

Garden characteristics and types of program involvement associated with sustained garden membership in an urban gardening support program

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ABSTRACT

The ability of urban and community gardens to enhance health and social connections is dependent on the continued availability of places to garden and continuation of gardening by individuals. Gardener support organizations offer resources to enhance the success of gardens, such as providing free or low-cost material resources, gardening education, and technical support. They can also nurture local social networks of gardeners that share gardening support, experiences, and knowledge. In order for garden support programs to be effective, gardeners need to participate and avail themselves of the resources provided. Few studies have looked at factors that are associated with sustaining participation in garden support programs, including garden characteristics and gardeners' involvement in specific types of programming and services. This study worked with data on garden characteristics and program participation obtained from Keep Growing Detroit, a gardener support organization in Detroit, Michigan. Associations between garden characteristics, gardeners' involvement in various types of programming offered through a gardener support program, and the likelihood of continued garden membership in the gardener support program the following year were examined using multilevel logistic regression and mediation analysis. From 2012 to 2014, between 1189 and 1335 gardens participated in the garden support program each year. Garden characteristics and program components associated with continued garden membership in the garden support program included land ownership, gardeners' attending educational classes and volunteering, number of years of garden membership in the garden support program, and the garden receiving seeds and plants. Number of adults participating in the garden, garden size, receiving a site visit, and gardeners participating in city-wide events were not significantly associated with continued membership. Gardener support programs may be able to increase retention of gardens within their network by encouraging increased participation in specific types of programming.

1. Introduction

Home and community gardening are credited with a multitude of health benefits, including increased fruit and vegetable consumption (Alaimo et al., 2008; Litt et al., 2011; Bail et al., 2018; Demark-Wahnefried et al., 2018), providing a source of physical activity (Park et al., 2014, 2011), and improved mental wellbeing (Van Den Berg and Custers, 2011; van den Berg et al., 2010). Additionally, community or allotment gardens, gardens tended either collectively by community members and/or areas where gardeners are allotted garden plots and garden side-by-side, can provide sources of rich social interaction and

community development ('Yotti' Kingsley and Townsend, 2006; Ober Allen et al., 2008; Teig et al., 2009; Alaimo et al., 2016; Beavers et al., 2020). Globally, gardens are served by gardener support programs that offer an array of resources to facilitate gardening and reduce gardening barriers. These organizations also play an important role in creating local networks of gardens, facilitating connections between their member gardens (Porter, 2018; Ghose and Pettygrove, 2014; Gray et al., 2014).

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1.1. Gardener support programs

Sustaining a garden requires consistent access to land as well as yearly inputs of both material resources, such as seeds, plants, and compost, and physical efforts by gardeners who have adequate gardening skills and knowledge (Conway, 2016; Diaz et al., 2018; Schupp et al., 2016; Wakefield et al., 2007). Many gardener support programs address these needs by providing land, material resources for gardening, such as free or low-cost seeds and plants, gardening education, and technical assistance (Porter, 2018; Gray et al., 2014; Drake and Lawson, 2015). These programs are found throughout the world, including North America, Europe, and Australia (Drake and Lawson, 2015; Kingsley et al., 2019; Fox-Kämper et al., 2018; Social Farms and Gardens, 2021). Some gardening organizations serve both home and community gardeners (Denver Urban Gardens, 2021; Greater Lansing Food Bank, 2021), while other organizations serve solely home gardeners (Porter, 2018; Gray et al., 2014). Gardener support programs are often run by community-based organizations, but city departments also operate gardener support programs (Porter, 2018; Drake and Lawson, 2015). There is substantial variation in organization type, size, and emphasis on home or community gardeners, but a common thread among these organizations is their emphasis on facilitating gardening by making it more affordable and accessible, and increasing gardening skills and knowledge (Porter, 2018; Gray et al., 2014). Many gardener support programs also create local, place-based networks of gardens and/or gardeners (Porter, 2018; Ghose and Pettygrove, 2014; Gray et al., 2014). Belonging to a gardener support program allows member gardens to gain material resources and technical assistance from the gardening organizations, reducing barriers to gardening (Porter, 2018; Ghose and Pettygrove, 2014). These networks also forge connections between their member gardens and gardeners (Ghose and Pettygrove, 2014; Gray et al., 2014). Through the networks created by gardener support programs, gardening knowledge and skills can be exchanged between the gardeners belonging to the network (Gray et al., 2014). These networks allow for a greater number of local gardens and gardeners to interact, potentially increasing the spread of knowledge, creating larger social networks, and enhancing gardening effects.

