AN EXPLORATION OF GARDENER SUPPORT PROGRAMS, COMMUNITY GARDENERS' EXPERIENCES, AND ASSOCIATIONS WITH PERCEIVED DIETARY CHOICES, FOOD SECURITY, AND FOOD VALUES

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ABSTRACT

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Gardening is associated with health behaviors, including fruit and vegetable consumption and physical activity. Maintaining these benefits is dependent on sustaining gardens and interest of gardeners, which can be challenged by lack of gardening skills and knowledge and financial cost. Gardener support programs reduce these barriers by providing gardening resources and education, especially important for new gardeners who may lack gardening skills and knowledge. The overall objectives of this dissertation were to understand how and why gardening influences diet, the challenges faced by new gardeners, and aspects of gardener support programs that may be most beneficial to sustaining gardens. The aims of this dissertation were to: 1. Investigate how and why gardening is perceived to influence dietary choices and food security, 2. Explore the experiences of new community gardeners, and 3. Examine the associations between garden characteristics, participation in components of a gardener support program, and continued program participation.

For the first aim, in-depth semi-structured qualitative interviews were conducted with 28 experienced members of the Garden Resource Program operated by Keep Growing Detroit, a non-profit organization in Detroit, Michigan. Data were analyzed by thematic coding. Many gardeners perceived that gardening led to increased vegetable intake and decreased intake of less healthy foods, including fast food and processed foods. They perceived knowing how their food was produced, an emotional attachment to food they grew, and that home-grown produce tasted

better caused these dietary changes. Gardening was perceived to influence aspects of food security by contributing to financial savings on food and providing ample access to fresh vegetables, which gardeners preserved for year-round use.

In the second aim, in-depth semi-structured qualitative interviews were conducted with 15 new community gardeners participating in a randomized controlled trial of community gardening in Denver, Colorado to examine their perceptions of leadership, social interaction in the garden, and challenges. Thematic coding was used to analyze data. Key challenges described by new gardeners included limited time and lack of gardening knowledge. There was variation in new gardeners' perceptions of social interaction in the garden and support from their garden leaders. Engaged garden leaders and other experienced gardeners helped alleviate challenges by sharing their gardening knowledge and assisting new gardeners.

In the third aim, data from Keep Growing Detroit's records on 2,318 gardens participating in their program from 2012-2015 was used to examine the association between components of their programming and continued garden participation using multilevel logistic regression and mediation analysis. Program components associated with continued garden participation in the Garden Resource Program included attending educational classes, volunteering, previous years of garden membership in the Garden Resource Program, and receiving seeds and plants. Comprehensive education indirectly increased the likelihood of continued garden membership through participation in other aspects of the program.

Overall, these three studies advance the understanding of sustaining and expanding gardening's health impacts by demonstrating how gardening is perceived to influence dietary choices and food security, and highlighting the importance of leadership, social interaction, education, and resources to sustain gardeners' participation and improve garden longevity.

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CHAPTER 1-INTRODUCTON

Background

The vast majority of Americans do not consume the recommended amount of fruits and vegetables or meet recommended levels of physical activity.[1,2] Meeting these recommendations is associated with a host of health benefits including reduced risk of chronic diseases such as cardiovascular disease and diabetes.[3-6] Research studies have demonstrated an association between gardening and health behaviors implicated in the reduction of chronic diseases, including consuming fruits and vegetables more often and providing a source of physical activity.[7-10] Additionally, psychosocial benefits have been attributed to gardening, including improved mental wellbeing and providing sources of rich social interaction and community development. [11,12] [13-17]

Cross-sectional studies have demonstrated that gardeners consume fruits and vegetables more often than non-gardeners,[7,8,18] and in intervention studies participants self-report eating more fruits and/or vegetables after gardening.[18-21] There is also evidence that gardeners value food produced via alternative production practices, including local and organic.[22,23] An association between valuing alternative food production and healthier diets has been found: adults whose diets contained more locally-produced food had higher Healthy Eating Index scores,[24] and young adults who valued alternative food production practices more had higher intakes of fruits and vegetables and lower intake of added sugars and fast food.[25]

However, gardeners experience numerous challenges, including time constraints, lack of gardening knowledge, and financial cost,[26,27] and sustaining both gardens and gardeners is challenging.[28,29] Hundreds of gardener support organizations across the country help to reduce these challenges by providing free or low-cost access to material resources such as plants and

seeds, providing educational opportunities to learn gardening skills, offering technical support, and cultivating local social networks of gardeners.[28]

It is important to discover how and why gardening may contribute to increased vegetable intake. Additionally, the role that gardener support organizations play in supporting gardeners and maintaining participation in their programs, and the experiences of new gardeners, who may lack gardening knowledge and skills, have not been examined in research literature. There is a need to address these gaps to inform the use of gardening as a public health intervention and reduce the barriers to gardening, namely by determining if and how gardening influences vegetable intake, how gardener support programs can most successfully maintain garden participation in their programs, and understanding the challenges new gardeners experience.

My long-term goal is to determine the effectiveness of gardening as a health promotion intervention, and to understand how gardener support programming can support continuation of gardening. The objectives for this dissertation are to explore how gardening is perceived to influence diet, explore the experiences of being a new community gardener, and identify which aspects of a gardener support program can most successfully maintain continued participation in the gardening programs. These objectives are achieved by addressing the following specific aims.

Specific Aims

- Specific Aim 1A: Qualitatively examine experienced Detroit, Michigan Garden Resource Program participants' perceptions of whether, how, and why gardening and participation in the support program has influenced their dietary choices.

- Specific Aim 1B: Qualitatively examine experienced Detroit, Michigan Garden Resource Program participants' values related to food, as well as examine if these participants perceive that gardening and participation in the support program influenced these values.
- Specific Aim 2: Qualitatively explore the experiences of new Denver Urban Gardens community gardeners in Denver, Colorado, with respect to motivations to garden, challenges experienced, perceptions of garden leadership, and social interactions.
- Specific Aim 3A: Describe garden characteristics (including garden type, size of garden, number of people involved, and ownership of garden land by gardeners) and gardener participation (including in educational classes, volunteering, social events, comprehensive gardening programs, site visits, and length of participation) in the Detroit Garden Resource Program.
- Specific Aim 3B: Investigate the association between garden characteristics, participation in a gardener support program, and continued participation in the gardener support program controlling for average education, race, and poverty of the zip-code where the garden is located.
    - $\underline{H_1}$: Our hypothesis is that increased participation in components of the gardener support program is positively associated with continued participation in the gardener support program.

Significance

Gardening is a popular pastime in the United States, with approximately one-third of American households growing food in 2013.[30] This demonstrates wide acceptability of gardening, which enhances the feasibility of gardening interventions.

This research builds upon the existing research on gardening and health behaviors by

addressing key gaps in the literature, including examining how gardening influences vegetable intake, determining which components of a gardener support program are most successful at retaining gardens in their programs, and examining the experiences of being a new community gardener.

Aims 1 and 3 were conducted in collaboration with the non-profit organization Keep Growing Detroit, which operates the Garden Resource Program in Detroit, Michigan. In 2018, over 1,600 community, family, school, and market gardens were members of this program. In addition to providing seeds, plants, and other material resources for gardening, Keep Growing Detroit offers gardening education and social events for its gardeners. They are committed to fostering a vibrant network of gardeners who not only share their knowledge of gardening with each other, but who also advocate for urban gardening and food access in the city of Detroit. They are uniquely suited for collaboration in these aims due to the large number of gardens and gardeners involved in this organization and the emphasis on building social connections between gardeners.

Aim 1 examined gardeners' perceptions of how gardening influences their dietary choices, identified how gardening is perceived to contribute to changes in dietary choices, and explored gardeners' values related to food. These findings can be beneficial for gardener support organization to tailor their programming to maximally support health behaviors, and are also applicable for other public health organizations and others interested in behavioral interventions to improve diet and physical activity. Examining gardeners' food values elucidated how food values are perceived to relate to diet quality amongst gardeners. Previous research has demonstrated that gardeners value local and organic foods,[22,23] and these values have been associated with healthier diets in other studies.[24,25]

Aim 2 was conducted in collaboration with Denver Urban Gardens, a non-profit organization that manages community gardens and supports gardeners in the metro Denver, Colorado area. Like Keep Growing Detroit, Denver Urban Gardens provides gardening education, technical support, and social events for gardeners in its network. The participants in Aim 2 were a subsample of participants taking part in a randomized controlled trial of community gardening, where participants garden at community gardens managed by Denver Urban Gardens. Aim 2 examined motivations for gardening, identify challenges experienced by new gardeners, gardeners' perceptions of leadership, and examine social interactions in the garden. Thus far, qualitative research on community gardening has not specifically examined new gardeners. It is essential to examine the experience of new gardeners to determine how to most effectively support new gardeners who may lack the knowledge and skills required to garden successfully. The outcomes of this aim can be used by gardener support programs and other organizations that implement gardening programs, including cooperative extension services, public health departments and coalitions, and city-led programs to inform their programs to best support new gardeners.

Aim 3 determined which aspects of the Garden Resource Program (including receiving seeds and plants, attending educational events, attending social events, volunteering) are associated with continued garden participation in the Garden Resource Program. In our preliminary data analysis we found that from 2009 to 2014, 36-46% of gardens participating in the Detroit Garden Resource Program did not participate the following year. While substantial research has demonstrated an association between gardening and fruit and vegetable intake, mental health, and social interaction, it is important to examine mechanisms to sustain involvement in gardening support programs for the continuation of gardening's health benefits.

Our collaborating organization, Keep Growing Detroit, can use this information to inform their programming, by emphasizing the aspects that are associated with sustained participation. Additionally, this data can aide other gardener support programs and aide the design of gardening programs to determine the most useful facilitators to increase garden sustainability and gardener retention.

CHAPTER 2-LITERATURE REVIEW

Fruit and Vegetable Intake and Chronic Disease

The 2015 Dietary Guidelines for Americans recommends that average adults consume between 2 and 3 cups of vegetables and between 1½ to 2 cups of fruit per day, depending on calorie needs.[31] However, the vast majority of Americans do not meet these recommendations. A study using data from the national Behavioral Risk Factor Surveillance Study found that average intake among adults was 0.79 cups per day for fruit and 1.28 cups per day for vegetables, and only 8% and 14% of adults met vegetable and fruit recommendations, respectively.[1]

Fruits and vegetables are not only important sources of nutrients such as vitamins, minerals, and fiber, but they are also important for the prevention of lifestyle-related chronic diseases. Recent meta-analyses of prospective cohort studies have examined the association between fruit and vegetable intake and chronic diseases, including type 2 diabetes, cardiovascular disease, and cancer. For example, one study found that neither total fruit and vegetable intake nor vegetable intake alone were associated with reduced relative risk of type 2 diabetes, but greater fruit intake and intake of dark green vegetables were associated with a reduced relative risk of type 2 diabetes.[4] In another meta-analysis, an inverse relationship was found between total fruit and vegetable intake and cardiovascular disease, as well as all-cause mortality, but not cancer mortality.[3] However, fruit and vegetable intake was associated with reduced risk of colorectal cancer in another meta-analysis.[32]

Food Environment

The ecological framework posits that eating behaviors are influenced by factors at multiple levels, including individual factors, the social environment, the physical environment,

and the macro-level environment.[33] The physical environment, also called food environment, includes food retailers, restaurants, and other sources of food that an individual encounters in their daily life. The physical environment shapes eating behaviors in numerous ways, including dictating what foods are available to an individual to purchase/acquire and consume.[33]

Considerable research has examined the relationship between the food environment and nutrition-related outcomes. These studies measure the healthfulness of the food environment using a variety of methods. Oftentimes distance to supermarkets is used as an indicator of healthy food access because supermarkets tend to have a greater variety of healthful foods at lower costs than other food retailers.[33] Other methods include assessing the quality or variety of healthy foods in nearby food stores, or measuring shelf space dedicated to healthy foods.[34]

Due to the importance of fruits and vegetables for health and low average consumption in the U.S., studies have examined characteristics of the food environment and their association with fruit and vegetable intake. These studies have inconsistent findings regarding the importance of different types of food stores for influencing fruit and vegetable intake. A recent review found that indicators of healthy food environments such as shorter distance to supermarkets or greater variety of produce available in stores were associated with increased intake of fruit and/or vegetables in about half of studies reviewed.[34] This inconsistency in findings can be due to many factors, including variability in methods used in assessing healthfulness of the food environment, and intricacies of the local context in mediating the relationship between food environment and dietary intake.

Research has also examined the association between healthful food environments and health outcomes, including diabetes, blood pressure, coronary heart disease risk, and serum cholesterol. A study examining access to healthy foods, including fresh fruits and vegetables,

found an inverse relationship with insulin resistance and diabetes,[35] while another study found no relationship between healthy food outlets (supermarkets, fruit and vegetables stores, and natural food stores) and having gestational diabetes.[36] Other studies have examined risk factors for cardiovascular disease and their association with healthful food environments. One study found a small but significant inverse relationship between grocery store density and diastolic blood pressure, but no significant relationship with systolic blood pressure,[37] while another study found no relationship between grocery stores per 1,000 residents and 10-year coronary heart disease risk[38] Additionally one study examining multiple outcomes found no association between presence of supermarkets in a census tract and diabetes, high serum cholesterol, or hypertension after adjusting for sociodemographic variables and presence of other food stores.[39]

Food Environment -Detroit

Detroit, Michigan has been in the national spotlight for its paucity of healthy retail food options for its residents.[40] This reputation was further heightened in 2007 when Detroit was left without any national chain supermarkets within the city limits.[41] Since that time, Detroit has gained a few large national chain supermarkets and recent research has found that Detroit has 96 supermarkets and large grocery stores, many more than commonly believed.[40] Due to the presence of large grocery stores and supermarkets, only a small fraction (19 out of 297 census tracts) of the city is designated as a food desert by USDA definitions.[40]

Despite the presence of large grocery stores and supermarkets in Detroit, research indicates that residents are concerned with the quality and availability of nutritious food. A 2015 survey by the Detroit Food Policy Council found that 94% of survey respondents were concerned with access to healthy food in Detroit. These survey respondents cited lack of quality produce, lack of grocery stores, and high prices as areas to target to improve food access in Detroit.[42] In

focus groups with residents of Detroit, participants reported there was a lack of fresh food in the city, and residents had negative perceptions of the small neighborhood stores that predominate the city. They described these stores as having low-quality food, and being unclean, bad smelling, moldy, and infested with cockroaches. They reported price gouging, and deceit, such as selling spoiled meat. Additionally, African American residents reported racial tensions between themselves and the non-resident, non-African American storeowners. The theme of racial inequality in access to quality food was prevalent, with a particular emphasis on inequality between the majority African American city of Detroit and the majority white suburbs. While many of the focus group residents cited difficult access to transportation, those that did have access to transportation reported shopping in the suburbs to obtain fresh food.[43]

As indicated in the focus group findings described above, Detroit residents perceive the city's small food retailers as being unclean and having low quality food. In research literature, these food outlets are oftentimes referred to as fringe retailers. This label can include liquor stores, small grocers, convenience stores, and corner stores, and they outnumber supermarkets and large grocery stores by about 11 to 1 in Detroit.[40] To empirically measure the sanitation and food quality in these food outlets, Data Driven Detroit conducted in-store surveys of 207 randomly selected Detroit food retailers with liquor licenses. This study found a high prevalence of food safety and sanitation violations. The most prevalent food safety violations included expired food being sold (38% of stores surveyed), food marked without an expiration date (33%), expired meat being sold (22%), decaying fruits (22%), and decaying vegetables (18%).[44] The most prevalent sanitation violations included dirty floors (56%), moldy filth on walls (33%), moldy filth on refrigerator racks (32%), dirty counter tops (25%), bad smells (21%), and evidence of insect infestation (12%).[44] This study also found higher average rates of food safety

and sanitation violations in census tracts with higher poverty (1.6 violations in census tracts with 0-15% of residents living in poverty, compared with 5.0 in census tracts with more than 45% of residents living in poverty) and in majority non-Caucasian census tracts (3.0 in majority Caucasian, 3.8 in majority Latino, and 3.9 in majority African American).[44]

Other studies have empirically demonstrated racial and socioeconomic disparities in food access in metro Detroit. One study found that in high poverty areas of metro Detroit, supermarkets were on average 1.1 miles further away in neighborhoods with a medium or high African American population when compared with neighborhoods with low African American populations.[45] Another study examined produce quality, availability, and price, as well as prevalence of various types of food stores by race and socioeconomic status in metro Detroit. The sample for this study was drawn from three communities in Detroit and one Detroit suburb that varied in racial composition and socioeconomic status. The communities in Detroit included a primarily African American low income community, a racially heterogeneous low income community, and a middle income predominantly African American community, while the suburban community was racially heterogeneous and middle income. This study found that in the racially heterogeneous suburban community there were 10.2 chain grocery stores per 100,000 residents, compared with 2.2 per 100,000 in the African American middle income community, and no chain grocery stores in the low income African American community or racially heterogeneous low income community. Selection and price of fresh produce did not vary by community, but quality of produce was significantly lower in the African American low income community than the racially heterogeneous suburb.[46]

Gardening

Prevalence of Food Gardening in U.S.

Food gardening, growing edible plants such as fruits and vegetables, is a prevalent activity in the U.S and is gaining in popularity. In 2013, an estimated one in three households, 42 million, were growing food in the U.S., a 17% increase from 36 million households in 2008.[30] Specific demographic groups have recently seen marked increases in food gardening. These groups include people aged 18-34 (8 million in 2008, 13 million in 2013), households with children (12 million in 2008, 15 million in 2013), households with high school education or less (8 million in 2008, 14 million in 2013), households with high incomes (over $75,000 per year, 8 million in 2008 to 15 million in 2013), and households with low incomes (less than $35,000 per year, 8 million in 2008 to 11 million in 2013).[30]

The vast majority of American households that gardened did so at their own home. In 2013, 37 million American households gardened at their own home, 2 million households gardened at a friend or relative's home, and 3 million gardened at a community garden.[30] This is a three-fold increase in community gardening since 2008, when one million households participated in community gardening.[30]

Background on Community Gardening in U.S.

The history of community gardening in the United States dates to the 1890's.[47] These first community gardens were urban vacant lot gardens implemented during an economic recession to help the many unemployed laborers feed their families. While this first wave of community gardens largely disappeared as economic status improved, numerous crises gripped the country in the first half of the 20th century, leading to a renewed focus on community gardening. The impetus for community gardening shifted beginning in the 1970's. The

community gardens of that era were motivated by environmentalism and urban renewal. These same factors, as well as many more (explained below), serve as the motivations for current community gardens.

Community gardens burgeoned during the national crises of World War I, the Great Depression, and World War II. The national World War I "War Garden" campaign promoted household and community gardens to produce fruits and vegetables for domestic consumption, sparing farm-raised food to be sent abroad to support the troops. From 1917-1918 millions of gardens were planted in the U.S. annually, producing hundreds of millions of dollars worth of fruits and vegetables each year.[47] While the War Garden campaign promoted gardening as a patriotic activity, during the Great Depression of the 1930's the focus of gardening programs returned to that of the 1890's: to provide food for out-of-work laborers. The World War II wartime gardens were rebranded as "Victory Gardens." Like the War Gardens of World War I, Victory Gardens were also promoted as a patriotic duty to the country and as a morale booster. Gardens at this time were also intended to improve the poor nutritional status of American civilians and military: 40 percent of potential military recruits did not pass physical examinations due to malnutrition.[47] Fruit and vegetable consumption was promoted nationally to increase vitamin and mineral intake, and improve health.

In the 1970's new catalysts for gardening emerged, including concern for the environment, health effects of agricultural chemicals, and urban revitalization.[47] Disinvestment in urban areas resulted in vacant and blighted areas, and community gardening was seen as a means to improve neighborhoods and build community cohesion. The community gardens of today are supported by hundreds of local organizations that assist in building gardens, providing material resources and gardening education, and foster social networks of community

gardeners.[28] Members and staff of these organization cite a multitude of benefits of community gardening, including food production and access, improved nutrition, social engagement, physical activity, personal satisfaction, environmental benefits, gardening education, intergenerational activities, inter-cultural communication, and neighborhood revitalization.[28]

Gardens and Fruit and Vegetable Intake

Consuming fruits and vegetables confers a wealth of physical health benefits that are increasingly important in this era of diet-related chronic diseases. Published literature has demonstrated a positive association between both community and home gardening and fruit and vegetable consumption. Various study designs and methods to assess fruit and vegetable intake have been used to examine this association. Methods include food frequency questionnaires of fruit and vegetable intake frequency, and measuring perceptions that gardening has increased fruit and/or vegetable consumption. Study designs used include cross-sectional studies with random population-based surveys or case-control surveys, as well as intervention studies. Some intervention studies include a pre-post test design, while others include a post-test only design. None of the intervention studies examining fruit and vegetable intake in gardeners have used a control group.

<u>Community Gardens and Fruit and Vegetable Intake: Quantitative, Cross-Sectional</u>

Several cross-sectional studies have examined the frequency of fruit and vegetable intake of community gardeners compared with non-gardeners. The first such study compared 144 community gardeners from the Philadelphia Urban Gardening Project with 67 non-gardening controls living near the gardens. Community gardeners consumed vegetables from 12 out of 14 categories more frequently than non-gardeners, with 6 of the categories consumed significantly more often in community gardeners. However, non-gardeners consumed fruit more often than

gardeners.[48] In Flint, Michigan, a telephone survey was conducted of 766 participants from randomly selected households. This study found that people with a household member participating in a community garden consumed fruits and vegetables 4.4 times per day, significantly more than 3.3 times per day for people without a household member participating in a community garden. Additionally, those with a household member participating in a community garden were 3.5 times more likely to consume fruits and vegetables at least 5 times per day.[8] In Denver, Colorado community gardeners consumed fruits and vegetables 5.7 times per day, significantly more than home gardeners (4.6 times per day) and non-gardeners (3.9 times per day). In this study 56% of community gardeners consumed fruits and vegetables at least 5 times per day, compared with 37% of home gardeners and 25% of non-gardeners.[7] While the three aforementioned studies were conducted in urban settings, a study examining the association of community garden participation with fruit and vegetable intake frequency was conducted in a rural area of Missouri. In this random survey of 1,000 adults, respondents who participated in or received food from a community garden were 2.76 times more likely to consume fruits 2 times per day and vegetables 3 times per day than those who did not.[18] These studies provide evidence that supports the hypothesis that gardening can improve fruit and vegetable intake. However, due to the cross-sectional study designs, it is not possible to infer causation from these results. People who choose to garden may like fruits and vegetables more or they may be more concerned with diet and health than non-gardeners.

Gardens and Fruit and Vegetable Intake: Intervention

Research has also demonstrated that participants perceive that gardening interventions increase their fruit and vegetable intake. Two such studies were conducted in rural Missouri. In a convenience sample of 141 community gardeners, 65.6% who gardened at least once a week

perceived that they consumed more fruits and vegetables because of the garden, compared with 24.6% who gardened less than once per week, indicating an effect of gardening frequency.[18] In another community gardening intervention implemented in rural Missouri, 50 participants were surveyed. After garden involvement, 89% of participants reported that they ate more vegetables and fruit because of the garden.[19]

Home gardening interventions have similar results. A community-based participatory research project with Latino seasonal farmworkers in rural Oregon provided an intervention that included gardening education, gardening resources, gardening support, and social involvement. There was a significant increase in report of consuming vegetables several times per day for the gardeners, 18% pre-intervention and 85% post, and their children, 24% pre and 64% post.[21] A community-based research project in San Jose, California provided raised beds and other gardening resources (seedlings and soil) for home gardens in a primarily Latino community. Over 90% of the 56 respondents reported agreeing or strongly agreeing that they ate more vegetables due to gardening.[20]

Two pilot randomized controlled trials involving home gardening interventions in cancer survivors suggest an improvement in fruit and vegetable intake. In one, 24 older cancer survivors (age 60+) received a one-year home gardening intervention and 22 participants served as controls. Fruit and vegetable intake were assessed at baseline and 12 month follow up using a quantitative food frequency questionnaire. There was a trend towards increased fruit and vegetable intake in the intervention group compared with the control group: the intervention group increased fruit and vegetable intake by 0.91 servings per day (within group $p=0.02$), compared with a 0.10 servings per day decrease in the control group (between groups $p=0.06$).[49] The other involved breast cancer survivors, 44 of whom received the gardening intervention and

38 allocated to the control group. There was a 0.86 serving of vegetables per day increase in the intervention group (within group p=0.0002), compared with a 0.23 serving increase in the control group (within groups p=0.06).[50]

While intervention studies are needed to demonstrate a causal effect of gardening on fruit and vegetable intake, there are weaknesses in the designs of these studies that preclude inferring causation. The two community garden interventions and the home gardening intervention in California measured perceived change in fruit and vegetable intake, and the home gardening intervention assessed vegetable intake by asking participants if they had consumed vegetables several times per day. Quantifying fruit and vegetable intake through food frequency questionnaires or 24-hour recalls would strengthen the study designs. The home gardening intervention conducted in Oregon had the strongest design of the intervention studies due to a pre-post design. However, lack of a control group makes it impossible to separate the impact of gardening and seasonal variability on vegetable intake. The two pilot randomized controlled trials have strong study designs to infer a causal effect of gardening on fruit and vegetable intake, but larger randomized controlled trials are needed.

Gardening and Food Values

The aforementioned studies provide evidence that gardening is a promising avenue to increase fruit and vegetable intake. However, to fully capitalize on gardening's potential to increase fruit and vegetable intake, it is important to understand the mechanisms by which this occurs. Similar to the quantitative research on the subject, qualitative research has also shown that people who garden perceive that they eat more fresh produce because of the garden and this research has also provided insights into factors that contribute to this increase.[23,26,27] Prominent themes in the literature include better freshness and taste of produce, and an emotional

connection to produce grown yourself, and knowledge of how the food is grown and control over chemical inputs by gardening organically. These factors contribute to gardeners preferring produce they grew themselves, and may partially explain the increase in fruit and vegetable consumption in gardeners. Additional factors that may influence the fruit and vegetable intake in gardeners include increased accessibility and affordability, and will be discussed in the food security section.

Overwhelmingly gardeners reported the produce they grew was fresher and tasted better than produce they could purchase.[19,22,23,26,27,51-53] As one community gardener from Baltimore stated, "See I actually get upset in the wintertime because I have to buy cucumbers and it's a big difference between going out in the garden, picking it."[51] In some instances, gardeners attributed the difference in taste to differences in growing practices. A rural Latino farmworker describes how the food he grows is different than food from the store: "The cilantro has a different flavor than the one they sell in the store….They use fertilizers [on store bought food], but in the garden we use only purely natural [practices] and it has another flavor…"[52]

In interviews, gardeners demonstrate an emotional attachment to the food they have grown.[22,23,26,53] Theories of embodiment and place may explain this attachment. As Turner explains, embodiment is "the idea that we know and experience the world through our bodies."[53] This includes not only what we feel with our hands or do with our bodies, but also what we experience through our other senses. Gardening is an inherently bodily and sensory activity: it involves physical work to tend the land, as well as the smells, sights, tastes, sounds, and feels of the garden and the harvest. The concept of place is explained by another scholar as "a setting or landscape of profound meaning and connection to an individual by virtue of personal, direct experience."[54] Place is constructed through our lived experiences, linking it inextricably to

embodiment. DeLind explains how place and embodiment are intertwined with respect to food:

> We learn about living contexts and we learn to engage with the spaces, rhythms, smells, tastes, colors, textures, periodicities of our food….bodies are place holders. They keep in corporeal and cognitive ways dynamic records of the interactions, relationships, and histories of any given place.[55]

Additionally, gardening invokes feelings of pride, accomplishment, and satisfaction derived from the literal fruits of the gardeners' labor.[22,26]

A quote from a home gardener in Toronto, Canada gives an example of how multiple senses are involved in eating food from the garden: "No store bought tomato will ever match something you've grown yourself, because the smell of a tomato when you're working on or picking them gets all over your hands, and then when you eat it and it hasn't been stored, it just bursts right away."[23] In another quote, a community gardener from Australia articulates the embodied relationship that occurs when you grow and eat produce from your garden, and the satisfaction that comes with growing your own food: "But it's the fact that it's your garden, you grew it, you ate it, you prepared it […] with your own hands, you planted it with your own hands, you watered it, you watched it grow. It's really satisfying."[22] In Hale et al., community gardeners in Denver were proud of more than just the vegetables produced in their gardens. Gardeners were also proud and felt accomplished of the aesthetic beauty of their gardens, especially when others could see their gardens. A gardener in this study explains how an emotional connection to produce can result in eating more vegetables: "When you grow it, like you said, it's just so much better. And so you want to eat more of it. It's not yucky vegetables. It's wonderful and plus you grew it."[26]

In qualitative studies, most home and community gardeners reported that they gardened

without pesticides or gardened organically, which gardeners valued.[21-23,26,27,52,53,56] Gardeners value organically grown produce because it is conceived as "pure" or "natural," [21,26,52] and a conception that food that is grown organically is healthier.[21-23,53,56] Gardeners expressed comfort over having control and knowledge of how the produce from their gardens was grown. For example, a community gardener in Australia said, "there's no better whole food than the food you grow yourself knowing what input you've applied, or not ... I mean, it doesn't get any better than that."[22] In a few studies, gardeners vocalized a strong distrust of conventionally grown produce. This distrust was one of the motivations to garden for home gardeners in Toronto, Canada, who in the authors' words, had "a desire to control what goes into the food they eat." [23] A quote from a gardener in this study epitomizes this sentiment:

> I can control what goes into the ground...[and] what I feed the plants….I don't know what stores or producers have done. They've enhanced them, they've genetically altered them, they've put pesticides on them, they've done all kinds of stuff and, it's sat on a truck for however long…So that's why I would rather do my own…Because I can say my kids are eating something that doesn't have chemicals in them….I don't care what anybody says, they can't tell me that all the chemicals that we've got in this world are good for [my son].

This distrust of conventional produce was also found in a small study of participants in a community garden in Baltimore, Maryland, which made gardeners dislike buying produce from the store. As one gardener said, "You know what you grow."[51] In addition to valuing that the food they grew is organic, in some studies gardeners also valued that it was locally produced. In one study, some gardeners perceived locally grown produce as fresher and healthier,[22] and gardeners in another study perceived locally grown food to be more sustainable.[23] Research has

demonstrated an association between alternative food production practices and healthier diets. In one study, individuals whose diets contained more locally-produced food had higher Healthy Eating Index scores.[24] In another study, young adults who valued alternative food production practices more had higher intakes of fruits and vegetables and lower intake of added sugars and fast food.[25]

Food Security and Gardening

Food security is defined by the Food and Agriculture Association as "A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life."[57] Gardening has the potential to contribute to household food security by delivering financial savings on food and increasing access to high quality fruits and vegetables. Many gardeners preserve their garden produce for year-round use, giving access to fruits and vegetables beyond the growing season.

