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Participation in a farmers' market fruit and vegetable prescription program at a federally qualified health center improves hemoglobin A1C in low income uncontrolled diabetics

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ABSTRACT

Fruit and vegetable prescription programs have been shown to increase consumption of fresh produce, but whether they have an impact on medical outcomes is unknown. The purpose of this study was to examine the role of participation in a farmers' market and fruit and vegetable prescription program on changes in hemoglobin A1C (HbA1C), blood pressure (BP) and weight in patients with uncontrolled type 2 diabetes at a federally qualified health center (FQHC) in Detroit, MI.

The 13-week Fresh Prescription program (June 2015–October 2015) was designed to improve access and consumption of produce among low-income patients with uncontrolled type 2 diabetes. The program allotted up to \$40 (\$10 per week for up to four weeks) for purchase of produce from a FQHC located farmers' market. Adult, non-pregnant patients with a history of type 2 diabetes that had an elevated HbA1C > 6.5 within three months before Fresh Prescription program were eligible to participate. HgA1c, BP and weight were collected within three months of program start and within three months of completion.

There were 65 eligible participants with complete biometric data. A statistically significant ($p = 0.001$) decrease in HbA1C was found (9.54% to 8.83%). However, weight (208.3 lbs. to 209.0 lbs.) and BP (135.1/79.3 mm Hg to 135.8/77.6 mm Hg) did not change from pre- to post-study ($p > 0.05$).

Access to a fruit and vegetable prescription program over a 13-week period led to decreased HbA1C concentrations in uncontrolled type 2 diabetic patients living in an urban area of predominately-lower socioeconomic status.

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1. Introduction

Eating a diet rich in fruits and vegetables may prevent chronic diseases (Van Duyn and Pivonka, 2000). Increasing fruit and vegetable intake has been shown to decrease the risk of developing type 2 diabetes and can be beneficial in the treatment of type 2 diabetes (Carter et al., 2010). Despite these benefits, many people in the United States, especially those of lower socioeconomic status, do not consume the recommended servings of fruits and vegetables (Kimmons et al., 2009).

There has been an increase in the number of farmers' markets in the United States; numbers have doubled in the last 10 years (Martinez et

al., 2010). Access to fresh fruits and vegetables has grown significantly in areas where these markets are available (Caldwell et al., 2009). Unfortunately, this growth and development has been much slower to penetrate into poorer urban areas in the United States (Singleton et al., 2015). Those living in these areas are often left to turn to eating cheap processed food (Boone-Heinonen et al., 2011) instead of fresh produce. Diets high in cheap processed food and low in nutrients may have adverse health consequences (Martinez-Steele et al., 2016).

Bringing farmers' markets to poorer areas can provide access to fresh produce (Centers for Disease Control and Prevention, 2011). Although improving access to fresh produce in these neighborhoods is helpful, there are additional challenges: individuals must still choose the more expensive fresh produce over cheap processed and nutrient deficient foods (King et al., 2004). Giving these individuals a financial incentive to obtain fruits and vegetables may be the stimulating factor to improve food choices. The goal of incentive-based fruit and vegetable programs is to empower economically poor consumers to make healthier food

Abbreviations: BP, blood pressure (mm Hg); CHASS, Community Health and Social Services Center; FQHC, federally qualified health center; Fresh Rx, Fresh Prescription program; HbA_{1c}, hemoglobin A1c concentration (%).

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choices by increasing affordable access to fresh produce. The incentive-based fruit and vegetable programs have been designed in many different manners. The Double Up Food Bucks program doubles the value of federal nutrition (SNAP or food stamps) benefits spent at participating markets and grocery stores, helping people bring home more healthy fruits and vegetables while supporting local farmers (Food Fair Network, 2016). Other programs give vouchers directly to low-income individuals that can be used to purchase fresh produce free or at discounted costs. Fruit and vegetable prescription programs are set up for healthcare providers to give patients prescriptions to be spent on fresh produce. Incentive-based fruit and vegetable programs have been shown to increase fresh produce consumption in low-income individuals (Abusabha et al., 2011; Anderson et al., 2001; Evans et al., 2012; Savoie-Roskos et al., 2016).