In contrast to the numerous studies documenting benefits of gardening, gardener support programs have received little attention in the research literature. Few studies have investigated participation in specific resources and programming offered by garden support organizations, and no studies have examined which of these types of resources are associated with continued participation in gardener support programs. This study focuses on the Garden Resource Program (GRP), a garden support program operated by the organization Keep Growing Detroit, which serves gardens located in and around Detroit, Michigan, USA. The aims of this study were to measure associations between: 1) garden characteristics and 2) garden and primary 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.

2. Methods

2.1. Local setting: Detroit, Michigan

Since the 1950's, Detroit, a large U.S. city of approximately 673,000 residents, has experienced decades of population decline and segregation due to deindustrialization and disinvestment (Sugrue, 1996). Detroit has one of the highest poverty levels in the United States, estimated at 36% in 2019 (U.S. Census Bureau QuickFacts, 2021). High poverty and poor access to healthy foods serves as a barrier for Detroit residents to eat a healthy diet (Treuhhaft et al., 2009). Approximately 80% of residents are African American (Sugrue, 1996), and Detroit residents also describe racial inequity in their poor access to high quality, affordable, and healthy food compared with the majority-white

suburbs (Treuhhaft et al., 2009; Zenk et al., 2005). One study found that among high-poverty neighborhoods in Detroit, areas with the highest proportion of African American residents were 1.1 miles further from the nearest supermarket than areas with the lowest proportion of African American residents (Zenk et al., 2005). In fact, poor access to healthy foods and grocery stores is one of the biggest health-related concerns of Detroit residents (Treuhhaft et al., 2009; Detroit Health Department, 2018). This concern over access to affordable, healthy food has in large part fueled the expansive urban gardening movement in Detroit (White, 2011a, b).

2.2. Keep Growing Detroit and membership in their Garden Resource Program

The non-profit organization Keep Growing Detroit (<https://detroitagriculture.net/>) serves family, community, school, and market gardens located in the city of Detroit, Michigan as well as Hamtramck and Highland Park, two towns that are surrounded by the city of Detroit. The organization defines community gardens as spaces cultivated by gardeners from more than one family, family gardens as 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 (Fig. 1). It is important to note that most community gardens in Detroit are not plot- or allotment-based gardens in which gardens are divided up into plots and allocated to individuals or families. Instead, community gardens are collectively gardened by neighbors or organizations. In 2019, Keep Growing Detroit supported approximately 1600 family, community, school, and market gardens.

Keep Growing Detroit focuses substantial efforts to promote connectivity between their member gardens and gardeners. In addition, they foster a local network of gardeners to support the local food system and the Detroit urban agriculture movement. To develop connections, they provide abundant opportunities for gardeners across the city to interact through educational and social events, plant and seed distributions, and workdays at local gardens (Fig. 2). 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 (Beavers et al., 2020).

The centerpiece of Keep Growing Detroit's programming is the Garden Resource Program (GRP), 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 GRP members who attend at least one workshop or gardener event per year. 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. For the years of this study, the costs of membership in the GRP was ten U.S. dollars for family gardens and twenty U.S. dollars for school, market, and community gardens. The value of just the seeds and plants included in GRP membership is estimated at several hundred U.S. dollars annually, thus joining the GRP substantially reduces the cost of planting a garden.

In addition to the GRP, 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. Additionally, Keep Growing Detroit runs the Grown in Detroit program, where member gardeners can sell their produce at

GARDEN RESOURCE PROGRAM, 2015

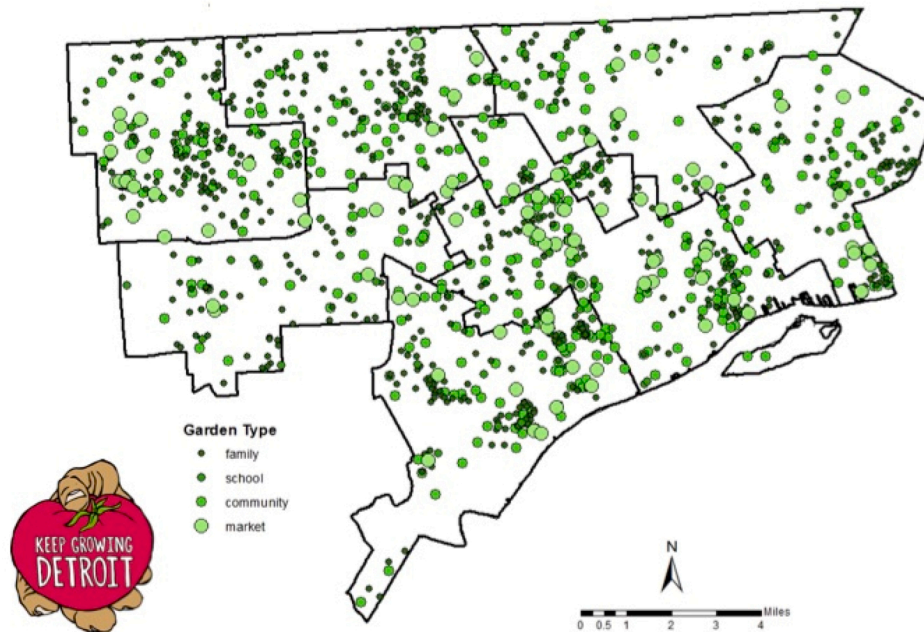


Fig. 1. Map of gardens in the Garden Resource Program in 2015.