Few studies have precisely measured the amount of money gardeners spend on their garden in comparison with the dollar value of produce grown. One such study was conducted in Guelph, Canada, where 50 community and home gardeners calculated financial inputs and weighed their harvests. This study found that on average, participants spent 39% more compared with the market price at nearby supermarkets.[58] However, this study found that there was large variation in garden productivity and inputs, with some gardeners saving money by gardening. In another study where 10 community gardeners in San Jose, California weighed their produce and calculated financial inputs from memory, there was an average savings of $435.[59] Two other studies approximated produce value by calculating yield potential. Community gardeners produced an estimated $130 (in 1987-1988 dollars) in Philadelphia,[60] and after subtracting an

average $25 in inputs, an estimated $475 (in approximately 1989 dollars) in Newark, New Jersey.[60]

Surveys of gardeners and qualitative studies have found that many gardeners perceive that they save money due to gardening. Over half of home gardeners in a low-income area of San Jose, California reported saving more than $480 annually on food from gardening.[20] In rural Missouri, 80% of community gardeners surveyed reported spending less on food and 86% reported being better able to provide for families.[19] Also in rural Missouri, another study found variability in responses to these questions based on how often people gardened. For those gardening at least once a week, 58.9% reported spending less on food, compared to 17.9% of respondents who reported gardening less than once a week. The percentage reporting being better able to provide food for their family was 58.3% and 20.8% for those who reported gardening at least once a week, and less than once per week, respectively.[18] In many qualitative studies gardeners report saving money from gardening.[19,21,27,51,52] However, in another study many gardeners perceived that growing your food costs more than purchasing it at the store. As one gardener explains,

> I always laugh when people talk about growing food as a way of saving money on vegetables, because…it costs more to grow food than to buy food. You know because it's just much more labour intensive to grow organic vegetables than, you can buy tomatoes for three dollars a kilo in summer….I couldn't grow them for three dollars a kilo.[22]

The potential for gardening to confer cost savings on food is dependent on a number of factors. Since commercial produce has the benefit of economies of scale, inputs (seeds, plants, fertilizer, etc.) can be procured at lower prices for commercial growers than for an individual home or community gardener. However, many programs exist nationwide that provide these

inputs for free or at a low cost to both home and community gardeners. For example, Denver Urban Gardens' Grow a Garden program provides seeds and transplants for a small fee for income-qualified households.[61] Keep Growing Detroit's Garden Resource Program also provides seeds and transplants for a small fee, as well as compost and other gardening inputs.[62] These programs can turn gardening's potential for cost saving into a reality, and may also explain some of the variability in results in the aforementioned studies. Some of these studies provided seeds, plants, and other gardening inputs for participants, and/or collaborated with gardening programs who did so.

Improving availability of high quality fresh produce is another means by which gardening may contribute to improved food security, especially in urban and rural areas afflicted to poor food access. In qualitative studies gardeners report having improved access to high quality fresh produce.[19,21-23,27,52] Additionally, many gardeners freeze or can their produce to preserve it beyond the growing season.[21,23,51-53] Particularly for those living in areas with poor food access or where food is expensive, food preservation can improve food security into the winter months. As one gardener states, "[We] are saving a lot of food until now [late January]. I still have my tomatoes in the freezer. The store is very expensive. It helps us a lot to save them."[52]

Few studies have examined food security impacts of gardening beyond cost savings and availability of produce. In a home gardening intervention for Latino farmworkers in rural Oregon, before the gardening season 31.2% of participants reported 'Sometimes'' or ''Frequently'' worrying in the past month that food would run out before money was available to buy more, which dropped to 3.1% during the post garden period.[21] Another study of Latino farmworkers found that home and community gardeners reported that before gardening they prioritized purchasing high calorie foods but could not afford fruits and vegetables. These

gardeners were able to obtain an abundance of fresh vegetables from the garden.[52]

Other Dietary Outcomes

While many studies have examined fruit and vegetable intake in relation to gardening, a few have also examined gardeners' intake of other food groups or types of food. These studies suggest that gardening not only increases intake of fruits and vegetables, but also decreases intake of other foods. In a cross-sectional survey of community gardeners and controls in Philadelphia, gardeners consumed less milk products, sweets, and sweet drinks than non-gardeners.[48] In another study, after a community gardening intervention 53% of those who gardened at least once a week reported eating less fast food, and 68% reported eating food that is "fresher (less packaged food)."[18] A qualitative study of home gardeners found that after gardening, home gardeners in Toronto preferred buying fresh produce instead of processed/prepared foods.[23]

Gardening and Physical Activity

Gardening not only provides fresh produce, but also provides another important contributor to health that is lacking in Americans: physical activity. Gardening involves a wide range of activities that vary in intensity. The intensities of gardening tasks have been quantified by measuring the Metabolic Equivalent of Task (MET). In young adults most gardening tasks, including raking, hoeing, weeding, and watering, were found to be moderate intensity, while digging was high intensity.[10] In older adults, it was found that gardening activities were low to moderate intensity in one study,[9] and moderate in another study.[63] These studies support the notion that gardening can contribute to meeting physical activity recommendations (150 minutes of moderate or 75 minutes of vigorous activity weekly).[64] Research has also provided evidence that gardeners are more physically active than non-gardeners. A survey conducted in Denver, found that community gardeners reported 33% more activity than non-gardeners and 10% more

than home gardeners (Litt, unpublished), and another study found that gardeners perceived that they were more active than non-gardeners.[65]

Qualitative research has also demonstrated that many community gardeners perceive they are more active since they began gardening or that gardening is physically strenuous.[19,21,26,27,56] Additionally, in some studies community gardeners preferred gardening to more conventional forms of exercise.[26,56,66] For example, a gardener in Port Melbourne, Australia stated, "It's more interesting than going to the gym and walking up and down on a treadmill,"[56] and in Denver another gardener reflected a similar sentiment, saying "It's better than, 'Ooh, I spun the treadmill belt for a half hour.'"[26] In addition to being more interesting than conventional exercises such as walking, community gardeners in Wales referred to gardening as an "all-around exercise" because of the involvement of the whole body required for the wide variety of movements required in tending the garden.[66] Physical activity from gardening appears to be especially important for older gardeners: some gardeners in Port Melbourne and Wales reported that gardening benefited their fitness despite their age.[56,66] Not all gardeners in the Port Melbourne study agreed that gardening had benefited their physical fitness, with some citing gardening as "not overly taxing," or they were physically fit before they started gardening.[56] In addition to getting exercise from the gardening itself, gardeners in Denver and Port Melbourne reported that walking or biking to the garden also provided them with physical activity, and some gardeners reported they benefited more from the physical activity of getting to the garden than the gardening itself.[26,56]

Gardening and Mental Well-being

Gardening has been shown to benefit mental health and well-being by promoting relaxation and reducing stress, as well as improving other measures of mental health. In

qualitative studies, gardeners describe escaping from daily stressors while gardening.[26,51,56] Hawkins and colleagues found that focusing on the physical work of gardening, getting away from home, and being in nature contributed to this stress reduction.[66] In this study gardeners also referred to feeling calm, relaxed, and at peace in the garden, which is echoed in other studies of home and community gardeners.[21,23,27,56]

There is also quantitative evidence to support the mental health and well-being effects of gardening. A case-control study was conducted with allotment gardeners and matched non-gardeners in England. This study assessed scores for mental health metrics in the allotment gardeners as well as for controls. Compared with non-gardeners, allotment gardeners had significantly better self-esteem, general mental health, depression, vigor, and fatigue, as well as composite score of total mood disturbance. There was no significant different in tension, anger, or confusion between the allotment gardeners and non-gardeners. This study also assessed the same metrics in gardeners before and after a session of allotment gardening. After the gardening session, gardeners had significantly improved self-esteem, tension, depression, anger, confusion, and composite total mood disturbance score, but no significant change in vigor or fatigue.[67] A randomized controlled trial in the Netherlands aimed to objectively measure the impact of gardening on stress by measuring salivary cortisol, a stress hormone. In this study community gardeners conducted a mentally stressful task and were randomly assigned to then either do light gardening activities in their garden plot or read indoors for 30 minutes. Those who were assigned to garden saw a bigger reduction in cortisol after the stressful task when compared with those who were assigned to read.[11]

Gardening and Health Indicators

Gardening has the potential to improve physical health in a multitude of ways, including increased fruit and vegetable consumption, increased physical activity, and improved mental health. Research has examined the impact of gardening on a number of health indicators, including weight status, biomarkers of chronic disease, measures of physical functioning, and self-rated health.

The increased physical activity and consumption of fruits and vegetables associated with gardening provide a theoretical basis for it to aid in weight management. In a study to assess the association of community gardening with weight status, a case-control study was conducted comparing BMI of community gardeners with their non-gardening siblings and neighbors serving as controls. For female community gardeners, BMI was on average 1.84 units lower compared with female neighbors and 1.88 units lower than their sisters; for men BMI was 2.36 lower than male neighbors and 1.33 lower than their brothers.[68]

Gardening is also associated with improved physical functioning in older adults. In a study by Park and colleagues, it was found that gardeners who met CDC's physical activity recommendation (150 minutes of moderate activity weekly) through gardening had higher physical function and less bodily pain than both non-gardeners and gardeners who did not meet physical activity recommendations through gardening. They also examined hand function by measuring hand strength and pinch force, and found that gardeners had higher grip strength and pinch force than non-gardeners.[69] Hand function is particularly important in older adults because of its necessity in completing activities of daily living, which are important for self-care and maintaining independence at advanced ages. This study also examined bone mineral density, and found no differences between any of the groups.

A small number of studies have examined biomarkers of chronic disease in relation to gardening. In a small pilot study of Marshallese refugees with type 2 diabetes, a community gardening intervention resulted in a decrease in hemoglobin A1C levels in active participants.[70] In Seoul, South Korea, another pilot study examined the effects of a community gardening intervention on multiple biomarkers of chronic disease (blood pressure, blood lipids, and proinflammatory and prooxidant biomarkers) in women over 70 from a senior community center, using women from another community center as a control group. Women in the intervention had a significant decrease in diastolic and systolic blood pressure, and in two of the five proinflammatory/prooxidant biomarkers. The remaining proinflammatory/prooxidant biomarkers decreased in the intervention group, but these decreases were not significant. The gardening group had a significant increase in total cholesterol, HDL cholesterol, and marginally significant (P=0.06) increase in LDL cholesterol. The women in the control group had no significant changes in these measures, except for a marginally significant (P=0.06) increase in systolic blood pressure.[71]

Several studies have examined the association of perceived or self-rated health with gardening. In Denver, Colorado, it was found that gardeners had higher self-rated health than non-gardeners, and Litt and colleagues conducted a path analysis to determine the factors that contributed. They found that social involvement with the community, aesthetic appeal of the neighborhood, and collective efficacy were indirectly associated with self-rated health in gardeners.[72] A study in the Netherlands examined health and wellbeing of community gardeners and those who did not participate in a community garden. They found that gardeners over age 62 reported a significantly composite score of perceived health, and better perceived ratings of physical constraints, health complaints, and general practitioner consults, and marginally better

ratings of perceived health and chronic illnesses. Gardeners under age 62 did not differ in these variables from non-gardeners.[12] In Japan a survey was conducted of community gardeners and non-gardeners on their perceived physical and mental health. After adjusting for sociodemographic and lifestyle variables, they found that gardeners reported better self-rated health and mental health, and fewer health complaints. This study found no variation with regards to the amount of time spent gardening.[73]

Factors Affecting Sustained Gardener Participation and Garden Longevity

Maintaining these benefits for both communities and individuals is dependent upon the sustained participation by gardeners and the longevity of gardens over time. Sustaining a garden require yearly inputs of both material resources and physical efforts by gardeners who have adequate gardening skills and knowledge, as well as consistent access to land. Garden longevity is threatened without these necessary components. In a nationwide survey, respondents from 445 gardening organizations that represented 8,548 gardens in 2012 reported a loss of 1,615 community gardens from 2007-2012.[28]

Urban and other gardens face numerous challenges to their longevity, and researchers have emphasized the need to understand factors that improve and hinder garden longevity in order to sustain the benefits of gardening.[28,29] The challenge of obtaining and sustaining land for urban gardens is the most well-documented threat to urban garden longevity in the research literature.[29,74-79] Urban gardens are frequently located on vacant or abandoned lots or are granted short-term leases on city-owned land. When leases are not renewed or vacant land undergoes development, garden permanency is threatened.[74,78,79]

Participation, both sustaining gardeners and attracting new gardeners, poses another threat to garden longevity. Representatives from community gardening organizations reported

that lack of participation was a greater contributor to garden loss than land insecurity, and factors such as gardening taking too much time and challenges in the garden (bad weather, pests) contribute to gardener drop-off.[28] Other studies have cited lack of participation or participant turnover as contributors to garden loss,[76,78] with a survey of community gardening stakeholders revealing that lack of gardening knowledge leading to gardener dropout is an important factor in declining participation.[29] Home gardeners have also reported lack of gardening knowledge and crop failure as contributing factors to abandoning their gardens.[80] This highlights the importance of gardening knowledge to sustain both gardens and gardeners. Gardening inherently requires skills and knowledge throughout the gardening process, from garden design, land preparation, watering, and pest control.

Lastly, cost of obtaining gardening resources (seeds, plants, soil, raised beds, etc.) can pose a substantial barrier to gardening and threaten garden longevity. Produce-weighing studies have quantified the dollar value of produce grown by home and community gardeners. Two recent studies, one with eight home gardeners and the other with 10 community gardeners, found that gardeners on average saved $339 and $435 on produce in a growing season,[59,81] respectively. However, in the study of home gardeners, most gardening inputs (seeds, plants, raised beds, and soil) were provided to participants free of charge. In the study of community gardeners, costs for gardening inputs were recalled from memory and therefore may be an underestimate. A much larger study involving 50 home or community gardeners found that after subtracting the cost of garden inputs (which were reported in a dairy throughout the growing season), growing produce cost an average of 39% more than purchasing from grocery stores.[58] Thus, when gardeners do not have financial assistance in acquiring the material resources needed for gardening, cost savings may not be realized. In fact, studies have demonstrated that low-income individuals are

especially susceptible to cost as a barrier to gardening.[27,82] Community gardens often have additional funding and resource needs beyond home gardens, requiring means to obtain water such as installing wells or pipes, building other garden infrastructure.[28,78] Obtaining funding and material resources is a commonly cited challenge by community garden organizers, and a contributing factor to garden loss.[28]

Detroit Demographics, Health Behaviors, and Health Indicators

As of 2016, the city of Detroit, Michigan had approximately 673,000 residents,[83] approximately 80% of whom are African American.[84] Detroit's poverty rate of 40.3% is one of the highest poverty rates of any major city in the nation,[84] and Detroit's unemployment rate of 8.7%[85] is more than twice the national average.[86] Low income and minority communities such as Detroit have a disproportionately high burden of poor health.[87] Table 1 demonstrates health indicators from the 2013-2015 Behavioral Risk Factor Surveillance Survey for the city of Detroit, Wayne County (the county in which Detroit is located) excluding Detroit, and for the state of Michigan.[88] Wayne County and the state of Michigan both have substantially lower minority populations and lower poverty rates, and are given for comparison.[83,84] This data illustrates that there are a number of health behaviors and outcomes where Detroiters fare substantially worse than the rest of Wayne County and the state of Michigan as a whole. This includes health outcomes of self-reported general health, physical health, and mental health, as well as high blood pressure, stroke, and diabetes. Additionally, residents of Detroit have lower levels of beneficial health behaviors, including no leisure time physical activity and vegetable consumption.

Table 1: 2013-2015 Michigan BRFSS regional and local health department estimates

Health Behaviors and Outcomes	City of Detroit	Wayne County Excluding Detroit	Michigan Total
General health, fair or poor	29.7%	18.0%	17.4%
Poor physical health on at least 14 days in the past month	18.2%	13.4%	12.8%
Poor mental health on at least 14 days in the past month	17.8%	12.9%	12.2%
No leisure time physical activity	35.5%	24.3%	25.1%
Adequate physical activity	17.9%	19.1%	19.5%
Fruits <1 time/day	40.8%	38.3%	38.7%
Vegetables <1 time/day	33.3%	23.5%	24.7%
Fruits and vegetables ≥5 times/day	15.8%	16.0%	14.9%
Every told high blood pressure	44.9%	35.4%	33.9%
Every told high cholesterol	35.8%	41.3%	39.4%
Ever told heart attack	5.3%	5.2%	5.0%
Ever told angina or coronary heart disease	4.6%	4.9%	5.1%
Ever told stroke	5.6%	3.4%	3.4%
Ever told any cardiovascular disease	11.3%	9.9%	9.7%
Ever told cancer	7.0%	13.3%	12.0%
Ever told diabetes	13.5%	10.8%	10.5%

Gardener Support Organizations

Throughout the U.S., hundreds of organizations support gardeners by providing material resources, offering gardening education, and organizing social activities.[28] These services are invaluable for lowering barriers to gardening and creating a vibrant social network of local gardeners. This section of the literature review will give an overview of the programming of the two gardening organizations that are collaborating on the present research.

Keep Growing Detroit

The non-profit organization Keep Growing Detroit serves gardeners in the city of Detroit, Michigan as well as Hamtramck and Highland Park, two towns that are surrounded by the city of Detroit. Unlike some gardener support organizations that manage and oversee community gardens, Keep Growing Detroit provides guidance and support, but does not provide garden management. The organization defines community gardens as spaces cultivated by gardeners from multiple families, family gardens where one or more members of a single family garden, school gardens as gardens located at schools or early child education centers, and market gardens as gardens where produce is grown primarily for sale. In 2018, they supported over 1600 family, community, school, and market gardens. While participation in Keep Growing Detroit's programs is not income restricted, the organization focuses its outreach efforts to those at risk of food insecurity, including low-income individuals and families with young children.

The centerpiece of Keep Growing Detroit's programming is the Garden Resource Program, which provides gardening support and resources, and distributes plants and seeds to their members four times each year for a small annual fee. Additional resources such as help with new garden development and design, and access to soil tests, compost, and raised beds are

available to "active" Garden Resource Program members who attend at least one workshop or gardener event per year.

In addition to the Garden Resource Program, Keep Growing Detroit offers opportunities for member and non-member residents to increase their knowledge of gardening, including a variety of educational classes on gardening, cooking, and other related topics. They also offer comprehensive educational programs which consist of a series of classes that go in depth on specific topics including Urban Roots, a community garden leadership course, which combines education on horticulture and community organizing; Sweet on Detroit, a beginner beekeeping course; and season extension programs that focus on methods to extend the gardening season. Keep Growing Detroit emphasizes the importance of building relationships between gardeners throughout the city, and they provide abundant opportunities for gardeners to interact with each other. They host social events and encourage gardeners to volunteer with their organization and with other member gardens. These events allow even home gardeners to belong to a network of thousands of gardeners across Detroit. At Keep Growing Detroit events, members share knowledge about gardening and food systems, as well as create new friendships and provide social support.[89] Additionally, Keep Growing Detroit runs the Grown in Detroit program, where member gardeners can sell their produce at Detroit farmers markets and restaurants and receive 100% of the proceeds.

Denver Urban Gardens

Denver Urban Gardens is a non-profit organization that operates over 165 community gardens in the metro Denver area.[61] They provide technical support to gardeners, offer gardening education classes, and Master Composter and Master Community Gardener training programs. Through their Grow a Garden program, home and community gardeners who are low-

income receive seeds and transplants for a small fee. Additionally, they operate Delaney community farm, where refugees grow food for themselves as well as the community. Denver Urban Garden is also actively involved in youth education. One third of their community gardens are located at schools, and they provide training for teachers or other volunteers on implementing youth garden education programs. They also assist in implementing youth farm stands, where youth sell produce grown in their school gardens. Their Garden to Cafeteria program facilitates the use of produce grown in school gardens to be served in school meals.

Summary

Gardening is a popular activity in the U.S., with one-third of U.S. households gardening. Hundreds of gardener support programs exist nationally to provide resources and education to home and community gardeners. Gardening is associated with improvements in health behaviors, including increased fruit and vegetable intake and physical activity, as well as improvements in food security. Additionally, intervention studies have found improved health outcomes after gardening, including reductions in stress, hemoglobin A1C in diabetics, and blood pressure. Qualitative research demonstrates that gardeners prefer produce they grew themselves due to it being fresher and tasting better than store-bought, as well as feeling more comfortable that they knew how it was grown. This research suggests mechanisms that may in part be responsible for the increase in fruit and vegetable consumption, but more research is needed to more deeply understand how gardening influences fruit and vegetable intake. Additionally, there is little research as to the role gardener support programs play in sustaining gardening, or their role in influencing health behaviors.

CHAPTER 3- HOW GARDENING AND A GARDENER SUPPORT PROGRAM IN DETROIT INFLUENCE PARTICIPANTS' DIET, FOOD SECURITY AND FOOD VALUES

Introduction

Fruits and vegetables are not only important sources of nutrients such as vitamins, minerals, and fiber, but they are also linked to the prevention of lifestyle-related chronic diseases.[3,4,32] However, the vast majority of American adults do not meet Dietary Guidelines for Americans recommendations to consume between 2 and 3 cups of vegetables and between 1 ½ to 2 cups of fruit per day, depending on calorie needs.[31] A study using data from the national Behavioral Risk Factor Surveillance Study found that average intake among adults was 0.8 cups per day for fruit and 1.3 cups per day for vegetables, and only 8% and 14% of adults met the vegetable and fruit recommendations, respectively.[1] Fruit and vegetable consumption is even lower amongst low-income adults and adults with food insecurity,[90,91] which affects 12.3% of U.S. households.[92]

Gardening is one promising means of both increasing fruit and vegetable consumption and improving food security. Cross-sectional studies have found that community gardeners consume fruits and vegetables more often than non-gardeners,[7,8,18] and in both home and community garden intervention studies, gardeners perceive that they eat more fruits and/or vegetables after gardening.[18-21,93] In qualitative studies, gardeners report having improved access to high quality fresh produce.[19,21-23,27,52] There is also quantitative evidence for gardening's contribution to food security. In a home gardening intervention, before gardening 31.2% of participants reported sometimes or frequently worrying that food would run out, which dropped to 3.1% after gardening; however there was no control group for this study.[21] Additionally, one study found that food insecure community gardeners more strongly agreed that gardening had

increased their fruit and vegetable consumption and decreased their spending on food.[93]

Food Environment in Detroit

The retail food environment in Detroit, Michigan is dominated by small food retailers, such as corner stores and convenience stores, which often do not sell fresh produce.[46] When produce is sold at these food retailers, it is often of poor quality.[44] Small food retailers outnumber supermarkets and large grocers eleven to one within the city.[40,44] Focus groups reveal that Detroit residents have negative perceptions of these stores, including that these stores have low-quality food, unclean and unsanitary conditions, and price gouging.[43] Low income is another serious barrier to healthy eating for many Detroiters. The poverty rate in Detroit is 39.4%, one of the highest of any major city in the country, and Detroit's unemployment rate of 9.9% is more than double the national unemployment rate.[84,85]

Keep Growing Detroit

Detroit has a vibrant urban agriculture community, which is in part spurred by Detroit residents' and community leaders' desires to improve access to fruits and vegetables, and improve health and food security in Detroit. The non-profit organization Keep Growing Detroit plays an important role in supporting the gardeners and farmers of Detroit through an integrated fabric of programming that includes resource, educational, and social/networking support for gardeners and farmers.

The backbone of Keep Growing Detroit's programming is the Garden Resource Program, which provides a large number of diverse seeds and plants for a small annual fee, and access to technical gardening support from the organization. The organization defines community gardens as gardens where members of two or more families garden together, family gardens as gardens where one or more members of a single family garden, school gardens as gardens located at

schools for use by youth, and market gardens as gardens where produce is grown primarily for sale. The gardens they support are located within Detroit's city limits, as well as Hamtramck and Highland Park, two municipalities geographically located within the city of Detroit. In 2017, over 1500 community, family, school, and market gardens were enrolled in the Garden Resource Program. In addition to the Garden Resource Program, Keep Growing Detroit runs the Grown in Detroit program for gardeners to sell their produce and receive 100% of the profits.

Keep Growing Detroit offers a wide variety of educational classes that cover topics on gardening, cooking, and good gardening practices for preventing lead exposure, such as covering all bare soil with mulch or vegetation, washing produce before consumption, and removing dirty shoes before entering homes. Less than 20% of garden soil samples tested since 2003 have exceeded the action level of 320 parts per million estimated lead, and safe growing practices are used for high lead areas such as selecting another site for growing or growing food in raised beds with new soil.

Building relationships is a tenet of Keep Growing Detroit's work, and the Garden Resource Program is designed to foster a social network of gardeners who can build on each other's knowledge and experience. They host a number of social events for gardeners each year, which allow even family gardeners to be part of a network of gardeners throughout the city. Another social opportunity they support is volunteer work, both with the organization itself and with other gardens that are members of the Garden Resource Program. By volunteering, gardeners gain access to additional resources for their garden, such as compost and free soil tests.

Keep Growing Detroit believes there should be places to grow food in every neighborhood in the city, so their staff works to grow connections with residents and community groups through active participation and networking at community events and with diverse

community partners. They work to ensure that their outreach and communication strategies are accessible to all Detroiters, by mixing door-to-door organizing, reminder calls, and mailings with text messages, email, and Facebook. With a focus on reaching low income residents, Keep Growing Detroit has developed relationships with numerous organizations that currently serve Detroit's most vulnerable populations, such as the Detroit Health Department's Women, Infants, and Children clinics, neighborhood food pantries, and early childhood Head Start agencies. With several Spanish speakers on Keep Growing Detroit's staff, they have significantly increased their capacity to reach and serve the Spanish speaking population in the city. To further increase accessibility, they continue to develop efforts to improve their diverse outreach and communication strategies to reach new audiences, including making more of their programs compatible with enrollment using Electronic Benefit Transfer payment option.

The purpose of this study was to qualitatively examine experienced Garden Resource Program participants' perceptions of whether, how, and why gardening and participation in the gardening support program has influenced their food choices, food security, and values and beliefs related to food. Previous qualitative studies have examined the impacts of gardening on diet, food security, and food values, but few have been conducted in urban U.S. cities with mostly African American participants. As Detroit's population is mostly African American,[84] the majority of interviewees in this study are African American to ensure that their perspectives are represented in this research. Additionally, the role of gardener support programs in influencing gardeners' diet, food security, and food values has not been addressed in previous research.

Social Ecological Model and Gardening

The social ecological model posits that dietary habits are influenced by factors at various

levels, including the individual level, interpersonal level, settings, and policy and systems.[94] Gardening can influence fruit and vegetable intake through the individual, interpersonal, and settings levels of the social ecological model.[95,96] Gardening can influence attitudes and preferences for eating fruits and vegetables.[96] The Garden Resource Program focuses much of its programming on interpersonal interactions, where gardeners can interact with each other to learn about food systems and nutrition. Gardening influences the settings level of the social ecological model through providing increased access to fresh, high quality vegetables. The Garden Resource Program also facilitates affordable access by offering seeds, transplants, and other gardening resources at very low cost.

Methods

This project used a community based participatory research (CBPR) approach, and was conducted in collaboration with Keep Growing Detroit. The CBPR approach was developed in response to the history of health research in communities of color and low-income communities not only failing to benefit those who participate in research, but in some cases severely harming them [97]. CBPR aims to address these issues by adopting a collaborative approach where decision-making and power are shared between researchers, community partners, and community members [97]. Additionally CBPR incorporates the local and contextual knowledge and skills of community partners and community members, which improves the feasibility and real-word application of research [97]. The study was approved by Michigan State University's Institutional Review Board for Human Subjects.

Research Committee

A committee made up of Keep Growing Detroit staff, Garden Resource Program members, and researchers was created to plan and conduct this study. The committee consisted

of six Garden Resource Program members, one staff member at Keep Growing Detroit, and two Michigan State University researchers. Preliminary results of the qualitative data analysis were presented to the committee for feedback.

Recruitment and Informed Consent

For this study, Keep Growing Detroit recruited 28 participants who had been members of the Garden Resource Program for at least two years. Participants were chosen through purposive sampling to vary in demographic characteristics (race, age, gender) and type of garden (school, market, family, community). There were an equal number of male and female participants (n=13 for each), with the majority over 50 years of age (n=20) and identifying as Black or African American (n=17). Two participants declined to answer the demographic questionnaire, with one additional participant declining to respond to the question pertaining to age. Prior to interviews, participants completed informed consent for participation in this study. Data saturation was reached and was determined by the absence of new emergent themes found in the interviews.

Data Collection

Semi-structured qualitative interviews were performed. Topics included in the interviews were chosen by the research committee, and the principal investigator created interview questions based on these topics. The research committee gave feedback on these questions to the principal investigator. The interview guide included open-ended questions on how gardening and involvement in the Garden Resource Program impacted the interviewees in the areas of dietary choices and food security, as well as attitudes, beliefs, and values towards food. The interviews were conducted by three committee members: two members of the Garden Resource Program, and the principal investigator. The two committee members who served as interviewers were trained in qualitative interviewing techniques by the principal investigator.

Interviews were tape recorded, transcribed, and transcripts were checked for accuracy by researchers. Additionally, participants completed a demographic questionnaire including age, race, and gender.

Data Analysis

Transcripts were analyzed in Atlas.ti qualitative data analysis software by two trained coders.[98] Based on the interview guide questions, themes identified during transcript checking, and nine randomly chosen interviews, a preliminary codebook was developed with emergent themes related to the specific aims by the first author. The preliminary codebook included code definitions and examples of when to apply them for some codes. After the preliminary codebook was developed, an additional nine interviews were coded independently by each of the two coders. The two coders discussed coding differences and reached consensus on coding. The codebook was continuously modified to clarify definitions, add new codes, and combine existing codes that were similar. The first author coded the remaining interviews. Four main themes were chosen for analysis and are described in the results section. For each of these main themes, summary statements were written for each gardener and put into conceptually-clustered matrix displays.[99] Conclusions were drawn based on comparison of summary statements across gardeners. Participant names were replaced with numbers to ensure participant confidentiality.

