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RESEARCH ARTICLE

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Who practices urban agriculture? An empirical analysis of participation before and during the COVID-19 pandemic

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Abstract

Coronavirus disease-2019 (COVID-19) disrupted the food system motivating discussions about moving from a dependence on long food supply channels toward shorter local supply channels, including urban agriculture. This study examines two central questions regarding the adoption of urban agriculture practices at the household level during the COVID-19 pandemic: whether the outbreak of the novel coronavirus elicited participation in urban agriculture (e.g., community growing and home growing) and what are the characteristics of individuals who participate. To answer these questions, we conducted two online surveys in Phoenix, AZ, and Detroit, MI. The first round occurred during 2017 and the second during the lock-down in 2020. Using bivariate probit models, we find that (1) considerably fewer individuals participate in urban agriculture at community gardens compared to at-home gardening; (2) participation overall is lower in 2020 compared to 2017; and (3) respondents in Detroit practice urban agriculture more than respondents in Phoenix. Across both cities, our results suggest that the continuity of individuals' participation in growing food at community gardens and home is fragile. Not all characteristics that determined who participated in community gardens before COVID-19 are determining the likelihood to participate during the pandemic. In addition, growing food at home

before COVID-19 was practiced by larger households and employed respondents, yet, during the pandemic, we find that home-growing was more likely when children were in the household and households were smaller and younger (Detroit), and younger and more educated (Phoenix). These findings suggest that many urban households' food-growing practices may not yet be mainstream and that other barriers may exist that inhibit households' participation.

KEYWORDS
community garden, COVID-19, food supply chain, outbreak, pandemic, urban farming

JEL CLASSIFICATION
D12; C83; J10

1 | INTRODUCTION

The 2019 novel coronavirus (COVID-19) has disrupted many industries and behaviors across the globe. Among others, "economic activity, employment, food consumption, and workplace environments" have seen significant shifts (Coble, 2020, p. 3). Notably, the onset of shelter-in-place orders resulted in many individuals spending more time at home, which altered the way that households spent time on domestic activities. Not only did individuals increase their home cooking (Lusk & McCluskey, 2020; Thilmany McFadden & Malone, 2020), with 51% of consumers preparing 91%–100% of their meals at home (IRI, 2020), but anecdotes indicate that spending more time at home inspired households to start growing food (Walljasper & Polansek, 2020). In this article, we examine participation in small-scale urban agriculture, which considers urban agriculture related to household food production such as participation in home growing and growing at community gardens (McDougall et al., 2019), during the 2020 lockdown and compare these behaviors to a sample of households in the same geographic areas before the pandemic.

The motivations for home growing during the pandemic may be attributed to several factors. Recently, it was reported that households did so to counter food shortages, minimize the frequency of shopping trips, or avoid going to the store altogether, even if gardening at home only proved to be "supplementary" (Russell, 2020; Thilmany McFadden & Malone, 2020; Timmins, 2020; Walljasper & Polansek, 2020). Additional evidence also suggests that seeds experienced unusually high demand, with orders for some companies being six to ten times higher than normal (Timmins, 2020). In addition, the spike in food prices may have served as a further incentive to start home growing. The grocery store consumer price index saw an increase of 2.7% from March to April 2020—a 4.1% increase from April 2019 (Lusk & McCluskey, 2020). Gardening was also adopted as an activity for children, as well as, filling free time due to loss of work, canceled events, and closed businesses (Walljasper & Polansek, 2020).

From an empirical standpoint, questions remain regarding whether the shelter-in-place orders, and the surrounding uncertainty of COVID-19, motivated consumers to grow food themselves and what the characteristics are of those individuals who adopted gardening practices. This study aims to contribute to the literature by investigating participation in small-scale agriculture before and during COVID-19, with a quantitative comparative

analysis of households engaged in food growing at home and at community gardens before and during the lockdown. While seed sales are not a valid indicator of a surge in home growing, this trend underscores an issue with potential economic implications. On the supply side, concerns within the agribusiness sector suggest that home food growing could lower demand for fresh fruits and vegetables produced by large-scale growers (Walljasper & Polansek, 2020). On the demand side, if households allocate time to gardening activities, they may do so at the expense of other activities, albeit with possible positive externalities, such as an added source of healthy food consumption and increased food security (Warren et al., 2015; Zezza & Tasciotti, 2010). In this sense, participation in home growing or community gardens may elicit deeper insights into the role of small-scale urban agriculture and its position within the local food system.