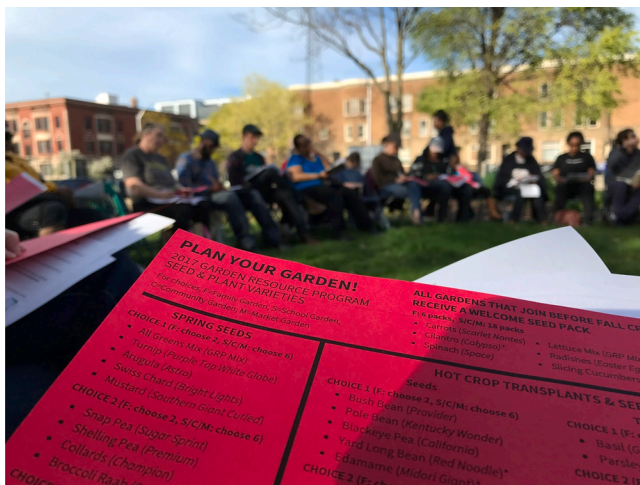


Fig. 2. Participants at a Keep Growing Detroit gardening class.

Detroit farmers markets and restaurants and receive 100% of the proceeds.

2.3. Data sources

Data was obtained from Keep Growing Detroit’s program records for the years 2012–2015. At least one member of each garden must submit an application annually for the garden to become a member of the GRP for the year, which makes the garden eligible to receive resources and services from Keep Growing Detroit. Any garden located in Detroit, Highland Park, or Hamtramck may join the GRP. Gardens that had an application on file for 2012, 2013, and/or 2014 were included in analysis. School gardens were excluded from analysis because many school gardens stopped participating in the GRP during this time due to similar resources being provided by Detroit Public Schools.

Because application to the GRP is by garden, the unit of analysis for both independent and dependent variables was each garden belonging

to the GRP. Garden characteristics, such as garden size and garden type (family, school, community, or market) were obtained from GRP applications. Keep Growing Detroit records were used to assess garden-level participation in Keep Growing Detroit’s programming. Sign-in sheets where gardeners recorded their attendance at Keep Growing Detroit events (classes, volunteer events, comprehensive programs, and citywide events) were used to obtain data on primary gardener event attendance. This allowed us to examine how active participants in each garden were within the Keep Growing Detroit network. The organization’s records from 2004 to 2011 were also used to obtain the number of years each garden had previously held membership in the GRP. Demographic characteristics for the zip codes where gardens were located were obtained from the American Community Survey (United States Census Bureau, 2010). This study was approved by the Michigan State University Institutional Review Board.

2.4. Dependent variable: continued garden membership in the GRP

The outcome variable was continued garden membership in the GRP, measured by whether a garden submitted an application to the GRP in the years 2013–2015. Garden membership (as opposed to gardener membership) was chosen as the outcome because membership in the GRP occurs by garden, not by gardener.

2.5. Independent variables: garden characteristics

Independent variables included garden characteristics and primary gardeners’ involvement (measured per garden) in Keep Growing Detroit’s programming and services the previous year (2012, 2013, or 2014). Self-reported garden characteristics were obtained from GRP membership applications. Garden characteristics included size of garden, number of adults involved in the garden, garden land ownership, and garden type. For garden size, open-ended responses were recoded into five categories. Garden land ownership was a dichotomous response and indicated whether or not the land was owned by the gardener(s) submitting the application. Garden type options were defined by Keep Growing Detroit and included the following: community, family, or

market gardens. As described earlier, school gardens were excluded from analysis.

2.6. Independent variables: Garden-level program involvement

GRP applications requested information on the primary gardener for each garden. While many gardens have more than one individual participating, often not all individuals participating in a garden are listed on the applications. Therefore, program involvement variables were created solely from data on the primary gardener(s). 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 GRP.

Keep Growing Detroit involvement was measured by attendance at Keep Growing events and programs, including educational classes, volunteer events, citywide events, and comprehensive educational programs. 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. Citywide events, events for all GRP participants, were held three times annually, and this variable was categorized into 0, 1, and 2–3 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.