Results

The results are organized into four main themes: perceived dietary changes, reasons for change in intake, food security, and food values. Each main theme had subthemes as follows. Perceived dietary changes included subthemes of increased vegetable intake and changes in intake of other foods and food groups. Reasons for change in intake included subthemes of taste and freshness, gardening organically, an emotional connection to the produce they grew, a desire

not to waste their produce, and to improve their health. Food security included subthemes of saving money and food preservation. Lastly, food values included subthemes of industrial food, seasonality, alternative, food networks, and interactions with other gardeners.

Perceived Dietary Changes

Interviewees described multiple dietary changes that they attributed to gardening. This included not only an increase in vegetable intake, but also decreases in other foods and food groups.

Vegetable Intake

The majority of interviewees indicated that their intake of vegetables had changed in some way due to gardening. Some reported eating more vegetables overall or an increase in certain types of vegetables, eating more fresh vegetables, a greater variety of vegetables, or trying new vegetables. Green leafy vegetables like kale, collards, and Swiss chard were new to many of the gardeners, who began eating them because of gardening or receiving the seeds and seedlings from the Garden Resource Program. For example, gardener 12 explained, "I think it [the garden] makes me try new things like kale, I don't know if I would have gone to the store and bought kale… but they have it and it's part of, you know, your membership." Gardeners also gained access to vegetables they were not able to purchase, as gardener 20 explained: "You go to the grocery store, you have to get whatever they have. I have the heirlooms [tomatoes], all kinds."

For some, having vegetables from the garden resulted in meals that were more vegetable-centered. Some gardeners reported eating mostly out of the garden during the summer months, while others planned meals around what was available from the garden or added more vegetables to dishes. Gardener 19 stated, "My meals are not the same, they may consist of soups made out

of all the different vegetables out of my garden." Gardener 2 explained how having an abundance of a vegetable from the garden led him to use that vegetable in a new way: "All this kale! I had to find things to do with that. I have never made smoothies until I had a garden…I did not know that smoothies were like the bomb."

Some gardeners reported that the garden has changed the diets of their family members. Gardener 18 reported how the garden influenced her husband and adult children:

> I always make sure I eat a lot of vegetables and fruit to the point that my husband and my family have gotten into eating healthy…I have older children…they come and actually pick from the garden and get their own….so, it has impacted my family immensely.

Gardener 16 reported how the garden influenced the diet of her young child:

> My daughter is growing up with it [the garden] … It's kind of amazing how much she likes vegetables… actually some mornings I'm guilty of not feeding her breakfast, and just going outside and working in the garden and she just like eats the tomatoes and eats the beans.

Intake of Other Foods and Food Groups

In addition to changes in vegetable intake, many gardeners also attributed changes in intake of other foods or food groups to gardening. A number of gardeners stated that they eat little to no meat and/or have excluded red meat from their diets. Gardener 19 stated, "I don't eat any meat anymore…because I get everything I need from my vegetables." Some gardeners also attributed eating less of other foods, such as fried food, processed food, or starches, to gardening. For some, these dietary changes occurred because of nutrition education coordinated with gardening, as gardener 17 explained:

> Well I do read labels, I do watch the salt intake….The awareness of all that came through

> going through the Garden Resource Program…and then we started even having healthy eating classes at church through some of the programs that Youth Grow Detroit and Keep Growing Detroit had….The learning process has taken on, has come to the point where you are cognizant of what you purchase.

Other gardeners did not explicitly state what about gardening had changed their intake of foods, but did attribute the change to gardening, such as gardener 10:

> Gardening in a nutshell has shown me about food…I wouldn't have known how damaging food is [if it hadn't been for gardening]… I put [processed] food in the same category as drugs and alcohol…Some of the same dangers in alcohol and drugs is in processed food. When you asked what has [the] garden done for me, it's educated me.

Reasons for Change in Intake

Gardeners mentioned a number of factors that may explain why gardening leads to an increase in vegetable intake. This included the freshness and taste of the produce they grew, gardening organically, an emotional connection to growing food, and not wanting to waste the food they grew. Additionally, some gardeners described diet changes that were health-related, which were only related to gardening for a few gardeners.

Taste, Freshness

The superior taste of garden vegetables compared with store-bought was a prevalent theme amongst interviewees. Some gardeners attributed this to the freshness of the produce they grew. As gardener 5 states, "at the store sometimes you got stuff that look like it's been there 20 years and, you know, it's fresh out the garden, it has a different taste." Others attributed the taste difference to gardening without pesticides, as gardener 11 describes:

> The thing that moved me was the taste. I had never tasted fresh, no chemicals in

> vegetables [until growing my own]…I would say wow, the difference is phenomenal…It is hard to describe the difference in the taste with no chemical and the taste with chemicals.

Gardener 9 perceived that he did not have to worry about food-borne illnesses with his garden's produce because it was fresh:

> They grow cilantro in California…They bring to Detroit and they take more than three-four days. When they sell in the store they had the black spots in the leaf and later they say it's E. coli … but since we have fresh food growing here and so we don't need to worry.

Gardening Organically

Overwhelmingly, gardeners reported that they gardened organically or did not use chemicals in their gardens, with some stating that the Garden Resource Program spurred them to garden organically. Gardener 17 said,

> So realizing that you don't have to put fertilizations other than natural fertilizers on crops…For the longest [time] you always thought people had to go get Miracle Grow, you know what I am saying? But now we've learned that there was another way and it is more healthier for you, but again, again all of that [came] from learning, you know, from the team that came on and helped us to develop our garden program [Keep Growing Detroit].

This quotation demonstrates the most commonly cited reason for gardening organically: perceived negative impacts of agricultural chemicals on human health. Many believed that the vegetables they grew were healthier because they were grown without pesticides, and for some, this was not a concern until after they began gardening. As gardener 14 said,

> We are eating food that we can just take, pick, and eat…You don't have to wash it [because we don't use pesticides], and that, that's a big deal and I think until you're actually growing it yourself you don't realize how big a deal that is…Growing them without that, I just feel so much healthier eating them…It was nothing for us to buy food that was sprayed until we really started gardening ourselves.

Knowing how their vegetables were grown and having control over chemical inputs was important to many gardeners. Some gardeners attributed an increase in their vegetable consumption to this, including gardener 8: "Knowing where the fresh fruits and vegetables came from, knowing how the soil is cultivated, knowing what's in the soil makes me more willing to consume it." In addition to distrusting agricultural chemicals, a number of gardeners were also wary of genetically modified organisms (GMO's), and valued that the vegetables they grew were non-GMO. As gardener 15 said of GMO's, "These must be doing something to your body. You can't change nature without it changing you, so I just don't trust it."

Emotional Connection with Growing Food

Gardeners expressed an emotional connection to growing food, as well as the vegetables they grew. Gardeners used the words "miracle," "love," and "magical" to refer to the process of growing food, including gardener 19 who said,

> So that's why you need more people doing gardening, because then you will have more love, you know, people that are really concerned about the foods that we eat. Because I am sure that the food feels your love, the leaves feel your love, you know, they feel this person really loves you.

Gardeners also valued eating food that they grew themselves, such as gardener 13, who stated, "It's always such a gift to be using something and what we're cooking that we had a hand

in growing." Gardener 10 explained how this emotional connection can lead to eating more vegetables: "Well, my experience with gardening …we touch it, we going to want to eat it and…[it] just has that appeal." For some, gardening was more than just growing food, it was a way of life. According to gardener 23, "Then if you don't grow, you know you are just missing the whole idea of what eating is. Eating real natural food is a wonderful, wonderful way to live and so much cheaper, if you buy, if you grow it yourself." Some gardeners expressed feelings of pride for the vegetables they grew, and valued the self-sufficiency that came with gardening. As gardener 16 said, "Like when those green beans start coming in, I can't [help] but be so proud. Like okay, the green beans won't stop, they just keep coming and coming. So being able to, and knowing like, I have the skills to feed my family."

Waste

A number of gardeners mentioned not wanting to waste what they grew, which in part explains what motivates people to incorporate the produce into their diets. According to gardener 7, "For one thing when you grow something, you really don't want to see it go to waste. I think you're much more cognizant and aware of waste and not wanting to do that. So that means you more intentionally try to get it in your diet or share it with others."

Health-related Diet Change

Some gardeners reported diet changes that were not related to gardening, or were peripherally related to the garden. Gardener 27 was unsure if there was a change in his diet because he has been a vegetarian as long as he has been gardening. Other gardeners reported that they have been trying to eat healthier due to health problems, including being diagnosed with diabetes and a husband's high cholesterol. Gardener 19 reported that when she was diagnosed with cancer that her diet changed tremendously:

> Then when I found out I was sick, I really you know got into more different types of vegetables, so that's how gardening has been impacting me because before, you know, I was kind of like doodling around with it and everything and I always tried to eat healthy but I eat really healthy now, I mean every day of my life, I eat real healthy.

Food Security

Many gardeners reported saving money on food because of the garden, and preserving their garden's produce.

Saving Money

Most gardeners agreed that they saved money on food from the garden. During the growing season, many explained that they bought little from the grocery store. Gardener 9 said, "Three or four months [of the year] I don't buy nothing from the store…only the meat." Gardener 1 said, "When I had six kids I fed them from the end of June to the end of October totally out of the garden…not totally, but for a big part." None of the gardeners knew exactly how much they saved from the garden, but those that speculated how much they saved estimated several hundred dollars per year. Some gardeners reported that the primary reason they gardened was for the financial benefits such as gardener 21: "Well, the reason I'm involved with gardening is because it supplements my income." While few gardeners indicated signs of food insecurity, gardener 19 explained how gardening helped her stretch her food stamp dollars:

> I was getting food stamps. I am thinking 'Oh my god how am I going to make this work,' you know, having to buy this for food. And I did…I was only getting like $87, but I put my program together with the growing of the garden, that helped.

Gardener 23 said,

> I will tell anybody, I may not have a dime in my pocket but I will never be hungry. And

> that's because I've got enough sense and enough love and enough wherewithal to grow my own food and when you grow it organically, it's not a lot of money you have to spend.

While the majority reported saving money due to the garden, some gardeners reported that they did not save money because of the money and/or labor that they put into it. However, few gardeners mentioned that they had put money into the garden. While the costs associated with gardening can be substantial, the Garden Resource Program significantly reduces these costs by providing seeds, transplants, and other gardening resources for a small annual fee (ten dollars for family gardens, twenty dollars for school, community, and market gardens).

Food Preservation

Food preservation was common amongst the gardeners interviewed. While some canned vegetables, including tomatoes and green beans, many more froze vegetables. Gardeners froze a wide variety of vegetables, with greens being the most common, as well as tomatoes and corn. Most of the gardeners who froze their vegetables also mentioned they had an abundance that lasted through the winter. As gardener 19 said:

> You know the greatest thing about this whole thing is, I didn't have to spend a dime the whole winter …I didn't have to buy any fresh vegetables for my green smoothies the whole winter, and I am just now getting low [in March].

Having access to their home-grown vegetables throughout the winter was important to gardeners for some of the same reasons they valued eating fresh vegetables from the garden: it tasted better, did not have pesticides, and it was grown themselves. Gardener 25 said,

> During the winter months I like to have fresh greens, so I would always put some greens away in the summer and go in the freezer and just—I knew that I grew them, so this is

perfect, and not going to the grocery store and just having my own collard greens that I grew.

Food Values

Many gardeners held strong beliefs and values about the food system. This included negative perceptions of the industrial food system. Some gardeners also avoided purchasing produce that was out-of-season and utilized alternative food networks. Interactions and communication with other Detroit gardeners and the staff at Keep Growing Detroit were influential in these beliefs and values.

Industrial Food

Many interviewees had a strong dislike for and distrust of the industrialized food system, from the farming methods used to the foods it produces. As mentioned earlier, many interviewees are particularly concerned about the impacts of pesticides on human health, while there was also concern about environmental impacts of conventional farming. Additionally some gardeners were concerned about low wages and poor working conditions of farm workers. A quote from gardener 22 sums up this attitude towards industrial food: "Agribusiness and stuff like that is bad for the land, bad for the people." Some gardeners also verbalized a strong dislike of processed foods, including gardener 24:

> The food industrial complex, with all its advertising, with all its corn syrup-laced foods that promote food addictions…what these types of foods that have been made in the food processing labs do to our taste buds and that psychology, they make us eat way more than we should and make us addicted to food.

Gardener 24 mentioned another idea that was shared by other market gardeners; that urban farming is drastically different than industrial food in the way it affects people and the

environment:

> We [urban farmers] as a community of people who know that the system that we have in place today as a community or as a society is not sustainable and it doesn't work for a lot of people in the community. So I believe people who are in the urban farming community gravitate to urban farming because they know it's [the current agriculture system] not financially sustainable, it's not environmentally sustainable, and that society as it is today has disenfranchised more and more people right, and so see there is a groundswell of support for a new, a …paradigm shift in how we think, how we eat, how we buy our food, how we relate to the economy.

Some gardeners were also skeptical of the capability of the food system to provide them with food, as gardener 27 explained:

> The model that we have is just, it's a captive model. And you know, unless you get outside the captive model you are willing to get hurt…When these guys decide that they can't make enough money off you they're gone. You're left high and dry, and if you have no transportation or no means to get a hold of food, you are just SOL.

These gardeners stated that growing your own food provides security from a break-down in the food system. Gardener 10 said, "They can black out the food if they choose to and so the more I know about gardening, the more I will be able to survive in that too-large situation."

Seasonality

Some gardeners reported purposefully avoiding buying produce that was not in season. Motivations for avoiding out-of-season produce varied. The most commonly cited was that out-of-season produce, particularly tomatoes, have no taste. Other reasons for avoiding out-of-season produce were values-laden, echoing gardeners' criticisms of industrial food. Some

gardeners were concerned about the distance that the produce traveled, how the farmworkers were treated, or not knowing how food from other countries is produced. Gardener 1 describes her motivations and experience with seasonal eating:

> I've turned back to seasonal eating. And we've made kind of a ritual of the seasonal eating, you know, I will not buy a tomato unless I can grow it in my own garden or somebody else grew it in their own garden. So I don't have tomatoes 8 months out of the year…And people think that's strange, but you know, it doesn't taste good, it's got to come from very far, it costs a lot of energy to produce. And I'd rather eat my fill of tomatoes for two months. And eat the best and then have this hankering for the rest of the year, you can't wait until next year rolls around. So it's not like I don't ever buy anything out of season but a lot less, a lot

Alternative Food Networks

Some gardeners bought food from alternative food networks, including community supported agriculture (CSA's), farmers' markets, and fresh produce box programs (weekly boxes of fresh produce that supply local when possible), as well as exchanging food with other local growers. Supporting local economies and local farmers was one of the contributing factors to buying local. As gardener 2 explained,

> I really want to wean myself off of going to the grocery store and putting value back into supporting local farmers…and just encourage more people to go to farmers markets, encourage more people to be a part of CSA's, encourage more people to know their local farmers and buy directly from them.

Trusting other local growers and knowing how they produce food was another reason for buying local. Gardener 3 was willing to spend more for local food because, "the person that grew them

just dropped them off. And I don't know who grew those down the street [at the grocery store], I don't know anything about them, so someone called me before these were picked and told me about them, don't you think it's worth a dollar more?" Gardener 8 even preferred buying local fish due to trusting that local producers will follow organic methods. Gardener 8 also explained that he was not concerned with how food is produced until he started gardening:

> I prefer to buy seafood from some place here in Detroit…I can go over and probably take a look and see how it is growing and know that they are probably fellow gardeners and feel the same way that I feel way about using products that doesn't have the chemicals, you know basic organic stuff. But you know, when you are buying stuff in the store…you have no idea what those people did to it…[Before gardening] I wouldn't even think about it. Go in the store, grab stuff and okay, now as you get into the gardening and you understand more about the organic and using chemical[s].

Interactions with Other Gardeners

Keep Growing Detroit teaches and encourages organic and sustainable growing practices, which instigated some gardeners to grow organically (described above). Another key influence on gardeners' food values was interactions with other gardeners involved in Keep Growing Detroit. As gardener 1 said,

> As I got involved in Keep Growing Detroit and started talking to all the gardeners, you know, attending education classes, listening to discussions, little by little, it took me several years, I became convinced that growing locally and eating locally was-and eating organic was very important for multiple reasons. You know, economic reasons, energy wise, and health-wise….It was not the gardening. It was everything around it, it was the classes, it was the discussions….So it's a long term thing, I don't think it's anything that

you can do in one class, or in one time. It's relationship, and I think that's what Keep Growing Detroit is good at is building relationships… in a very non-threatening way.

Gardener 1 as well as others, emphasized the role of interacting with other gardeners in them valuing local and organic food. Additionally, some gardeners educated themselves about the food system by reading books, watching documentaries, and other sources.

Discussion

This study elucidates perceived dietary changes and impacts on aspects of food security related to gardening, as well as factors that contribute to these changes, amongst racially diverse participants in a gardener support program in Detroit, Michigan. Additionally, this study explored gardeners' values and beliefs around food and food systems.

Numerous changes in vegetable intake were cited by gardeners in our study, including consuming more vegetables overall. Gardening's association with increased vegetable intake has been demonstrated in other quantitative [7,8,18-21,93] and qualitative studies.[23,26,27] One potential reason that gardening may increase vegetable intake is the superior taste and freshness of garden produce cited by gardeners in our study, as well as many other qualitative studies.[19,22,23,26,27,51-53] Gardening may be especially influential in increasing vegetable intake in areas like Detroit where produce quality and availability can be poor.[44,46] Having knowledge of how produce is grown and control over chemical inputs are other potential explanations for why gardening may increase vegetable intake, which were commonly cited amongst interviewees in our study. In our study, as well as other qualitative studies, gardeners had a strong preference for growing food organically, and believed that organically grown food is healthier.[21-23,53,56] Additionally, some gardeners in our study displayed an emotional connection to the food they grew, including valuing the food they grew themselves, and feelings of pride for their ability to grow their own

food, which we theorize may contribute to gardeners eating more vegetables. This is consistent with other qualitative studies, where gardeners describe feelings of pride, accomplishment, and satisfaction for the produce they grow.[22,26] The emotional connection towards the food they grew may also explain why the gardeners in our study intentionally incorporated more produce into their diets to avoid wasting it.

Gardeners in our study also tried new vegetables, mentioning kale, collards, and Swiss chard, and began eating them frequently because of receiving seeds and seedling to grow them through the Garden Resource Program. Green leafy vegetables are amongst the most nutritious vegetables, and provide key nutrients that are lacking in the American diet, such as fiber.[31,100] This finding suggests that gardener support programs can also influence the types of vegetables that gardeners eat through the seeds and plants they provide to participants. Gardeners in our study also reported making vegetables the centerpiece of meals, as well as eliminating or reducing processed foods and meat intake. This indicates that the diets of these gardeners are becoming more in line with the Dietary Guidelines for Americans.[31] Some gardeners attributed dietary changes to participating in nutrition education in conjunction with their gardens. Additionally, some gardeners disliked processed food because of its negative effects on human health. This belief was in part influenced by talking with other gardeners at Keep Growing Detroit's classes and social events, where many conversations revolve around gardening, food, and health. This underscores some participants' viewpoint that it was not just the gardening that influenced their diets, but the social exchanges that occurred through being a member of the Garden Resource Program.

Other studies have shown an association between gardening and changes in intake of foods other than fruits and vegetables. In a cross-sectional survey of community gardeners and

controls in Philadelphia, gardeners consumed fewer sweets and sweet drinks than non-gardeners.[48] In another study, after a community gardening intervention 53% of those who gardened at least once a week reported eating less fast food, and 68% reported eat food that is "fresher (less packaged food)."[18] A qualitative study of home gardeners found that after gardening, home gardeners in Toronto preferred buying fresh produce instead of processed or prepared foods.[23] These studies, as well as the findings of our study, provide evidence that gardening can contribute to changes in dietary intake beyond increasing vegetable intake.

Our study also found that many gardeners held strong beliefs and values surrounding the food system. Many distrusted industrialized farming and industrialized food, especially processed food, due to concerns for human health and well-being and the environment. Some interviewees viewed gardening and urban agriculture as a departure from industrialized food in the way that it affects people and the environment. This highlights the importance of values for these gardeners: gardening was not only a way to provide themselves with fresh, healthy produce, but was also a means to produce food that did not harm people and the environment, and avoid the industrialized food system. Gardening was a means to resist the industrial food system. This echoes what White found in interviews with female farmers involved in the Detroit Black Community Food Security Network, an organization that promotes the involvement of Black Detroiters in urban agriculture in the city of Detroit. As one woman she interviewed stated, "You resist when you grow. Gardening resists the corporations that are knowingly putting things that we can't even pronounce in our foods."[101] Gardening as resistance to industrial food was also described by gardeners in a study in Australia.[22] In addition to growing food themselves, some gardeners in our study prioritized purchasing foods in season and through alternative food networks, in part to align their food purchases with their values. In another

qualitative study, gardeners also attributed paying more attention to seasonality of food after gardening.[23]

Gardening's food security implications have been examined in both qualitative and quantitative studies. In qualitative studies gardeners report having improved access to high quality fresh produce,[19,21-23,27,52] and also report saving money on produce in most studies.[19,21,27,51,52] In our study, most gardeners perceived that they saved money on food from their garden. Recent studies have mixed results regarding food savings from gardening. Two recent studies found that home and community garden plots produced an average of $339 and $435 worth of produce,[59,81] respectively, but another study found that home-grown produce costs an average of 39% more than purchasing produce from the grocery store.[58] Members of the Garden Resource Program are able to access material resources for gardening at a fraction of the retail price. The Garden Resource provides 30 packets of seeds and over 100 transplants to family gardeners for an annual fee of ten dollars, and school, community, and market gardens receive more than double the number of seeds and transplants for a fee of twenty dollars. They also provide free compost to gardeners who volunteer at least once, offer additional gardening supplies such as raised beds, and have regional hubs where gardeners can rent tools for free. The Garden Resource Program members are able to garden with little financial cost, allowing for savings on food. Additionally, many gardeners preserved their produce for consumption beyond the growing season, which has also been found in other qualitative studies.[21,23,51-53] Some gardeners in this study still had their garden's produce frozen in March, indicating that gardening can provide produce nearly year-round.

Limitations

While this study found that gardening benefits diet and aspects of food security amongst

experienced Garden Resource Program participants, these findings may not hold for new gardeners. New gardeners may lack the knowledge and skills needed to produce enough vegetables to substantially contribute to their food security and vegetable intake. While gardeners in this study perceived saving money due to gardening, we did not measure the amount of money spent on gardening supplies or the dollar value of produce grown. Additionally, participants were not asked questions related to income or employment status. Gardening may not be a feasible means of improving dietary habits and food security amongst those who do not have the time to garden or are not interested in gardening. Most interviewees were over age 50, and may have more free time to dedicate to gardening.

Conclusions

The findings from this study can inform community-based approaches to improve nutrition and food security. There are hundreds of gardener support organizations throughout the United States, and the creation of new gardener support programs can expand gardening's benefits into new communities. Through offering opportunities for gardeners to interact with each other, gardener support programs can create social networks where gardeners learn about gardening, food systems, and nutrition through each other. These programs can influence the dietary intake of their participants by introducing them to new vegetables. Gardening also provides a platform for nutrition education, where gardeners can learn how to prepare the produce from their gardens.

While this study found that participants perceived they saved money by participating in a gardener support program, future research is needed to quantitatively measure the potential cost savings from participation in these programs. This is especially relevant for programs amongst low-income and food insecure individuals.

CHAPTER 4-A QUALITATIVE EXPLORATION OF NEW COMMUNITY GARDENERS' EXPERIENCES

Introduction

Community gardening is associated with multiple health and psychosocial benefits, including increased fruit and vegetable consumption,[7,8] a source of physical activity,[9] improved mental wellbeing,[67] and positive social interactions.[15,16] These benefits may arise through the synergistic processes of spending time in an attractive natural setting, nurturing plants, producing fresh food, social interaction, and collective efficacy.[7,8,12,14-16,26,102-104] Community gardening can be thought of as a comprehensive public health intervention that could expand the adoption of health behaviors and improve overall public health if promoted and propagated to people not currently involved in a community garden.[96]

The act of gardening is often not intuitive, however, and for new gardeners, requires the development of new knowledge, skills, and habits. While substantial research has examined gardening's potential to influence health behaviors and physical and mental health, little if any research has focused on the experiences of new gardeners. The research participants in most studies of community gardening have been experienced gardeners who have either gardened in their community garden for many years, or had grown food as children. Published research on community gardening rarely includes information on how long participants have been gardening. Additionally, scant research exists regarding perceptions and importance of community garden leadership. A small body of literature indicates that leadership can improve or hinder the experience of community gardeners.[13,79,105] In order to broaden community gardening's public health impacts, it is imperative that we listen beyond the voices of experienced gardeners, and expand our understanding to include the experiences of people who are gardening in a community setting for the first time.

This study was conducted in collaboration with Denver Urban Gardens, an organization that manages community gardens in the metro Denver, Colorado area. In this study, we conducted qualitative interviews with a subset of new community gardeners enrolled in a randomized controlled trial investigating the health impacts of community gardening, the Community Activation for Prevention Study. The aims of this study were to explore new community gardeners' experiences in order to learn how to best promote community gardening to new people, and to tailor support systems to their needs. The paper describes results with regard to new community gardeners' motivations to garden, perceptions of garden leadership, challenges experienced, and social interactions with other gardeners.

Built Environment, Community Gardens, and Health Behaviors

Chronic diseases, including cardiovascular diseases, cancer, and diabetes, are among the leading causes of death in the U.S.[106] Eating fruits and vegetables and physical activity are important actions people can take to reduce their risk of chronic diseases. However, both fruit and vegetable consumption and physical activity levels in the U.S. fall far short of national health recommendations.[1,2] Ecological theories of physical activity and dietary intake posit that health behaviors are influenced by factors at multiple levels, including the built environment.[33,107] The built environment includes buildings, retail food outlets, and recreation spaces including parks and trails. With regards to diet, the availability of healthy foods near an individual's residence may play an important role in dietary quality. For example, a recent review found that indicators of healthy food environments, such as shorter distance to supermarkets or greater variety of produce available in stores, were associated with increased intake of fruit and/or vegetables in about half of studies reviewed.[34] Similarly, neighborhood walkability, parks and playgrounds, and trails are associated with increased physical

activity.[108,109]

Community gardens can be viewed as an environmental intervention that provides a place to be active as well as a source of fresh vegetables. Community gardening is associated with improvement in both physical activity and fruit and vegetable intake. Community gardeners had higher fruit and vegetable intake than non-gardeners in several cross-sectional studies,[7,8,18] and gardening is a source of moderate to vigorous physical activity in younger adults and low to moderate physical activity in older adults.[9,10] There is also a potential link between community gardening and weight status: a case-control study found that BMI of community gardeners was significantly lower than controls,[68] and another study found that non-gardeners had a significantly higher BMI than both home gardeners and community gardeners.[110] Studies in several countries have also demonstrated a positive association between self-rated health and gardening.[12,72,73]

Gardening and Mental Wellbeing

In addition to physical health, gardening is also beneficial for mental health and wellbeing by promoting relaxation and reducing stress. In qualitative studies, gardeners describe escaping from daily stressors while gardening.[26,51,56] Hawkins and colleagues found that focusing on the physical work of gardening, getting away from home, and being in nature contributed to this stress reduction.[66] In this study gardeners also referred to feeling calm, relaxed, and at peace in the garden, which is echoed in other studies of home and community gardeners.[21,23,27,56] There is also quantitative evidence to support the mental health and well-being effects of gardening. A case-control study found that several mental health metrics, including depression, were better in community gardeners when compared to controls. This study also assessed the same metrics in gardeners before and after a session of gardening. After

the gardening session, gardeners had significant improvements in multiple aspects of mental health.[67] In a randomized controlled trial, Van Den Berg and others aimed to objectively measure the impact of gardening on stress by measuring salivary cortisol, a stress hormone. In this study community gardeners conducted a mentally stressful task and were randomly assigned to then either do light gardening activities in their garden plot or read indoors for 30 minutes. Those who were assigned to garden saw a bigger reduction in cortisol after the stressful task when compared with those who were assigned to read.[11]

Community Gardening and Social Interactions

Community gardens can also offer social benefits by providing opportunities to interact and build relationships with other gardeners. They provide places for people to socialize, including among people who would not normally interact.[13,14] There is often a diversity of people within community gardens in terms of nationality, race, or socioeconomic status.[15,17,27] In one study, gardening was referred to as a "common language" that facilitated bringing dissimilar people together in the garden through a shared interest to talk about.[17] Being part of a community garden can also give people a sense of belonging and develop a more cohesive feeling of community in a neighborhood.[15-17] Relationships that begin in the garden often extend beyond the garden, resulting in creation of new friendships, social support in times of need, or neighbors looking out for each other.[15-17] However, community gardens are not always hubs of positive social interactions. In some instances, interaction with other gardeners is rare and a sense of community is lacking.[13,111]

Community gardens can also be places of conflict between gardeners, as well as between gardeners and garden leadership.[79,105] Garden leaders, garden members tasked with managing community gardens, have roles such as communicating garden rules and expectations and

organizing events such as workdays and social gatherings, and mediating garden conflicts such as produce theft. However, garden leadership can also be a source of conflict in community garden when gardeners perceive rules to be overly restrictive and feel that they are not included in decision-making processes.[79,105] Conversely, there is also evidence that garden leaders can have a positive influence in the garden. In one community garden, a change in the leadership committee resulted in a profound change in the social dynamic in the garden. Previously there was little social interaction in this garden, but as a result of the new leaders bringing "more energy," gardeners believed conflicts were resolved more swiftly and social interaction increased.[13]

Methods

For this study, semi-structured qualitative interviews were conducted with a subsample of participants enrolled in a randomized controlled trial (RCT) examining the health impacts of community gardening, the Community Action for Prevention Study (CAPs) (for a full explanation of the CAPs methodology see Litt et al., 2018),[112] being conducted in partnership with Denver Urban Gardens.[112] Both the present study and the full RCT were approved by the University of Colorado Boulder Institutional Review Board (Protocol # 16-0644), and funded by a grant from the American Cancer Society (ClinicalTrials.gov, ID: NCT03089177).

Denver Urban Gardens

Denver Urban Gardens is a non-profit organization that operates over 165 community gardens in the metro Denver area.[61] They provide technical support to gardeners, offer gardening education classes, and Master Composter and Master Community Gardener training programs. Through their Grow a Garden program, home and community gardeners who are low-income receive seeds and transplants for a small fee. Denver Urban Gardens community gardens are

divided into multiple plots that are available for gardening by individuals and families for a small fee. Gardens are organized and administered by volunteer garden leaders who receive comprehensive training in garden leadership from Denver Urban Gardens staff.