Against this background, we use data collected in March/April 2017 and May 2020 for two major US metropolitan areas to compare participation in small-scale urban agriculture before and during the pandemic. We focus on urban agriculture—the growing and processing of food in or around metropolitan areas—because people living in urban areas in the United States amount to more than 80% of the population (World Bank, 2016). The expansion of urban areas places a heavy toll on local resources, such as (affordable) food retail options, to meet the needs of households within cities, which was highlighted by COVID-19. As mentioned above, urban agriculture has found new popularity, and could even be seen as a "catch-all" given that it provides access to local and fresh food (Thilmany McFadden & Malone, 2020), and enables those who grow their own food to be less dependent on traditional food outlets (Walljasper & Polansek, 2020). This study is most similar to Bellemare and Dusoruth (2020) who found that high-income households in Montreal were more likely to participate in urban agriculture during the pandemic, yet, to the best of our knowledge, no study has examined the characteristics of urban households who engaged in home growing both before and during the lockdown, which we seek to address.

The remainder of the paper is organized as follows. Section 2 provides a brief literature review of urban agriculture. Section 3 describes the design of the study. Section 4 presents the empirical results, and Section 5 concludes the paper.

2 | BACKGROUND

With urbanization on the rise, urban agriculture has received more attention in recent years (e.g., Bellemare & Dusoruth, 2020; Dimitri et al., 2016; Grebitus et al., 2020, 2017; McDougall et al., 2019; Printezis & Grebitus, 2018; Warren et al., 2015). Urban agriculture "is a dynamic concept that comprises a variety of livelihood systems ranging from subsistence production and processing at the household level to more commercialized agriculture. It takes place in different locations and under varying socioeconomic conditions and political regimes" (FAO, 2007, p. V). Urban agriculture is a growing sector within the farming industry that aims to increase overall food production in urban and periurban areas through the conversion of available land into agricultural farms. Local and small-scale food production has been integrated into urban areas across US cities, whether as commercial urban farms or community gardens, as well as growing food at ones' home (Hughes & Boys, 2015; Printezis & Grebitus, 2018). According to the USDA (2020), urban agriculture "takes the form of backyard, roof-top and balcony gardening, community gardening in vacant lots and parks, roadside urban fringe agriculture and livestock grazing in open space." Urban food production often focuses on specialty crops that include most fruits, vegetables, and tree nuts. Compared to traditional agriculture and commodities, these foods are rich in nutrients, vitamins, and minerals, which are considered part of an optimal diet (WHO, 2018).

A number of studies have looked at the benefits of small-scale urban agriculture as it relates to food production, dietary patterns, and food security. Research finds that growing food enhances knowledge of food utilization, for example, cooking and preserving vegetables (Libman, 2007). Furthermore, there is a positive association between those who have grown food and produce consumption (Libman, 2007; Van Lier et al., 2017). These findings are supported by another study, which finds that indicators of health and well-being not only improved,

but home gardening provides increased access to affordable and nutritious produce and improves food security for the community (Kortright & Wakefield, 2011). Furthermore, from an environmental standpoint, the more individuals participate in urban agriculture, the greater the impact on air quality, reduction in food miles, and mitigation effects of urban heat islands (Grebitus et al., 2020).

Aside from the benefits associated with participating in small-scale urban agriculture, participation requires the availability of tangible and intangible resources, such as land, equipment, seeds, and an elementary knowledge of gardening practices. These inputs are directly correlated with garden yields, either at the community- or household-level. One study, conducted in Chicago, IL, compares the role of community and home gardens in terms of food production, and the authors find that only a small percentage of sites are community gardens producing food (Taylor & Taylor Lovell, 2012). Rather, home gardens make up the majority of urban food production areas. Given the additional constraints imposed by the shelter-in-place orders, home gardening may have been more attractive to individuals interested in participating in home food production.

Except for Bellemare and Dusoruth (2020), little empirical research has examined participation in small-scale urban agriculture during the pandemic. In their study, Bellemare and Dusoruth (2020) elicit participation among households in Montreal, and find that respondents who are lower-income and male are less likely to participate in urban agriculture, while middle-aged respondents, home-ownership, and larger household size increases the likelihood of participation. Unlike their study, which also considers herb growing, we focus solely on household food growing of fruits and vegetables, as we assume that herbs do not add substantially to food consumption. Similarly, home gardening often considers flowers, which we exclude from our investigation for the same reasons as herbs. We aim to extend the existing research by utilizing data on urban agriculture from two major US cities three years before the pandemic and during the novel coronavirus pandemic to investigate whether the conditions surrounding COVID-19 led more or fewer households to practice urban agriculture than before. Developing a deeper understanding of households participating in small-scale urban agriculture may provide key insights useful for food retailers and food manufacturers who must quickly adapt to a constantly changing environment as well as policymakers, for example, with regard to community planning.