Federally qualified health centers (FQHC) are medical centers that are required to serve an underserved area or population, offer a sliding fee scale, and provide comprehensive multidisciplinary services (Health Resources and Services Administration, 2012). FQHCs serve the most economically disadvantaged, a population likely to have their health affected by poor food choices. FQHCs, by virtue of their patient populations, are well positioned to evaluate the impacts of increasing access of healthy foods in terms of facilitating health behavior change, with the ultimate goal of improved health outcomes. When FQHCs have brought farmers' markets to their centers, vegetable intake in patients of lower socioeconomic status improved (Freedman et al., 2013).

Unfortunately, many chronic conditions, including type 2 diabetes, hyperlipidemia, hypertension, obesity and cancer are exacerbated by certain health behaviors, such as poor nutritional intake and lack of physical activity (Hung et al., 2004). These disease processes are more prevalent in low-income individuals (Agardh et al., 2011). Physicians have an opportunity to connect nutrition to health for their patients while also motivating them to become more actively engaged in improving their own health (Armstrong et al., 2011). Consequently, providing the opportunity for physicians to prescribe fruits and vegetables as a form of "medicine" maybe an approach that would create positive health change. To date, there has been no research investigating the quantitative health benefits of incentive-based fruit and vegetable programs based at FQHCs in patients with preventable chronic disease.

The purpose of this study was to examine the impact of participating in a farmers' market and fresh fruit and vegetable prescription program on changes hemoglobin A1C (HbA_{1c}) concentration, blood pressure (BP) and weight in patients with uncontrolled type 2 diabetes at a FQHC.

2. Methods

2.1. Program

The Fresh Prescription (Fresh Rx) program is a fruit and vegetable prescription program that brings together the healthcare system and the food system, fostering innovative relationships to build a healthy sustainable food system in Detroit. Fresh Rx is the result of collaboration between the Ecology Center, an organization based in Southeastern Michigan that works to develop innovative solutions for healthy people and a healthy planet, and Community Health and Social Services (CHASS) Center, an FQHC located in Southwest Detroit, MI. The majority of CHASS' patients are of lower socioeconomic status, are Latino or African American, and are Spanish speaking.

Participants were referred to the program by their medical providers for the following chronic conditions: diabetes, hyperlipidemia, obesity, and hypertension. Also, patients who are pregnant or who have children with limited access to fruits and vegetables may be referred. The 13-week Fresh Rx program allotted up to \$40 (\$10 per week for up to four weeks) for purchase of fresh fruits and vegetables at that CHASS farmers' market (referred to as the Mercado). A \$5 incentive, for use

at the Mercado, was also offered to those that completed a health goals sheet. The Mercado operated on every Thursday (9 am–1 pm) from June 2015–October 2015.

For the purpose of our study, we focused only on non-pregnant, adult, uncontrolled type 2 diabetics.

2.2. Study participants

Adult non-pregnant CHASS patients were eligible to participate in the study if: 1) they had a previous diagnosis of type 2 diabetes, 2) had an elevated hemoglobin A1c (HbA_{1c}) > 6.5 within three months before the Fresh Rx program, and 3) were referred to the program from his or her primary care provider.

2.3. Intervention

All participants signed an informed consent form and completed a basic program orientation that included receiving their Fresh Rx debit card and the opportunity to fill out a health goals sheet. They also had their BP, weight and HbA_{1c} tested at the time of orientation if they had not had them tested within three months of the Fresh Rx orientation.