Recruitment, Eligibility, and Interview Guide

CAPs is a four-year randomized controlled trial. In order to meet recruitment goals and not overburden Denver Urban Gardens by the demands of the study, the design of the study was tailored to include three waves of data collection. Participants from Wave 1 of the CAPs trial comprised the sample from which interviewees for this current qualitative study were selected. After informed consent was obtained to enroll in CAPs, participants were randomized to the control group (remain on the garden waitlist) or the intervention group (community gardening group). Randomization occurred by permuted block randomization with varying block sizes.[112] A description of recruitment, randomization, and eligibility for CAPs can be found in Litt et al., 2018.[112]

The intervention consisted of material resources and technical support for cultivating a community garden plot. The community garden plot fee was paid for by the CAPs trial, and participants were provided with vegetable seeds and transplants provided by the CAPs trial and Denver Urban Gardens. Participants were invited to attend a free beginner gardening class. Additionally, if desired by the participants, CAPS study staff were available to answer gardening questions and assist with initial preparing and planting of plots.

An advisory team consisting of Denver Urban Gardens staff members, community garden leaders, past American Community Gardening Association presidents, nutritionists, and academic partners was created to inform the design and implementation of the CAPs trial. For this qualitative study, the interview guide was reviewed, revised, and approved by the advisory

team. The advisory team suggested topics for interview questions and provided feedback on question wording. Topics of the interview guide analyzed for this study included motivations to garden, challenges experienced, social interactions with other gardeners, and perception of garden leadership. Pilot testing of draft interview questions was conducted with four community gardeners in the metro Lansing, Michigan area. In the pilot interviews, participants were asked to provide feedback on appropriateness and clarity of question wording and the final interview guide was informed by these pilot interviews.

Data Collection

For the present qualitative study, 20 Wave 1 CAPs participants in the intervention group were contacted to participate in an interview in spring of 2018. In order to understand the variation in experiences of new community gardeners as well as garden leadership, participants were selected by purposive sampling to reflect different community gardens and different levels of garden involvement. Fifteen participants who gardened in 13 different DUG gardens agreed to be interviewed, while five declined or did not respond to researchers. Participants completed a separate written informed consent prior to the qualitative interviews.

Participants were provided with a $20 gift card for participation in the interviews. Two interviewers trained in qualitative research methods conducted the interviews. Interviews were tape-recorded, transcribed, and transcripts were checked and corrected for accuracy.

Demographic characteristics were obtained from demographic data captured in the CAPs surveys. Selected interviews were mostly non-Hispanic white (67%, n=10) and female (80%, n=12). Interviewee age ranged from 20-75 years, with a mean age of 42 (standard deviation ± 16.8 years).

Data Analysis

Transcripts were analyzed by thematic coding using Atlas.ti software. Two trained researchers coded six of the 15 interviews independently to generate the initial codebook. Codes related to the research questions (motivations to garden, perception of garden leadership, challenges experienced, and social interactions) were included. The two researchers collaboratively refined code definitions and discussed coding discrepancies based on this preliminary coding. The remaining interviews were coded independently, and the interviews used for codebook development were recoded using the final codebook. The first author checked all coding for consistency. One interview was discarded due to a limited amount of relevant data, resulting in 14 interviews being used for analysis. Codes were organized into over-arching themes. For each code, summary statements were written for each interviewee and organized into conceptually-clustered matrix displays.[99] Conclusions were drawn based on comparing summary statements across interviewees.

Results

Table 2 presents information on each participant's age, whether they received an orientation to the garden, if they attended the CAPs gardening class, how long the community garden they joined had been under cultivation, the number of plots in each garden, and whether the garden was full for the season. The qualitative analysis results are organized into major themes. Themes and codes within each theme are found in Table 3. Themes include participants' motivations for gardening, their perceptions of garden leadership, challenges experienced, and lastly their plans for gardening in the future.

Table 2: Participant and garden characteristics

Participant Number	Participant Age (Years)	Participant Attended Gardening Class	Participant Received Garden Orientation	Years Since Community Garden was Started	Number of Plots in Garden	Garden Was Full
1	> 50	yes	yes	< 5	<30	no
2	20-30	yes	yes	>10	<30	yes
3	> 50	yes	yes	>10	≥30	yes
4	40-50	yes	yes	>10	<30	yes
5	20-30	yes	no	< 5	<30	yes
6	> 50	yes	no	< 5	<30	yes
7	> 50	no	yes	6-10	<30	yes
8	20-30	yes	no	6-10	<30	yes
9	20-30	yes	yes	>10	<30	yes
10	40-50	yes	yes	6-10	≥30	no
11	20-30	yes	yes	>10	≥30	yes
12	20-30	no	yes	>10	<30	yes
13	20-30	yes	no	6-10	≥30	yes
14	> 50	yes	yes	< 5	<30	yes

Table 3: Perceptions of new community gardeners: themes and codes

Theme	**Codes**		
Motivations	Motivations for gardening in general	Motivations for community gardening	
Leadership	Leadership	Orientation	
Social interactions	General interactions	Learning from other gardeners	Gardening events
Challenges	Time/level of commitment	Technical challenges	Other challenges

Motivations

New gardeners' motivations for joining a community garden fell into two general categories: motivations related to gardening in general and motivations specific to community gardening. Motivations for gardening in general included a desire to be outside/in nature, to grow their own food, and improve their health. The participants that were drawn to community gardening specifically wanted to receive support from other gardeners or meet new people, as well as lack of a space to garden at their home.

Motivators for gardening in general included enjoying being outside, with one participant saying, "I like working with my hands too. I like being outside. Even though it's outside, it's more inward kind of, you know, it's more of a meditative thing. You're working with your hands, you're digging in the ground, you're pulling weeds, you know" (participant 1). Two other participants also mentioned "getting their hands dirty" as an aspect of gardening that was appealing to them, with another calling gardening a "good trajectory for doing things with the earth" (participant 2).

Growing their own food was a motivation to garden for most participants, but the reasons that this was important to them varied. Two participants who were vegetarian or vegan and were drawn to gardening because vegetables comprised a large portion of their diet. There was also a belief that garden vegetables tasted better. As one participant said, "When I go to the store, the vegetables that are presented are not flavorful, in other words tomatoes look good, but they don't have any taste or flavor. When I grow them in a garden they have a certain flavor" (participant 3). Another appeal of growing their own food was concern about how food is grown and what goes into the food they ate, such as chemicals used in food production. As one gardener said, "It's [home-grown vegetables] fresh. I know where it came from. I know what went into it"

(participant1). Two participants wanted to save money on food, with one of these wanting to improve access to fresh vegetables. She referred to her neighborhood as a "food desert" and stated that she had to go outside of her neighborhood to access food. Improving health was another motivator, with one participant wanting to lose weight and another wanting to improve his eating habits because he had been recently diagnosed as prediabetic.

Additionally, participants were asked their motivations for joining a community garden (as opposed to gardening at home or elsewhere). Those who lived in an apartment or condo were drawn to community gardening because they did not have space to garden at home. Interacting with other gardeners to get guidance on gardening was another key motivator to join a community garden: "I haven't had a ton of experience with it [gardening] so I just thought a community garden would be a good place to learn and maybe there would be people there who could help me" (participant 4). Additionally, the garden was seen as an opportunity to gain new social connections. As one participant said,

> Just getting to know people in the neighborhood maybe and make some friends because we were new to the neighborhood about a year and a half ago. Then just, because I'm isolated as a mother and my husband's a [occupation omitted], I'm alone a lot, so I thought it would be a nice way for me to be able to meet people casually (participant 5).

Leadership

Each community garden in the DUG network has at least one volunteer garden leader who oversees garden organization and maintenance. Garden leaders are responsible for introducing gardeners to the garden and their plots, communicating with gardeners, and organizing garden events such as workdays and potlucks. DUG highly encourages garden leaders to attend a garden leader training course, and provides leaders with ongoing support.

Orientation

Many DUG gardens have group orientations for their gardeners in March, April or May each year, where garden expectations and guidelines are communicated to gardeners. However, due to what needed to occur for study participants prior to getting their garden plots (consent, health visits, dietary recalls, and so forth), participants were not assigned to their plots until May. Instead, most participants had a one-on-one orientation to the garden, where they were assigned their plot and shown around the garden by their garden leader. While most participants found their orientation helpful, several participants stated they would have liked a group orientation to be able to meet the other gardeners. As one participant said, "[I would have liked] maybe a group event. Like the beginning of the season hullabaloo. Like, 'This is everyone in the garden.' Just to know who is there" (participant 8).

The importance of the garden orientation to new gardeners' experiences throughout the season became clear through the responses of four participants who did not get any sort of garden orientation (Table 2), which left them without key information. One participant did not know how to operate the watering system in her garden, which prevented her from watering her plants at the beginning of the season. Another participant who did not receive a garden orientation reported feeling "lost" and "dismotivated" when there was an unplanned water shut-off and she did not know who to contact about this issue.

Perceptions of Leadership

Participants valued having an engaged garden leader who they saw frequently and served as a source of gardening knowledge. This was evident by gardeners' reports of garden leaders being willing to help participants and answer their questions. One gardener said about her garden leader,

> He tended to go early morning which is when I went. I looked forward to seeing him in the morning…. He has great stories to tell and [is] just a very kind person….[Having him there] *made* my experience really. He was very willing to help me in every way….I felt pretty informed when I first started and then anything that I did have a question about, he was just always so willing to answer them that I never felt like I didn't know something….he would always come and check on me. "How is it going? Do you have any questions?" (participant 4).

For another gardener, the leader made it more enjoyable to be in the garden:

> The garden leader really stood out to me because she, in my opinion, had the right idea of what I expected with a community garden. I guess, hippie in a way. She had a lot of information and she's just really pleasant to be around and to work with, and that made it not feel like work when I went to the community garden. Whereas honestly, most of the time I felt like it was a chore to get there and I felt stressed out by [some family obligations] it (participant 5).

Another said,

> [The garden leader] was one of I think the core group that attended. I would say the leadership was very welcoming and really open to answering questions as well, being new to gardening I think my first work day I remember being like, "Do I pull this? Is this the weed?" He's like, "Yes, if it's not so what? You learned." Had a very casual attitude of it not being this exact science which you know, was refreshing to hear, if you pull something out, you pull something out. That's gardening (participant 9).

For two participants, their garden leaders also expanded their gardening knowledge by connecting them with other gardeners to teach them about specific gardening topics.

More evidence of the desire for an engaged leader came from participants who did not see their garden leaders frequently. Some of these participants wanted to see the leader in the garden more frequently to get hands-on instruction and ask questions, as well as wanting their leader to check in on them since they were new to gardening. One gardener said, “It just didn't feel very supportive, I guess. I felt like I was pretty much on my own” (participant 6). Another gardener said, “[I wanted] guidelines; this is how you do it, this is how you garden. I had a little bit of knowledge and I did a little bit of reading beforehand, but I was thrown in the fire and told to find my way out basically” (participant 7). Another participant said, “there was two people in the garden [herself and the other study participant] that have no clue what they are doing with gardening and knowing that, it would've been nice to have him maybe reach out a few times just personally instead of on the group email” (participant 2).

Social Interactions

Socializing in the Garden

The extent of social interactions with other gardeners varied widely amongst participants, ranging from seeing other gardeners every time they went to the garden to only seeing other gardeners a few times the entire season. Two participants reported seeing others in the garden often and were positive about these interactions. These two participants both had people of different nationalities in their garden and they enjoyed these intercultural exchanges, including learning about how gardeners from other countries grow productive plants. As one said,

> That is the beauty of gardening with someone from another country. They can show you different ways to use what you already have…I also learned that they grow differently. We just look at the ground, and that's it. They look, "Well, how much cubic space can we get out of this little space? Can we go up with this? Can we go diagonal with this? How

much can we get out of this space?" That really impressed me (participant 10).

The other participant said,

> It had probably four or five different nationalities as far as folks that gardened there. While we couldn't always communicate, while they didn't speak my language and I didn't speak theirs, we could communicate through smiles and hugs and handing over vegetables and things like that, which was lovely. I absolutely adored that piece of it (participant 6).

Two participants who enjoyed the social aspects of the garden were *surprised* by the presence of community in the garden. As one participant said,

> I don't think I really thought there was going to be a community part of it. Even though it's in the word I just thought I'd go to my garden, tend my plot, and go. I thought that was the extent of the experience. I didn't really think that there would be the other aspect of it, of making friends and really having a community within the neighborhood (participant 9).

This participant did not see other gardeners often on a typical day in the garden but developed close relationships through meeting up outside of the garden and on garden workdays. She referred to herself and three others, including the garden leader, as the "core group" within the garden who actively participated at workdays and met outside the garden. They met up weekly outside the garden, which continued beyond the gardening season. The other participant who was surprised by the interactions with others had mental health issues, and not only found the socialization surprising, but also very beneficial to his mental health:

> The socialization was great. For me, I need to get out of my apartment. Growing fresh vegetables and having that opportunity, weeding and socializing is really good. It's a

> good opportunity for me because when I get depressed, I tend to isolate myself, having me get out and water all the time really helped (participant 3).

In contrast, most participants rarely saw other gardeners on typical days when there was not a group event such as a workday. While participants described other gardeners as friendly, interactions tended to be limited to brief exchanges. As one participant said,

> At the garden itself, it was seriously—like I could probably count on one hand how many times I ran into someone there. Usually, it was just-- sometimes it wasn't any conversation at all, just like kind of "Hey, we're at the same place at the same time head nod kind of thing." Sometimes it was like, "Oh, you're working on that garden, I've seen that garden, it's beautiful, what are you growing," kind of thing (participant 8).

This participant went on to say,

> My square is a different concept than the whole community garden. I know it's a part of that and the reason why I did so well was because of the community garden but when asking about gardening, I definitely am just thinking about my garden in itself and that was really fun and I loved that. The community garden itself wasn't a bad experience. It was just, like I said, neutral. If this garden could have been on my balcony or it could have been in a community garden, it made no difference, in theory (participant 8).

Another participant said, "It was like a 'Hello' or a 'Good morning.' But that was about it. Everybody was kind of there to do their thing and then off to do what they needed to do. Nobody was unkind or unfriendly. It was just not a lot of conversations or whatnot" (participant 4). The idea that the other gardeners were "there to do their own thing" then leave was echoed by several other participants. One said, "It was just a bunch of adults almost there to do chores" (participant 7).

For nearly half of interviewees (six out of 14), the infrequent interactions and lack of depth of interactions left them disappointed or surprised by the lack of community atmosphere in the garden. Almost all participants who rarely saw other gardeners wished they would have had more interactions with other gardeners. As one participant said, "It was lonely. Yeah, basically that was it 'cause I could be there longer if there was somebody there, you know, but all I did was like go, water, weed, kind of look at the flowers, look at how everything is growing" (participant 1). There was an expectation or assumption among these participants that the community garden would inherently bring people together, but they found that this was not the case. As one participant said,

> You didn't see anybody in it, hardly ever. I don't know, it wasn't what I expected a community garden to be….it didn't give me the warm welcoming vibe of, 'Come. Let's talk garden.'… I just assumed community gardens, it was a community, like the gardeners actually interacted on a frequent basis. It just doesn't seem to happen which was really odd to me (participant 2).

Two participants also felt that there was a group of people in the garden that knew each other, but that they were not part of it. One participant, whose garden was located at a school, said he felt like "the black sheep" because all the other gardeners knew each other from working at the school. Another participant said,

> Interviewee: If it [community in the garden] did exist, it was almost cliquey. If you were in that group, you were friends already with them… I was an outsider, so that's how I was treated was an outsider. You can have a plot but don't-- You're not invited.
>
> Interviewer: Did you see other people interacting in the garden?

> Interviewee: Yes. A few of them were interacting with one another, but they were friends. They had known each other for a long time. Two women introduced themselves to me…I was told right away that don't touch our stuff (participant 7).

Gardening Assistance

While there was not a large amount of interaction with other gardeners in most of the gardens, there was still a culture of helping others, especially with watering. For example, participants would show up to their garden and find their plots watered, and when going out of town other gardeners would water participants' plots. When there was an unplanned water shutoff at one garden, one of the gardeners who lived near the garden allowed the rest of the gardeners to fill up buckets of water at her house. Two participants mentioned helping others out, including one who said, "We just learn to take care of each other. I would come in sometimes and look around, I've noticed my garden was watered. Yes, or I would do it for others… or I would see weeds along their pathway, I would pull them up. We learned to do little things for each other" (participant 10). Another participant said,

> I felt like that's [helping others] part of working as a community. It's helping each other out, especially people who are less able-bodied. Then I knew that other people were better at keeping up on the stuff that I was rubbish at, like watering my plot. I think other people watered my plot more than I did (participant 5).

Most participants got advice from other gardeners, such as when to harvest, how to manage plant diseases, and how to control pests. For one participant, getting advice from others stood out as improving her experience: "I think it was probably better than what I was expecting because so many people gave me helpful advice" (participant 11), as well as the participant described above who got extensive help from her garden leader.

However, due to the infrequency of seeing other gardeners, learning from other gardeners did not happen extensively for most participants. Additionally, a few participants did not feel comfortable asking others for advice. As one said about asking for help,

> It was super intimidating. I know I could've and I would've been fine, but of course being just an introvert, a shy person, I didn't want to ask. Thinking, knowing that I was a super beginner and thinking everyone else was an expert and not wanting to ask, not wanting to jump out of my comfort zone. That's what it was all about. I'm thinking that I can't do it on my own (participant 12).

About three participants got help from other gardeners beyond advice, with other gardeners helping in their plots. For example, a gardener helped one of the participants use the tiller, which she said she would not have figured out how to use on her own. Another participant's plot was covered with weeds when she started, and she did not know where to start. She got help from another gardener with clearing the weeds from her plot, and the next day that gardener's husband cleared the remaining weeds from her garden. This participant also got help from a CAPs garden liaison with planting her garden:

> She [the CAPs garden liaison] stayed there the whole day…. She created a garden for me…. Yes, she was so helpful, I wouldn't have planted if it wasn't for her….It really helped me learn the basics because I didn't know how to even plant things. She taught me how to do it into a row. Because I don't think I would've ever planted anything if she wouldn't help me physically plant the plants. Because I was just scared I was like, "I don't want to kill it" (participant 13).

Garden Events

DUG community gardens often have group events for gardeners, such as workdays and

potlucks. Close to half (six out of 14 participants) attended events in their gardens, which included workdays, potlucks, gardening lessons, and other social events. Four participants reported there were group events in their gardens but did not attend them. Reasons for not attending events included not hearing about events in time and schedule conflicts. Additionally, one participant felt uncomfortable going to events since did not know the other gardeners, while another avoided garden events because she did not want to be around alcohol. Four participants were not aware of any group events in their gardens. These were gardens where participants perceived their leaders to be corresponded to gardens that were perceived to not be engaged. Two of these four were disappointed about the lack of group events, as they wanted more opportunities to engage with other gardeners.

Challenges/Barriers to Gardening

The time and/or level of commitment required to garden were commonly cited as barriers to gardening due to competing obligations such as working and taking care of children. The fact that participants had to go to the community garden, versus gardening at home, made it more challenging to spend time gardening. As one participant said,

> The time and it being a walk and a place that I had to get to [made it challenging], it wasn't in my backyard where I could just wake up and do it…. It was close [but]… sometimes, I would even drive and just make it as quick as possible and not really spend time there (participant 12).

One participant who said that the garden not being in her backyard made it challenging eventually stopped gardening due to the stress of the time commitment of gardening:

> I work ten hours shifts… and I also have dogs and do foster care…When I started losing interest or realizing that it was just more than I could deal with, it dwindled little by little

> until I wasn't going any longer…. When I stopped going it was a tremendous relief as far as time, that sort of thing. It took a lot of pressure off (participant 6).

Another participant found the garden stressful at times and referred to the garden as "another thing to add to the to-do list." The distance to the garden was also difficult for other participants, such as one who moved further from the garden mid-season, and another who lived three to four miles from the garden had difficulty getting there after her car broke down.

Going out of town was also a commonly cited challenge due to needing someone to water. As described above, some participants easily found other people to help them water, but others did not. As one participant said, "the garden wasn't really a place that felt supportive," (participant 2) so she did not feel that anyone else would water her plot for her while she was gone. Another participant did not find anyone to water her plot while she was out of town, and when she returned all her plants had died so she stopped gardening.

Technical challenges such as pests (both mammals and insects) and plant diseases were common. Weeds were a common problem particularly at the beginning of the season, with plots being entirely covered with weeds when participants were assigned their plots. This led to feeling overwhelmed or not knowing where to begin. As one gardener said, "the plot was just filled with weeds. I mean, just filled….[when] I saw those weeds, I about died" (participant 4). This participant got help from her garden leader to clear out the weeds, and other participants got help with this as well: "When I stepped in, it was full of weeds, and I didn't even know where to start, I tried so hard to get rid of them. Then people started helping me… and they helped us clear it out….The next day, her husband cleaned it all out" (participant 5).

Lack of gardening knowledge was a problem, which left participants feeling frustrated with the experience. As one participant said,

> None of the seeds came up. It's actually really frustrating because I didn't know what I was doing and I was trying to do it on my own. I knew that there were resources available but didn't-- The classes were available, I couldn't go ….I think disappointment was part of it too. Looking back, I wish I would have spent more time there. I wish I would have made it more of a priority. Gotten more engaged with the community too (participant 12).

Another participant, who got a lot of help at the beginning of the season from other gardeners and CAPs staff, struggled throughout the rest of the season when she was not able to get help from others. A few other participants struggled with a lack of gardening knowledge at the beginning of the season, but as described above, received help from their garden leader or other gardeners.

Theft and vandalism were a challenge, but only for two participants. One participant put gnomes and other decorations in her garden, which would often go missing. This participant also reported a lot of theft of produce from her garden, but she was understanding of this and attributed it to hunger in the community. As she said,

> What else stood out was actually how hungry people in my neighborhood were because they sometimes will help themselves to your food… I took it all in stride… Yes, some days it did [affect how much food I had to harvest] but your plants are going to grow more. You bounce back. It's no big deal (participant 10).

Future Gardening

Five out of 14 participants were planning on community gardening again for a second season. Reasons for continuing in the community garden included living in an apartment and the community garden being the only option to garden, finding gardening relaxing, and wanting to fix the mistakes they made gardening during the first season. Two participants were unsure if

they were going to community garden again for a second season. Both cited the lack of community in the garden as a contributing factor to this decision. As one participant said, "the garden itself is so new and there's no cohesiveness…There's not a whole lot I can look forward to from my past experience" (participant1). The other was interested in joining a different garden that had more of a sense of community: "I'm hoping that they're [the other gardeners] there to be part of the community…I wanted a group that was a community, and it wasn't all just people doing their own thing. I have a place I can now garden [at home], but I want to be part of a community" (participant 7). Another participant was not planning on joining a community garden again immediately but was open to community gardening again if she found a garden with a more cohesive community: "I really like the idea of a community garden, I'd probably try another one again. I think if I tried a community garden again though I would want to talk to a few of the different leaders and see what the community culture was before I joined. I wouldn't just randomly join a garden" (participant 2).

The time commitment and traveling over the summer were other reasons cited for not community gardening again for a second year, while two had since moved away from the neighborhood where their garden was located. Four were planning on or considering gardening at home instead of the community garden for the second season due to either moving away from the garden or finding it more convenient to garden at home.

Discussion

This study examined the experience of new community gardeners with respect to motivations to garden, perceptions of garden leadership, social interactions with other gardeners, and challenges experienced. To our knowledge, this is the first study to focus on the experience of new community gardeners. Understanding new community gardeners' perspectives is

valuable in order to be able to expand the benefits of community gardening to new people, and to customize organizational systems to support their needs.

In this study, motivations for gardening in general included a desire to be outside or in nature, to grow food, and improve health, all of which have been previously cited motivations for gardening in the research literature.[22,73,113] Motivations specific to community gardening in this study included meeting new people – for learning and for socializing. The social aspect of community gardening appealed to participants in this study, and has been found to be a key motivator for community gardening in other studies.[17,22,56,73,114] While community gardens are often initiated by health coalitions with the intent to improve diet and health of area residents through healthy food production,[18,115,116] it is also important for community garden projects to focus on fostering social interaction between gardeners since this is a motivator for participation. Participants were also drawn to community gardening because they lacked a space to garden at home, indicating the importance of community gardens for those who live in apartments or condos.

We found there was a wide variation in participants' perception of garden leadership. Garden leaders who were perceived positively were willing to help participants in the garden by sharing their gardening experience and knowledge and answering participants' questions about gardening. These participants tended to see their garden leaders frequently and were kept informed about garden events and issues through regular communication. However, more participants had negative perceptions of the leadership in their gardens. Most of these participants had minimal interaction with their garden leaders, with some only meeting them once the entire season. Some of these participants felt that they did not get adequate support from their garden leaders and that they were on their own. When asked what they wanted out of

a garden leader, participants reported wanting to see the leader in the garden to get hands-on instruction and ask questions as well as having their leaders check in on them.

While new gardeners may need more guidance and support than experienced gardeners, in many cases it is not feasible to delegate this responsibility solely to garden leaders. Garden leaders have substantial responsibilities to manage their garden, and it can be difficult to find people to fill this role and continue in this position for multiple years; in the current study, several garden leaders resigning mid-season without anyone replacing them. DUG recommends development of an engaged leadership team (Lara Fahnestock, personal communication). Having a team of leaders, as opposed to a single leader, may help avoid overwhelming garden leaders and provide additional assistance to new gardeners. Additionally, other experienced gardeners within the garden can be encouraged to provide new gardeners with hands-on instruction and mentorship. Another potential source of assistance for new community gardeners are Master Gardeners or volunteers in similar programs such as DUG's Master Community Gardening Program, an 11-week course which teaches both community organizing and organic gardening practices that requires participants to volunteer at least 30 hours in their first year, half of which must be outside their own community garden.[117] Volunteers dedicated to assisting new gardeners could enhance their success and preserve garden leaders' time.

Extensive research has demonstrated that community gardens are places where gardeners meet new people, build friendships that often span outside of the garden, and confer a sense of belonging.[13,15-17,26,113,114,118] Notably, two of these studies focused on community gardeners within the DUG network.[15,26] Similarly, some of the participants in this study regularly interacted with other gardeners often, and two met up with other gardeners outside of the garden. Additionally, two participants' gardens had many international gardeners, and the participants

enjoyed these intercultural interactions. Other studies have found that community gardens bring diverse groups of people together, including different socioeconomic statuses, nationalities, and races,[15,17,27] as well as meeting people they otherwise would not interact with.[13,14,114]

However, contrary to most of the previously published literature, most participants in this study saw other gardeners infrequently and when they did see other gardeners, conversation was sparse and other gardeners were "there to do their own thing." This was disappointing for participants who were in part motivated to join the garden by the potential to meet new people, with some deciding not to garden for a second season due to the lack of social interaction. Four of the gardens were relatively new gardens and had only been in existence less than 5 years, and according to Denver Urban Gardens, social cohesion may take several years for cohesive leadership to get established within a garden (Lara Fahnestock, personal communication). Two of the gardens were not full which may have limited the number of people visible in the garden. In other studies, community gardeners benefited from the knowledge and skill sharing that occurred within the garden.[13,15,17,26,27,104] While some participants in this study benefited from the knowledge and help offered by other gardeners, for other participants this was minimal. In a study by Glover et al., enhancing social interaction was described as a key factor for sustaining community gardens.[17]

There are several factors that may contribute to the relatively low amount of social interaction between gardeners found in our study compared to other published research. Study participants were only placed at community gardens that were able to reserve at least two plots for study participants. This may have precluded gardens that are in higher demand from participating in this study; gardens with high demand may have stronger social interaction and foster a deeper sense of community. In addition, because of the timing of onboarding

participants into the study, some participants missed their group orientation or an orientation entirely, which may have affected participants' experience of social interactions in the garden. Additionally, the fact that participants were new may have influenced social interactions. Most studies on social interaction and community gardening do not indicate how long participants have belonged to the community garden, thus it is possible that it takes multiple seasons at a garden to develop strong relationships with other gardeners. It is possible that new gardeners do not spend as much time at community gardens as experienced gardeners, thus limiting their opportunities to interact with other gardeners. It may be especially important for new gardeners to actively participate in social activities and workdays as a means to interact with experienced gardeners.

The most commonly cited challenges with respect to gardening reported by participants in this study were limited time, going out of town, technical challenges, and lack of knowledge. Gardening inherently requires consistent time and effort, and additional time is required to travel to a community garden if it is not in the immediate neighborhood. Both time and distance have been mentioned as challenges to community gardening in other studies.[13,26] However, education on time-saving strategies, such as mulching to reduce weeds and water use, may reduce the number of trips to the garden required and make gardening accessible to more people. Finding someone to water while going out of town was a challenge for some, but other participants found other gardeners eager to water their plots while they were gone. To address this difficulty, gardens can set up a formal system, either through email or a community board at the garden, where participants can request assistance from other gardeners to water when they are out of town. Lastly, technical challenges such as pests, plant diseases, and weeds, as well as lack of gardening knowledge were challenges. While some participants were able to learn from or get

help from others with these issues, other participants did not get much advice or support from their garden leader or other gardeners. Some participants were uncomfortable asking for help and others would have liked their garden leaders to check in on them since they were new. Providing new gardeners with resource lists at the beginning of the season, including websites to locate gardening information, may be beneficial. As described above, encouraging experienced gardeners from within the garden or external to the garden to reach out to new gardeners would allow them to get the support they needed without overburdening garden leaders.

Limitations

Several aspects of this study limit the transferability of findings to broader new gardener experiences. Interviewees in this qualitative study were part of a larger RCT of community gardening and may not have considered joining a community garden until being recruited for the study. Due to selection bias, there is a possibility of inherent differences between CAPs participants and DUG gardeners who join a community garden outside of a research study context. For example, study participants may have expected more support with learning how to garden compared with gardeners not enrolled in a study. Due to CAPs requiring garden leaders to reserve plots for study participants, garden enrollment in CAPs was limited to gardens that could guarantee at least two plots for study participants. Gardens without waitlists may be in harder to reach neighborhoods or newer than gardens who did not have empty plots or were unwilling to reserve them for the study. Additionally, due to the study timeline participants were assigned to their gardens after group garden orientations. This may have been crucial for participants to get to know their garden leader and meet other gardeners, setting gardeners up for success throughout the gardening season. The sample size for this study was relatively small compared to many other published qualitative studies, and the majority of participants were non-

Hispanic white and female. Thus, the experiences of interviewees in this study may not be representative of other demographic groups. Participant burden may have presented an additional limitation. Participants in this study had already participated in data collection at three timepoints for the CAPS trial, thus it is possible that those who agreed to participate in the qualitative interviews may not be representative of all Wave 1 CAPS participants.