3 | DESIGN OF THE STUDY

3.1 | Data

To investigate participation in urban agriculture and the extent to which the outbreak of COVID-19 changed participation, we pose the following research questions (RQ):

RQ1: Who participated in urban agriculture *before* COVID-19?

RQ2: Who participated in urban agriculture *during* COVID-19?

To answer these questions, we use data from two online surveys conducted in March and April 2017 (between March 30, 2017 and April 10, 2017) and May 2020 (between May 13, 2020 and May 30, 2020). The survey carried out during COVID-19 took place in May after most of the early constraints receded, conversations about re-opening the economy took place, and a stimulus had been sent to many individuals. While we do not know whether households that practice urban farming during COVID-19 will continue doing so after the pandemic, we believe it is worth comparing behavior before and during this event to get an indicator of possible future behavior.

We select Detroit, MI, and Phoenix, AZ as the study sites for our comparative analysis. Both Detroit and Phoenix metropolitan areas are among the 15-largest core-based statistical areas in the United States, with Maricopa County, AZ, as the fastest-growing county in the United States (US Census Bureau, 2019). Population

density demonstrates an important need for sustainable urban farming practices, given the benefits of food security, economic stability, and sustainability. Beyond population density, Detroit, MI was chosen due to rapid economic development and opportunities for small-scale urban agriculture (Carmodym, 2018). As of 2019, Keep Growing Detroit (2019) reported nearly 1,600 urban gardens and farms in the Detroit metro area. Additionally, Detroit is a city characterized by a history of food access issues where a high proportion of households live without access to a supermarket or large grocery store (e.g., Budzynska et al., 2013; Taylor & Ard, 2015). Hence, there is an opportunity to alleviate some of the burdens from poor food access when consumers grow food themselves. We chose Phoenix, AZ as the second location because Phoenix provides a context that has a similar diversity of residents, as well as barriers to accessing healthy, affordable foods. In addition, unique climatic conditions characterize Phoenix. Namely, Phoenix has a climate where food can be grown all year round. Moreover, extreme weather conditions are common, which include short- and long-term drought and seasonal monsoons that can bring rapid flooding. Finally, Phoenix has begun to recognize urban agriculture as an attractive fixture in revitalizing communities, especially since urban expansion has replaced nearby agriculture at a large rate (Shrestha et al., 2012), and, unlike Detroit, vacant land that can potentially be used for urban farming is more readily available in Phoenix (Aragon et al., 2019).

The surveys were programmed by the researchers in the platform Qualtrics. Data in 2017 were collected by the consumer panel company Qualtrics, and in 2020 by the company Dynata. Participants were recruited in urban and suburban areas. The studies were approved by the ethics board (IRB) of Arizona State University.

3.2 | Summary statistics

In 2017, a total of 840 respondents completed the survey, with $n = 420$ (50%) participants from Phoenix, AZ, and $n = 420$ (50%) from Detroit, MI. In 2020, survey participation was slightly lower for Phoenix with $n = 412$ participants, compared with $n = 449$ from Detroit, MI. Of the pooled sample ($n = 1{,}701$), 28 observations were dropped due to missing demographic data, resulting in a final sample of 1,673 responses. In addition, because of the differences in sampling populations between 2017 and 2020, we applied weights to the 2020 sample to match the distribution of demographic characteristics from the 2020 data to the 2017 data. The demographic characteristics considered were gender, age, educational attainment, presence of children in the household, race, and income in the respective locations. Weights were constructed using an iterative proportional fitting technique (Chenarides et al. (2020.); Izrael et al., 2000). Thus, when weights are applied to the data, the difference in means of these demographic variables from the 2017 and 2020 samples in both locations are not statistically significant, with the exception of "Employed, Part-Time," "Unemployed, not looking for work," "Disabled," and "Asian" (see Table 1). In this sense, we can make comparisons between years within each study site. In regard to the generalizability to the US population, Dynata applied a quota according to age and gender, therefore sampling populations are consistent with the national US Census estimates.

The 2017 sample consists of 50% male and 50% female respondents. The average age of participants is 45 years. The education level of the sample varies: less than a high school degree (2%), high school diploma (20%), some college experience (29%), 2-year degree (11%), 4-year degree (26%), a professional degree (10%), and doctorate (2%). Approximately 51% of the participants have an income lower than $50,000 annually before taxes. Some 25% of respondents have children in the household, with an average household size of 2.7 persons. Regarding employment, 42% of the participants are employed full time and 14% are employed part-time, while 20% are retired, 6% are students, and 7% are disabled. About 8% of the participants are unemployed looking for work, 6% are unemployed not looking for work.

