

“Prevention Produce”: Integrating Medical Student Mentorship into a Fruit and Vegetable Prescription Program for At-Risk Patients

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ABSTRACT

Introduction: Fruit and vegetable prescription (FVRx) programs provide increased access to produce to food-insecure, at-risk populations, yet many lack the educational and social components to support long-term disease prevention.

Objectives: To address these barriers, students at Penn State College of Medicine designed “Prevention Produce”—a modified FVRx program that integrated a community-based, month-long educational curriculum—and undertook preliminary evaluation.

Methods: Nine families deemed by clinicians as at risk of chronic disease and food insecurity received weekly \$40 “prescriptions” for produce at partnering farmers markets. Participants were paired with medical student mentors who delivered weekly nutrition education modules and assisted in produce shopping. Preprogram and postprogram surveys were administered, categorizing perceptions and practices of healthy eating. All participants were interviewed by phone 3 years later to assess long-term impact. Medical students provided written reflections via online survey.

Results: Postprogram fruit and vegetable consumption increased, and more patients expressed efforts to include produce in every meal. More participants strongly agreed that fruits and vegetables prevented chronic diseases. In reflective interviews, participants praised the program’s ease of use, mentor-patient relationship, and increased access to produce. Student mentors expressed gratitude for one-on-one interaction and felt empowered to learn and deliver nutrition education.

Conclusion: Integration of an FVRx program with education, mentorship, and community-based focus may increase produce consumption and improve opinions about healthy eating. This program serves as a model for integrating preventive strategies within larger health care systems. Additionally, the model can facilitate early clinical interventions that may benefit medical trainees’ professional development.

INTRODUCTION

Fruit and vegetable prescription (FVRx) programs¹ are emerging as clinical-community interventions to address the epidemic of obesity-related chronic disease in the US and to strengthen prevention efforts.^{2,3} Such programs allow clinicians to “prescribe” fruits and vegetables via vouchers that can be redeemed for produce at participating farmers markets, grocery stores, and Community Supported Agriculture (CSA) programs. Several studies have found an increase in consumption of fruit and vegetables as a result of giving at-risk patients subsidized coupons to farmers markets.^{4,5} However, access to produce does not appear to be in itself sufficient to promote long-term behavioral changes surrounding healthy eating habits,⁶ and studies on government-subsidized coupons for fresh produce have shown that nutrition education is

needed to increase utilization.⁷⁻⁹ Meaningful change resulting from FVRx and other food access programs requires other contextual barriers to be addressed for at-risk patients, including lack of time, inadequate cooking skills/equipment, resistance to change, lack of motivation, lack of social/household support, and environmental barriers (eg, food deserts).¹⁰⁻¹⁴ Efforts to improve nutrition cannot be confined to the clinical setting alone.

Indeed, it has been established that almost 60% of physicians spend between 13 minutes and 24 minutes with each patient,¹⁵ an inadequate amount of time to properly and effectively address diet and nutrition education in patients with chronic disease, let alone other social- and community-oriented preventive strategies that might address contextual barriers for patients. As such, there is a clear need to develop comprehensive

community-based interventions outside the clinic that can augment the benefits of increased access to produce through FVRx programs.^{16,17}

One such model, Prevention Produce, was developed by students at Penn State College of Medicine. Building on the traditional FVRx model, Prevention Produce offers vouchers for fruits and vegetables to participants living in US Department of Agriculture (USDA)-identified “food deserts” but includes an additional intervention: A month-long, one-on-one weekly mentorship by medical students, formal education and shopping sessions at a farmers market, and inclusion of family members to provide additional infrastructure supporting behavioral change. Although the feasibility of the model has been established,¹⁸ evaluation of the program has not yet been undertaken. This study undertook a preliminary evaluation to begin understanding how participation in a more comprehensive program such as Prevention Produce might change behaviors and perceptions about healthy eating. Additionally, we sought to assess the effects of an early mentorship experience on the professional development of medical students.

