardless of how often they shopped at Veggie Van) whether “having the Veggie Van has changed the amount of fruits and vegetables that you (or your family) eat(s)?” We also asked participants to choose other possible dietary changes that they felt they had made as a result of using Veggie Van. The list was created based on topics covered in the newsletters.

Demographics

Baseline demographics included age, gender, race, income, marital status, education, and use of government assistance. Participants were asked to indicate whether anyone in their household participated in the following programs within the past 12 months: SNAP, previously known as “food stamps”; Special Supplemental Nutrition Program for Women, Infants and Children; free or reduced price school meals; Head Start; food pantry; Medicaid; Temporary Assistance for Needy Families or welfare; or Social Security disability benefits. We also used self-reported height and weight to compute body mass index (BMI).

Analysis

All analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC). For the perceived access variables, we used paired *t* tests to compare scores at baseline and follow-up. For the F&V intake variables, we used paired *t* tests to compare differences in changes from baseline to follow-up among frequent shoppers versus rare/nonusers. We used PROC MIXED to compare F&V intake at follow-up for frequent versus rare/nonusers while controlling for income, education, marital status, BMI, age, and baseline F&V intake.

Results

Participant characteristics

A total of 72 people participated in the baseline survey across both phases: 16 at the housing community, 27 at the community college, and 29 at the health department. Of those, 61 people (85%) completed follow-up surveys. Demographics for study completers are shown in [Table 1](#). The majority of participants were women (82%) and African American (48%). Average age was 42 and average BMI was 30. Over half of participants reported having a college degree or higher (56%) and over a third (37%) of participants reported an average yearly household income under \$30 000. The majority (61%) reported participating in at least one government program, with 20.8% reporting receipt of SNAP benefits. Among study completers, 44 (62.2%) reported using Veggie Van and, among those, 34 (55.7%) were categorized as frequent shoppers.

Table 1. Study Participant Demographic Characteristics, *N* = 61

Characteristics	Total sample
Female (%)	82.0
Education (%)	
Less than high school	4.9
High school/GED/trade school	11.5
Some college	27.9
College graduate	29.5
More than college	24.6
No response	1.6
Marital status (%)	
Married/living with a partner	55.2
Never married	22.4
Divorced/separated	22.4
Income (%)	
<\$10 000	14.8
\$10 000–\$29 999	22.3
\$30 000–\$49 000	32.8
\$50 000+	28.2
No response	3.3
Race/ethnicity (%)	
Black/African American	47.5
White/European American	39.3
Hispanic/Latino	8.2
No response	4.9
Receives government assistance ^a (%)	61.1
Age (mean ± SD)	42.4 ± 10.5
Body mass index (mean ± SD)	29.7 ± 7.8
Number of adults in household (mean ± SD)	1.9 ± 0.69
Number of children in household (mean ± SD)	1.22 ± 1.0
Fruit and vegetable servings/day	
Baseline (mean ± SD)	4.9 ± 2.6
Follow-up (mean ± SD)	4.6 ± 2.1

^aGovernment assistance includes Supplemental Nutrition Assistance Program; Special Supplemental Nutrition Program for Women, Infants and Children; free or reduced price school meals; Head Start; food pantry; Medicaid; Temporary Assistance for Needy Families; or Social Security disability benefits.

Perceived changes in access

For the perceived access scale measuring fresh F&V availability, selection, and quality (items 1–3), there were no significant differences between baseline and follow-up scores ($P = .51$). The proportion of participants reporting that they could afford to buy enough F&V to feed their families increased from 56.7% at baseline to 77.1% at follow-up (+20.3 percentage points, $P = .09$), but these changes were not statistically significant either.

Fruit and vegetable intake

On average, F&V intake of all participants as measured using the 2QS decreased between baseline and follow-up by 0.31 servings/day ($P = .34$, $n = 59$). Table 2 summarizes the changes in F&V intake for frequent Veggie Van shoppers compared to those who rarely or never shopped at Veggie Van. Individuals who reported shopping at Veggie Van frequently ($n = 32$) increased their intake by 1.6 servings/day more than those who rarely/never shopped at Veggie Van ($P = .01$). Based on the 2QS measure, 41.2% of frequent shoppers showed increases in their F&V intake over the intervention period.

Additional outcomes collected with phase 2 participants only

Food frequency questionnaire

At follow-up, average servings/day for all participants decreased from 4.3 (SD = 1.9) to 3.7 (SD = 1.9) servings per day, a decrease of 0.6 servings per day ($P = .05$, $n = 47$). There were no differences between frequent users and those who rarely or never used Veggie Van based on the FFQ measure (Table 2).

Table 2. Changes in Fruit and Vegetable Intake for Frequent Veggie Van Shoppers vs Rare/Never Users

Phase 1 and phase 2 participants: 2-Question F&V Intake Item			
	Frequent Veggie Van shoppers ($N = 33$)	Rare/non-Veggie Van users ($N = 27$)	P value
Baseline servings/day (SD)	4.65 (1.86)	5.17 (3.41)	
Follow-up servings/day (SD)	5.05 (2.10)	4.06 (2.00)	
Change in servings/day (SE)	0.41 (0.42)	-1.19 (0.46)	.01
Phase 2 Participants only: Food frequency questionnaire			
	Frequent Veggie Van shoppers ($N = 26$)	Rare/non-Veggie Van users ($N = 21$)	P value
Baseline servings/day (SD)	4.44 (1.83)	4.18 (1.97)	
Follow-up servings/day (SD)	3.76 (1.47)	3.67 (2.45)	
Change in servings/day (SE)	-0.68 (0.36)	-0.50 (0.51)	.18

Two-question data were collected during phase 1 and phase 2; food frequency questionnaire data were only collected during phase 2.