While most program involvement data were recorded by gardener, other items were recorded by garden: seed and plant distributions received, participation in Grown in Detroit, receiving a site visit from Keep Growing Detroit staff, and prior years the garden had been a member of the GRP. The GRP has four seed and plant distributions per year: a March distribution for seeds, an April distribution for cold weather crops such as brassicas, a May distribution for heat-loving plants (tomatoes, peppers, etc.), and a July distribution for fall harvest. The Grown in Detroit program provides gardens that are members of the GRP the opportunity to sell their produce at Detroit farmers' markets and restaurants. Site visits consist of Keep Growing Detroit staff providing guidance on garden design or expansion. This variable indicated if gardens had ever received a site visit, either in the current year or any previous year. Lastly, the number of previous years the garden had participated in the GRP since the program's inception in 2004 was included.

2.7. Control variables: demographic characteristics of garden zip code

To control for geographical demographic characteristics, the U.S. postal zip code where the garden was located (obtained from GRP applications) was matched with zip code-level demographics from the 2010–2014 American Community Survey (United States Census Bureau, 2010). Demographic variables included percent of people in poverty, percent identifying as African American, and percent over 25 years of age having a high school degree or higher.

2.8. Statistical analysis

Statistical analysis used multilevel logistic regression. 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 (Rabe-Hesketh and Skrondal, 2012). Stata 14 was used for all analysis (StataCorp, College Station, TX).

Both bivariate and multivariate multilevel logistic regression models were calculated to determine the associations between each aspect of garden characteristics, garden-level Keep Growing Detroit program involvement, and the likelihood of the garden continuing membership in the GRP. To determine if control variables improved model fit for multivariate regression models, Akaike 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 GRP. Mediation analysis following the Baron and Kenny method (Baron and Kenny, 1986) was conducted to determine if participation in the comprehensive education programs indirectly influenced likelihood of continued garden membership in the GRP through involvement in other aspects of the GRP. An index of GRP involvement was created to serve as a mediator. The 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 citywide events attended, number of plant and seed distributions attended, and garden receiving a site visit).

3. Results

3.1. Descriptive statistics: garden characteristics

Descriptive statistics of garden characteristics are found in Table 1. In total, 2318 unique gardens (i.e. not counting duplicates for gardens that returned) participated in the GRP between 2012 and 2014, with 1189–1335 gardens participating annually. Each year approximately 31% of gardens were community gardens, 62% were family gardens, and 6% were market gardens. Geographical demographic data, zip code level data from the American Community Survey, was as follows: 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) (United States Census Bureau, 2010). While the demographic characteristics of the zip code where gardens are located is similar to that of the city of Detroit, this does not mean that the demographics of participants is similar.

3.2. Descriptive statistics: Keep Growing Detroit program involvement

Descriptive statistics of Keep Growing Detroit program involvement are found in Table 2. By far, the highest program participation was for seed and plant distributions, with an average of 90% of member gardens receiving seeds and/or plants from Keep Growing Detroit each year. Next highest was volunteering, with approximately 30% of primary gardeners volunteering each year. Keep Growing Detroit actively encourages and incentivizes their members to volunteer in various ways, such as seed packing and work days at member gardens. Gardens that have a member volunteer are eligible for additional gardening resources, such as compost or tomato stakes. In addition to benefiting the network, volunteering also provides opportunities for gardeners across the city to engage with each other. Classes, attended by 22% of primary

Table 1
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 2
Keep Growing Detroit program participation of gardens participating in the Garden Resource Program from 2012 to 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						
No	1067	80.5	996	83.8	1113	83.4
Yes	258	19.5	193	16.2	222	16.6
Participated in Grown in Detroit						
No	1272	96.0	1141	96.0	1281	96.0
Yes	53	4.0	48	4.0	54	4.0
Number of seed/plant pickups						
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)						
No	1196	90.3	1062	89.3	1198	89.7
Yes	129	9.7	127	10.7	137	10.3
Participated in Sweet on Detroit (ever)						
No	1256	94.8	1135	95.5	1272	95.3
Yes	69	5.2	54	4.5	63	4.7
Participated in Season Extension (ever)						
No	1265	95.5	1141	96.0	1266	94.8
Yes	60	4.5	48	4.0	69	5.2
Number of volunteer events						
0	923	69.7	875	73.6	1032	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
Number of citywide events						
0	1154	87.1	1015	85.4	1168	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						
0	1027	77.5	954	80.2	1015	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	1.6	1.8	2.0	2.1	2.1	2.3

gardeners, and citywide events, attended by 13% of primary gardeners, are additional ways that gardeners can socialize. The comprehensive programs, which consist of a series of classes, had the lowest participation: 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.