METHODS

Study Site

This pilot program was conducted in partnership between the Penn State Hershey Medical Center (PSHMC) in Hershey, PA, and 2 farmers markets located within 10 miles of the hospital: The Farmers Market in Hershey (PA), and the

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Broad Street Market in Harrisburg, PA. The PSHMC is a Level I pediatric and adult trauma center and academic hospital serving 8 counties in central Pennsylvania. The Farmers Market in Hershey is a seasonal market open from May through October, located across from PSHMC. The Broad Street Market is a year-round farmers market. All aspects of the study were approved by the Penn State College of Medicine institutional review board.

Study Sample and Recruitment

In 2015, we began recruiting families or individuals aged 5 to 75 years who were existing patients in the Penn State Health system identified by their primary care physician as being at risk of chronic illness or metabolic disease. Difficulty obtaining fruits and vegetables, as determined by their primary care physician or care manager, also served as a strict inclusion criterion. Patients who were not local, not able or willing to meet at the farmers markets, unable to complete the required surveys, or non-English speaking were excluded. After giving informed consent, 10 families were enrolled in the pilot program and were paired with medical students who served as nutrition mentors and were trained to deliver a curriculum at the farmers markets. The sample size for this study was not powered for statistical significance.

Mentor Training and Curriculum

Each medical student underwent an orientation and training with project leaders that included logistics of the program and a review of nutrition concepts. Each mentor was given a curriculum designed by medical student leaders that consisted of learning objectives, recipes, and optional shopping lists revolving around weekly themes. The curriculum was developed using USDA MyPlate resources and basic nutrition concepts regarding vitamins and minerals, differences between healthy and unhealthy carbohydrates and fats, glycemic index/load, and the relationship between dietary intake and the development of chronic disease.

Market Intervention

For the duration of the 6-week program, participants met with their medical student mentors for 4 farmers market

visits as was convenient in the participants' schedules. During each visit, students outlined specific educational modules addressing the curriculum topic of the week. The families then exchanged their "prescription" vouchers to receive \$40 of tokens to be spent on produce, along with an optional healthy recipe and shopping list. Student mentors accompanied families to the market, helping them shop for fresh produce and answering additional questions regarding healthy eating. Visits lasted an average of 1 hour.

Data Collection and Interpretation

Before their participation in the program, the head of each household completed a program survey, which included demographic information, frequency of fruit and vegetable consumption, exercise frequency, and perceptions and practices of healthy eating and food preparation. Questions were compiled from several standardized survey instruments: The 2012 USDA Household Food Security Survey Module,¹⁹ the 2011 Behavioral Risk Factor Surveillance System questionnaire from the Centers for Disease Control and Prevention (modified to a self-administered format),²⁰ the 2007 Health Survey for England survey,²¹ and the 2011 CookWell initiative survey.²² The same survey was also administered at the conclusion of the program. Although not specifically addressed in the curriculum, we also assessed whether or not exercise behaviors changed throughout the course of the program using a simplified version of the 2002 International Physical Activity Questionnaire.²³ Additionally, medical student mentors were given an online survey approximately 1 year after program completion assessing via free-form response the weaknesses and strengths of the program as well as what they perceived to be the most important benefits to both themselves and the patients. Patient participants were also contacted for follow-up via phone interview approximately 3 years after program completion for subjective comments on their overall experience and the long-term impact of the program. Interviews were digitally recorded and transcribed.

Survey questions regarding food preparation/cooking skills and opinions on healthy eating were administered on a

5-item Likert-type scale. The responses were assigned a value of 1 to 5, with "strongly agree" valued at 1 and "strongly disagree" valued at 5. Survey responses regarding fruit and vegetable consumption were based on frequency of consumption for the previous month and were assigned values of none, less than once per week, 1 to 6 times per week, once per day, and greater than once per day. The responses were divided for analysis by consumption of 1 or more times per week, except for fresh fruit consumption, which was divided by 1 or more times per day. Questions regarding exercise behavior were analyzed by assigning a value of 0 to 7 to the number of days engaged in activity. Because of the small sample size of this pilot study, analyses for statistical significance were not of value.

Qualitative data from medical student and participant reflection were read over and thematically analyzed by the research team. Apposite quotes were selected to provide insight into each major theme.