Participants were then directed to go to the Mercado and fill their prescription for fresh produce up to four times during the 13-week Fresh Rx program. The debit cards were loaded with the \$10 stipend at each visit to the Mercado. Those that did fill out their health goals sheet received an additional \$5 incentive on their Fresh Rx debit card that they could use at the Mercado. At each visit, community health workers followed up with participants to assess progress of their goals from their health goals sheet. Participants, as well as, vendors at the Mercado were educated about the program and signage at vendor booths reinforced eligible purchases which included only fresh produce. Prepared foods and/or juices, even if they were fruit or vegetable based, were not an eligible purchase. At each market session, cooking demonstrations took place that reinforced healthy food options and how to prepare foods that were available at the Mercado. Participants were allowed to return to the Mercado at other times after their four visits but did not receive any further financial incentives.

All participants had their BP, weight and HbA_{1c} tested within three months of the end of the Fresh Rx program. Due to the partnership between the CHASS Center, the Ecology Center and other community partners, this study used a community-based participatory research approach and was approved by the appropriate Institutional Review Board.

2.4. Statistical analyses

Descriptive analyses were conducted to determine the percentages, means, and standard deviations of participant demographics and the number of times participants utilized the market. Paired sample *t*-tests were conducted from pre- to post-program to evaluate changes in HbA_{1c}, weight, systolic and diastolic blood pressure readings. All analyses were performed using SPSS version 20.

3. Results

There were 224 adult, non-pregnant, patients with diabetes who were referred and invited to participate in the program. Of these, the majority were female (57.6%, *n* = 129). Of those who were contacted and asked to participate in the study, 80 (35.7%) agreed. Six participants were excluded due to HbA_{1c} < 6.5. HbA_{1c}, BP and weight were collected within three months of the program start and within three months of completion. Nine were lost to follow up; therefore, there were 65 eligible participants with complete pre- and post-biometric data.

Age ranged from 25 to 73 with a mean age of 52.5 years old (SD = 10.6). The majority of participants were female, Latino, and were either

uninsured or underinsured (Table 1). Most participants attended four market visits (63.1%, $n = 41$), 16.9% ($n = 11$) attended three times, 6.2% ($n = 4$) attended twice, and 13.8% ($n = 9$) attended once throughout the 13-week program. Of eligible participants, 84.6% (55/65) received the \$5 incentive by completing their health goals sheet.

From pre- to post-program, there was a statistically significant decrease in HbA_{1c} concentration mean (Table 2). There was not a significant change in average weight or average BP (Table 2).

4. Discussion

The findings suggest the importance of a fruit and vegetable prescription program in low-income patients with type 2 diabetes in regards to improved health outcomes, specifically statistically significant decrease in HbA_{1c}. This significant decrease in HbA_{1c} (a 0.71 decrease), may appear surprising due to minimal investment in each participant (maximum \$45), however this impact may reflect effectiveness of the entire program and the challenging situations that arise from those dealing with poverty. There are other studies that showed similar results when comparing diabetic education in low-income diabetics (Huckfeldt et al., 2012; Rosal et al., 2005). The poor nutritional value of diets of people in low-income neighborhoods is due to cost, quality of food and food choice limitations (Hendrickson et al., 2006). Due to these challenges, the effectiveness of a fruit and vegetable prescription program on health outcomes may increase. The connection of health and nutrition in the Fresh Rx program is exemplified by the prescribing provider, the community health worker, the cooking demonstrations and farmer's market taking place at the health center. Those who participated and were exposed to a fruit and vegetable prescription program may be more motivated to make healthier food choices on their own accord. This type of prescription program may be useful in helping to promote improved health effects in patients with uncontrolled type 2 diabetes.

We did not detect any significant changes in BP and weight among study participants, perhaps because the duration of the study (incentives for four weeks of fresh produce during a 13-week farmers' market "season") may have been too short to impact on these parameters (John et al., 2002). We did not attempt any other behavioral change interventions, and those may have had a synergistic effect with the Fresh Rx program (Carlton, 2007). It is possible that HbA_{1c} may be more sensitive to decrease from such a short intervention. We also did not find a dose-response relationship between number of Fresh Rx visits and decrease in HbA_{1c}. This may have been due to the decreased sample size when separating the participants by number of Fresh Rx visits (one to four).