Using the FFQ, 26.4% of frequent shoppers showed increases in their F&V intake over the intervention period.

Newsletter usage

We found that 84% ($n = 42$) of people in phase 2 recalled receiving the Veggie Van newsletters; of those, most people (76.2%, $n = 32$) said they read them one time; only 2 people did not read any of the newsletters. When asked about the topics included in the newsletter, people accurately recalled some of the topics: produce tips ($n = 13$), recipes ($n = 11$), cooking information ($n = 5$), and nutrition information ($n = 5$). No one mentioned topics that were not included in a Veggie Van newsletter. Most people found the newsletters to be somewhat (48.8%) or very much/completely (36.6%) relevant to their life. Over 80% reported that they very much or completely trusted that the newsletter information was true. There were no differences in Veggie Van intake for those who reported receiving/reading the newsletters versus those who did not (data not shown).

Self-reported behavior changes

When asked whether their F&V intake increased, decreased, or stayed the same due to Veggie Van, 89.3% of the 32 Veggie Van shoppers in phase 2 reported that they had increased their intake. Table 3 indicates the changes that Veggie Van shoppers reported making as a result of using Veggie Van, including eating more locally grown food (82.4%) and less processed food (82.1%).

Table 3. Self-reported Dietary Changes Reported by Phase 2 Veggie Van Users^a

What changes have you made as a result of shopping at Veggie Van?	Percentage agreeing
I am using MyPlate when creating meal portion sizes.	21.4
I am cooking more at home.	58.8
I am using batch cooking and/or freezing as a technique to save time and/or money.	46.4
I am comparing unit prices and/or stocking my pantry to save more money on groceries.	60.7
I am eating more locally grown food.	82.4
I am using alternative ingredients to replace those that are high in fat, sodium, and/or sugar.	53.6
I am choosing more lean/non-meat proteins.	53.6
I am choosing more whole grains to include in my meals.	60.7
I am eating less processed foods.	82.1
I am eating healthier snacks.	76.5
I am eating more healthy fats.	78.6
I am eating less sugar.	67.6

^aThese data are based on questions asked during phase 2 on the follow-up survey only and represents the proportion of Veggie Van shoppers ($n = 34$) who self-reported making each change as a result of shopping at Veggie Van.

Discussion

Our pilot mobile market program showed potential for increasing consumption of F&V in lower-income communities. Across all sites, people who shopped at the Veggie Van reported an average increase in F&V intake of 1.6 servings more than people who rarely or never used the Veggie Van; however, we did not see an impact in the subset of participants who completed an FFQ. Though our study lacked a control group, Veggie Van shoppers reported making many positive changes, which they attributed to using the Veggie Van program. These findings are timely as mobile market programs are becoming increasingly popular across the country. This is one of the few studies addressing the impact of mobile market programs on diet and perceived access to fresh F&V.

A Veggie Mobile in Albany, New York, also used a pre–post design to measure changes in consumption among individuals living in senior housing.²⁰ Among people who used the program, average F&V intake increased by 0.37 servings/day. A South Carolina farmers' market program at a federally qualified health center showed an increase of 1.6 servings per day,²¹ similar to the results we saw with 2QS measure. Their study also used the 12-item FFQ but added 9 additional F&V, which could possibly amplify the affect. Their study provided \$50 in vouchers that could be used at the farmers' market, which was much larger than the free box voucher provided in phase 2 of our study (approximately \$8).

Our study is different from previous mobile market studies in that use of the Veggie Van among study participants was optional. We recruited people from the target population, prior to the start of Veggie Van, with no guarantee that they would eventually use Veggie Van. In phase 2 we used vouchers and newsletters (in addition to general advertising) to encourage study participants to use the program. Because we could not require everyone to use the program, we were able to look at both the effects that Veggie Van had on people's perceptions of food access in their community (regardless of whether or not they used Veggie Van) and a comparison in F&V consumption for frequent shoppers vs rare/nonusers. Overall, the majority of participants felt that the Veggie Van program helped them to purchase and eat more F&V and make other positive dietary changes.

One major limitation of our study was the usage of self-reported frequency of F&V consumption, which is easier and less costly to administer but less accurate at detecting changes in F&V consumption than 24-hour dietary recalls.²² For both intake measures we saw a decrease in F&V consumption between baseline and follow-up across all participants. It is possible that this was a seasonality effect because all surveys were only 2–3 months apart; however, we expected that this effect would be attenuated because the 3 sites opened at different times of year. It is possible that we saw increases among Veggie Van users for the 2QS measure and not the FFQ because the FFQ did not specifically ask about common local produce items grown in North Carolina (greens, sweet potatoes, root vegetables). We chose

the FFQ because it was a validated measure but would recommend that future studies considering this measure ensure that it accurately reflects diets of the target population.

Based on our findings, we will continue to evaluate the Veggie Van program. A logical next step would be a randomized controlled trial comparing communities that receive the intervention to delayed intervention controls. This study design will allow us to not only compare people who use the Veggie Van to those who do not but will allow us to look at differences in outcomes between the communities that receive Veggie Van compared to those that do not. This will help provide more conclusive evidence of the role of mobile markets on food access and dietary intake.

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Conflict of interest statement

Dr. Leone and Dr. Haynes-Maslow are both unpaid members of the Board of Directors for Community Nutrition Partnership, the nonprofit organization that runs the Veggie Van.

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