RESULTS

Demographics

Nine of the 10 families completed the pilot program, with 4 men and 5 women serving as head of household. One family could not complete the program because of scheduling constraints. Six identified as "African-American or black," 2 identified as "Caucasian [white]," and 1 wished to have race remain unidentified. Six participants indicated a total family income below \$40,000; 2 between \$50,000 and \$59,000, with 1 remaining participant not wishing to disclose this information. All 9 participants had seen their primary care physician within the last 6 months. Self-rating of health quality before the program was rated as "good" by 4 participants and "fair" by 3 participants.

Food Insecurity and Barriers

All respondents received a score denoting "low food security" according to the USDA's 6-item US Household Food Security Survey Module,¹⁹ with 1 participant scoring "very low food security." With regard to the query about the biggest obstacles to eating fresh food, the top response was "affordability" (77.8%) followed by "lack of desire" (22.3%).

Views about Healthy Eating, Food Preparation, and Cooking Skills

The comparison between pre- and postprogram responses to statements regarding the effects of fruits and vegetables on overall health is detailed in Table 1 along with views on food preparation and cooking skills.

Of note, all respondents either agreed or strongly agreed that eating fruits and vegetables is "satisfactory," "essential," and "tasty." After the program, more participants strongly agreed with the statements that "fruits and vegetables kept them from getting sick" (25% preprogram vs 78% postprogram; preprogram median 2.00 vs postprogram median 1.00) and "prevented chronic diseases" (50% preprogram vs 78% postprogram; preprogram median 1.50 vs postprogram median 1.00). In general, participants were willing to try new foods, would rather cook their meals, and were trying to incorporate fruits and vegetables in every meal. Notably, 78% of participants strongly agreed they felt "more confident" in cooking a main dish from a recipe after the program vs 50% before the program (median = preprogram 1.50, postprogram 1.00).

Fruit and Vegetable Consumption

Differences between before and after the program were based on daily consumption for fruits and weekly consumption for vegetables (Table 2).

Daily fresh fruit consumption increased from 37.5% before the program to 62.5% after the program. Green vegetable consumption of at least once per week increased from 62.5% to 87.5%, as did orange-colored vegetable consumption from 38% to 87.5%. "Other" vegetable consumption also increased, with more respondents reporting consumption of greater than 1 per week from 75% to 100% day (from 13% to 33%). Fruit juice consumption decreased, with more participants reporting "never" after the program (25% preprogram vs 44% postprogram).

Exercise Behavior

Differences between pre- and postprogram medians are detailed in Table 3. Of note, more participants were involved in vigorous exercise for 3 days or more after

the program (44% postprogram vs 12% preprogram; preprogram median 0.5, postprogram median 2.50).

Narrative Feedback from Participants

Overall, subjective responses from our 3-year postprogram follow-up with participants were positive. A major theme that emerged with regard to the Prevention Produce model was ease of use.

One participant stated, "That program was excellent. It was informative; it really helped with trying to see how much the difference would be to eat healthy vs eating more ready-made food for my children." The same participant felt as if "the amount of produce was perfect; it didn't go bad. I like that we had provided recipes and they were easy. ... I liked having the medical student with me; it just made

Table 1. Survey responses regarding food preparation, cooking skills, and perceptions about healthy eating in Prevention Produce program participants, Fall 2015^a

Variable	Preprogram median	Postprogram median
It is essential that I eat fruits and vegetables	1.00	1.00
Eating fruits and vegetables can keep you from getting sick	2.00	1.00
Eating fruits and vegetables can prevent chronic disease like heart disease and diabetes	1.50	1.00
Fruits and vegetables are tasty	1.00	1.00
I really care about what I eat	2.00	2.00
Eating fruits and vegetables is satisfactory	2.00	2.00
Eating fruits and vegetables is expensive	2.00	2.00
If you do enough exercise, you can eat whatever you like	4.00	4.00
The tastiest foods are the ones that are bad for you	3.50	3.00
I get confused over what's supposed to be healthy and what isn't	4.00	4.00
I am willing to try new foods	2.00	2.00
I feel confident cooking a main dish from a recipe with basic ingredients	1.50	1.00
I feel confident cooking vegetables from scratch with basic ingredients	1.00	1.00
Cooking meals from scratch is inconvenient	3.00	3.00
I would rather eat packaged foods or premade meals than cook them	5.00	4.00
I am currently trying to include fruits and vegetables in every meal I prepare	1.00	1.50

^a Responses were assigned a value of 1-5, with "strongly agree" = 1 and "strongly disagree" = 5.