The 2020 sample consists of 53% female, 46% male, and 1% nonbinary gender respondents. The average age of participants is 53 years. The education level of the sample ranges from high school diploma (13%), some college experience (23%), 2-year degree (11%), 4-year degree (32%), to a professional degree (18%), and doctorate (2%),

TABLE 1 Sample characteristics

	2017		Without weights 2020		With weights 2020	
	Detroit	Phoenix	Detroit	Phoenix	Detroit	Phoenix
Demographics						
Female	50.0	50.1	56.6*	49.5	50.0	49.4
Households with children	25.1	25.4	16.9***	21.4	23.4	28.1
Age (#)	45.2	45.3	52.5***	54.0***	45.1	45.6
Household size (#)	2.7	2.8	2.5**	2.4***	2.7	2.6
Education						
Less than high school	2.2	1.7	1.8***	1.2***	1.8	1.2
High school graduate	22.9	16.7	13.9	12.8	13.9	12.8
Some college	27.3	30.5	20.9	24.6	20.9	24.6
2-Year degree	9.8	12.8	10.1	11.1	10.1	11.1
4-Year degree	26.1	24.9	30.8	33.5	30.8	33.5
Professional degree	9.3	11.4	20.0	14.8	20.0	14.8
Doctorate	2.4	1.9	2.5	2.0	2.5	2.0
Income						
Less than $10,000	8.0	5.6	4.3***	4.7***	4.3	4.7
$10,000–$19,999	9.5	8.2	5.8	5.2	5.8	5.2
$20,000–$29,999	12.2	13.6	6.7	5.9	6.7	5.9
$30,000–$39,999	10.5	12.8	8.1	6.9	8.1	6.9
$40,000–$49,999	9.5	10.7	9.2	8.4	9.2	8.4
$50,000–$59,999	12.2	12.6	10.1	9.6	10.1	9.6

(Continues)

TABLE 1 (Continued)

	2017		Without weights 2020		With weights 2020	
	Detroit	Phoenix	Detroit	Phoenix	Detroit	Phoenix
$60,000–$69,999	6.1	6.1	7.6	7.1	7.6	7.1
$70,000–$79,999	10.7	9.0	8.8	9.4	8.8	9.4
$80,000–$89,999	3.7	4.1	5.6	6.9	5.6	6.9
$90,000–$99,999	4.1	5.1	5.4	6.9	5.4	6.9
$100,000–$149,999	9.8	9.0	16.4	17.0	16.4	17.0
More than $150,000	3.7	3.4	11.9	12.1	11.9	12.1
Employment						
Employed full time	41.0	42.9	38.0	40.4	41.3	41.9
Employed part time	15.1	13.3	8.8***	6.9***	11.0	8.1**
Unemployed looking for work	6.3	9.2	2.9**	4.9**	4.7	8.0
Unemployed not looking for work	6.1	6.1	2.0***	4.9	2.9*	5.9
Retired	19.3	21.1	29.9***	32.5***	17.2	18.9
Student	6.1	5.8	4.5	2.7**	6.2	5.3
Disabled	8.8	4.6	3.8***	4.4	4.4**	5.9
Lost job due to COVID-19	N/A	N/A	3.4	1.2	5.7	1.9
Furloughed due to COVID-19	N/A	N/A	6.7	3.0	6.4	2.9
Race						
White	75.4	85.2	77.5	87.2	74.0	83.0
Black or African American	17.6	4.4	18.7	3.9	19.0	4.9
American Indian or Alaska Native	1.0	1.9	1.6	1.2	1.7	2.1

TABLE 1 (Continued)

			Without weights		With weights	
	2017		2020		2020	
	Detroit	Phoenix	Detroit	Phoenix	Detroit	Phoenix
Asian	4.4	2.9	1.8**	1.2*	2.1*	0.7**
Native Hawaiian or Pacific Islander	0.0	0.5	0.4	0.0	1.1	0.0
N	409	413	445	406	445	406

Note: All values are in percentages unless otherwise noted; *, **, *** indicate that the difference in means between years within each location is statistically different from zero at the 90%, 95%, and 99% confidence levels, respectively. Iterative proportional fitting was used to construct weights for the 2020 responses to match the distribution of the 2017 sample.

2% have less than a high school degree. Approximately 50% of the participants have an income lower than $70,000 annually before taxes. Some 19% of respondents have children in the household, with an average household size of 2.5 persons. Regarding employment, 39% of the participants are employed full time and 8% are employed part-time, while 31% are retired, 4% are students, and 4% are disabled. About 4% of the participants are unemployed looking for work, 4% are unemployed not looking for work, and 7% either lost or furloughed their job due to COVID-19. Several participants indicated multiple statuses, such as being employed and a student.