The strengths of this study are that the cohort does reflect a typical FQHC population of an urban area in the United States by ethnicity

Table 1
Demographics of participants with uncontrolled diabetes in the Fresh Rx program study ($n = 65$).

Characteristics	n	%
Gender		
Female	46	70.8
Male	19	29.2
Age		
18–39	8	12.3
40–49	15	23.1
50–59	23	35.4
>60	19	29.2
Race/ethnicity		
Hispanic or Latino	43	66.1
Black/African American	18	27.7
White	4	6.2
Insurance status		
No insurance	26	40.0
Medicaid	24	36.9
Medicare	12	18.5
Commercial insurance	3	4.6

Table 2

Weight, blood pressure and hemoglobin A1C concentration means of participants before and after participation in Fresh Rx program study ($n = 65$).

	Pre-Fresh Rx mean	Post-Fresh Rx mean	t	p
Weight (lbs.)	208.3	209.0	−0.76	0.45
Systolic BP (mm Hg)	135.1	135.8	−0.39	0.70
Diastolic BP (mm Hg)	79.3	77.6	1.40	0.17
HbA _{1c} (%)	9.54	8.83	3.54	0.001

and insurance status. This is the first study to assess changes in biometric health data associated with an incentive-based fruit and vegetable program. The limitations include low enrollment (35.7% of those contacted were able to participate in the program). This low percentage may self-select for those that were motivated to participate. However, when patients are motivated and able to participate, it appears that there could be an impact on utilization of the program, and lowering HbA_{1c}. The low rates of participation could possibly be due to weekday daytime commitments. Making Fresh Rx hours more flexible in the future may combat this challenge. Other confounding variables could have influenced the results. Participants may have been associated with other diabetic education programs; they may also be getting adjustments to their diabetic medications through their providers and/or improving their own health in other ways etc. Future research could focus on these influences or attempt to eliminate them by a randomized controlled trial. This was not attempted through the Fresh Rx as our main goal is to improve access and affordability to any/all of our patients that were able to participate in the program. In addition, the long-term effects of this program are unknown. The question remains, does participant behavior change to include increased fruit and vegetable consumption and maintained HbA_{1c} for years to come. It would be of benefit to follow-up with participants in the future to better understand these possible effects. Examining the impact of continued fruit and vegetable prescriptions/consumption over an extended period of time (more than four weeks) and assessing for sustained decreases (after three months) in HbA_{1c} would be quite valuable for effective sustainable management of type 2 diabetes.

HbA_{1c} plays a significant role in the monitoring diabetic control, and although there are options for medications in type 2 diabetes care, some may have a marginal improvement in HbA_{1c} concentration and come with side effects (Sherifali et al., 2010). Consumption of fresh produce should be emphasized in the treatment of type 2 diabetes, due to its positive health benefits and lack of side effects. Findings from this study suggest that if patients are given a "prescription" to redeem at a farmers' market, several potential benefits are likely: promotion of the use of the market and positive impact on health outcomes such as improved glycemic control. As Hippocrates stated "let food be thy medicine and medicine be thy food." Providing patients the opportunity to obtain healthy foods, can make a significant impact on their overall health.

5. Conclusion

Findings highlight the importance of fruit and vegetable prescription programs on the health of patients with uncontrolled type 2 diabetes. The enhanced access to fruits and vegetables over a 13-week period led to decreased HbA_{1c} concentrations in uncontrolled diabetic patients living in an urban area of predominately-lower socioeconomic status. Providing the opportunity to obtain healthy foods and to teach patients the importance of nutrition in health, could make a significant impact on health, especially in areas of lower socioeconomic status.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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