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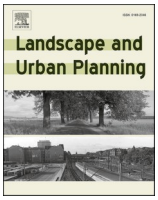

Comparing happiness associated with household and community gardening: Implications for food action planning

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HIGHLIGHTS

- No difference across frequency and duration of community and household gardening.
- Community gardeners report higher happiness and peak meaningfulness while gardening.
- Community gardening happiness reduces with family and increases with neighbors.
- Low-income and female household gardeners report higher happiness while gardening.
- In different ways, both household and community gardening can advance social equity.

ABSTRACT

Municipal food action planning promotes local food production based on presumed environmental, health, equity, and well-being benefits. However, little is known about the well-being benefits of household versus community-scale agricultural gardening. This exploratory study in the Minneapolis-St. Paul area, USA, presents a first direct comparison of happiness (net affect, average happiness, and average meaningfulness) associated with agricultural gardening at the two scales surveying 118 household and 55 community gardeners. Although both groups, in our sample, were statistically similar demographically and reported similar interactions with their gardens (frequency: 3.0–3.6events/wk; duration-of-event: 1.45–1.84hr; and total-time/week: 3.78–5.30hr/wk), different self-reported, happiness patterns emerged. For both groups, gardening's net affect ranks among the top five among 12 daily activities. Community gardeners' average net affect while gardening (3.25; scale −6 to 6) is significantly higher than biking (2.32) and walking (2.08), whereas household gardeners showed no difference across these two activities. Through matched regressions (by demographics), community gardeners report statistically higher net affect (Δ = 0.664, p-value = 0.034) and peak meaningfulness (Δ = 0.254, p-value = 0.001) while gardening. Community gardener's net affect while gardening correlates negatively with family-companionship (Δ = -0.660, p-value = 0.038) and positively with neighbor-companionship (Δ = 0.945, p-value = 0.009). Companionship had no significant association for household gardeners. Additionally, female (Δ = 0.389, p-value = 0.037) and low-income household gardeners (Δ = 1.516, p-value = 0.009) reported higher gardening net affect than counterparts; these differences were not significant for community gardeners in this study. Results suggest community gardening generates greater net affect, while household gardening could specifically improve well-being for women and low-income gardeners. Food action plans should consider both household and community gardening for varying benefits.

1. Introduction

Initiatives such as the Milan Urban Food Pact are promoting local food production as a means to address access to fresh food in cities (Milan Urban Food Policy Pact, 2015). In addition, the human well-being/happiness benefits of greenery in the city, including agricultural gardening, has also been recognized (Ambrose, Das, Fan, & Ramaswami, 2020; Keeler et al., 2019; Tzoulas et al., 2007 ; Lee & Maheswaran, 2011). As policy makers and practitioners determine how best to allocate limited urban land for maximal benefit, urban agricultural gardens (henceforth called urban gardens) may represent an opportunity to meet multiple goals, including local food production and social/emotional well-being. Urban agriculture is also purported to be particularly valuable to various underserved populations including rural to urban immigrants (Tei, Benincasa, Farneselli, & Caprai, 2009) as well as low-income and other marginalized communities who have lower access to fresh foods (Sanyé-Mengual, Specht, Grapsa, Orsini, & Gianquinto, 2019; Poulsen, 2017) offering a potential means to address inequity

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across food access and well-being.

With a renewed interest in the urban food system, governmental groups (e.g. Fao, 2019; City of Minneapolis, 2017), non-profits (Wilk & Solutions, 2019) and researchers have promoted local-scale urban food production for its perceived economic (Orsini et al., 2020; Poulsen, Neff, & Winch, 2017; Vitiello & Wolf-Powers, 2014), environmental (Orsini et al., 2020; Azunre et al., 2019) and social/equity benefits (Bailey & Kingsley, 2020; Petrovic, Simpson, Orlove, & Dowd-Uribe, 2019, Egerer, Ordóñez, Lin, & Kendal, 2019). However, there are relatively few studies that specifically address how these benefits compare across different urban agriculture modalities in cities, particularly across household and community gardens. Household gardens are defined as private gardens located at the participant's residence; whereas community gardens refers to "land managed by a group of individuals…used to grow food or ornamental crops for donation or for use by those cultivating the land and their households" (Minneapolis Code of Ordinances, Title 20, Chapter 520.160). A distinction is often made that urban household and community agricultural gardeners do not aim to sell their produce, in contrast to urban commercial farms established with the intent to sell grown produce (Santo, Palmer, & Kim, 2016). Furthermore, while the gardens included in the survey are identified as 'community gardens' in municipal code and by gardeners, the gardens function as allotment gardens, where each gardener is allotted their own plot of land at the gardening site (Firth, Maye, & Pearson, 2011). While literature delineates between allotment and community gardens, in this paper we use the term 'community gardens' to match the term used for gardens in the municipal code as well as by the gardeners who use them. The overarching goal of this paper is to quantitatively compare the benefits to subjective human well-being across household and community gardening in a USA metro area.