Table 1 shows socio-demographics by location for both years. It is noticeable that the 2020 sample is, on average, older than the 2017 sample. Also, the income and education levels are higher but employment is lower. In addition, there are more retired participants in 2020, which likely correlates with the age difference. We include these (weighted) socio-demographics in the analysis as independent variables to test their associations with urban agriculture participation.

4 | EMPIRICAL RESULTS

4.1 | Urban agriculture participation before and during COVID-19

To analyze participation in urban agriculture, we asked respondents whether they grow food at home or at community gardens. While the survey responses ranged from never (0) to always (4), we recoded the answers into a dummy variable where zero equals never and one equals at least sometimes. This allows us to account for individuals who might be very involved in food production, but also to account for the "hobby gardener" who might only grow food sometimes. Also, not everyone might grow food all year round, whether that is for weather reasons or other circumstances. Phrasing the answer categories sufficiently open allows us to capture those involved in small-scale food production.

Results in Table 2 show several differences. First, considerably fewer individuals participate in urban agriculture at community gardens compared to at-home gardening. Furthermore, respondents in Detroit participate more than those in Phoenix. In 2017, 35% of Detroit participants grew produce at community gardens, while 67% did so at home. In Phoenix, only 23% grew produce at community gardens and 57% grew produce at home.

All shares are higher in 2017 than in 2020 during COVID-19. In the 2020 survey, 23% of respondents from Detroit report growing produce at community gardens, and 63% at home. Again, numbers for Phoenix are lower, with 21% reporting that they grow produce at community gardens and 51% stating that they grow produce at home.

These descriptive statistics do not point toward a spike in urban agriculture participation due to the pandemic. Rather than seeing an uptick in participation, we note lower numbers, especially for community gardens. This observation, however, could be due to the social distancing and shelter-in-place guidelines during that time. Nevertheless, this does not explain the lower numbers for growing produce at home.

4.2 | Analysis of practitioners of urban agriculture before and during COVID-19

To investigate the determinants of small-scale urban agriculture participation before and during COVID-19, we use four bivariate probit models. The questions regarding growing produce at home and community gardens serve as dependent variables. We estimate one model each for Phoenix and Detroit in 2017 and 2020. We use bivariate probit models to test whether the production of produce at home or the community garden is related to each other. This is tested using the Wald test of Rho. A significant and positive Rho would suggest that those who grow at home are also more likely to grow at the community garden, whereas a significant and negative Rho would indicate otherwise. If Rho is not significant, individual probit models are more appropriate. Our results for Rho show a significant and positive Wald test of Rho for all four models indicating that the bivariate probit models are appropriate.

TABLE 2 Participation in urban agriculture before and during COVID-19

	Detroit		Phoenix	
	2017	2020	2017	2020
Grow at community garden	35%	23%***	23%	21%
Grow at home	67%	63%	57%	51%**

Note: *, **, *** indicate that the difference in means between years within each location is statistically different from zero at the 90%, 95%, and 99% confidence levels, respectively.

To begin, we compare Detroit and Phoenix to each other, with regard to participating in community gardening (see Table 3). In Detroit in 2017, characteristics including male, younger, having a lower level of education and less income, and nonwhite increase the probability of growing produce at a community garden. In Phoenix in 2017, being younger and not being a student increases the likelihood of growing produce at a community garden. Results for Detroit during COVID-19 are slightly different than in 2017. Again being male and younger increases the probability of participating in urban agriculture at a community garden, in addition not being a student determines urban agriculture participation. Results in 2020 differ quite a bit for Phoenix compared to 2017. During the coronavirus pandemic, people in Phoenix are more likely to participate in urban agriculture when being male, having children in the household, being younger, having a lower income, and being employed.

Compared to growing produce at community gardens, growing produce at home is determined by different variables. In Detroit in 2017, larger households and not being unemployed made it more likely to participate in growing produce at home. However, during the coronavirus pandemic, younger individuals with children in the household and larger households were more likely to grow food at home in Detroit. In Phoenix in 2017, males with higher income were more likely to grow food at home. Results from the survey during COVID-19 show that younger individuals with a higher education level, retired, students, and White, Black or African Americans, and American Indians or Alaska Natives are more likely to grow produce at home in Phoenix.[1]

5 | DISCUSSION AND CONCLUSION

Anecdotal evidence suggests that households were increasingly participating in urban agriculture during the COVID-19 pandemic. The potential benefits of urban agriculture are well established in the literature, such as the link between healthy dietary patterns and improved food security for those who practice food growing; yet, during the pandemic, new motivations to garden became known. These reasons included any number of the following: individuals were anxious to go to the store, they wanted to be prepared against out-of-stock situations, they felt a need to become more independent from the traditional food supply, parents needed an activity to entertain children, and simply to adopt a new hobby as individuals found themselves spending more time at home. Nevertheless, adopting home-growing activities is not without tradeoffs. For example, partaking in home-food growing may not be an optimal use of time, especially for individuals who may have lost their jobs due to the shelter-in-place orders. In this study, we set out to investigate two central questions about who practices urban agriculture more generally (already before COVID-19) and who participated during COVID-19.