3.3. Bivariate regression

Bivariate regression models assessed the association between garden

characteristics or Keep Growing Detroit program involvement and the likelihood of continued GRP membership (Table 3). Year and zip code demographics were included as controls. Continued GRP membership was measured as the unadjusted percentage of gardens returning to the GRP the following year, and was calculated for each dichotomous or categorical independent variable.

3.4. Association between garden characteristics and likelihood of continued GRP membership

The overall percentage of gardens returning to the GRP the following year was 58.6%, thus just over 41% of gardens did not continue GRP membership the following year. Community and market gardens were significantly more likely to return (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 return compared with gardens up to 100 square feet. Land ownership (OR = 1.28, 95% CI 0.96–1.70, p = 0.091) 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 gardens returning. Additionally, garden zip code demographics were not significantly associated with continued garden membership (p > 0.47 for each variable, data not shown).

3.5. Association between Keep Growing Detroit program involvement and likelihood of continued GRP membership

Aside from receiving seeds/plants once (compared with zero times), each aspect of participation in Keep Growing Detroit’s programming was significantly associated with an increased likelihood of continued garden membership in the GRP (p ranging from <0.001 to <0.02). For all participation variables on an ordinal scale (seed and plant pickups, citywide events, and volunteering), the percent of gardens returning to the GRP the following year increased alongside increased participation. Additionally, previous years of participation in the GRP was significantly associated with an increased likelihood of continued garden membership in the GRP (OR = 1.47, 95% CI 1.40–1.56, p < 0.001). Attending comprehensive programs (Urban Roots, Season Extension, and Sweet on Detroit), participation in Grown in Detroit, and receiving a site visit were all significantly associated with continued garden membership compared to the reference groups of not participating in that specific program. This indicates that participation in any aspect of Keep Growing Detroit’s programming was associated with increased likelihood of continued garden membership in the GRP.

3.6. Multivariate regression

Multivariate regression models were used to examine the association between involvement in each part of Keep Growing Detroit’s programming and likelihood of continued garden participation in the GRP. To determine if garden characteristics and garden zip-code demographics improved multivariate model fit, AIC and BIC were compared between regression models. In the best-fitting model, number of people and garden size were included, but garden zip code demographic variables were not included (model 1, Table 4). Due to the high p-values for the comprehensive education programs, an additional model was performed (model 2, Table 4). Model 2 had the lowest AIC and BIC, indicating that removing comprehensive education program variables improved model fit.

In model 2, there was an increased odds of continued garden membership in the GRP when garden land was owned by gardener(s) compared with gardens where land was not owned by gardeners, (OR = 1.34, 95% CI 1.07–1.66, p = 0.010). Odds of returning also increased when more seeds and plants were picked up, and with additional

Table 3

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.

	Continued GRP Membership (%)	Odds Ratio	Std. Err	95% Conf. Interval	P-value
Garden type					
Family	54.8	Ref.			
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					
0	34.8	Ref.			
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)					
No	55.4	Ref.			
Yes	73.7	3.86	0.78	(2.60, 5.73)	<0.001
Sold with Grown in Detroit					
No	57.7	Ref.			
Yes	80.0	5.25	1.96	(2.52, 10.92)	<0.001
Urban Roots (ever)					
No	57.1	Ref.			
Yes	72.8	2.81	0.67	(1.76, 4.49)	<0.001
Sweet on Detroit (ever)					
No	58.0	Ref.			
Yes	71.0	2.26	0.78	(1.15, 4.43)	0.018
Season Extension (ever)					
No	57.7	Ref.			
Yes	78.0	4.64	1.70	(2.26, 9.52)	<0.001
Number of classes attended					
0	54.2	Ref.			
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
Number of citywide events attended					
0	56.2	Ref.			
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					
0	53.5	Ref.			
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		<0.001

(continued on next page)

Table 3 (continued)

	Continued GRP Membership (%)	Odds Ratio	Std. Err	95% Conf. Interval	P-value
				(3.66, 10.97)	
Land owned by gardener(s)					
No	56.2	Ref.			
Yes	60.9	1.28	0.18	(0.96, 1.70)	0.091
Size of garden					
100 sq ft or less	56.5	Ref.			
>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	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.

previous years in the GRP (model 2 Table 4). The odds of gardens returning were higher when primary gardeners volunteered one or two times, and attended one or more classes (model 2, Table 4). Notable differences between the bivariate analyses (Table 3) and the multivariate analyses (Table 4) are that number of adults participating in the garden, garden size, receiving a site visit, participating in the Grown in Detroit program, and citywide event attendance were not significantly associated with continued garden participation in the GRP in the multivariate models, but were significant in the bivariate models. Additionally, garden land ownership was not significant in the bivariate model but was significant in multivariate models.