Table 2. Summary of fruit and vegetable consumption in Prevention Produce program participants, Fall 2015

Variable	Preprogram responses, %	Postprogram responses, %
Consumption of salad/dark green vegetables (≥ 1 per week)	62.5	87.5
Consumption of fruit juice (≥ 1 per week)	50	37.5
Consumption of fresh fruit (≥ 1 per day)	37.5	62.5
Consumption of orange-colored vegetables (≥ 1 per week)	37.5	87.5
Consumption of other vegetables (≥ 1 per week)	75	100

Table 3. Summary of changes in exercise behavior in Prevention Produce program participants, Fall 2015^a

Variable	Preprogram median	Postprogram median
Number of days of vigorous activity (≥ 10 min)	0.50	2.50
Number of days of moderate activity (≥ 10 min)	1.50	3.00
Number of days walking (≥ 10 min)	6.50	5.50

^a Responses were coded 0-7, such that 0 = zero days of physical activity and 7 = 7 days of physical activity.

things easier ... to shop for produce for my family when [the educational module] was over." Similarly, another participant stated, "I enjoyed the young people who came to help. ... I really did like my mentor, [and] they learn more about people they aren't [usually] around and more about the medical field." Participants also seemed to retain what they learned in the program. One participant stated, "I eat more vegetables now and not a lot of fruits because of the sugars in them. I give my grandkids less fruits and more green leafy vegetables. Four oranges is like a candy bar!"

However, participants did acknowledge feeling limited in their ability to eat healthy after the program's subsidization ended, largely because of cost and affordability. As one participant said, "My son just started college, and we are in the same predicament. It's not that you don't want to get the fresher products and stuff like that ... it's just more costly ... it's hard to make ends meet, and you have to compromise and cut corners, and usually the corners that you cut aren't healthy." Another participant said, "[The cost of] produce is high. We got \$40 of produce every week, and my family doesn't usually buy that amount at one time. ... People don't always have the money or resources to eat right and that causes a lot of illnesses. ... It's just expensive. I still go down to Broad Street Market and get food locally when I can."

Narrative Feedback from Medical Student Mentors

Medical students cited the formal nutrition education and their one-on-one relationships with patients as the strongest aspects of the program. As one student expressed, the program was "a chance to be trained and interact with the community and get to know a patient on a personal level over several weeks." Students were heartened by the material benefit they observed in patients. For instance, one student expressed that, for patients "access to a tremendous amount of fresh produce ... and the guidance of a medical trainee ultimately provided healthful sustenance as well as [hopefully] education." The physical space of the farmers market also appeared to confer

a benefit to participants. As one student mentor noted, by gradually navigating the market together during the month-long experience, the patient learned that "eating more produce isn't impossible."

Mentors commonly identified reciprocal benefits for themselves, frequently expressing that being entrusted to facilitate an in-depth, sustained encounter with a patient provided a valuable learning experience that can be rare in the preclinical years. As one participant expressed, "As a younger medical student, this experience was some of the most involved interactions I've had with a patient/client. It honed my early skills of interacting, answering questions." In addition to relationship building, students felt they gleaned important and enduring skills from the experience. One student expressed gratitude at "learning more about educating individual patients and how to personalize the nutritional information to their situation."

Students also identified a few programmatic weaknesses. For instance, one participant reflected on the relatively short and discrete duration of the 1-month program: "[I] wish it could be longer so we could work with more patients." Students also felt that they could have had a greater impact had they been able to longitudinally work with the patient across their 4 years in medical school.

DISCUSSION

This pilot study built on the traditional FVRx model in an effort to implement and evaluate a more comprehensive intervention to address persistent contextual barriers potentially preventing the behavioral changes necessary to reduce the risk of chronic disease. The Prevention Produce program increased access and affordability of produce for low-income families living in a USDA-identified food desert, while offering formal education, one-on-one weekly mentorship support from medical students, shopping sessions at a farmers market, and a review of healthy recipes to prepare produce. The program included the household unit for added support.