To investigate small-scale urban agriculture participation before and during COVID-19, we use data from online surveys conducted in Phoenix, AZ, and Detroit, MI in 2017 and 2020 (during the first wave of the coronavirus). Overall, we did not find that urban agriculture participation increased during the pandemic. On the contrary, we found that

[1]In addition to the weighted results, we include the unweighted results in the Appendix. A comparison of both models shows that findings are similar between weighted and unweighted models with regard to significance, signs, and margins. In fact, the only coefficient that changed from being significant to being insignificant is household size, which is not significant for Detroit in 2020 for home gardening in the unweighted model.

TABLE 3 Determinants of urban agriculture participation before and during COVID-19

	Detroit 2017		Detroit 2020		Phoenix 2017		Phoenix 2020	
Grow at...	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**
Community Garden								
Female	−0.414***	0.143	−0.521***	0.199	−0.112	0.146	−0.651***	0.209
Household with children	0.236	0.184	−0.218	0.260	0.112	0.186	0.559**	0.244
Age	−0.013**	0.006	−0.043***	0.008	−0.028***	0.006	−0.024***	0.008
Household Size	0.100	0.063	−0.021	0.077	0.039	0.036	0.010	0.079
Education	−0.099*	0.055	0.070	0.070	0.076	0.052	0.085	0.081
Income	−0.046*	0.025	−0.016	0.032	−0.023	0.027	−0.086**	0.034
Employed full time	0.126	0.170	0.132	0.230	0.283	0.196	0.497*	0.281
Unemployed, looking for work	−0.399	0.308	−0.429	0.512	−0.152	0.275	−0.381	0.487
Retired	−0.026	0.254	−0.027	0.342	0.410	0.311	0.348	0.421
Student	0.061	0.296	−0.966**	0.470	−0.517*	0.304	0.542	0.524
White	−0.372*	0.222	0.157	0.463	−0.377	0.231	0.009	0.312
Black or African American	−0.086	0.257	0.585	0.469	−0.009	0.381	0.413	0.484
American Indian or Alaska Native	0.452	0.720	0.448	0.537	0.355	0.450	1.225	0.757
Constant	0.914**	0.431	1.010*	0.579	0.365	0.421	0.111	0.573
Home								
Female	−0.079	0.137	−0.221	0.158	−0.262**	0.132	−0.232	0.169
Household with children	0.179	0.191	0.736***	0.242	0.281	0.183	0.283	0.235
Age	−0.003	0.006	−0.016**	0.007	−0.005	0.006	−0.020***	0.007
Household Size	0.150**	0.066	−0.119*	0.064	0.034	0.046	0.017	0.076

TABLE 3 (Continued)

Grow at...	Detroit 2017		Detroit 2020		Phoenix 2017		Phoenix 2020	
	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Education	−0.058	0.053	0.039	0.060	0.042	0.050	0.221***	0.063
Income	−0.010	0.025	−0.001	0.025	0.049**	0.025	−0.023	0.025
Employed full time	0.177	0.173	−0.010	0.202	0.078	0.171	−0.125	0.221
Unemployed, looking for work	−0.477*	0.288	−0.454	0.435	−0.373	0.247	−0.327	0.369
Retired	0.102	0.233	−0.039	0.252	0.084	0.229	0.072	0.273
Student	0.417	0.314	−0.144	0.384	−0.169	0.280	0.990**	0.472
White	−0.084	0.234	−0.483	0.439	−0.173	0.222	0.523*	0.296
Black or African American	−0.400	0.267	−0.598	0.448	−0.222	0.372	1.205***	0.445
American Indian or Alaska Native	−0.333	0.747	−0.674	0.489	0.257	0.448	2.333***	0.597
Constant	0.505	0.436	1.723***	0.527	0.076	0.415	−0.272	0.523
Rho	1.093***	0.138	0.828***	0.172	0.879***	0.116	1.152***	0.169
N	409		438		413		404	

Note: Robust standard errors reported. Survey weights applied. Estimates presented for the preferred model, selected based on lowest value of Bayesian Information Criteria (BIC).

*$p < .10$.