3.7. Mediation analysis

Comprehensive education programs were highly non-significant in multivariate regression models (Table 4), with p-values ranging from 0.455–0.907. 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 GRP the following year.

Mediation models are found in Figs. 3–5. Garden type, year, and garden zip code demographics 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 ($p = 0.671$ for Season Extension and 0.970 for Urban Roots). Sweet on Detroit had a near significant relationship with the outcome variable ($p = 0.057$), 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 ($p = 0.551$). This indicates that these programs indirectly increased the likelihood of continued garden membership in the GRP through participation in other aspects of the GRP.

4. Discussion

This study examined the relationships between garden characteristics and involvement in Keep Growing Detroit's programming with continued garden membership in the GRP. These findings expand upon the previous research on gardener support programs (Porter, 2018; Gray et al., 2014; Drake and Lawson, 2015). This study is relevant to the hundreds of gardener support organizations that provide assistance to gardens worldwide (Drake and Lawson, 2015; Kingsley et al., 2019; Fox-Kämper et al., 2018; Social Farms and Gardens, 2021). 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 GRP 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 GRP remained significantly associated with continued garden membership in the GRP. Mediation analysis revealed that the comprehensive education programs Urban Roots, a community garden leadership program, and the Season Extension program were indirectly related to continued garden membership in the GRP through participation in other aspects of Keep Growing Detroit's programs (attending classes, volunteer events, and citywide events, number of plant and seed distributions received, and the garden receiving a site visit).

Garden characteristics that were associated with an increased likelihood of continued garden membership in the GRP in the multivariate regression analyses included gardeners owning the land where their garden was located. The challenge of obtaining and sustaining land for urban gardens is the most documented threat to urban garden longevity in the research literature. (Ghose and Pettygrove, 2014; Diaz et al., 2018; Drake and Lawson, 2015; Schmelzkopf, 1995; Egerer and Fairbairn, 2018; Smith and Kurtz, 2003) Urban gardens are frequently located on vacant or abandoned lots or are granted short-term leases on city-owned land (Drake and Lawson, 2015; Fox-Kämper et al., 2018). When leases are not renewed or vacant land undergoes development, garden permanency is threatened (Ghose and Pettygrove, 2014; Drake and Lawson, 2015; Egerer and Fairbairn, 2018). Each year, only between 28% and 37% of the gardens who were members of the GRP were on land owned by gardeners.

Receiving seeds and plants was the most used service by gardeners, with 85–93% 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 GRP in all regression models ($p < 0.001$), and the odds of continued membership in the GRP increased with each additional plant and seed distribution attended. 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 (Ghose and Pettygrove, 2014; Schupp et al., 2016; Wakefield et al., 2007; Drake and Lawson, 2015). Produce-weighting 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, respectively (Algert et al., 2016, 2014). However, in the study of home gardeners, most gardening inputs (seeds, plants, raised beds, and soil) were provided to participants free of charge (Algert et al., 2016). In the study of community gardeners, costs for gardening inputs were recalled from memory and therefore may have been underestimated (Algert et al., 2014). A larger study involving 50 home or community gardeners found that after subtracting the cost of garden inputs reported

Table 4

Multivariate logistic regression examining association between garden characteristics and primary gardener involvement in aspects of Keep Growing Detroit’s programming, and continued garden participation in the Garden Resource Program. n = 1660 gardens.