Conclusions

This study examined the experiences of community gardeners participating in a RCT of community gardening and health, and offers important insights into the experiences of new gardeners, a topic that has not been previously addressed in the research literature. Challenges that new community gardeners faced included limited time to garden or get to their garden, lack of gardening knowledge, and technical challenges such as dealing with pests. In this study, there was wide variation in new gardeners' perceptions of support from their garden leaders. Participants reported that engaged garden leaders positively influenced their experiences by providing an orientation, hands-on assistance, social support, and gardening advice, while those with less engaged leaders were more frustrated and felt more isolated. Finding ways to enhance garden leaders' ability to support new gardeners may be helpful such as recruiting other experienced gardeners to mentor new gardeners to avoid over-burdening garden leaders.

While substantial research has demonstrated widespread social cohesion and community development afforded by community gardens, we found a wide variation in social interaction reported by the new gardeners in this study. While some new gardeners enjoyed the social interactions and events in the garden and help with watering, many rarely saw other gardeners, would have appreciated organized social events, and found a sense of community lacking. The lack of community was striking enough to dissuade some participants from continuing to garden

at their community garden the next season. The fact that several gardens in this study were relatively new and may not have had fully formed leadership may have contributed to the perceptions of social interaction and leadership found in this study. Since community gardens are widely viewed as a means to promote community development and social support, future research should examine how and why perceptions of leadership and social interaction may vary between gardeners and at different community gardens, as well as which mechanisms best promote gardening support, particularly for new gardeners.

As the selected interviewees were part of a larger RCT, several key differences between these participants and typical new community gardeners may have influenced their experiences. Gardeners involved in the RCT may have had different expectations of garden support than typical new gardeners and the study timeframe resulted in them missing a group garden orientation, a valuable opportunity to meet garden leaders and other gardeners. Therefore, future research with new community gardeners who are not part of a larger study would elucidate if the experiences presented in this study are typical of new gardeners more generally. Additionally, future research involving more and diverse participants from a larger pool of community gardens is needed to more fully understand the range of experiences of new gardeners.

CHAPTER 5- CHARACTERISTICS OF GARDENS AND GARDENER PROGRAM INVOLVMENT ASSOCIATED WITH SUSTAINED PARTICIPATION IN AN URBAN GARDENING SUPPORT PROGRAM

Introduction

Gardening is attributed with a multitude of health benefits, including increased fruit and vegetable consumption,[7,8,49,50] providing a source of physical activity,[9,10] and improved mental wellbeing,[11,12] Additionally, community gardens provide sources of rich social interaction and community development.[13-17] Maintaining these benefits for both communities and individuals is dependent upon the sustained participation by gardeners and the longevity of gardens over time. Sustaining a garden requires yearly inputs of both material resources, such as seeds, plants, and compost, and physical efforts by gardeners who have adequate gardening skills and knowledge, as well as consistent access to land. Garden longevity is threatened without these necessary components. In a nationwide survey, respondents from 445 gardening organizations that represented 8,548 gardens in 2012 reported a loss of 1,615 community gardens from 2007-2012.[28]

Factors Affecting Sustained Gardener Participation and Garden Longevity

Researchers have emphasized the need to understand factors that improve and hinder garden longevity in order to sustain the benefits of gardening.[28,29] The challenge of obtaining and sustaining land for urban gardens is the most well-documented threat to urban garden longevity in the research literature.[29,74-79] Urban gardens are frequently located on vacant or abandoned lots or are granted short-term leases on city-owned land. When leases are not renewed or vacant land undergoes development, garden permanency is threatened.[74,78,79]

Sustaining gardeners' interest and attracting new gardeners poses another threat to garden longevity. Representatives from community gardening organizations reported that lack of

participation was a greater contributor to garden loss than land insecurity, and factors such as gardening taking too much time and challenges in the garden such as bad weather and plant pests contribute to gardener drop-off.[28] Other studies have cited lack of participation or participant turnover as contributors to garden loss,[76,78] with a survey of community gardening stakeholders revealing that lack of gardening knowledge leading to gardener dropout is an important factor in declining participation.[29] Home gardeners have also reported lack of gardening knowledge and crop failure as contributing factors to abandoning their gardens.[80] This highlights the importance of gardening knowledge to sustain both gardens and gardeners. Gardening inherently requires skills and knowledge throughout the gardening process, from garden design, land preparation, watering, and pest control.

Lastly, cost of obtaining gardening resources such as seeds, plants, soil, and raised beds can pose a substantial barrier to gardening and threaten garden longevity. Produce-weighing studies have quantified the dollar value of produce grown by home and community gardeners. Two recent studies, one with eight home gardeners and the other with 10 community gardeners, found that gardeners on average saved $339 and $435 on produce in a growing season,[59,81] respectively. However, in the study of home gardeners, most gardening inputs (seeds, plants, raised beds, and soil) were provided to participants free of charge. In the study of community gardeners, costs for gardening inputs were recalled from memory and therefore may have been underestimated. A much larger study involving 50 home or community gardeners found that after subtracting the cost of garden inputs reported in a diary throughout the growing season, growing produce cost an average of 39% more than purchasing from grocery stores.[58] Thus, when gardeners do not have financial assistance in acquiring the material resources needed for gardening, cost savings may not be realized. In fact, studies have demonstrated that low-income

individuals are especially susceptible to cost as a barrier to gardening.[27,82] Community gardens often have additional funding and resource needs beyond home gardens, requiring means to obtain water such as installing wells or pipes, or building other garden infrastructure.[28,78] Obtaining funding and gardening resources are commonly cited challenges by community garden organizers, and a contributing factor to garden loss.[28]

Gardener Support Programs

Gardener support programs, organizations that provide gardening resources such as seeds and plants, education on gardening, food, and nutrition, and technical assistance for gardening, are important to reducing barriers to gardening and reducing garden turnover. Community gardens are supported by hundreds of organizations throughout the United States.[28] Some community gardening organizations also serve home gardeners,[61] while other gardening organizations focus specifically on home gardeners.[20] Often these are community-based organizations, but city departments also organize community gardening programs, such as Green Thumb, operated through the New York City Parks and Recreation Department and P-Patch, operated through the Seattle Department of Neighborhoods.[119,120] There is substantial variation in organization type, size, and emphasis on home or community gardeners, but a common thread runs among these organizations in their emphasis on facilitating gardening by making it more affordable and accessible, and increasing gardening skills and knowledge. Thus, these organizations have the capacity to address barriers and facilitators to garden longevity. The gardener support organization, Keep Growing Detroit, serving gardeners in Detroit, Michigan will be the focus of this chapter.

Keep Growing Detroit and Membership in their Garden Resource Program

The non-profit organization Keep Growing Detroit serves gardeners in the city of Detroit,

Michigan as well as Hamtramck and Highland Park, two towns that are surrounded by the city of Detroit. Unlike some gardener support organizations that manage and oversee community gardens, Keep Growing Detroit provides guidance and support, but does not provide garden management. The organization defines community gardens as spaces cultivated by gardeners from multiple families, family gardens where one or more members of a single family garden, school gardens as gardens located at schools or early child education centers, and market gardens as gardens where produce is grown primarily for sale. In 2018, they supported over 1600 family, community, school, and market gardens. While participation in Keep Growing Detroit's programs is not income restricted, the organization focuses its outreach efforts to those at risk of food insecurity, including low-income individuals and families with young children.

The centerpiece of Keep Growing Detroit's programming is the Garden Resource Program, which provides gardening support and resources, and distributes plants and seeds to their members four times each year for a small annual fee. Additional resources such as help with new garden development and design, and access to soil tests, compost, and raised beds are available to "active" Garden Resource Program members who attend at least one workshop or gardener event per year.

In addition to the Garden Resource Program, Keep Growing Detroit offers opportunities for member and non-member residents to increase their knowledge of gardening, including a variety of educational classes on gardening, cooking, and other related topics. They also offer comprehensive educational programs which consist of a series of classes that go in depth on specific topics including Urban Roots, a community garden leadership course, which combines education on horticulture and community organizing; Sweet on Detroit, a beginner beekeeping course; and season extension programs that focus on methods to extend the gardening season.

Keep Growing Detroit emphasizes the importance of building relationships between gardeners throughout the city, and they provide abundant opportunities for gardeners to interact with each other. They host social events and encourage gardeners to volunteer with their organization and with other member gardens. These events allow even home gardeners to belong to a network of thousands of gardeners across Detroit. At Keep Growing Detroit events, members share knowledge about gardening and food systems, as well as create new friendships and provide social support.[89] Additionally, Keep Growing Detroit runs the Grown in Detroit program, where member gardeners can sell their produce at Detroit farmers markets and restaurants and receive 100% of the proceeds.

Motivation for the Present Study

In summary, the longevity of gardens and sustaining interest of gardeners have been found to be affected by factors such as long-term access to land, lack of gardening skills and knowledge, and the financial cost of providing gardening resources such as seeds, plants, and garden infrastructure.[27-29,74,76,78] Gardener support organizations are abundant throughout the U.S. Through providing material resources, providing gardening education, and offering technical support, these organizations play an important role in sustaining urban gardens. In contrast to the numerous studies documenting benefits of gardening, few studies have investigated specific resources and programs offered by garden support organizations and whether they contribute to garden sustainability and gardeners' continued participation. In this study, we examined the associations between garden characteristics, gardeners' involvement in various aspects of Keep Growing Detroit's programming, and continued garden membership in the organization's Garden Resource Program.

Methods

Study Aim and Overview

The aim of this study was to measure associations between garden characteristics and gardeners' involvement in various aspects of Keep Growing Detroit's programming and the likelihood of continued garden membership in the Garden Resource Program the following year. We hypothesized that increased involvement in Keep Growing Detroit's programming was associated with an increased likelihood of continued garden membership in the Garden Resource Program.

Data used for analysis was obtained from Keep Growing Detroit's records for the years 2012-2015. Because application to the Garden Resource Program is by garden, the unit of analysis for both the independent and outcome variables is each member garden of the Garden Resource Program. The outcome variable was whether or not the garden submitted a membership application to the Garden Resource Program in 2013, 2014, or 2015. Independent variables included garden characteristics and gardeners' involvement (per garden) in Keep Growing Detroit's programming and services the previous year (2012, 2103, or 2014). This study was approved by the Michigan State University Institutional Review Board.

Data Sources

Data used for this study was obtained from two sources of Keep Growing Detroit's programmatic records for the years 2012-2015: 1. Garden Resource Program applications, which are submitted annually for each garden to join the program; and 2. Sign-in sheets where gardeners record their attendance at Keep Growing Detroit events (classes, volunteer events, comprehensive programs, and social events). In addition, Keep Growing Detroit databases from 2004-2011 were used to obtain the years each garden had been previously held membership in

the Garden Resource Program. Geographical demographic characteristics were obtained for the zip codes where gardens were located from the American Community Survey.[84]

Dependent Variable: Garden Membership in the Garden Resource Program

Gardens who wish to be members of the Garden Resource Program to receive resources and services from Keep Growing Detroit submit an application annually for each garden. The costs of membership during the years of analysis was ten dollars for family gardens and twenty dollars for school, market, and community gardens (cost as of 2019 have increased to fifteen dollars for family gardens and thirty dollars for the remaining garden types). Gardens that had an application on file for 2012, 2013, and/or 2014 were included in analysis. The outcome variable was continued garden membership in the Garden Resource Program, measured by whether or not a garden submitted an application to the Garden Resource Program in the years 2013-2015.

Independent Variables: Garden Characteristics

Independent variables included self-reported garden characteristics obtained from Garden Resource Program membership applications and garden participation in Keep Growing Detroit's programming and services obtained from the organization's records. An overview of all variables used in analysis is found in Table 4. Garden characteristics included garden type, size of garden, number of adults involved in the garden, and garden land ownership. Garden membership applications requested gardeners to indicate whether the garden was a community, family, market or school garden. Application that indicated "school garden" for garden type were excluded from analysis because many school gardens had stopped participating in the Garden Resource Program during the years of analysis due to similar resources being provided by the

Table 4: Variables used in analysis

Variable	**Variable Description**
Outcome Variable	
Garden membership in Garden Resource Program in 2013, 2014, or 2015	Dichotomous: 0=no, 1=yes
Garden Characteristics in 2012, 2013, or 2014	
Garden type	Categorical: community, family, market
Size of garden	Categorical: Up to 100 square feet, >100 square feet to ≤400 square feet, >400 square feet to <1 city lot, ≥1 city lot to <2 city lots, ≥2 city lots
Number of adults involved in garden	Continuous (1-172)
Ownership of garden land by gardener(s)	Dichotomous: 0=gardener(s) do not own land, 1=gardener(s) own land
Keep Growing Detroit Program Involvement (data collected by garden or by primary contact gardener) in 2012, 2013, 2014, or ever	
Number of plants and seeds distributions attended by any gardener from the garden	Count: 0-4, integer
Number of classes attended by primary gardener	Categorical: 0, 1, 2, 3 or more
Number of volunteer events attended by primary gardener	Categorical: 0, 1, 2, 3 or more
Number of social events attended by primary gardener	Categorical: 0, 1, 2-3
Primary gardener participated with Sweet on Detroit program (ever)	Dichotomous: 0=no, 1=yes
Primary gardener participated with Season Extension program (ever)	Dichotomous: 0=no, 1=yes
Primary gardener participated with Urban Roots program (ever)	Dichotomous: 0=no, 1=yes
Any gardener from the garden participated with Grown in Detroit	Dichotomous: 0=no, 1=yes
Garden received a site visit by Keep Growing Detroit staff (ever)	Dichotomous: 0=no, 1=yes
Number of previous years garden participated in Garden Resource Program	Continuous (0-10)
Demographic characteristics of zip-code where garden is located	
Percent of population Black or African American	Continuous
Percent of population high school or higher	Continuous
Percent of population below poverty level	Continuous

school district during this time. For garden size, open-ended responses were recoded into five categories: up to 100 square feet, >100 square feet to ≤400 square feet, >400 square feet to <1 city lot, ≥1 city lot to <2 city lots, and ≥2 city lots. Garden land ownership was a dichotomous response, and indicated whether or not the land was owned by the gardener(s) submitting the application.

Independent Variables: Keep Growing Detroit Program Involvement

Garden participation in Keep Growing Detroit's programming and services included number of times per year a gardener from the garden picked up seeds and plants at Garden Resource Program distributions, any gardener from the garden participating in the Grown in Detroit program, receiving a site visit either in the current year or any previous year from Keep Growing Detroit staff, number of previous years the garden had participated in the Garden Resource Program (2004-2014), and the primary gardener's participation in various programs. The Garden Resource Program offers seeds and plants four times per year. Grown in Detroit is a program where gardens that are members of the Garden Resource Program sell their produce at Detroit farmers' markets and restaurants. Site visits consist of Keep Growing Detroit staff providing guidance on garden design or expansion. Previous years of participation in the Garden Resource Program was obtained from Keep Growing Detroit's records of when gardens joined their program.

At least one individual was listed as a garden's primary gardener on each garden's Garden Resource Program application. While there are often additional gardeners participating in a garden, often not all gardeners are listed on the applications. Therefore, it was determined to analyze only Keep Growing Detroit program participation data from the primary gardeners. If two people were listed as primary gardeners for a given garden, the data for both people were

collapsed to the maximum value for each variable. This approach was based on the assumption that participation of both primary gardeners would influence the likelihood of continued garden membership in the Garden Resource Program.

Participation variables consisted of attendance at Keep Growing events and programs, including educational classes, volunteer events, social events, and comprehensive educational programs; data was obtained from sign-in sheets. Educational classes offered by Keep Growing Detroit cover topics related to gardening, cooking, and special topics related to urban agriculture such as community organizing, urban agriculture ordinances, and grant writing. Volunteer events include both volunteering for Keep Growing Detroit, such as packing seeds and working at the Keep Growing Detroit farm, or garden workdays at Keep Growing Detroit's member gardens. Both number of classes and volunteer events were converted to categorical variables (0, 1, 2, and 3 or more) due to the small percentage of participants attending more than three classes or volunteering more than three times. Social events were held three times annually, and this variable was categorized into 0, 1, and 2-3 social events attended due to the small percentage of participants attending all three events. Comprehensive educational programs consist of a series of classes on a given topic: Urban Roots is a community garden leader training program, Sweet on Detroit is a beekeeper training program, and Season Extension teaches season extension techniques such as hoop house building. The comprehensive education variables indicated whether a gardener had ever participated in the programs, in the current year or any previous year.

Control Variables: Demographic Characteristics of Zip-Code Where the Garden was Located

To control for geographical demographic characteristics, garden zip code (obtained from Garden Resource Program applications) was matched with zip code-level demographics from the

2010-2014 American Community Survey.[84] Demographic variables included percent of people in poverty, percent African American, and percent over 25 years completing high school or higher.

Statistical Analysis

Statistical analysis utilized multilevel logistic regression with random intercepts to measure the association between independent variables, control variables, and the likelihood of continued garden membership in the Garden Resource Program. A multilevel approach can be used to analyze longitudinal data where repeated measures are nested within clusters. In this analysis, data for each year is nested within each garden. Multilevel analysis accounts for the inherent non-independence of repeated observations, and random intercepts account for omitted time-constant variables for each garden.[121] A three level model including gardens nested within their zip codes was tested to determine if there was a geographical effect. Due to a negligible effect of zip code, data analysis was continued with the two level model of year nested within garden (data not shown). Models were fit using both complete case analysis (using all observations with no missing data) and multiple imputation by chained equations.[122] Because multiple imputation includes all observations, it allows for increased power compared with complete case analysis, which drops observations with missing data.[123] Additionally, multiple imputation typically results in less biased estimates compared with complete case analysis.[123] Stata 14 was used for all analysis (StataCorp, College Station, TX).

Both bivariate and univariate regression models were calculated to determine the association between each aspect of garden characteristics, Keep Growing Detroit program involvement, and the likelihood of continued membership in the Garden Resource Program. To determine if control variables improved model fit for multivariate regression models, Aikaike

information criterion (AIC) and Bayesian information criterion (BIC) were compared between models.

As will be described in the results, we found evidence of a mediation relationship between participation in comprehensive education programs and likelihood of continued garden membership in the Garden Resource Program. Mediation analysis following the Baron and Kenny method[124] was conducted to determine if participation in the comprehensive education programs indirectly influenced likelihood of continued garden membership in the Garden Resource Program through involvement in other aspects of the Garden Resource Program. Two indices of Garden Resource Program involvement were created to serve as mediators for subsequent mediation analysis. One index (sum index) was created by summing all involvement in Keep Growing Detroit programs other than comprehensive education programs (primary gardener classes attended, primary gardener volunteer events attended, primary gardener social events attended, number of plant and seed distributions attended, and garden receiving a site visit). The second index (factor index) was created using factor analysis to create a factor score of these same variables, which results in a weighted score. Both summed and factor indices are commonly used as mediators for mediation analysis.[125]

The Baron and Kenny method consists of a series of three regression models to determine if a mediation effect exists: 1. The dependent variable (continued garden membership in the Garden Resource Program) is regressed on the independent variable (participation in comprehensive education program by the primary gardener), 2. The mediator (sum or factor index of Keep Growing Detroit program involvement the previous year) is regressed on the independent variable, and 3. The dependent variable is regressed on both the mediator and independent variable. For a mediation relationship to exist, the independent variable must be a

significant predictor of both the dependent variable and the mediator, and the effect of the independent variable on the dependent variable is greatly reduced when the mediator is added as a model covariate.

Results

Descriptive Statistics

Descriptive statistics for garden characteristics are described in Table 5, and Table 6 for Keep Growing Detroit program involvement. From 2012-2014, between 1189 and 1335 gardens participated in the Garden Resource Program each year. Each year approximately 31% of gardens were community gardens, 62% were family gardens, and 6% were market gardens. In total, 2318 unique gardens participated in the Garden Resource Program between 2012 and 2014. The average number of seeds and plant pickups per garden decreased over the years, from 2.8 in 2012 to 2.0 in 2014. Approximately 30% of primary gardeners volunteered, 13% attended social events, and 22% attended classes each year. Approximately 5% of primary gardeners had ever participated in Sweet on Detroit, 5% had ever participated in the Season Extension program, and 10% had ever participated in Urban Roots. Geographical demographic data, zip-code level data from the American Community Survey, is found in Table 7. An average of 77.5% of residents who lived in the zip code where the garden is located had graduated high school or higher, 78.9% were African American, and 39.9% were below the poverty level. These demographics are comparable to 2010-2014 American Community Survey estimates for the city of Detroit (77.8%, 80.9%, and 39.8%, respectively).[84]

Table 5: Garden characteristics of gardens participating in the Garden Resource Program from 2012-2014

	2012		2013		2014	
	(n=1325)		(n=1189)		(n=1335)	
	Number of Gardens	Percent	Number of Gardens	Percent	Number of Gardens	Percent
Garden type						
Family	841	63.5	744	62.6	815	61.1
Community	406	30.6	369	31.0	432	32.4
Market	78	5.9	76	6.4	88	6.6
Land owned by gardener(s)						
Yes	376	28.4	349	29.4	495	37.1
No	806	60.8	788	66.3	759	56.9
Missing	143	10.8	52	4.4	81	6.1
Size of garden						
100 sq ft or less	216	16.3	205	17.2	246	18.4
>100 sq ft & ≤400 sq ft	233	17.6	202	17.0	219	16.4
>400 sq ft & <1 city lot	242	18.3	233	19.6	242	18.1
≥1 city lot & <2 city lots	134	10.1	129	10.9	149	11.2
≥2 city lots	118	8.9	147	12.4	164	12.3
Missing	382	28.8	273	23.0	315	23.6
	Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Number of adults involved in garden	3.7	7.9	3.7	7.1	3.8	7.4

Table 6: Keep Growing Detroit program involvement of gardens participating in the Garden Resource Program from 2012-2014

	2012		2013		2014	
	(n=1325)		(n=1189)		(n=1335)	
	Number of Gardens	Percent	Number of Gardens	Percent	Number of Gardens	Percent
Ever received site visit[a]						
No	1,067	80.5	996	83.8	1,113	83.4
Yes	258	19.5	193	16.2	222	16.6
Participated in Grown in Detroit[b]						
No	1,272	96.0	1,141	96.0	1,281	96.0
Yes	53	4.0	48	4.0	54	4.0
Number of seed/plant pickups[c]						
0	95	7.2	111	9.3	205	15.4
1	85	6.4	245	20.6	343	25.7
2	284	21.4	228	19.2	317	23.8
3	425	32.1	330	27.8	224	16.8
4	436	32.9	275	23.1	246	18.4
Participated in Urban Roots (ever)[d]						
No	1,196	90.3	1,062	89.3	1,198	89.7
Yes	129	9.7	127	10.7	137	10.3
Participated in Sweet on Detroit (ever)[e]						
No	1,256	94.8	1,135	95.5	1,272	95.3
Yes	69	5.2	54	4.5	63	4.7
Participated in Season Extension (ever)[f]						
No	1,265	95.5	1,141	96.0	1,266	94.8
Yes	60	4.5	48	4.0	69	5.2
Number of volunteer events[g]						
0	923	69.7	875	73.6	1,032	77.3
1	225	17.0	181	15.2	173	13.0
2	73	5.5	69	5.8	65	4.9
3+	104	7.9	64	5.4	65	4.9

Table 6 (cont'd)

Number of social events [h]						
0	1,154	87.1	1,015	85.4	1,168	87.5
1	123	9.3	106	8.9	117	8.8
2 or 3	48	3.6	68	5.7	50	3.8
Number of classes attended[i]						
0	1,027	77.5	954	80.2	1,015	76.0
1	174	13.1	121	10.2	153	11.5
2	64	4.8	53	4.5	87	6.5
3+	60	4.5	61	5.1	80	6.0
	Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Prior years in Garden Resource Program[j]	1.6	1.8	2.0	2.1	2.1	2.3

[a] Garden ever received a site visit by Keep Growing Detroit staff ; [b] Any gardener from the garden participated with Grown in Detroit; [c] Number of plant and seeds distributions attended by any gardener from the garden; [d] Primary gardener ever participated with Urban Roots program;[e] Primary gardener ever participated with Sweet on Detroit program; [f] Primary gardener ever participated with Season Extension program; [g] Number of volunteer events attended by primary gardener; [h] Number of social events attended by primary gardener; [i] Number of classes attended by primary gardener; [j] Number of previous years garden participated in Garden Resource Program

Table 7: Demographic characteristics of residents in zip-codes where gardens participating in the Garden Resource Program are located

	2012		2013		2014	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
% Population completed high school or higher	77.2	8.65	77.8	8.09	77.4	8.63
% Population African American	78.2	24.63	79.8	23.17	78.7	24.18
% All people in poverty	40.0	7.54	39.7	7.58	40.0	7.40

Bivariate Regression

Bivariate regression models assessed the association of garden characteristics and involvement in each aspect of Keep Growing Detroit's programs with the likelihood continued garden membership in the Garden Resource Program, and are found in Table 8. Year and variables describing the demographics of the zip-code where the garden was located were included as controls in these models. The return-rates, or the unadjusted percentages of gardens returning to the Garden Resource Program the following year, were calculated for each dichotomous or categorical independent variable.

The overall return rate was 58.6%, thus just over 41% of gardens who were members of the Garden Resource Program in a given year did not continue membership the following year. Community and market gardens were significantly more likely to continue membership (OR=2.06, 95% CI 1.53-2.78, $p<0.001$ for community gardens and OR=2.39, 95% CI 1.37-4.16 $p=0.002$ for market gardens) than family gardens. Gardens that were between 400 square feet and one city lot (OR=1.52, 95% CI 1.02-2.24, $p=0.037$), as well as gardens at least two city lots (OR=2.00, 95% CI 1.25-3.20, $p=0.004$), were more likely to continue membership in the Garden Resource Program compared with gardens up to 100 square feet ($p<0.05$). Land ownership (OR=1.28, 95% CI 0.96-1.70) and number of adults participating in the garden (OR=1.02, 95% CI 1.00-1.05, $p=0.058$) were not significantly associated with continued garden membership in the Garden Resource Program. Additionally, demographics of the zip-code where the garden was located were not significantly associated with continued garden membership ($p>0.47$ for each variable, data not shown).

Aside from receiving seeds/plants once, each aspect of participation in Keep Growing Detroit's programming was significantly associated with an increased likelihood of continued

Table 8: Bivariate relationships between garden and primary gardener involvement in aspects of Keep Growing Detroit's programming and continued garden participation in the Garden Resource Program[†]

	Return Rate	Odds Ratio	Std. Err	95% Conf. Interval		P-value
Overall (all gardens)	58.6					
Garden type						
Family (reference)	54.8					
Community	64.3	2.06	0.32	1.53	2.78	<0.001
Market	68.2	2.39	0.68	1.37	4.16	0.002
Number of seed/plant pickups[a]						
0 (reference)	34.8					
1	43.8	1.40	0.27	0.96	2.05	0.084
2	52.1	2.63	0.50	1.81	3.81	<0.001
3	65.4	6.09	1.18	4.16	8.92	<0.001
4	78.0	14.39	3.03	9.53	21.72	<0.001
Site visit (ever)[b]						
No (reference)	55.4					
Yes	73.7	3.86	0.78	2.60	5.73	<0.001
Sold with Grown in Detroit[c]						
No (reference)	57.7					
Yes	80.0	5.25	1.96	2.52	10.92	<0.001
Urban Roots (ever)[d]						
No (reference)	57.1					
Yes	72.8	2.81	0.67	1.76	4.49	<0.001
Sweet on Detroit (ever)[e]						
No (reference)	58.0					
Yes	71.0	2.26	0.78	1.15	4.43	0.018
Season Extension (ever)[f]						
No (reference)	57.7					
Yes	78.0	4.64	1.70	2.26	9.52	<0.001
Number of classes attended[g]						
0 (reference)	54.2					
1	69.2	2.38	0.42	1.69	3.36	<0.001
2	77.9	3.90	1.04	2.31	6.58	<0.001
3+	80.6	4.94	1.42	2.81	8.68	<0.001

Table 8 (cont'd)

Number of social events attended[h]						
0 (reference)	56.2					
1	71.8	2.34	0.48	1.56	3.50	<0.001
2 to 3	82.5	5.40	1.84	2.77	10.51	<0.001
Number of times volunteered[i]						
0 (reference)	53.5					
1	68.7	2.46	0.39	1.80	3.36	<0.001
2	74.9	3.70	0.97	2.22	6.17	<0.001
3+	81.6	6.33	1.78	3.66	10.97	<0.001
Land owned by gardener(s)						
No (reference)	56.2					
Yes	60.9	1.28	0.18	0.96	1.70	0.091
Size of garden						
100 sq ft or less (reference)	56.5					
>100 sq ft & ≤400 sq ft	61.0	1.29	0.26	0.87	1.91	0.201
>400 sq ft & <1 city lot	64.7	1.52	0.30	1.02	2.24	0.037
≥1 city lot & <2 city lots	62.6	1.47	0.34	0.93	2.32	0.100
≥2 city lots	67.1	2.00	0.48	1.25	3.20	0.004
Number of People	N/A	1.02	0.01	1.00	1.05	0.058
Years in Program[j]	N/A	1.47	0.04	1.40	1.56	<0.001

[†]Demographic variables (percent of zip code residents completing high school or higher, percent of zip code residents in poverty, and percent of zip code residents identifying as African American), garden type, and year served as control variables. [a] Number of plant and seeds distributions attended by any gardener from the garden; [b] Garden ever received a site visit by Keep Growing Detroit staff ; [c] Any gardener from the garden participated with Grown in Detroit; [d] Primary gardener ever participated with Urban Roots program; [e] Primary gardener ever participated with Sweet on Detroit program; [f] Primary gardener ever participated with Season Extension program; [g] Number of classes attended by primary gardener; [h] Number of social events attended by primary gardener; [i] Number of volunteer events attended by primary gardener; [j] Number of previous years garden participated in Garden Resource Program

garden membership in the Garden Resource Program ($p<0.02$). For all participation variables on an ordinal scale (seed and plant pickups: OR ranging from 1.40-14.39, classes: OR ranging from 1.69-2.81, social events: OR ranging from 2.34-5.40, and volunteering: OR ranging from 3.36-10.97), return rate increased alongside increased participation. Additionally, previous years of participation in the Garden Resource Program was significantly associated with an increased likelihood of continued garden membership in the Garden Resource Program (OR=1.40, 95% CI 1.40-1.56, $p<0.001$). Attending comprehensive programs (Urban Roots: OR=2.81, 95% CI 1.76-4.49, $p<0.001$, Season Extension: OR=4.64, 95% CI 2.26-9.52, $p<0.001$, and Sweet on Detroit: OR=4.64, 95% CI 1.15-4.43, $p<0.001$), participation in Grown in Detroit (OR=5.25, 95% CI 2.52-10.92, $p<0.001$), and receiving a site visit (OR=3.86, 95% CI 2.60-5.73, $p<0.001$) were all significantly associated with continued garden membership in the Garden Resource Program compared with the reference groups of not participating in these aspects of Keep Growing Detroit's programs and services.