**$p < .05$.

***$p < .01$.

participation was lower than 3 years ago. Results show that about one-third of Detroit participants grew produce at community gardens in 2017 and two-thirds did so at home. In Phoenix, the share of those growing produce at community gardens was considerably lower with 23%, and the share of those who grow produce at home was also approximately 10% lower (57%). Urban agriculture participation during COVID-19 was lower in both cities, with 23% of Detroiters growing produce at community gardens and 63% at home. Phoenicians had lower numbers than Detroiters (21% grew produce at community gardens, 51% at home). These findings do not suggest that the pandemic led households to take up urban agriculture significantly. While other factors might have led to a reduction over time, it does not seem that the novel coronavirus motivated a large share of households to grow food.

We then used the information regarding growing produce at home and at community gardens as dependent variables and estimated the associations between a number of socio-demographics and participation. We found differences between 2017 and 2020 but also between metropolitan areas. In 2017, male, nonwhite, and younger Detroit respondents with a lower level of education and income were more likely to grow produce at a community garden. During COVID-19, education, income, and non-white were no longer significant. In 2017 in Phoenix, being younger and not being a student increased the probability to grow produce at a community garden, but during COVID-19 male, younger participants with a lower income, and children in the household were more likely to grow produce at community gardens. Growing produce at home in 2017 in Detroit was practiced by larger households and employed respondents but during the pandemic, this changed to younger individuals with children in the household and smaller households. In Phoenix in 2017, males with higher income were practicing home food growing but during the pandemic younger individuals with a higher education level were more likely to do so.

Our study is most comparable to Bellemare and Dosuruth (2020). However, while they found that lower income households were less likely to participate in urban agriculture, we find the opposite for urban agriculture practiced at community gardens. This might be an indicator that the structure of urban agriculture determines who participates. Lower income households might not own a property with a yard or balcony that would enable them to grow food at home. Hence, distinguishing between urban agriculture settings might be important when studying participation in small-scale urban agriculture.

We acknowledge that regardless of these results, participation in small-scale urban agriculture during a pandemic has its challenges, with barriers to adoption being that many nurseries selling plants and seeds were considered nonessential businesses, and therefore acquiring the resources necessary to grow food at home may affect the ability for the adoption of home or community gardening. Reasons for the limited use of community gardens during the pandemic could be community gardens being closed. Those dependent on public transportation might not have been able to get to the community garden. Community gardens often have waitlists, which might have prevented individuals not formerly involved in gardening from participating during the pandemic even though they wanted to. Most community gardens charge a fee, which could have prevented some from participating especially considering that a high number of Americans lost their jobs during the pandemic. With regard to growing produce at home, a number of difficulties might have also arisen for gardening novices. These include: the low availability of seeds; not having a yard or balcony to garden; not having the resources for soil, fertilizer, pesticides, seeds, or seedlings; not knowing how to cook with the fresh produce; and, not knowing how to grow produce. Ultimately, while (financial) resources may be overcome, the lack of knowledge might be harder to tackle. Especially, if one invests resources the disappointment of plants not growing, dying, or not carrying fruit might easily discourage individuals to pursue agriculture in the long term.

Our results suggest to stakeholders in the food industry that individuals continue to have a strong dependence on traditional food supply chains, as we saw fewer households shifting toward household food production during the pandemic. However, there might be increased demand for certain businesses such as seed providers and distributors, producers of gardening soil, fertilizer and pesticides, gardening containers, garden centers, home improvement stores, irrigation systems, and so forth. While we are usually focused on the traditional food chain from farmers to food retailers, this shows that there is another part of agribusinesses that would benefit from higher participation in small-scale (urban) agriculture. Also, given the stock-outs of seeds, it would be of interest to investigate whether increased availability would increase participation in urban gardening. Furthermore, past research found that knowledge and

education were determinants of urban agriculture participation (Grebitus et al., 2017). Hence, those who have an interest in increasing partaking in small-scale urban agriculture, such as, seed growers, could offer educational materials and classes to enable individuals to grow produce. For policymakers and urban planners involved in making community gardens available, our findings suggest the importance of making resources available and providing support to households who wish to grow food, but may not have the expertise, time, or other resources necessary.