	Model 1				Model 2			
	OR	Std. Err.	95% Conf. Inter.	P-value	OR	Std. Err.	95% Conf. Inter.	P-value
Year								
2012	Ref.							
2013	1.53	0.19	(1.20, 1.95)	0.001	1.54	0.19	(1.20, 1.96)	0.001
2014	1.45	0.19	(1.12, 1.86)	0.004	1.44	0.19	(1.12, 1.86)	0.005
Garden type								
Family	Ref.							
Community	1.22	0.16	(0.94, 1.59)	0.137	1.22	0.16	(0.94, 1.58)	0.144
Market	0.90	0.21	(0.57, 1.42)	0.655	0.89	0.21	(0.57, 1.40)	0.613
Owns land								
No	Ref.							
Yes	1.33	0.15	(1.07, 1.66)	0.011	1.34	0.15	(1.07, 1.66)	0.010
Size of garden								
≤100 sq ft	Ref.							
>100 sq ft & ≤400 sq ft	0.90	0.13	(0.68, 1.20)	0.479	0.91	0.13	(0.68, 1.20)	0.490
>400 sq ft & <1 city lot	0.96	0.14	(0.71, 1.28)	0.757	0.95	0.14	(0.71, 1.27)	0.738
≥1 city lot & <2 city lots	0.92	0.17	(0.65, 1.31)	0.661	0.92	0.17	(0.65, 1.31)	0.636
≥2 city lots	1.01	0.19	(0.69, 1.47)	0.965	0.99	0.19	(0.68, 1.45)	0.975
Number of adults	1.01	0.01	(1.00, 1.02)	0.198	1.01	0.01	(1.00, 1.02)	0.194
Ever received site visit								
No	Ref.							
Yes	1.23	0.18	(0.92, 1.65)	0.167	1.23	0.18	(0.91, 1.65)	0.172
Participated in Grown in Detroit								
No	Ref.							
Yes	1.76	0.53	(0.97, 3.18)	0.063	1.71	0.52	(0.95, 3.09)	0.074
Number of seed/plant pickups	1.48	0.07	(1.36, 1.61)	<0.001	1.48	0.07	(1.36, 1.61)	<0.001
Urban Roots (ever)								
No	Ref.				-	-	-	-
Yes	0.94	0.18	(0.64, 1.37)	0.740	-	-	-	-
Sweet on Detroit (ever)								
No	Ref.				-	-	-	-
Yes	0.97	0.26	(0.57, 1.64)	0.907	-	-	-	-
Season Extension (ever)								
No	Ref.				-	-	-	-
Yes	0.80	0.24	(0.45, 1.43)	0.455	-	-	-	-
Number of volunteer events								
0	Ref.							
1	1.59	0.23	(1.19, 2.12)	0.002	1.58	0.23	(1.19, 2.11)	0.002
2	1.68	0.40	(1.05, 2.67)	0.030	1.66	0.39	(1.04, 2.64)	0.034
3+	1.68	0.45	(1.00, 2.84)	0.052	1.65	0.44	(0.98, 2.78)	0.061
Number of citywide events								
0	Ref.							
1	1.01	0.19	(0.70, 1.46)	0.961	0.99	0.19	(0.69, 1.44)	0.973
2–3	1.52	0.51	(0.78, 2.94)	0.217	1.45	0.48	(0.76, 2.79)	0.262
Number of classes attended								
0	Ref.							
1	1.41	0.23	(1.03, 1.93)	0.032	1.41	0.23	(1.03, 1.93)	0.032
2	2.25	0.57	(1.36, 3.69)	0.001	2.19	0.55	(1.34, 3.60)	0.002
3+	1.77	0.48	(1.04, 3.01)	0.037	1.72	0.46	(1.02, 2.90)	0.043
Prior years in program	1.35	0.04	(1.28, 1.43)	<0.001	1.35	0.04	(1.27, 1.43)	<0.001

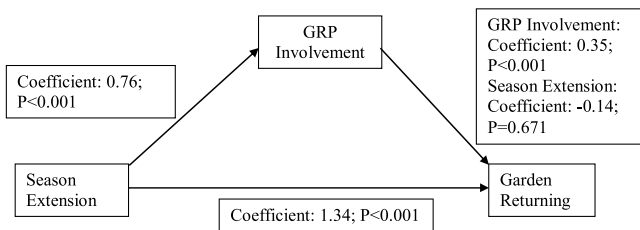


Fig. 3. Mediation analysis of Season Extension and summed index variable of Garden Resource Program (GRP) involvement on gardens returning.

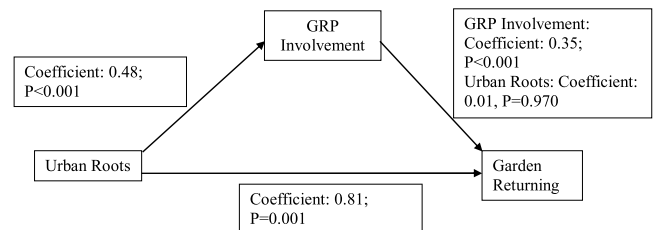


Fig. 4. Mediation analysis of Urban Roots and summed index variable of Garden Resource Program (GRP) involvement on gardens returning.

in a diary throughout the growing season, growing produce cost an average of 39% more than purchasing from grocery stores (CoDyre et al., 2015). 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 (Schupp et al., 2016; Wakefield et al., 2007). Providing gardening resources may be an important strategy that gardener support programs can use to support gardens, particularly in cities with a high proportion of low-income residents such as Detroit.

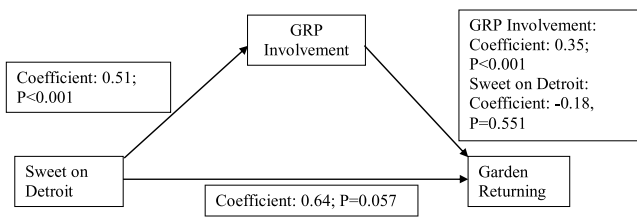


Fig. 5. Mediation analysis of Sweet on Detroit and summed index variable of Garden Resource Program (GRP) involvement on gardens returning.