Multivariate Regression

Multivariate regression models examined the associations between involvement in each of the Keep Growing Detroit's programs while taking into account involvement in the other programs and garden characteristics. To determine if garden characteristics and demographic variables of the zip-code where the garden was located improved multivariate model fit, AIC and BIC were compared between regression models that included observations with no missing variables (see Table 9 for model description, AIC, and BIC). Model 2 was the best fitting model, indicating that number of people and garden size improved model fit but garden zip code location demographic variables did not (results from model 2 are in Table 10, remaining models in appendix G). The same regression models 1-4 described above were estimated with imputed

Table 9: Comparison of Aikaike information criterion (AIC) and Bayesian information criterion (BIC) of logistic regression models

Model Number	Garden characteristic variables included	Keep Growing Detroit program participation variables included	Demographic control variables included	AIC	BIC
1	Garden type, land ownership, number of adults, garden size	All[a]	Percent completed high school or higher, percent African American, percent in poverty	3094.40	3270.98
2	Garden type, land ownership, number of adults, garden size	All[a]	None	3091.29	3250.23
3	Garden type, land ownership, garden size	All[a]	None	3178.84	3332.64
4	Garden type, land ownership, number of adults	All[a]	None	3919.96	4060.88
5	Garden type, land ownership, number of adults, garden size	All excluding comprehensive educational programs[b]	None	3086.13	3227.42

[a]All Keep Growing Detroit program variables: Garden ever received a site visit by Keep Growing Detroit staff; Any gardener from the garden participated with Grown in Detroit, Number of plant and seeds distributions attended by any gardener from the garden; Primary gardener ever participated with Urban Roots program; Primary gardener ever participated with Sweet on Detroit program; Primary gardener ever participated with Season Extension program; Number of volunteer events attended by primary gardener, Number of social events attended by primary gardener, Number of classes attended by primary gardener , Number of previous years garden participated in Garden Resource Program; [b]All Keep Growing Detroit program variables excluding comprehensive educational programs: Garden received a site visit by Keep Growing Detroit staff (ever), Any gardener from the garden participated with Grown in Detroit, Number of plant and seeds distributions attended by any gardener from the garden; Number of volunteer events attended by primary gardener, Number of social events attended by primary gardener, Number of classes attended by primary gardener, Number of previous years garden participated in Garden Resource Program.

Table 10: Model 2-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program (complete case analysis)[†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.43	0.12	0.18	0.67	1.53	0.19	1.20	1.95	0.001
2014	0.37	0.13	0.12	0.62	1.45	0.19	1.12	1.86	0.004
Garden type[b]									
Community	0.20	0.13	-0.06	0.46	1.22	0.16	0.94	1.59	0.137
Market	-0.10	0.23	-0.56	0.35	0.90	0.21	0.57	1.42	0.655
Owns land[c]	0.29	0.11	0.07	0.51	1.33	0.15	1.07	1.66	0.011
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.10	0.14	-0.38	0.18	0.90	0.13	0.68	1.20	0.479
>400 sq ft & <1 city lot	-0.05	0.15	-0.34	0.25	0.96	0.14	0.71	1.28	0.757
≥1 city lot & <2 city lots	-0.08	0.18	-0.43	0.27	0.92	0.17	0.65	1.31	0.661
≥2 city lots	0.01	0.19	-0.37	0.38	1.01	0.19	0.69	1.47	0.965
Number of adults[e]	0.01	0.01	0.00	0.02	1.01	0.01	1.00	1.02	0.198
Ever received site visit[f]	0.21	0.15	-0.09	0.50	1.23	0.18	0.92	1.65	0.167
Participated in Grown in Detroit[g]	0.56	0.30	-0.03	1.16	1.76	0.53	0.97	3.18	0.063
Number of seed/plant pickups[h]	0.39	0.04	0.30	0.48	1.48	0.07	1.36	1.61	<0.001
Urban Roots (ever)[i]	-0.06	0.20	-0.45	0.32	0.94	0.18	0.64	1.37	0.740
Sweet on Detroit (ever)[j]	-0.03	0.27	-0.56	0.50	0.97	0.26	0.57	1.64	0.907
Season Extension (ever)[k]	-0.22	0.30	-0.80	0.36	0.80	0.24	0.45	1.43	0.455
Number of volunteer events[l]									
1	0.46	0.15	0.18	0.75	1.59	0.23	1.19	2.12	0.002
2	0.52	0.24	0.05	0.98	1.68	0.40	1.05	2.67	0.030
3+	0.52	0.27	0.00	1.04	1.68	0.45	1.00	2.84	0.052

Table 10 (cont'd)

Number of social events[m]									
1	0.01	0.19	-0.36	0.38	1.01	0.19	0.70	1.46	0.961
2-3	0.42	0.34	-0.25	1.08	1.52	0.51	0.78	2.94	0.217
Number of classes attended[n]									
1	0.34	0.16	0.03	0.66	1.41	0.23	1.03	1.93	0.032
2	0.81	0.25	0.31	1.31	2.25	0.57	1.36	3.69	0.001
3+	0.57	0.27	0.03	1.10	1.77	0.48	1.04	3.01	0.037
Prior years in program[o]	0.30	0.03	0.24	0.36	1.35	0.04	1.28	1.43	<0.001

[†]n=1660 gardens; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Number of adults involved in garden; [f] Garden ever received a site visit by Keep Growing Detroit staff ,did not receive site visit reference; [g] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [h] Number of plant and seeds distributions attended by any gardener from the garden; [i] Primary gardener participated with Urban Roots program (ever), did not participate in Urban Roots reference; [j] Primary gardener ever participated with Sweet on Detroit program, did not participate in Sweet on Detroit reference; [k] Primary gardener ever participated with Season Extension program, did not participate in Season Extension reference; [l] Number of volunteer events attended by primary gardener, 0 events reference; [m] Number of social events attended by primary gardener, 0 events reference; [n] Number of classes attended by primary gardener , 0 events reference; [o] Number of previous years garden participated in Garden Resource Program

Table 11: Model 2-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program imputed data) [†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.42	0.11	0.21	0.63	1.53	0.16	1.24	1.89	<0.001
2014	0.33	0.11	0.10	0.55	1.39	0.16	1.11	1.74	0.004
Garden type[b]									
Community	0.27	0.13	0.02	0.52	1.31	0.17	1.02	1.68	0.033
Market	0.09	0.22	-0.35	0.53	1.09	0.25	0.70	1.70	0.695
Owns land[c]	0.25	0.10	0.05	0.46	1.29	0.13	1.05	1.58	0.015
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.05	0.17	-0.40	0.30	0.95	0.17	0.67	1.36	0.787
>400 sq ft & <1 city lot	-0.02	0.17	-0.37	0.33	0.98	0.17	0.69	1.39	0.912
≥1 city lot & <2 city lots	-0.11	0.20	-0.52	0.29	0.89	0.18	0.60	1.34	0.576
≥2 city lots	0.01	0.20	-0.39	0.41	1.01	0.20	0.68	1.51	0.951
Number of adults[e]	0.01	0.01	0.00	0.02	1.01	0.01	1.00	1.02	0.157
Ever received site visit[f]	0.25	0.14	-0.03	0.52	1.28	0.18	0.97	1.68	0.076
Participated in Grown in Detroit[g]	0.56	0.29	-0.01	1.13	1.75	0.51	0.99	3.08	0.054
Number of seed/plant pickups[h]	0.49	0.04	0.41	0.56	1.62	0.06	1.50	1.75	<0.001
Urban Roots (ever)[i]	-0.20	0.18	-0.55	0.15	0.82	0.15	0.58	1.16	0.265
Sweet on Detroit (ever)[j]	-0.37	0.25	-0.86	0.11	0.69	0.17	0.43	1.12	0.131
Season Extension (ever)[k]	-0.10	0.28	-0.64	0.45	0.91	0.25	0.53	1.57	0.731
Number of volunteer events[l]									
1	0.41	0.13	0.16	0.66	1.51	0.19	1.17	1.94	0.001
2	0.50	0.22	0.07	0.92	1.65	0.36	1.08	2.52	0.021
3+	0.48	0.24	0.01	0.96	1.62	0.39	1.01	2.61	0.046

Table 11 (cont'd)

Number of social events[m]									
1	0.09	0.17	-0.24	0.42	1.09	0.19	0.78	1.52	0.600
2-3	0.25	0.28	-0.30	0.81	1.29	0.36	0.74	2.24	0.373
Number of classes attended[n]									
1	0.37	0.14	0.09	0.65	1.44	0.21	1.09	1.91	0.010
2	0.70	0.22	0.27	1.14	2.02	0.45	1.30	3.13	0.002
3+	0.77	0.25	0.29	1.26	2.17	0.53	1.34	3.52	0.002
Prior years in program[o]	0.30	0.03	0.25	0.35	1.35	0.04	1.28	1.42	<0.001

[†]n=2318 gardens, 10 imputations; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Number of adults involved in garden; [f] Garden ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [g] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [h] Number of plant and seeds distributions attended by any gardener from the garden; [i] Primary gardener ever participated with Urban Roots program, did not participate in Urban Roots reference; [j] Primary gardener ever participated with Sweet on Detroit program, did not participate in Sweet on Detroit reference; [k] Primary gardener ever participated with Season Extension program, did not participate in Season Extension reference; [l] Number of volunteer events attended by primary gardener, 0 events reference; [m] Number of social events attended by primary gardener, 0 events reference; [n] Number of classes attended by primary gardener , 0 events reference; [o] Number of previous years garden participated in Garden Resource Program

Table 12: Model 5-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, excluding involvement in comprehensive education, and continued garden participation in the Garden Resource Program (complete case analysis) [†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.43	0.12	0.19	0.67	1.54	0.19	1.20	1.96	0.001
2014	0.37	0.13	0.11	0.62	1.44	0.19	1.12	1.86	0.005
Garden type[b]									
Community	0.20	0.13	-0.07	0.46	1.22	0.16	0.94	1.58	0.144
Market	-0.12	0.23	-0.57	0.34	0.89	0.21	0.57	1.40	0.613
Owns land[c]	0.29	0.11	0.07	0.51	1.34	0.15	1.07	1.66	0.010
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.10	0.14	-0.38	0.18	0.91	0.13	0.68	1.20	0.490
>400 sq ft & <1 city lot	-0.05	0.15	-0.34	0.24	0.95	0.14	0.71	1.27	0.738
≥1 city lot & <2 city lots	-0.09	0.18	-0.44	0.27	0.92	0.17	0.65	1.31	0.636
≥2 city lots	-0.01	0.19	-0.38	0.37	0.99	0.19	0.68	1.45	0.975
Number of adults[e]	0.01	0.01	0.00	0.02	1.01	0.01	1.00	1.02	0.194
Ever received site visit[f]	0.21	0.15	-0.09	0.50	1.23	0.18	0.91	1.65	0.172
Participated in Grown in Detroit[g]	0.54	0.30	-0.05	1.13	1.71	0.52	0.95	3.09	0.074
Number of seed/plant pickups[h]	0.39	0.04	0.30	0.48	1.48	0.07	1.36	1.61	<0.001
Number of volunteer events[i]									
1	0.46	0.15	0.17	0.75	1.58	0.23	1.19	2.11	0.002
2	0.50	0.24	0.04	0.97	1.66	0.39	1.04	2.64	0.034
3+	0.50	0.27	-0.02	1.02	1.65	0.44	0.98	2.78	0.061
Number of social events[j]									
1	-0.01	0.19	-0.37	0.36	0.99	0.19	0.69	1.44	0.973
2-3	0.37	0.33	-0.28	1.03	1.45	0.48	0.76	2.79	0.262

Table 12 (cont'd)

Number of classes attended[k]									
1	0.34	0.16	0.03	0.66	1.41	0.23	1.03	1.93	0.032
2	0.79	0.25	0.29	1.28	2.19	0.55	1.34	3.60	0.002
3+	0.54	0.27	0.02	1.07	1.72	0.46	1.02	2.90	0.043
Prior years in program[l]	0.30	0.03	0.24	0.36	1.35	0.04	1.27	1.43	<0.001

[†]n=1660 gardens; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Number of adults involved in garden; [f] Garden ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [g] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [h] Number of plant and seeds distributions attended by any gardener from the garden; [i] Number of volunteer events attended by primary gardener, 0 events reference; [j] Number of social events attended by primary gardener, 0 events reference; [k] Number of classes attended by primary gardener , 0 events reference; [l] Number of previous years garden participated in Garden Resource Program

Table 13: Model 5-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, excluding involvement in comprehensive education, and continued garden participation in the Garden Resource Program (imputed data) †

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.42	0.11	0.21	0.64	1.53	0.16	1.24	1.89	<0.001
2014	0.33	0.11	0.10	0.55	1.39	0.16	1.11	1.74	0.004
Garden type[b]									
Community	0.25	0.13	0.01	0.50	1.29	0.16	1.01	1.65	0.045
Market	0.04	0.23	-0.40	0.49	1.05	0.24	0.67	1.63	0.843
Owns land[c]	0.27	0.10	0.07	0.47	1.31	0.14	1.07	1.60	0.009
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.04	0.17	-0.40	0.31	0.96	0.17	0.67	1.36	0.800
>400 sq ft & <1 city lot	-0.03	0.17	-0.38	0.32	0.97	0.17	0.69	1.38	0.881
≥1 city lot & <2 city lots	-0.12	0.20	-0.53	0.28	0.89	0.18	0.59	1.33	0.551
≥2 city lots	0.00	0.20	-0.41	0.40	1.00	0.20	0.67	1.49	0.984
Number of adults[e]	0.01	0.01	0.00	0.02	1.01	0.01	1.00	1.02	0.149
Ever received site visit[f]	0.25	0.14	-0.03	0.52	1.28	0.18	0.97	1.68	0.075
Participated in Grown in Detroit[g]	0.53	0.29	-0.04	1.10	1.70	0.49	0.96	2.99	0.067
Number of seed/plant pickups[h]	0.49	0.04	0.41	0.56	1.62	0.06	1.50	1.75	<0.001
Number of volunteer events[i]									
1	0.40	0.13	0.15	0.66	1.50	0.19	1.16	1.93	0.002
2	0.47	0.22	0.04	0.89	1.59	0.35	1.04	2.44	0.032
3+	0.44	0.24	-0.04	0.91	1.55	0.37	0.97	2.49	0.070
Number of social events[j]									
1	0.07	0.17	-0.26	0.41	1.08	0.18	0.77	1.50	0.668
2-3	0.18	0.28	-0.37	0.73	1.20	0.33	0.69	2.07	0.522

Table 13 (cont'd)

Number of classes attended[k]									
1	0.36	0.14	0.08	0.64	1.44	0.21	1.09	1.90	0.011
2	0.66	0.22	0.23	1.10	1.94	0.43	1.26	3.01	0.003
3+	0.74	0.24	0.26	1.21	2.09	0.51	1.29	3.37	0.003
Prior years in program[l]	0.29	0.03	0.24	0.34	1.33	0.03	1.27	1.40	<0.001

[†]n=2318 gardens, 10 imputations; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Number of adults involved in garden; [f] Garden ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [g] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [h] Number of plant and seeds distributions attended by any gardener from the garden; [i] Number of volunteer events attended by primary gardener, 0 events reference; [j] Number of social events attended by primary gardener, 0 events reference; [k] Number of classes attended by primary gardener , 0 events reference; [l] Number of previous years garden participated in Garden Resource Program

data (results from model 2 are found in Table 11 and the remaining models are found in appendix G). Due to the high p-values for the comprehensive education programs, an additional model (model 5) was performed (Table 12 for complete case analysis and Table 13 for imputed data). Model 5 had the lowest AIC and BIC, indicating that removing comprehensive education program variables improved model fit. In this model, land ownership by gardeners, primary gardener volunteering one or two times, primary gardener attending classes, picking up seeds and plants, and number of previous years the garden was in the Garden Resource Program were significantly associated with an increased likelihood of continued garden membership in the Garden Resource Program.

Findings from Model 5 calculated with imputed data are described in Table 13. Community gardens had higher odds of continued garden membership in the Garden Resource Program compared to family gardens (OR=1.29, 95% CI 1.01-1.65, p=0.045). There was an increased odds of continued garden membership in the Garden Resource Program when garden land was owned by gardener(s) compared with gardens where land was not owned by gardeners, (OR=1.31, 95% CI 1.07-1.60, p=0.009). Odd also increased when more seeds and plants were picked up (OR=1.62 for each additional seed and plant pickup, 95% CI 1.50-1.75, p<0.001), and with additional years in the Garden Resource Program compared with gardens that were new to the Garden Resource Program (OR=1.33,95% CI 1.27-1.40, p<0.001) Compared with the reference category of the primary gardener not volunteering, the odds were higher for primary gardeners volunteering at least once: odds ratio of 1.50 for primary gardeners volunteering once (95% CI 1.16-1.96, p=0.002), 1.59 for volunteering twice (95% CI 1.04-2.04, p=0.032), and 1.55 for three or more times (95% CI 0.97-2.49, p=0.07). There was an increased odds of continued garden membership in the Garden Resource Program with each additional class attended by the

primary gardener, compared to the reference of not taking any classes: odds ratio of 1.44 for attending one class (95% CI 1.09-1.90, p=0.011), odds ratio of 1.94 for attending two classes (95% CI 1.26-3.01, p=0.003), and odds ratio of 2.09 for attending three or more classes (95% CI 1.29-3.37, p=0.003). In the multi-variate analyses, number of adults participating in the garden, whether garden had ever received a site visits from Keep Growing Detroit staff, any gardener in the garden participating in the Grown in Detroit program, garden size, and primary gardener attending social events were not significantly associated with continued garden participation in the Garden Resource Program. In contrast, these variables were significant in the bivariate models (see Table 8): receiving a site visit. Additionally, garden land ownership was not significant in the bivariate model.

Mediation Analysis

Comprehensive education programs were highly non-significant in multivariate regression models (Tables 10 and 11), with p-values ranging from 0.131-0.907. These p-values were substantially increased compared with p-values in bivariate regression ($p<0.001$ for Urban Roots and Season Extension, p=0.018 for Sweet on Detroit). These results were presented to Keep Growing Detroit staff to gain their input on these findings, who reported that participants in their comprehensive programs may become more aware of and involved in Keep Growing Detroit's other components after attending their comprehensive programs. Thus, mediation analysis was performed to test the hypothesis that an indirect relationship occurred between comprehensive program participation and gardens returning to the Garden Resource Program the following year.

Mediation models using the factor index of other Keep Growing Detroit's program involvement (classes attended, volunteer events attended, social events attended, plant and seed

Figure 1: Mediation analysis of season extension and factor index variable of Garden Resource Program involvement on gardens returning

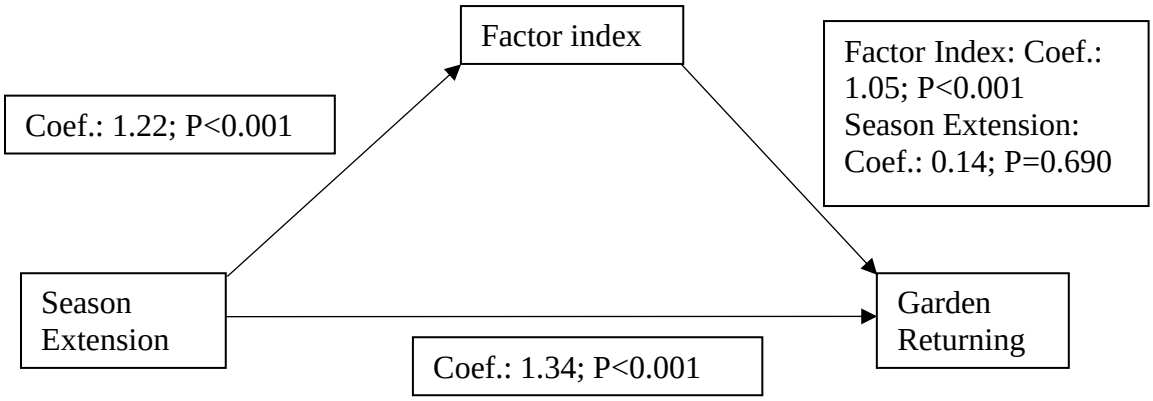
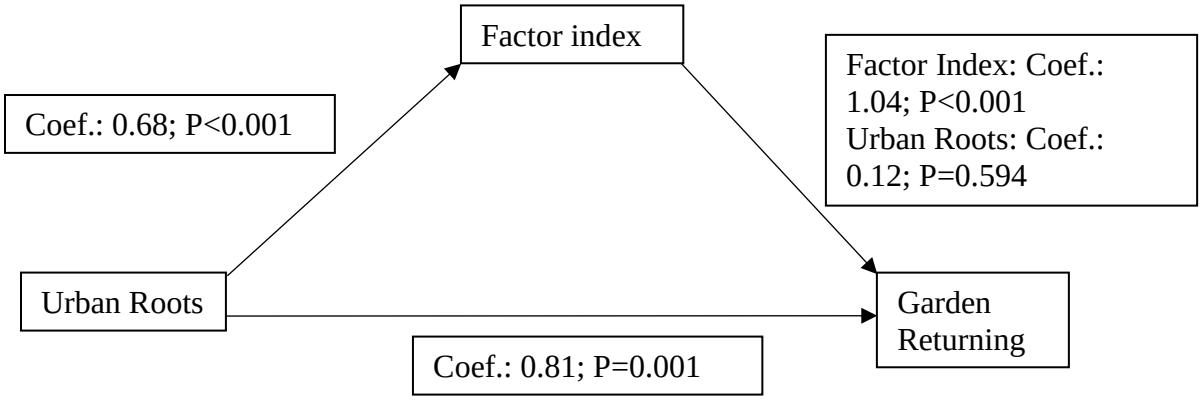


Figure 2: Mediation analysis of Urban Roots and factor index variable of Garden Resource Program involvement on gardens returning



distributions received, and site visits) are found in Figures 1 and 2 and summed index in the appendix. Garden type, year, and demographic variables for the zip code where the garden was located were included as control variables for all regression models for mediation analysis. The mediation models for Season Extension and Urban Roots fulfilled the Baron and Kenny criteria for a mediation effect: both programs were significant predictors of the outcome variable ($p<0.001$ for Season Extension and $p=0.001$ for Urban Roots), both were significant predictors of the mediator ($p<0.001$ for each one), and their effect on the outcome variable was diminished when the mediator was included as an independent variable ($p=0.690$ for Season Extension and 0.594 for Urban Roots). Sweet on Detroit had a near significant relationship with the outcome variable ($p=0.057$, see appendix H), and was likely not significant due to the small sample size who had attended this program. Sweet on Detroit fulfilled the remaining criteria for a mediation effect: Sweet on Detroit was a significant predictor of the mediator ($p<0.001$), and its effect on the outcome variable decreased when the mediator was included as an independent variable ($p=0.994$) but did not meet the criteria for mediation analysis due to an insignificant relationship with the outcome variable. This indicates that these programs indirectly increased the likelihood of continued garden membership in the Garden Resource Program through participation in other aspects of the Garden Resource Program. Mediation models using the summed index had similar findings as mediation using the factor index (appendix H).

Discussion

This study examined the relationships between garden characteristics and involvement in Keep Growing Detroit's programming, and continued garden membership in the Garden Resource Program. Our research expands upon the previous research into gardener and garden sustainability. These findings are relevant to the hundreds of gardener support organizations that

provide material resources, gardening education, and technical assistance to thousands of gardens across the U.S..[28]

We found that participation in each aspect of Keep Growing Detroit's programming was significantly associated with an increased likelihood of continued garden participation in the Garden Resource Program in bivariate regression. In multivariate regression, gardeners picking up seeds and plants, attending at least one class, volunteering, and prior years of garden membership in the Garden Resource Program remained significantly associated with continued garden membership in the Garden Resource Program, but not the garden receiving a site visit from Keep Growing Detroit, or gardeners attending social events. Mediation analysis revealed that the comprehensive education programs Urban Roots, a community garden leadership program, and the season extension program were indirectly related to the likelihood of continued garden membership in the Garden Resource Program through participation in other aspects of Keep Growing Detroit's programs (attending classes, volunteer events, and social events, number of plant and seed distributions received, and the garden receiving a site visit).

Receiving seeds and plants was the most utilized service by gardeners, with 85 to 93% of gardens receiving seeds and plants at least once in a given year. This variable was a highly significant predictor of continued garden membership in the Garden Resource Program in all regression models ($p<0.001$). The odds of continued membership in the Garden Resource Program increased 1.6 times ($p<0.001$) for each additional plants and seeds distribution attended in the multivariate analysis, and gardens who received plants and seeds at all 4 distributions were 14.4 times ($p<0.001$) more likely to continue membership in the Garden Resource Program compared to those who did not receive plants and seeds. The provision of seeds and plants addresses one of the main barriers to gardening and challenges of sustaining gardens - financial

cost of gardening and obtaining gardening resources.[27,28,78,82] Providing gardening resources to reduce the financial barrier for gardening may be an important strategy that many gardener support programs use to enhance garden success, particularly in cities with a high proportion of low-income residents such as Detroit. Other research studies have found that financial cost is a barrier to gardening for low-income inviduals,[27,82] and that when accounting for financial inputs, growing produce can cost more than purchasing from the grocery store.[58]

Primary gardener involvement variables that were associated with continued garden membership in the Garden Resource Program were attending classes and volunteering but not attending social events. During the years in our study, the percentage of primary gardeners attending at least one class in a year ranged from 20-24%, while between 23-30% of primary gardeners volunteered with the organization or with one of its member gardens. This is a much lower percentage than the percent of gardens that received seeds and plants from the organization. Keep Growing Detroit staff indicated that many people think the Garden Resource Program is "just seeds and plants," and that participants may not be aware of the other aspects of the program. Still, these two variables significantly predicted the likelihood of continued garden membership in the Garden Resource Program. Through attending classes, gardeners may improve their gardening skills and knowledge, which may in turn contribute to garden success. Lack of gardening knowledge and skills have been reported as barriers to gardening in some studies,[26,29,80] and is believed to contribute to garden loss due by causing frustration and dropout.[29] As sharing of knowledge within a garden has been found in numerous research studies,[13,15,17,26,27,104] the knowledge gained by primary gardeners may impact the success of the entire garden.

Primary gardeners volunteering may contribute to the success of their garden in two

ways. Firstly, Keep Growing Detroit incentivizes their participants to volunteer by providing them with access to no-cost additional resources, such as compost, if they volunteer at least once per season. Gardeners do not receive this benefit from attending social events, which may in part explain why attending social events was not significantly associated with continued garden membership in the Garden Resource Program but volunteering was significant. Additionally, our previous research has found that informal knowledge sharing and social ties are formed by attending Keep Growing Detroit events, including volunteering events.[89] Therefore, primary gardeners who volunteer may benefit their gardens by gaining additional gardening knowledge. Previous years in the Garden Resource Program may influence the likelihood of continued garden membership in the Garden Resource Program for two reasons. Firstly, as gardens that have been in the Garden Resource Program for many years are inherently older, this may indicate that new gardens are especially vulnerable in their first few years. Secondly, there may also be a cumulative influence of receiving support from Keep Growing Detroit for several years. Throughout multiple years in the program, gardeners gain more skills and knowledge, receive more technical assistance from Keep Growing Detroit, and meet other gardeners with whom they network and may build capacity to sustain their gardens.

Garden characteristics that were associated with an increased likelihood of continued garden membership in the Garden Resource Program included gardeners owning the land where their garden was located. In addition, community gardens were more likely to continue membership in the Garden Resource Program compared with family gardens. However, the number of adults participating in the garden or garden size were not significantly associated with continued garden membership in the Garden Resource Program. While previous research has demonstrated the importance of maintaining gardener participation to sustain gardens,[28,29] it may

be that the quality of participation is more important than the number of gardeners participating. As size was not significant, this may indicate that gardens of all scales benefit from gardener support programs. Each year, between 28% and 37% of the gardens were on land owned by gardeners, and land ownership was a significant predictor of continued garden membership in the Garden Resource Program in multivariate regression models. This is in line with previous research that has demonstrated land insecurity as a key threat to urban garden longevity.[29,74-79]

Limitations

While several significant associations between Keep Growing Detroit program participation and continued garden membership in the Garden Resource Program were found in this study, a causal relationship cannot be determined due to the observational nature of the study design. Gardens whose primary gardeners were more actively involved in the Garden Resource Program may be more motivated to sustain their gardens, and this increased motivation may be a causal factor for sustained participation. Additionally, while this study has implications for garden longevity, we did not objectively measure it. While it may be the case that most gardens that left the program were no longer under cultivation, we did not objectively confirm this by visiting garden sites or following up with garden members. We investigated associations between demographics of the zip-code where the garden was located and continued garden membership, not the demographics of gardeners within a garden. While zip code level education, poverty, and race where the garden was located were not significant predictors of remaining in the Garden Resource Program, demographic characteristics of gardeners such as age, gender, income, and education may be associated with Garden Resource Program membership.

Conclusions

This study examined the associations between garden characteristics, participation in programming offered through a gardener support program in Detroit, Michigan, and the likelihood of continued garden membership in the program the following year. Several aspects of program involvement including attending at least one class, volunteering at least once, receiving seeds and plants, and previous years of garden membership in the Garden Resource Program were positively associated with continued garden participation in the Garden Resource Program while controlling for other variables. In addition, gardens more likely to continue membership in the Garden Resource Program were community gardens (compared to family garden), gardens on land owned by gardeners, and gardens who had previously been members in the program. Participation in the comprehensive education programs, Urban Roots and Season Extension, and likelihood of gardens returning was found to be mediated through participation in other components of the Garden Resource Program (classes, volunteering, social events, plant and seed distributions, and site visits). By offering seeds and plants and gardening education to their member gardeners, gardener support organizations such as Keep Growing Detroit decrease key barriers to gardening including financial resources, education needed to garden, and providing social support.[89]

By lowering the barriers of gardening, gardener support programs have the potential to contribute to sustaining both gardens and gardeners. The ability for gardening to enhance health through providing fresh vegetables, places to be active, improvements in mental well-being, and providing a source of social connections is dependent on the continued availability of places to garden and continuation of gardening by individuals. While garden longevity was not expressly measured in this study, this research provides supporting evidence that gardener support

programs may improve longevity through their programming, potentially sustaining health benefits of gardening. Future research is needed to deepen the understanding of factors that both hamper and promote continued gardening participation, as well as garden longevity in order to shape gardening programs to maximize the health benefits of gardening.