In closing, this study is not without limitations. First, we focused on two major metropolitan areas in the United States, much like other studies on urban agriculture, which have almost exclusively focused on one location (e.g., Armstrong, 2000; Bellemare and Dosuruth, 2020; Libman, 2007; Wakefield et al., 2007; Firth et al., 2011; Jackson, 2017; Kortright & Wakefield, 2011; Sanye-Mengual et al., 2018; Taylor & Taylor Lovell, 2014). Though we correct for distributional differences across samples, it should be noted that the United States is very diverse in terms of demographics, resources, environmental conditions, and other factors, hence, findings should be interpreted with caution if looking to generalize these to the entire country. It should be further noted that, while we use weights to ensure the two samples are balanced with regard to certain key variables, our research is indeed survey-based rather than being a randomized control experiment. Nevertheless, this study offers valuable insights into the concept of small-scale urban agriculture before and during a pandemic. Future research could expand this analysis to a nationwide survey, including investigating food growing in rural areas. Second, as with all survey work, we rely on the ability of our participants to recall their behaviors, which inherently might lack precision. Future studies could employ other methods, such as face-to-face interviews with members of community gardens to add to our findings. Third, we only focused on socio-demographic factors. However, behavior surrounding urban agriculture is strongly affected by psychographic parameters, such as attitudes, knowledge, perception, as shown by Grebitus et al. (2017) and (2020). It would be of interest to investigate this in the context of urban agriculture participation during the novel coronavirus pandemic and beyond. While our research does not include any further investigation as to why individuals might have participated in urban agriculture during the COVID-19 lockdown, future research might consider more qualitative research to shed light on underlying motivations for participation.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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APPENDIX

Table A1

TABLE A1 Unweighted model: Determinants of urban agriculture participation before and during COVID-19

Unweighted model	Detroit 2017		Detroit 2020		Phoenix 2017		Phoenix 2020	
Grow at...	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Community Garden								
Female	−0.414***	0.143	−0.384**	0.165	−0.112	0.146	−0.640***	0.184
Household with Children	0.236	0.184	0.155	0.228	0.112	0.186	0.466**	0.225
Age	−0.013**	0.006	−0.033***	0.007	−0.028***	0.006	−0.019***	0.007
Household Size	0.100	0.063	−0.043	0.068	0.039	0.036	0.089	0.069
Education	−0.099*	0.055	0.044	0.061	0.076	0.052	0.079	0.072
Income	−0.046*	0.025	−0.010	0.027	−0.023	0.027	−0.088***	0.031
Employed Full Time	0.126	0.170	0.195	0.214	0.283	0.196	0.618**	0.243
Unemployed, looking for work	−0.399	0.308	−0.476	0.449	−0.152	0.275	−0.238	0.475
Retired	−0.026	0.254	0.041	0.313	0.410	0.311	0.271	0.355
Student	0.061	0.296	−0.820*	0.419	−0.517*	0.304	0.663	0.488
White	−0.372*	0.222	−0.143	0.423	−0.377	0.231	0.037	0.303
Black or African American	−0.086	0.257	0.386	0.431	−0.009	0.381	0.330	0.444
American Indian or Alaska Native	0.452	0.720	0.169	0.509	0.355	0.450	1.062	0.734
Constant	0.914**	0.431	0.793	0.533	0.365	0.4213	−0.372	0.549

TABLE A1 (Continued)

Unweighted model	Detroit 2017		Detroit 2020		Phoenix 2017		Phoenix 2020	
Grow at...	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error	Coefficient	Standard error
Home								
Female	−0.079	0.137	−0.140	0.131	−0.262**	0.132	−0.202	0.144
Household with Children	0.179	0.191	0.633***	0.217	0.281	0.183	0.215	0.212
Age	−0.003	0.006	−0.019***	0.006	−0.005	0.006	−0.012*	0.006
Household Size	0.150**	0.066	−0.071	0.058	0.034	0.046	0.066	0.069
Education	−0.058	0.053	0.048	0.050	0.042	0.050	0.181***	0.054
Income	−0.010	0.025	0.006	0.022	0.049**	0.025	−0.025	0.023
Employed Full Time	0.177	0.173	−0.063	0.173	0.078	0.171	0.083	0.189
Unemployed, looking for work	−0.477*	0.288	−0.618	0.390	−0.373	0.247	0.017	0.357
Retired	0.102	0.233	0.172	0.206	0.084	0.229	−0.042	0.228
Student	0.417	0.314	−0.437	0.369	−0.169	0.280	0.861**	0.431
White	−0.084	0.234	−0.363	0.424	−0.173	0.222	0.471*	0.262
Black or African American	−0.400	0.267	−0.696	0.434	−0.222	0.372	0.782*	0.417
American Indian or Alaska Native	−0.333	0.747	−0.716	0.494	0.257	0.448	1.388**	0.665
Constant	0.505	0.436	1.588***	0.518	0.076	0.415	−0.616	0.477
Rho	1.093***	0.138	0.838***	0.146	0.879***	0.116	0.89***	0.138
N	409		438		413		404	

Note: Robust standard errors reported. Estimates presented for the preferred model, selected based on lowest value of Bayesian Information Criteria (BIC).

*$p < .10$.

**$p < .05$.

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