Attending classes and volunteering were associated with continued garden membership in the GRP. The percentage of primary gardeners attending at least one class in a year ranged from 20 to 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 GRP is “just seeds and plants,” and that participants may not be aware of the organization’s other offerings that allow for deeper engagement between gardens such as gardening classes and volunteering. These two variables significantly predicted the likelihood of continued garden membership in the GRP, which indicates that more active participation may retain gardens within the network. Through attending classes, gardeners may improve their gardening skills and knowledge and engage with other gardeners, which may in turn contribute to garden success. Gardening inherently requires skills and knowledge throughout the gardening process, including garden design, land preparation, watering, and pest control. Lack of gardening knowledge and skills have been reported as barriers to gardening in some studies (Conway, 2016; Diaz et al., 2018; Hale et al., 2011), and is believed to contribute to garden loss due by causing frustration and dropout (Diaz et al., 2018). As sharing of knowledge within a garden has been found in numerous research studies (‘Yotti’ Kingsley and Townsend, 2006; Teig et al., 2009; Wakefield et al., 2007; Hale et al., 2011; Milligan et al., 2004), the knowledge gained by primary gardeners may impact the success of the entire garden. Gardening knowledge is also shared between gardens belonging to a gardener support program (Gray et al., 2014), which may further enhance garden success.

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 citywide events, which may in part explain why attendance at these events was not significantly associated with continued garden membership. Volunteering was significantly associated with continued garden membership. Informal knowledge sharing and social ties are formed by attending Keep Growing Detroit events, including volunteering events. Therefore, primary gardeners who volunteer may benefit their gardens by gaining additional gardening knowledge, as well as creating social ties with members of other gardens. Previous years in the GRP may influence the likelihood of continued garden membership in the GRP for two reasons. First, as gardens that have been in the GRP for many years are inherently older, this may indicate that new gardens are especially vulnerable in their first few years. Second, there may also be a cumulative influence of receiving support from Keep Growing Detroit for several years. Throughout multiple years in the program, gardeners may 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

Community gardens were more likely to continue membership in the GRP 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 GRP. While previous

research has demonstrated the importance of maintaining gardener participation to sustain gardens (Diaz et al., 2018; Drake and Lawson, 2015), it may be that the quality of participation is more important than the number of gardeners participating. As garden size was not significant, this may indicate that gardens of all scales benefit from gardener support programs.

This study has implications for the role of participation in gardener support programs in enhancing garden longevity. Gardens that remained in the GRP were likely still under cultivation, while gardens that left the GRP may have been no longer under cultivation. However, we did not objectively confirm this by visiting garden sites or following up with garden members. Previous research has demonstrated a high rate of garden loss: in a survey of 445 U.S. and Canadian community gardening organizations, these organizations reported a loss of 1615 community gardens from 2007 to 2012 (Drake and Lawson, 2015). This same survey found that lack of gardener participation was one of the greatest contributors to garden loss (Drake and Lawson, 2015). Attracting new gardeners, sustaining gardeners’ interest, and lack of participation have been identified as challenges in other studies (Ghose and Pettygrove, 2014).

4.1. Limitations

There were several limitations to the data used in this analysis. Since Keep Growing Detroit does not collect demographic information from their gardeners, we relied on U.S. postal zip-code level demographic data. However, this data may not match the demographics of the actual gardeners. While zip code level education, poverty, and race where the garden was located were not significant predictors of remaining in the GRP, demographic characteristics of gardeners such as age, gender, income, and education may be associated with continued GRP membership. In addition, we only included class and event attendance data from the primary gardeners since all individuals participating in a garden may not be listed on GRP applications. Therefore our analysis does not take into account the influence of attendance by the non-primary gardeners.

While several significant associations between Keep Growing Detroit program participation and continued garden membership in the GRP 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 GRP may be more motivated and interested in belonging to a gardener support program, and this increased motivation may be a causal factor for sustained participation.

5. Conclusions

Since more active participation in the GRP was associated with continued garden membership, gardener support programs may increase retention of gardens within their networks by encouraging active participation in specific types of their programming. 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 the role of gardener support programs in promoting successful gardens. Additionally, it is important to examine the role social networks between gardens play in sustaining gardens, and how gardener support organizations can contribute to building these networks. This study provides supporting evidence that active participation in a gardener support program may sustain gardens, potentially supporting the continuation of gardening’s individual and community benefits.

CRedit authorship contribution statement

Alyssa W. Beavers: Data curation, Formal analysis, Writing - original draft, Writing - review & editing. Ashley Atkinson:

Conceptualization, Writing - review & editing. **Wenjuan Ma:** Formal analysis, Writing - review & editing. **Katherine Alaimo:** Conceptualization, Funding acquisition, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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