CHAPTER 6 SUMMARY, CONCLUSIONS, AND FUTURE RESEARCH

Summary and Conclusions

The research in this dissertation examined participation in two gardener support programs, the Detroit Garden Resource Program in Detroit, Michigan and Denver Urban Gardens in Denver, Colorado, and includes the perspectives of gardeners that vary in experience from new to seasoned. Overall, these three studies examined: perceptions of experienced gardeners on how gardening and participation in the Garden Resource Program in Detroit, Michigan influenced their dietary choices, food security, and food values; new Denver Urban Gardens community gardeners' challenges with gardening and perceptions of garden leadership and social interaction; and the association between participation in the Garden Resource Program and the likelihood of continued gardens participation in the Garden Resource Program. Collectively, this research provides insights that may be relevant to the hundreds of gardener support organizations that support thousands of gardens and gardeners across the U.S,[28] as well as the extension services, public health departments, city departments, and other organizations that offer gardening programs to promote health.

In chapter 3, we found that most experienced Detroit, Michigan Garden Resource Program participants perceived that gardening increased their vegetable consumption, and some interviewees reported decreasing consumption of other foods, including red meat and processed foods. The findings of this study suggest that gardening can not only increase consumption of healthful foods, but also decrease consumption of foods that are overconsumed in the U.S.[31] Gardeners' values related to food, including preferring food grown without synthetic chemicals and distrusting industrialized food, were perceived to contribute to gardeners' dietary changes. Notably, these values have been linked to better diet quality in other studies.[22,23] Additionally,

gardeners perceived that gardening contributed to cost savings on food. By providing low-cost seeds and plants, the Garden Resource Program contributes to the cost-saving potential of gardening by reducing the amount of money spent on seeds and plants. This study is unique in that interviews were conducted with a majority African American sample of gardeners living in an urban U.S city.

This study also focused on how involvement in the comprehensive gardener support program available in Detroit influenced gardeners, which has not been addressed in previous literature. The gardener support program provided social connection between gardeners of all types (school, family, market, and school), provided low-cost seeds and vegetable transplants, and introduced gardeners to new nutritious vegetables. Engaging with other gardeners at classes and events was perceived to influence interviewees' food choices and values related to food. This provides evidence that gardener support programs provide more than just material resources and gardening education to their gardeners. They can also provide a platform and opportunity to try new vegetables, and for dialogue about food and nutrition, which may positively affect gardeners' diets.

In contrast to chapter 3 which consisted of interviews with experienced gardeners, chapter 4 examined the experiences of new gardeners in Denver, Colorado participating in a randomized controlled trial of community gardening. New gardeners faced challenges, such as lack of gardening knowledge, the time required to garden, and finding it inconvenient to get to the community garden. Engaged garden leaders who provided an orientation, shared gardening knowledge, provided hands-on assistance, and gardening support positively influenced new gardeners and helped alleviate the challenges of gardening, while participants with less engaged leaders experienced more frustration and isolation. Additionally, there was a wide variation in

perceptions of social interactions with other gardeners. Those who regularly interacted with other gardeners in or outside of the garden valued the socialization, others who found a sense of community lacking desired more interaction with other gardeners. While new community gardeners desire guidance and support from their leaders, it is likely not feasible to delegate this responsibility solely to garden leaders. Garden leaders have substantial responsibilities to manage their garden, and it can be difficult to find people to fill this role and continue in this position for multiple years.[29,105] To avoid over-burdening garden leaders, community garden organizations can support new gardeners by encouraging other experienced gardeners to share their gardening knowledge and providing hands-on training to newer gardeners. These findings are in line with Denver Urbans Gardens belief in the importance of creating an engaged leadership team, as opposed to a single garden leader.

Chapter 5 examined the association between participating in different aspects of Keep Growing Detroit's Garden Resource Program in Detroit, Michigan, and continued gardens participation in the Garden Resource Program. After controlling for garden characteristics and the demographic characteristics of residents in zip-codes where gardens are located, the following aspects of participation were associated with increased likelihood of continued garden participation in the Garden Resource Program: picking up seeds and plants, attending at least one educational classes, and volunteering at least once. Additionally, community gardens (compared to family gardens), gardens on land owned by gardeners, and gardens who had previously been members in the program were more likely to continue membership in the Garden Resource Program. Participation in the comprehensive education programs Urban Roots and Season Extension and likelihood of gardens returning was found to be mediated through participation in

other components of the Garden Resource Program (classes, volunteering, social events, plant and seed distributions, and site visits).

This study indicates that gardener support programs may be influential in sustaining gardens. By providing seeds and plants, gardener support program may contribute to garden success by addressing one of the key challenges of sustaining gardens, obtaining gardening resources such as seeds, plants, and soil.[28,78] Beyond the initial investment in building a garden, gardening inherently requires an annual investment of materials, which may be cost prohibitive to low-income audiences.[27,82] Gardener support programs often provide these resources for free or at low cost. These programs also typically offer gardening education, providing gardeners with the knowledge and skills necessary to sustain their gardens.

Taken together, these three studies deepen the understanding of the importance of gardener support programs for the gardens and gardeners they serve. This research found that participants in gardener support programs share gardening knowledge, provide social support, and dialogue around food and nutrition. The two gardener support programs studied provided participants with material gardening resources and gardening education, helping to alleviate financial and knowledge barriers to gardening and contribute to sustaining gardens.

Future Research

Qualitative studies, including chapter 3 of this dissertation,[23,26,27] cross-sectional studies,[7,8,18] intervention studies[20,21] [18,19] and pilot randomized controlled trials[49,50] provide supporting evidence that gardening leads to increases in fruit and vegetable intake. However, there is currently no published data from large randomized controlled trials examining the impact of gardening on diet in adults to provide causal evidence of the impact of gardening on fruit and vegetable intake. There are currently three large randomized controlled trials underway that will

address this gap in the literature: a community gardening trial in an urban setting (Denver, Colorado) with an enrollment of 312 participants, a home gardening trial on a rural Native American reservation in Wyoming with 338 participants, and a home gardening trial of 446 older (>65 years of age) cancer survivors in Alabama.[112,126,127] The trial in Denver is rigorously measuring dietary intake using 24-hour recalls at baseline, at the peak of garden harvest, and at 12 months after baseline.[112] While the trial in Wyoming is not measuring dietary intake, serum beta carotene, a biomarker of vegetable consumption, is being assessed.[126] The trial in Alabama is assessing fruit and vegetable intake frequency via the Eating at America's Table Screener (EATS) and is also assessing plasma alpha carotene.[127]

This dissertation found that gardeners perceived saving money on food and preserved their garden produce to last beyond the growing season, potentially benefiting food security. However, quantitative evidence assessing the impact of gardening on food security is scarce. To the author's knowledge only one study has quantitatively measured the impact of gardening on food security in the U.S. While this study found a significant decrease in the proportion of respondents that sometimes or frequently worried about running out of food, the lack of a control group in this study does not preclude the possibility of a seasonal effect.[21] The randomized controlled trials that are currently underway are quantitatively assessing food insecurity and will contribute to filling this gap in the literature.[112,126] However, additional research assessing food security implications of community gardening and in urban areas is needed.

Chapter 4 of this dissertation is to the author's knowledge the first study to examine the experience of new community gardeners. As lack of gardening skills and knowledge was a barrier for these gardeners, future research should examine the feasibility and impact of providing mentored support to first year community gardeners to determine if it influences

gardening knowledge and continuation of gardening. Since recruiting and sustaining garden leaders is difficult,[29,105] alternative avenues for mentoring new gardeners could be explored. Denver Urban Gardens' Master Community Gardeners, who have completed courses on gardening and are required to complete volunteer hours, currently provide mentorship to leaders of new gardens. Expanding their role to provide one-on-one mentorship to new gardeners may be a feasible means of providing new gardeners with the knowledge and skills they need to be successful. In chapter 4, we also found that sense of community within the garden was important to new gardeners. Denver Urban Gardens supports regular group events for gardeners, such as workdays and potlucks, in order to develop a sense of community within a garden. Future research should continue to examine the needs and experiences of new gardeners in different contexts.

In chapter 5, we examined the association between Garden Resource Program involved and the likelihood of gardens returning to the Garden Resource Program the following year. Existing research on garden longevity largely focused on the threats posed by land security,[29,74-79] with little study of other factors that contribute to garden loss. Community gardening organizations report that lack of participation and lack of funding contribute to garden loss,[28] while strong leadership is perceived as important to sustain community gardens.[76] To build upon the knowledge and experiences of successful community gardens and gardening organizations, future research is needed to identify the strategies they use to successfully engage participants, train garden leaders, and obtain funding to increase garden longevity. Additionally, research incorporating objective measures of garden longevity is needed. Methods of assessing garden longevity include visiting garden sites or contacting gardeners to determine if gardens are still under cultivation.

In sum, rigorous research on the links between gardening, dietary quality and food security is needed, as well as on strategies to expand the reach and permanence of gardening. Expanding the reach and increasing permanence of gardening will allow its health and psychosocial benefits to be realized by more people and will contribute to the long-term sustainability of these benefits to both individuals and communities.

APPENDICES

APPENDIX A Michigan State University Institutional Review Board Letter of Approval

MICHIGAN STATE UNIVERSITY

Revision Application Approval

January 20, 2015

To: Katherine Alaimo
302C Trout FSHN Building

Re: **IRB# 14-110** Category: EXPEDITED 5, 6, 7
Revision Approval Date: January 20, 2015
Project Expiration Date: January 6, 2016

Title: Growing Nutrition, Health and Food Security through Urban Agriculture (CGA134978)

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **the revision has been approved**.

This approval includes adding A. Beavers and A. Atkinson to the list of investigators as well as minor edits to the recruitment script and interview guide.

The review by the committee has found that your revision is consistent with the continued protection of the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an ***Application for Renewal*** application at least one month before expiration. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an ***Application for Revision*** to have your changes reviewed. If changes are made at the time of renewal, please include an ***Application for Revision*** with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

Good luck in your research. If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Sincerely,

Harry McGee, MPH
Vice Chair, Biomedical and Health Institution Review Board (BIRB)
Human Research Protection Program

c: Ashley Atkinson, Alyssa Beavers

Office of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

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APPENDIX B Aim 1 Consent Form

Detroit Urban Gardener and Farmer Storytelling Project
Participant Informed Consent Form

A Detroit Urban Gardener and Farmer Storytelling Project is being conducted by Keep Growing Detroit and the Michigan State University Department of Food Science and Human Nutrition.

This research project is being done to document and preserve oral histories and stories related to urban agriculture in Detroit, and to identify trends and needs in the Detroit urban agriculture community. Products of the project include stories, audio recordings, photos, and academic reports. You are being asked to participate in this study because you are a Detroit gardener and are at least 18 years of age or older. Your participation will include a face-to-face interview that will take about an hour. With your permission, the study team would like to audio record the interview and possibly take some photos of you or ask to use photographs that you have taken.

If you agree to participate:

1) A representative of the Keep Growing Detroit Storytelling Committee may interview you one or several times, as part of the project. In addition, you may take photographs as part of this project or photographs may be taken of you.

2) Some interviews and/or activities that you participate in will be tape recorded, as part of this project, and the tapes will be typed (transcribed) into written words.

3) Your participation is voluntary. It is your choice to be involved in this project. You can refuse to answer specific questions, or withdraw from the entire project or any part of the project at any time. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. You may also decide not to have your voice transcribed as part of this research and then anything you say during the activity that was taped will not be used as part of the research.

4) All information you discuss during the interview is private, confidential, cannot be obtained by any individual who is not on the Keep Growing Detroit Storytelling Committee, and will not be shared with others to the extent provided by Federal, State and Local law. Only a code number, not your name, will be placed on all notes, interview transcriptions and/or cassette tapes. All Storytelling Committee members have signed a statement that says they will not share confidential information about this project. You will not be identified in any research paper or report based on the results of this research.

5) The Keep Growing Detroit Storytelling Committee may wish to use your name or a photograph that identifies you in publications by Keep Growing Detroit (i.e., newsletters, website, and/or program materials). In this case, you will be shown the printed material and its intended audience and use will be clearly described to you before publication, and you will be asked to sign another consent form that allows the use of your name and/or photograph.

6) The Keep Growing Detroit Storytelling Committee will keep all research related data in an office on MSU campus and/or on protected computers for at least three years after the close of the project. Only members of the Storytelling Committee and research teams, and the

This consent form was approved by a Michigan State University Institutional Review Board.
Approved 01/07/2015 - valid through - 01/06/2016. This version supersedes all previous versions. IRB #14-110

Michigan State University Human Research Protection Program will have access to research study records.

7) There are no foreseeable risks or discomforts to you, nor consequences to your participation in this research project. The information you provide will be used to benefit Keep Growing Detroit including the Garden Resource Program and Grown in Detroit.

8) Benefits of participation include the opportunity to share your experiences about gardening in Detroit.

9) As an incentive for participating, you have the choice of receiving either: 1) a $25 gift card to Detroit Farm and Garden, 2) a Keep Growing Detroit T-shirt (valued at $25), or 3) a $25 donation to Keep Growing Detroit. There is no cost to you to participate in this project.

10) One copy of this document will be kept with the Keep Growing Detroit Storytelling Committee's research records in Dr. Katherine Alaimo's lab at Michigan State University. A copy will be given to you to keep.

If you have any questions or concerns about this study, such as scientific issues, how do any part of it, or report an injury at any time or if you wish to withdraw your participation, you can contact: Katherine Alaimo, Ph.D., Associate Professor, Food Science and Human Nutrition, Michigan State University at (734) 330-3829, alaimo@msu.edu; or Ashley Atkinson, Keep Growing Detroit at 313-757-2635.

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at: 408 W. Circle Dr., Room 207 Olds Hall, MSU, East Lansing, MI 48824.

A member of the Keep Growing Detroit Storytelling Committee has offered to answer any questions I have concerning the project. I voluntarily agree to participate in the Detroit Urban Gardener and Farmer Storytelling Project.

_____	_____	_____
Print name	Signature	Date

This consent form was approved by a Michigan State University Institutional Review Board.
Approved 01/07/2015 - valid through - 01/06/2016. This version supersedes all previous versions. IRB #14-110

APPENDIX C Aim 1 Interview Guide

Keep Growing Detroit Storytelling Committee
2/3/15

Detroit Urban Gardener and Farmer Storytelling Project

INTERVIEW GUIDE

A. INTRO LANGUAGE and CONSENT

1. Interviewer introduces her/himself.

2. Ask participant to read and sign consent form. Offer to read aloud.

3. Thank you for allowing me to interview you about your garden/farm. I'm working with Keep Growing Detroit. We are interested in learning about your experiences gardening and/or farming in Detroit. First, we will talk about how you got started gardening, then we will talk about any benefits that come from gardening or farming and finally, we will talk about your hopes for the future, your organization, and Keep Growing Detroit.

4. I won't be able to write down every word that you say and I don't want to miss anything so I will be taping the interview. At any point during the interview, if you would rather speak without being recorded on tape, I will turn off the tape recorder – just let me know.
[Turn tape recorder on.] OK, I understand I have your permission to tape this interview.

B. STORYTELLING

General

1. Tell me how you got started gardening and/or farming.
2. Tell me about your current garden.
3. Can you share with me some of your recent or memorable gardening and farming experiences?
4. Why do you garden [or farm] and what do you enjoy?
5. What keeps you involved in gardening [or farming]?
6. What things help you garden or make it easier for you to garden [or farm]?
7. What are some things that make it hard for you to garden [or farm] or frustrate you?

Youth impact/linking generations

1. As a young person, were you influenced by an adult or older person to garden or not to garden?

2. How are you working with young people in your current garden?

3. Have you seen youth respond to the garden? If so, can you describe their response?

   Probes:
   a. Would you describe their response as positive, neutral, or negative?
   b. Are the youth engaged, interested?
   c. Do the youth talk about the garden in their personal discussions?
   d. Do youth have an aversion to getting dirty or going outside? If so, how do they express this?
   e. Describe a scenario that illustrates a youth's response to the garden.

Learning

1. What did you need to learn to get to where you are today with your garden [or farm]?

2. How did you learn those things?

3. What more would you like to learn about gardening [or farming]?

C. BENEFITS OF GARDENING

Next we are going to talk about the impacts of gardening.

General

1. How has gardening or your garden impacted your life?

   Probe: What have you gained from gardening?

Social support and relationships/networks/social capital

1. Have you made any new friends or acquaintances through the garden? [If they say yes]: Tell me how the garden had something to do with these new connections.

2. Have you benefited from networking or social connections you have made through your garden [or farm] or through The Garden Resource Program/Keep Growing Detroit? [If they say yes]: Tell me about these benefits.

3. Have your neighbors, friends and/or family given you any feedback about the garden? [If they say yes]: What have they shared with you?

Food security/Diet

1. Have your eating habits changed because of the garden? [If they say yes]: How has what you eat changed because of the garden?

   Probe: For example, do you eat differently than before you started gardening? Are there foods you eat more or less of?

2. Has the garden had an impact on how much food your family has to eat or the types of food your family has to eat?

3. Have you saved money on food because of the garden? [If they say yes] How much have you saved? How has the savings impacted your family?

Sovereignty and power in the food system

1. Have there been any changes in how you think about food or how food is produced because of your experiences gardening? [If they say yes]: Tell me about these changes.

2. Have there been any changes in how you get your food because of your experiences gardening? [If they say yes]: Tell me about these changes.

   Probes: Where or from whom you purchase food? What you purchase?

Activity

1. Has your physical activity or exercise habits changed because of the garden? [If they say yes]: How has your activity changed because of the garden?

Health/natural living/total lifestyle change

1. Have there been any changes in your health or things that you do to be healthy that you could attribute to gardening? [If they say yes]: What are they?

2. Has gardening affected your mood, stress level, or sleep? [If they say yes]: How?

3. Has gardening changed how you feel about spirituality? [If they say yes]: How?

Community

1. Can you describe any changes that you've noticed in your community because of your garden [or farm] or gardening in general or are things about the same?

Probes:

1. With regard to community members' interaction and how people get along?
2. With regard to adults or youth being able to get jobs or build businesses?
3. With regard to participation in other community projects?
4. With regard to property upkeep and/or property values? Both lived in and vacant lots?
5. With regard to crime, disorderliness, or awareness of crime?

→[For each] Tell me how gardening [or farming] had something to do with that. Do you think that these changes were because of the garden [or farm] or because of other things that were going on in the city?

Hope/Visioning for future

1. Based on your experiences with your garden, what do you hope for the city regarding vacant land and urban agriculture?

2. Based on your experiences with your garden, what do you hope for the city regarding fresh food availability and distribution?

D. Additional questions for HOME, SCHOOL AND COMMUNITY GARDENERS (if not covered in previous questions):

Now I have some additional questions about your organization and Keep Growing Detroit.

Organization

1. Is your garden hosted by an organization?

2. If there is an organization that hosts the garden, briefly describe the history of that organization.
    a. When did it start?
    b. How many members?
    c. How has the organization changed over the years?

3. How is the garden organized in terms of people? Is there a garden leader?

4. Who is welcome in the garden?

5. Are there any regular or special activities that your garden does?
   Probes: Educational activities? Social activities?

6. If you use the garden for educational purposes, what subject(s) do you teach using the garden? Why did you decide to teach that/those subjects using the garden?

Keep Growing Detroit

1. What was the role of the Garden Resource Program/Keep Growing Detroit in getting you started gardening and/or helping you now?

2. What services have you used or participated in from the Garden Resource Program and/or Keep Growing Detroit?

3. What is working with the Garden Resource Program and what is not working?

4. Do you have any suggestions for Keep Growing Detroit and the Garden Resource Program that would help you be a more productive and successful gardener?

E. Additional questions for MARKET GARDENERS (if not covered in previous questions):

Now I have some additional questions about your organization and Keep Growing Detroit.

Urban farming as viable business

1. Tell me how your market garden got started.
   Probes:
   a. What was your motivation?
   b. What made you decide to start a market garden?
2. How has your market garden changed over time?
3. Where have you received help or support for your market garden?
4. What are some things that make it hard for you to have a market garden?
5. What would help your business now?
6. What are your plans for the future?
7. Are you reaching financial goals you set for yourself? Why or why not?
8. Are you reaching other goals you set for yourself? Why or why not?
9. How are you reaching those goals?
10. For this question, you do not need to be specific, but can answer generally: Who are your customers? Do you think you are meeting their needs?
11. Can you describe any opportunities you have had through participating with Grown in Detroit?
12. Can you describe any challenges you have had from participating with Grown in Detroit?

KGD

1. What was the role of the Garden Resource Program/Keep Growing Detroit in getting you started gardening and/or helping you now?
2. What services have you used or participated in from the Garden Resource Program and/or Keep Growing Detroit?
3. What is working with the Garden Resource Program and what is not working?
4. Do you have any suggestions for Keep Growing Detroit and the Garden Resource Program that would help you be a more productive and successful gardener?

APPENDIX D University of Colorado Boulder Institutional Review Board Letter of Approval

Office of Research Integrity
UNIVERSITY OF COLORADO **BOULDER**
INSTITUTIONAL REVIEW BOARD

Institutional Review Board
563 UCB
Boulder, CO 80309
Phone: 303.735.3702
Fax: 303.735.5185
FWA: 00003492

APPROVAL

20-Mar-2018

Dear Jill Litt,
On **20-Mar-2018** the IRB reviewed the following protocol:

Type of Submission:	Amendment
Review Category:	Expedited
Title:	Community Activation for Prevention (CAPs): A Randomized Controlled Trial of Gardening
Investigator:	Litt, Jill
Protocol #:	16-0644
Funding:	Non-Federal
IND or IDE:	None
Documents Approved:	16-0644 Interview Consent (IRB Appvd 03.20.18); CAPS qualitative interview guide-gardeners FINAL.docx; CAPS qualitative interview guide-controls FINAL.docx; 16-0644 Protocol (IRB Appvd 03.20.18);
Documents Reviewed:	Cover Letter_16_0644_qual interviews.docx; 17-143.SRC Approval Letter.pdf; HRP-213 Amendment-v2;
Description:	This amendment updates the original qualitative interview plan and includes interview guides and a consent form.

IRB Approval for this protocol will expire on **20-Sep-2018**.

Click the link to find the approved documents for this protocol: Summary Page Use copies of these documents to conduct your research.

In conducting this protocol you must follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,
Misty White
IRB Panel Review Coordinator
Institutional Review Board

APPENDIX E Aim 2 Consent Form

University of Colorado Boulder

Permission to Take Part in a Human Research Study

Title of research study: Community Activation for Prevention (CAPs) Interviews: A Randomized Controlled Trial of Community Gardening

Investigators: *Jill S. Litt, PhD, Associate Professor, University of Colorado Boulder, Katherine Alaimo, PhD, Associate Professor, Michigan State University*

Why am I being invited to take part in a research study?

We invite you to take part in a research study because you are enrolled in the Community Activation for Prevention study.

What should I know about a research study?

- Someone will explain this research study to you.
- Whether or not you take part is up to you.
- You can choose not to take part.
- You can agree to take part and later change your mind.
- Your decision will not be held against you.
- You can ask all the questions you want before you decide.

Who can I talk to?

If you have questions, concerns, or complaints, or think the research has hurt you, you can talk to Angel Villalobos, the research study coordinator, at 303-724-1235.

This research has been reviewed and approved by an Institutional Review Board ("IRB"). You may talk to them at (303) 735-3702 or irbadmin@colorado.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research subject.
- You want to get information or provide input about this research.

Why is this research being done?

This research is being done to understand how participation in a community garden can affect nutrition, physical activity, weight status, and risk factors for heart disease, diabetes and cancer.

How long will the research last?

This research will consist of one interview that will take approximately one hour. You will also be asked to complete another interview after this year's gardening season

How many people will be studied?

We expect about 60 people will be in this qualitative research component of this study.

What happens if I say yes, I want to be in this research?

You will be interviewed about your diet, physical activity, interest in community gardening, and experience with gardening. This interview will last about one hour, and will be audio recorded

Do you consent for your interview to be audio recorded? □ yes □ no _____(Initials)

What happens if I do not want to be in this research?

You can leave the research at any time and it will not be held against you.

What happens if I say yes, but I change my mind later?

You can leave the research at any time it will not be held against you.

Is there any way being in this study could be bad for me?

There are no psychological, social, or legal risks associated with participation in the study, other than the psychological stress that may be associated with reporting your diet, health and physical activity habits.

Will being in this study help me in any way?

This research will help us understand of the effects of community interventions for the prevention of cancer and other chronic diseases. Thus, risks to study participants are reasonable in light of the knowledge that we expect to gain through this study.

What happens to the information collected for the research?

Efforts will be made to limit the use and disclosure of your personal information, including research study and medical records, to people who have a need to review this information. We cannot promise complete secrecy. A paid transcription service will transcribe the audio recordings of the interviews. All audio recordings will be deleted on or before December 31, 2023. Organizations that may inspect and copy your information include the IRB and other representatives of this organization.

Private data, including audio recordings of the interviews and interview transcripts, will be kept secured and disclosed only to those named in our study protocol. All data will be password protected and stored on a secured network at the University of Colorado and a secured online network.

What else do I need to know?

This research is being funded by the American Cancer Society.

If you agree to take part in this research, you will receive a gift card worth $20 at the completion of the interview.

Results from this research will be shared with Denver Urban Gardens.

May we contact you in the future for follow-up interviews regarding your experiences in this study?

□ yes □ no _____(Initials)

Signature Block for Capable Adult

Your signature documents your permission to take part in this research.		
Signature of subject		Date
Printed name of subject		
Signature of person obtaining consent		Date
		03.20.2018
Printed name of person obtaining consent		IRB Approval Date

APPENDIX F Aim 2 Interview Guide

CAPS Qualitative Interview Guide for Gardeners

Entrance script: Thank you for agreeing to participate in these interviews. I am going to ask you questions about your experiences over the past year and before, with regard to your community garden plot, the foods you eat, the physical activities you participate in, and your overall sense of health.

Recording consent:

We would like to audio record this interview for quality control purposes. Neither your name or any other identifying information will be associated with the audio or audio recording or the transcript. Only the research team and a paid transcription service will be able to listen to the recording.

The tapes will be transcribed by a paid transcription service. Transcripts of your interview may be reproduced in whole or in part for use in presentations or written products that result from this study. Neither your name or any other identifying information (such as your voice) will be used in presentations or in written products resulting from the study.

By consenting to be recorded, you are allowing the research team to audio tape you as part of the research. Your consent for this recording is effective until December 31st 2023. On or before that date, the recording will be destroyed.

Do we have your permission to begin the recording? Y/N

If at any time during the interview, you would like us to turn off the tape recorder or stop recording, that's okay, just let me know.

--End of consenting process for recording--

Gardeners-experience with gardening

1. When you signed up for the study, what interested you about gardening?
    a. Probe: If it was community gardening in particular: What interested you about community gardening?
    b. Probe: Had you grown food before last season? If yes, Tell me about your experiences

   c. Note: If they mention anything about wanting to eat healthier, be more active, etc. really probe to see if they were interested in these things before gardening

2. Can you tell me about your community garden?

3. Tell me about a typical visit to the garden?
   a. Probe: How did you get there?
   b. Probe: How far away is your garden from your home?
   c. Probe: What did you do when you were there?
   d. Probe: How often did you go to your garden? How did that change over the season?
   e. Probe: How much time did you spend there each time you went?

4. Did you have a garden orientation: if yes Can you tell me about your garden orientation?
   a. Probe: Who did your garden orientation?
   b. Probe: Is there anything you would have liked in your orientation that you didn't get? If yes: Tell me what would have been helpful to have in your garden orientation
   c. IF NO ORIENTATION: would you have liked a garden orientation? What would you have liked in a garden orientation?

5. Thinking back over the whole gardening season, from when you were assigned your plot to the very end of the gardening season, what stands out to you about your experience?
   a. Probe: How did community gardening compare to what you were expecting?
   b. Probe: Did anything surprise you about gardening? If yes: what surprised you?
   c. Is there anything else that stood out to you or surprised you?

6. Could you tell me about the leadership in your garden?
   a. Probe: Can you tell me about communication from your garden leaders, how often, what did they communicate about?

7. What were your interactions with other gardeners like?
    a. Probe: What was the social atmosphere like in the community garden?
    b. Probe: Did you feel welcome in the garden?
    c. Probe: Were there social events like workdays or potlucks in your garden? If yes, Did you go to any of the social events? If yes, what was that like? If no, why not?
    d. Probe: Did you spend time with youth in the garden?
    e. Did you make any new friends from the garden?
    Note: pay attention to intergenerational interactions, different cultures, different languages

8. During your time gardening last summer, did you involve your friends and family in the garden at all?
    a. If yes: how did your friends/family react to going to your garden?
    b. Probe: Did you talk about the garden with family and friends? What did you talk about?
    c. Probe: Has your gardening impacted other people in your family or people who are close to you? If yes: how?

9. How did you learn how to garden?
    a. Probe: Was there anyone that helped you garden, or taught you about gardening? If yes: how did having that help affect your experience in the community garden?
    b. Is there anything you didn't know that would have been helpful?

10. Were there things that made it hard for you to garden, either difficulties in the garden or anything that made it challenging to get to the garden?
    a. Probe: Were you able to find a solution to _____?
    b. Probe: What did you do when that happened?
    c. Probe: How did you deal with that?

11. What did you like about gardening?
    a. Probe: Is there anything else you liked about gardening?

12. What do you not like about gardening?
    a. Probe: Is there anything else you didn't like about gardening?

13. Has gardening impacted your life outside of the garden?

14. Are you planning on community gardening again in 2018? If yes: What made you decide to sign up for the community garden again this year? If they are not planning on gardening again: What made you decide to not sign up for the community garden this year?

"Life course" approach to eating

1. Can you describe how you eat in general terms? For example someone might say that convenience is really important to them so they eat a lot of frozen meals and fast food. Someone else may say they make mostly home-cooked meals.