Preliminary data showed increases in produce consumption and exercise habits as well as improved opinions regarding

healthy eating. The comprehensive nature of our program makes it difficult to delineate where the exact benefits stemmed from; however, narrative feedback from both mentors and participants provided insight into the value of information received from an educational curriculum and one-on-one mentorship in addition to subsidization of cost through the vouchers. Both the student mentors and patient participants enjoyed the one-on-one pairing and felt the program ran smoothly, yet perhaps ended too quickly. Patients retained the nutrition concepts learned in the program at 3-year follow-up, yet remained constrained by the affordability of fresh produce. Medical students valued the opportunity for an individualized patient-centered encounter that empowered them as leaders in patient care early in their education.

Healthier eating behaviors have been shown to be associated with a more future-oriented perspective.^{24,25} Education is a powerful and vital component for enriching such perspective, underscoring the value of a programmatic focus on relationship-based nutrition education with an emphasis on disease prevention. Indeed, we believe that the relationships built between study participants and medical student mentors as part of the pilot program were important to its success, as shown by the quotes given in the Discussion. The hour-long market visits not only provided dedicated time to learn and digest information but also facilitated a partnership in a nonclinical setting where the perceived hierarchies inherent to clinical medicine were perhaps less pronounced. The patient-centered nature of the "intervention" in a farmers market provided a safe environment for families to self-direct their experience at the markets, often driven by their own curiosities and questions rather than the "expertise" of students. It is perhaps through such an environment that participants gained self-efficacy and confidence in food preparation and choices, which has previously been shown to be an important psychological influence that promotes healthy eating.²⁶

Our innovation on the traditional FVRx model provides a logistical example of how clinicians at a large academic medical center who participate in FVRx

programs can supplement conversations initiated at the point of care about healthy diet and lifestyle with more supportive community-based follow-up. This is a unique health care experience in which one-on-one mentorship can provide greater opportunities to facilitate behavioral change.

An important secondary benefit from our program was an increase in exercise frequency for participants, particularly because none of the formal curriculum addressed exercise behavior. Previous studies have found the inverse—that when young adults were prescribed an exercise regimen and stuck to it, their fruit and vegetable intake naturally increased. Thus, it is possible that the observation in our preliminary study could be owed to a similar sort of “transfer effect,” where exercise influences nutrition behavior by application of self-regulatory psychological resources across behaviors.²⁷

Methodologically, our preliminary study was limited by its short duration and small sample size. Positive results may be owed to a “desirability effect” because student mentors also administered the pre- and postprogram questionnaires. Future inquiry might evaluate the Prevention Produce model using a randomized controlled trial design. Potential study designs might comparatively evaluate groups that receive a standard FVRx experience vis-à-vis groups who receive a self-guided curriculum and groups who receive the curriculum and in-person mentorship. There would be value in undertaking quantitative assessment of biomarker changes (eg, hemoglobin A_{1c}, lipid panels, waist circumference, and body mass index), and in evaluating follow-up of these biomarkers at 3 months and 6 months after the program's conclusion. Incorporation of supplemental components such as cooking classes at community kitchens, budgeting workshops, social media utilization, and school engagements are logical additions to the mentoring intervention.

Future studies might look to build interdisciplinary teaching approaches with other health care trainees (eg, students in nursing, physician assistance, dietetics, and social work) who might add further value to an FVRx intervention for both participants and mentors. Indeed, trainees who

participate in service-learning experiences in such community-based programs can build practical skills in preventive care and health coaching for patients while acquiring experiences that may be professionally formative. Additionally, more rigorous qualitative analysis can further elucidate the themes identified in this preliminary evaluation, particularly with regard to participants' learning and the professional development of medical students.

CONCLUSION

The Prevention Produce program represents an innovation on the FVRx model that can be employed in at-risk communities to increase nutrient-dense produce consumption while potentially aiding patient and physician education. This program has the potential to be adopted into a longer-term initiative in which quantitative biomarkers can be followed and assessed for change. Collaboration with other nonprofit or federally funded organizations might engender greater sustainability and efficacy of this program in the long term, which will further support long-term change. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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Weapon

Hunger is actually the worst weapon of mass destruction.
It claims millions of victims each year.

— Luiz Inácio Lula da Silva, b 1945, Brazilian politician and 35th President of Brazil