2. Can you list and describe for me in general terms what kinds of foods you eat for each meal and for your snacks? For example, someone might say: for breakfast I usually have oatmeal and a banana. For lunch, I usually have a sandwich like ham and cheese with chips or a piece of pizza and a Coke. For dinner, I either cook a meal for my family, like spaghetti with meatballs or a stir-fry with vegetables and some sort of meat, or get a take out salad or roasted chicken from the supermarket. So what would a typical day look like for you?

   A. Probe: If they don't mention snacks: what about snacks?

   b. Probe: What do you normally drink?

3. What do you think influences or has influenced how you eat? What's important to you when deciding what you eat?

4. Are there any differences in how you ate before you started gardening, compared with after you started gardening? If yes: Tell me about those changes. What do you think caused those changes?

5. Tell me about how you used the food from your garden.
    a. Probe: Did you share the food you grew?

6. Did you try new vegetables or herbs because of what you grew in your garden? If so, what are some examples? What did you think about them? What did you do with them?

"Life course" approach to physical activity

1. Tell me about what the physical work in the community garden was like for you.

2. What kind of physical activity do you normally do?
    b. Probe: How often do you do that and for how long?

3. Have there been any changes since you started gardening in how physically active you are, compared with before you started gardening? If yes: Tell me about those changes. What do you think caused those changes?

"Life course" approach to health

1. How did gardening and being in the community garden make you feel, physically and mentally?

2. Have there been any recent changes to your health, both positive and negative? If yes: Tell me about those changes. What do you think caused _____?

Do you have anything else you want to share with us?

Follow-Up probes: Use the following questions as potential probes if these topics are brought up in response to main questions

1. General probes: These probes will need to be tailored to the specific topic, but are designed to examine the mechanisms by which gardening influences diet, physical activity, social health, mental health, physical health, etc., and are also designed to determine if things have changed because of the garden.
   - What was it about gardening that…?
   - Have you always been interested in _____?
   - Has that always been the case for you?
   - How do you think gardening is related to _____?

APPENDIX G Aim 3 Regression Models

Table 14: Model 1-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program (complete case analysis)[†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.43	0.12	0.19	0.68	1.54	0.19	1.21	1.96	<0.001
2014	0.37	0.13	0.12	0.63	1.45	0.19	1.13	1.87	0.004
Garden type[b]									
Community	0.20	0.14	-0.06	0.47	1.23	0.17	0.94	1.60	0.129
Market	-0.10	0.23	-0.56	0.35	0.90	0.21	0.57	1.42	0.659
Owns land[c]	0.28	0.12	0.06	0.51	1.33	0.15	1.06	1.67	0.014
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.10	0.14	-0.38	0.18	0.91	0.13	0.68	1.20	0.490
>400 sq ft & <1 city lot	-0.04	0.15	-0.33	0.25	0.96	0.14	0.72	1.29	0.788
≥1 city lot & <2 city lots	-0.08	0.18	-0.44	0.27	0.92	0.17	0.65	1.31	0.646
≥2 city lots	0.00	0.19	-0.37	0.38	1.00	0.19	0.69	1.46	0.986
Number of adults[e]	0.01	0.01	0.00	0.02	1.01	0.01	1.00	1.02	0.193
Ever received site visit[f]	0.20	0.15	-0.10	0.50	1.22	0.18	0.91	1.64	0.184
Participated in Grown in Detroit[g]	0.57	0.30	-0.02	1.16	1.77	0.54	0.98	3.21	0.059
Number of seed/plant pickups[h]	0.39	0.04	0.31	0.48	1.48	0.07	1.36	1.62	<0.001
Urban Roots (ever)[i]	-0.07	0.20	-0.45	0.31	0.93	0.18	0.64	1.37	0.721
Sweet on Detroit (ever)[j]	-0.04	0.27	-0.56	0.49	0.96	0.26	0.57	1.63	0.890
Season Extension (ever)[k]	-0.22	0.30	-0.80	0.36	0.80	0.24	0.45	1.44	0.463

Table 14 (cont'd)

Number of volunteer events[l]									
1	0.46	0.15	0.17	0.74	1.58	0.23	1.18	2.11	0.002
2	0.51	0.24	0.04	0.98	1.67	0.40	1.04	2.65	0.032
3+	0.52	0.27	-0.01	1.04	1.67	0.45	0.99	2.82	0.054
Number of social events[m]									
1	0.01	0.19	-0.36	0.38	1.01	0.19	0.70	1.46	0.963
2-3	0.41	0.34	-0.26	1.07	1.50	0.51	0.77	2.92	0.228
Number of classes attended[n]									
1	0.34	0.16	0.03	0.65	1.41	0.22	1.03	1.92	0.033
2	0.80	0.25	0.30	1.30	2.23	0.57	1.35	3.66	0.002
3+	0.56	0.27	0.03	1.10	1.76	0.48	1.03	2.99	0.039
Prior years in program[o]	0.30	0.03	0.24	0.36	1.35	0.04	1.28	1.43	<0.001
Percent graduated high school[p]	0.00	0.01	-0.02	0.02	1.00	0.01	0.98	1.02	0.976
Percent African American[q]	0.00	0.00	-0.01	0.01	1.00	0.00	0.99	1.01	0.792
Percent in poverty[r]	0.00	0.01	-0.01	0.02	1.00	0.01	0.99	1.02	0.864

[†]n=1660 gardens; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Number of adults involved in garden; [f] Garden received a site visit by Keep Growing Detroit staff (ever), did not receive site visit reference; [g] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [h] Number of plant and seeds distributions attended by any gardener from the garden; [i] Primary gardener participated with Urban Roots program (ever), did not participate in Urban Roots reference; [j] Primary gardener participated with Sweet on Detroit program (ever), did not participate in Sweet on Detroit reference; [k] Primary gardener participated with Season Extension program (ever), did not participate in Season Extension reference; [l] Number of volunteer events attended by primary gardener, 0 events reference; [m] Number of social events attended by primary gardener, 0 events reference; [n] Number of classes attended by primary gardener , 0 events reference; [o] Number of previous years garden participated in Garden Resource Program; [p] Percent of population Black or African American in zip-code where garden is located; [q] Percent of population completed high school or higher in zip-code where garden is located ; [r] Percent of population below poverty level in zip-code where garden is located

Table 15: Model 1-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program (imputed data)[†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.43	0.11	0.21	0.64	1.53	0.17	1.24	1.89	<0.001
2014	0.32	0.11	0.10	0.55	1.38	0.16	1.10	1.73	0.005
Garden type[b]									
Community	0.29	0.13	0.04	0.54	1.33	0.17	1.04	1.71	0.023
Market	0.09	0.22	-0.35	0.54	1.10	0.25	0.71	1.71	0.675
Owns land[c]	0.24	0.11	0.03	0.45	1.27	0.14	1.03	1.57	0.026
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.05	0.17	-0.40	0.30	0.95	0.17	0.67	1.35	0.773
>400 sq ft & <1 city lot	-0.02	0.17	-0.37	0.33	0.98	0.17	0.69	1.39	0.909
≥1 city lot & <2 city lots	-0.12	0.20	-0.52	0.29	0.89	0.18	0.59	1.33	0.567
≥2 city lots	0.01	0.20	-0.39	0.41	1.01	0.20	0.68	1.50	0.958
Number of adults[e]	0.01	0.01	0.00	0.03	1.01	0.01	1.00	1.03	0.122
Ever received site visit[f]	0.23	0.14	-0.05	0.50	1.25	0.17	0.95	1.64	0.105
Participated in Grown in Detroit[g]	0.58	0.29	0.00	1.15	1.78	0.52	1.00	3.15	0.048
Number of seed/plant pickups[h]	0.49	0.04	0.41	0.56	1.63	0.06	1.51	1.76	<0.001
Urban Roots (ever)[i]	-0.19	0.18	-0.55	0.16	0.82	0.15	0.58	1.17	0.283
Sweet on Detroit (ever)[j]	-0.38	0.25	-0.86	0.10	0.68	0.17	0.42	1.11	0.124
Season Extension (ever)[k]	-0.09	0.28	-0.63	0.46	0.92	0.26	0.53	1.59	0.759

Table 15 (cont'd)

Number of volunteer events[l]									
1	0.42	0.13	0.16	0.67	1.52	0.20	1.18	1.96	0.001
2	0.49	0.22	0.06	0.91	1.63	0.35	1.06	2.49	0.025
3+	0.47	0.24	0.00	0.95	1.60	0.39	1.00	2.58	0.051
Number of social events[m]									
1	0.09	0.17	-0.24	0.42	1.10	0.19	0.79	1.53	0.591
2-3	0.24	0.28	-0.32	0.79	1.27	0.36	0.73	2.21	0.400
Number of classes attended[n]									
1	0.36	0.14	0.08	0.64	1.44	0.20	1.09	1.90	0.011
2	0.68	0.22	0.24	1.12	1.98	0.44	1.28	3.06	0.002
3+	0.76	0.25	0.28	1.24	2.14	0.53	1.32	3.47	0.002
Prior years in program[o]	0.30	0.03	0.24	0.35	1.34	0.04	1.28	1.42	<0.001
Percent graduated high school[p]	0.00	0.01	-0.02	0.02	1.00	0.01	0.98	1.02	0.883
Percent African American[q]	0.00	0.00	-0.01	0.01	1.00	0.00	0.99	1.01	0.755
Percent in poverty[r]	0.00	0.01	-0.02	0.01	1.00	0.01	0.98	1.01	0.810

[†]n=2300 gardens, 10 imputations; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Number of adults involved in garden; [f] Garden ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [g] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [h] Number of plant and seeds distributions attended by any gardener from the garden; [i] Primary gardener ever participated with Urban Roots program, did not participate in Urban Roots reference; [j] Primary gardener ever participated with Sweet on Detroit program, did not participate in Sweet on Detroit reference; [k] Primary gardener ever participated with Season Extension program, did not participate in Season Extension reference; [l] Number of volunteer events attended by primary gardener, 0 events reference; [m] Number of social events attended by primary gardener, 0 events reference; [n] Number of classes attended by primary gardener , 0 events reference; [o] Number of previous years garden participated in Garden Resource Program; [p] Percent of population Black or African American in zip-code where garden is located; [q] Percent of population completed high school or higher in zip-code where garden is located ; [r] Percent of population below poverty level in zip-code where garden is located

Table 16: Model 3-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program (complete case analysis)[†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.45	0.12	0.21	0.69	1.57	0.19	1.23	1.99	<0.001
2014	0.37	0.13	0.12	0.62	1.45	0.18	1.13	1.86	0.003
Garden type[b]									
Community	0.23	0.13	-0.02	0.48	1.26	0.16	0.98	1.61	0.072
Market	-0.08	0.23	-0.52	0.36	0.92	0.21	0.59	1.44	0.721
Owns land[c]	0.28	0.11	0.07	0.50	1.33	0.15	1.07	1.65	0.010
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.09	0.14	-0.36	0.19	0.92	0.13	0.69	1.21	0.542
>400 sq ft & <1 city lot	-0.03	0.15	-0.32	0.26	0.97	0.14	0.73	1.29	0.841
≥1 city lot & <2 city lots	-0.09	0.17	-0.43	0.25	0.91	0.16	0.65	1.28	0.594
≥2 city lots	0.08	0.19	-0.29	0.44	1.08	0.20	0.75	1.56	0.683
Ever received site visit[e]	0.20	0.15	-0.09	0.49	1.22	0.18	0.92	1.63	0.173
Participated in Grown in Detroit[f]	0.50	0.29	-0.08	1.07	1.64	0.48	0.93	2.91	0.089
Number of seed/plant pickups[g]	0.38	0.04	0.30	0.47	1.47	0.06	1.35	1.60	<0.001
Urban Roots (ever)[h]	-0.10	0.19	-0.47	0.28	0.91	0.17	0.62	1.32	0.609
Sweet on Detroit (ever)[i]	-0.03	0.26	-0.55	0.48	0.97	0.26	0.58	1.62	0.907
Season Extension (ever)[j]	-0.21	0.29	-0.78	0.37	0.81	0.24	0.46	1.45	0.483

Table 16 (cont'd)

Number of volunteer events[k]									
1	0.46	0.14	0.18	0.74	1.59	0.23	1.20	2.11	0.001
2	0.56	0.23	0.11	1.01	1.75	0.41	1.11	2.76	0.016
3+	0.55	0.26	0.03	1.07	1.73	0.46	1.03	2.91	0.038
Number of social events[l]									
1	-0.01	0.18	-0.37	0.35	0.99	0.18	0.69	1.42	0.959
2-3	0.35	0.33	-0.29	0.99	1.42	0.47	0.75	2.70	0.284
Number of classes attended[m]									
1	0.36	0.16	0.05	0.67	1.43	0.22	1.05	1.95	0.022
2	0.83	0.25	0.34	1.32	2.29	0.58	1.40	3.76	0.001
3+	0.59	0.27	0.06	1.12	1.80	0.48	1.06	3.05	0.030
Prior years in program[n]	0.30	0.03	0.25	0.36	1.35	0.04	1.28	1.43	<0.001

[†]n=1706 gardens; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Garden received ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [f] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [g] Number of plant and seeds distributions attended by any gardener from the garden; [h] Primary gardener ever participated with Urban Roots program, did not participate in Urban Roots reference; [i] Primary gardener ever participated with Sweet on Detroit program, did not participate in Sweet on Detroit reference; [j] Primary gardener ever participated with Season Extension program, did not participate in Season Extension reference; [k] Number of volunteer events attended by primary gardener, 0 events reference; [l] Number of social events attended by primary gardener, 0 events reference; [m] Number of classes attended by primary gardener , 0 events reference; [n] Number of previous years garden participated in Garden Resource Program

Table 17: Model 3-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program (imputed data)[†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.42	0.11	0.21	0.63	1.52	0.16	1.23	1.88	<0.001
2014	0.32	0.11	0.10	0.55	1.38	0.16	1.10	1.73	0.005
Garden type[b]									
Community	0.32	0.12	0.08	0.56	1.38	0.17	1.09	1.75	0.008
Market	0.09	0.23	-0.35	0.54	1.10	0.25	0.71	1.71	0.675
Owns land[c]	0.25	0.10	0.04	0.45	1.28	0.13	1.04	1.57	0.018
Size of garden[d]									
>100 sq ft & ≤400 sq ft	-0.05	0.17	-0.40	0.30	0.95	0.17	0.67	1.35	0.781
>400 sq ft & <1 city lot	-0.02	0.17	-0.37	0.33	0.98	0.17	0.69	1.39	0.917
≥1 city lot & <2 city lots	-0.11	0.20	-0.52	0.29	0.89	0.18	0.60	1.34	0.580
≥2 city lots	0.04	0.20	-0.36	0.43	1.04	0.21	0.70	1.54	0.861
Ever received site visit[e]	0.24	0.14	-0.03	0.51	1.27	0.18	0.97	1.67	0.082
Participated in Grown in Detroit[f]	0.56	0.29	-0.01	1.13	1.75	0.51	0.99	3.09	0.053
Number of seed/plant pickups[g]	0.48	0.04	0.41	0.56	1.62	0.06	1.50	1.75	<0.001
Urban Roots (ever)[h]	-0.20	0.18	-0.55	0.15	0.82	0.15	0.58	1.16	0.260
Sweet on Detroit (ever)[i]	-0.38	0.25	-0.86	0.11	0.69	0.17	0.42	1.11	0.127
Season Extension (ever)[j]	-0.10	0.28	-0.64	0.45	0.91	0.25	0.53	1.57	0.730

Table 17 (cont'd)

Number of volunteer events[k]									
1	0.41	0.13	0.15	0.66	1.50	0.19	1.17	1.93	0.002
2	0.49	0.22	0.07	0.92	1.64	0.36	1.07	2.51	0.023
3+	0.48	0.24	0.00	0.95	1.61	0.39	1.00	2.59	0.049
Number of social events[l]									
1	0.09	0.17	-0.25	0.42	1.09	0.18	0.78	1.52	0.611
2-3	0.25	0.28	-0.31	0.80	1.28	0.36	0.74	2.23	0.382
Number of classes attended[m]									
1	0.37	0.14	0.09	0.65	1.45	0.21	1.09	1.91	0.010
2	0.71	0.22	0.27	1.14	2.03	0.45	1.31	3.14	0.002
3+	0.77	0.25	0.29	1.26	2.17	0.53	1.34	3.51	0.002
Prior years in program[n]	0.30	0.03	0.25	0.35	1.35	0.04	1.28	1.42	<0.001

[†]n=2318 gardens, 10 imputations; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Size of garden, 100 sq ft or less reference; [e] Garden ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [f] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [g] Number of plant and seeds distributions attended by any gardener from the garden; [h] Primary gardener ever participated with Urban Roots program, did not participate in Urban Roots reference; [i] Primary gardener ever participated with Sweet on Detroit program, did not participate in Sweet on Detroit reference; [j] Primary gardener ever participated with Season Extension program), did not participate in Season Extension reference; [k] Number of volunteer events attended by primary gardener, 0 events reference; [l] Number of social events attended by primary gardener, 0 events reference; [m] Number of classes attended by primary gardener , 0 events reference; [n] Number of previous years garden participated in Garden Resource Program

Table 18: Model 4-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program (complete case analysis)[†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.42	0.11	0.20	0.65	1.53	0.17	1.22	1.91	<0.001
2014	0.36	0.12	0.13	0.60	1.44	0.17	1.14	1.82	0.002
Garden type[b]									
Community	0.28	0.12	0.04	0.51	1.32	0.16	1.04	1.67	0.022
Market	-0.01	0.22	-0.45	0.43	0.99	0.22	0.64	1.53	0.968
Owns land[c]	0.26	0.11	0.05	0.46	1.29	0.14	1.05	1.59	0.016
Number of adults[d]	0.01	0.01	0.00	0.02	1.01	0.01	1.00	1.03	0.177
Ever received site visit[e]	0.21	0.15	-0.08	0.49	1.23	0.18	0.92	1.63	0.156
Participated in Grown in Detroit[f]	0.58	0.31	-0.02	1.18	1.78	0.54	0.98	3.25	0.058
Number of seed/plant pickups[g]	0.44	0.04	0.36	0.52	1.55	0.06	1.43	1.68	<0.001
Urban Roots (ever)[h]	-0.17	0.19	-0.55	0.20	0.84	0.16	0.58	1.22	0.361
Sweet on Detroit (ever)[i]	-0.23	0.26	-0.74	0.28	0.79	0.21	0.48	1.32	0.377
Season Extension (ever)[j]	-0.17	0.29	-0.75	0.40	0.84	0.25	0.47	1.49	0.551
Number of volunteer events[k]									
1	0.48	0.14	0.20	0.75	1.61	0.22	1.23	2.11	0.001
2	0.44	0.23	-0.01	0.89	1.56	0.36	0.99	2.44	0.054
3+	0.47	0.25	-0.03	0.97	1.60	0.41	0.97	2.64	0.064
Number of social events[l]									
1	0.09	0.18	-0.26	0.45	1.10	0.20	0.77	1.56	0.609
2-3	0.36	0.30	-0.24	0.95	1.43	0.44	0.79	2.60	0.237

Table 18 (cont'd)

Number of classes attended[m]	0.31	0.03	0.25	0.36	1.36	0.04	1.29	1.44	<0.001
1	0.44	0.15	0.14	0.74	1.55	0.24	1.15	2.10	0.004
2	0.68	0.23	0.22	1.13	1.97	0.45	1.25	3.10	0.003
3+	0.82	0.26	0.31	1.34	2.28	0.60	1.36	3.80	0.002
Prior years in program[n]	0.30	0.03	0.25	0.35	1.35	0.04	1.28	1.42	<0.001

[†]n=2085 gardens; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Number of adults involved in garden; [e] Garden ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [f] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [g] Number of plant and seeds distributions attended by any gardener from the garden; [h] Primary gardener ever participated with Urban Roots program, did not participate in Urban Roots reference; [i] Primary gardener ever participated with Sweet on Detroit program, did not participate in Sweet on Detroit reference; [j] Primary gardener ever participated with Season Extension program, did not participate in Season Extension reference; [k] Number of volunteer events attended by primary gardener, 0 events reference; [l] Number of social events attended by primary gardener, 0 events reference; [m] Number of classes attended by primary gardener , 0 events reference; [n] Number of previous years garden participated in Garden Resource Program

Table 19: Model 4-Multivariate logistic regression examining associations between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit's programming, and continued garden participation in the Garden Resource Program (imputed data)[†]

	Coef.	Std. Err.	95% Conf. Inter.		OR	Std. Err.	95% Conf. Inter.		P-value
Year[a]									
2013	0.42	0.11	0.21	0.63	1.53	0.16	1.24	1.88	<0.001
2014	0.33	0.11	0.10	0.55	1.39	0.16	1.11	1.74	0.004
Garden type[b]									
Community	0.26	0.11	0.04	0.48	1.30	0.15	1.04	1.62	0.023
Market	0.09	0.21	-0.33	0.51	1.09	0.23	0.72	1.66	0.677
Owns land[c]	0.25	0.10	0.05	0.45	1.28	0.13	1.05	1.57	0.015
Number of adults[d]	0.01	0.01	0.00	0.02	1.01	0.01	1.00	1.02	0.142
Ever received site visit[e]	0.25	0.14	-0.02	0.52	1.28	0.18	0.98	1.68	0.074
Participated in Grown in Detroit[f]	0.56	0.29	-0.01	1.12	1.75	0.50	0.99	3.08	0.053
Number of seed/plant pickups[g]	0.48	0.04	0.41	0.56	1.62	0.06	1.50	1.75	<0.001
Urban Roots (ever)[h]	-0.20	0.18	-0.55	0.15	0.82	0.15	0.58	1.16	0.263
Sweet on Detroit (ever)[i]	-0.37	0.25	-0.85	0.11	0.69	0.17	0.43	1.12	0.132
Season Extension (ever)[j]	-0.09	0.28	-0.64	0.45	0.91	0.25	0.53	1.57	0.738
Number of volunteer events[k]									
1	0.41	0.13	0.16	0.66	1.50	0.19	1.17	1.93	0.002
2	0.49	0.22	0.07	0.92	1.64	0.35	1.07	2.50	0.022
3+	0.48	0.24	0.00	0.95	1.61	0.39	1.00	2.59	0.048
Number of social events[l]									
1	0.09	0.17	-0.24	0.42	1.09	0.19	0.78	1.52	0.600
2-3	0.25	0.28	-0.30	0.81	1.29	0.36	0.74	2.24	0.371

Table 19 (cont'd)

Number of classes attended[m]									
1	0.37	0.14	0.09	0.65	1.44	0.21	1.09	1.91	0.010
2	0.70	0.22	0.27	1.14	2.02	0.45	1.31	3.13	0.002
3+	0.77	0.25	0.29	1.26	2.17	0.53	1.34	3.51	0.002
Prior years in program[n]	0.30	0.03	0.25	0.35	1.35	0.04	1.28	1.42	<0.001

[†]n=2318 gardens, 10 imputations; [a] 2012 reference; [b] Family garden reference; [c] Garden land owned by gardener(s), does not own land reference; [d] Number of adults involved in garden; [e] Garden ever received a site visit by Keep Growing Detroit staff, did not receive site visit reference; [f] Any gardener from the garden participated with Grown in Detroit, did not participate reference; [g] Number of plant and seeds distributions attended by any gardener from the garden; * [h] Primary gardener ever participated with Urban Roots program, did not participate in Urban Roots reference; [i] Primary gardener ever participated with Sweet on Detroit program, did not participate in Sweet on Detroit reference; [j] Primary gardener ever participated with Season Extension program, did not participate in Season Extension reference; [k] Number of volunteer events attended by primary gardener, 0 events reference; [l] Number of social events attended by primary gardener, 0 events reference; [m] Number of classes attended by primary gardener , 0 events reference; [n] Number of previous years garden participated in Garden Resource Program

APPENDIX H Aim 3 Mediation Models

Figure 3: Mediation analysis of Sweet on Detroit and factor index variable of Garden Resource Program involvement on gardens returning

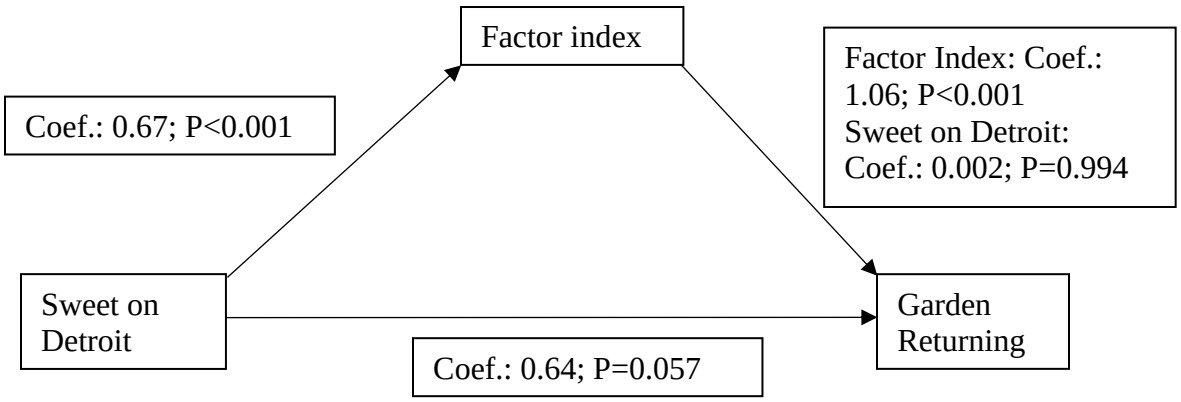


Figure 4: Mediation analysis of Season Extension and summed index variable of Garden Resource Program involvement on gardens returning

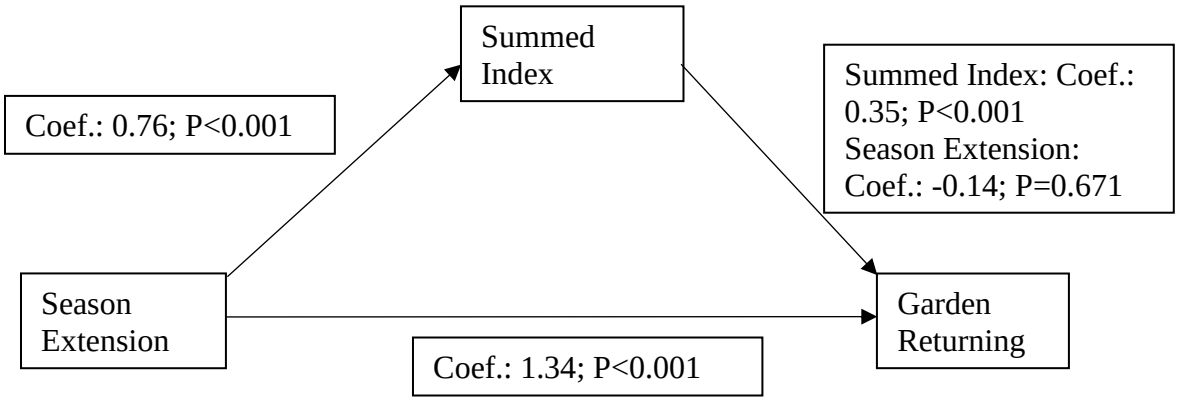


Figure 5: Mediation analysis of Urban Roots and summed index variable of Garden Resource Program involvement on gardens returning

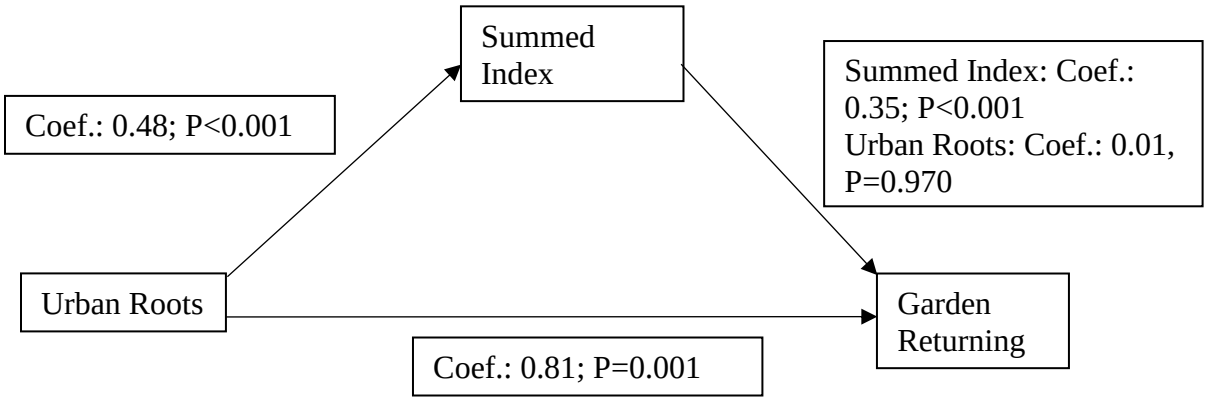
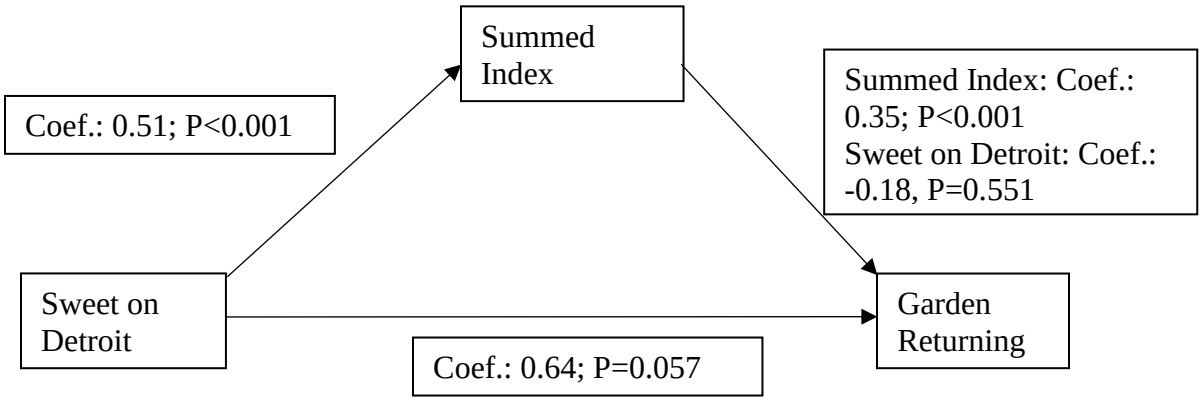


Figure 6: Mediation analysis of Sweet on Detroit and summed index variable of Garden Resource Program involvement on gardens returning



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