In USA cities, literature has shown both household and community gardening are actively promoted and practiced (Orsini et al., 2020; Sickler, 2018; Rogus & Dimitri, 2015; Taylor & Lovell, 2012; Guitart, Pickering, & Byrne, 2012). For instance, the Homegrown program of Phipps Conservatory (Pittsburgh, USA) implemented household, agricultural gardening interventions between 2013 and 2015 enrolling 180 households with the aims to develop self-sufficient gardening skills, increase vegetable consumption, and improve wellness (Sickler, 2018). In Guitart, Pickering, and Byrne's review of academic papers on community gardens (2012), the majority (82 %) of gardens were organized by non-profits or neighborhood groups to promote social cohesion and were seen as a means to overcome barriers to growing ones' own food due to ownership, contaminated soil, inadequate resources, and a lack of initial knowledge (Golden, 2013; Firth et al., 2011). In terms of the extent of gardening practiced, Taylor and Lovell (2012) used remote sensing to show substantial practice of both household and community gardens in Chicago, USA identifying 4001 household gardens, and 135 community gardens. Other gray literature by gardening groups estimate that 25 % of households in the US engage in growing some of their own food (National Gardening Association, 2021).

In addition to food production, literature suggests that the benefits of urban gardening extend to include substantial benefits to health and well-being (Bailey & Kingsley, 2020; Booth, Chapman, Ohmer, & Wei, 2018; Santo et al., 2016; Alaimo, Beavers, Crawford, Snyder, & Litt, 2016; Middling, Bailey, Maslin-Prothero, & Scharf, 2011). However, a majority of prior literature on the health and well-being benefits of gardening has been largely conducted at the community gardening scale (Booth et al., 2018; Soga et al., 2017; Alaimo et al., 2016; Litt et al., 2015; Taylor & Lovell, 2014; Poulsen et al., 2017; Lovell, Husk, Bethel, & Garside, 2014; Golden, 2013) with only a few studies exploring the household gardening scale (Palar, Hufstedler, Hernandez, Chang, Ferguson, Lozano, & Sheri, 2019; Sickler, 2018). Furthermore, the above-mentioned studies have largely focused on tracking food consumption changes associated with gardening and/or perceived improvements in health from gardening. For instance, 60 % of gardeners self-report better eating habits than before engaging in the practice of urban gardening (Sickler, 2018), participants in urban home gardening often link tending their gardens to increases in exercise and reductions in sedentary behavior (Palar et al., 2019), and 75 % of community gardeners report engaging in urban gardening for its mental health benefits (Armstrong, 2000). While these self-reported results are important, there are no studies, to the authors' knowledge, that have directly tracked and compared well-being across these two scales of urban gardening.

Well-being measurements quantitatively track how one thinks and feels about one's life (Centers for Disease Control and Prevention, 2018). Focusing on feelings, standardized measures of emotional well-being (EWB) have been streamlined in numerous surveys, which assess the net of one's positive and negative emotions (Tabor & Yull, 2018; National Research Council, 2012; Helliwell et al., 2012), including individual ratings of positive emotions such as happiness and meaningfulness, and negative emotions such as pain, sadness, tiredness, and stress. While the word 'happiness' is broadly used to refer to EWB in general (Helliwell et al., 2012), the specific emotion is represented as a component of net affect and can also be tracked individually.

More recently, instruments have also been developed to measure EWB associated with different activities during a person's life using the Day Reconstruction Methodology (Kahneman & Krueger, 2006; Krueger and Stone, 2014; Fan, Brown, Das, & Wolfson, 2019; Fan, Wolfson, & Adomavicius, 2017). These approaches allow us to assess EWB during different activities including gardening in comparison with other activities such as biking, walking, and other leisure activities (Ambrose, Das, Fan, & Ramaswami, 2020).

We use this emergent, activity-based EWB survey methodology to generate a unique empirical dataset to assess the EWB benefits of household versus community agricultural gardens. The survey also characterizes the fundamental differences in the two gardening types in terms of gardening frequency, duration, and companionship. Furthermore, uniquely we compare the EWB benefits of household and community gardening with other urban leisure activities such as biking and walking, which have been shown to improve EWB and are often the focus of urban infrastructure investment (Collier and Wayment, 2018; Fan, Brown, Das, & Wolfson, 2019). Last, to address issues of social inequity, this study also compares EWB benefits of community and household gardeners unpacking the potential effects of income, gender, and race/ethnicity. Thus, we ask: what are the differences in EWB outcomes associated with urban gardening across scale, i.e., household gardening and community gardening, and socioeconomic strata?

Specifically, the objectives of this study are as follows:

- Compare how household and community gardeners interact with their gardens (i.e. average count of events per week, average duration of a single gardening event, average time spent gardening per week).
- Assess gardening's rank among 11 other daily activities across five measures of EWB for both household and community gardeners.
- Use matched OLS regressions to compare EWB differences between household and community gardeners across all five EWB measures.
- Explore underlying factors that might shape EWB such as companionship, as well as if specific groups achieve different EWB outcomes (e.g., low-income, gender, urban-suburban).

2. Methods

2.1. Sampling

An initial survey (2016–2017) identified 118 household gardeners as part of a large Neighborhood Environment, Daily Activity and Well-Being Study conducted by the authors in the Minneapolis-St. Paul Metro area (Fan, Brown, Das, & Wolfson, 2019). Subsequently a second study focusing on community gardening was initiated in 2019 and recruited 61 participants. Comparisons between the two groups are the focus of this paper. Different recruitment approaches were needed for

the two groups owing to the unique requirements and challenges in recruiting participants. For example, household gardens are not easy to identify visually in a city due to their smaller size and location in private spaces, thus, the broader initial survey of 404 residents was effective in identifying 118 household gardeners and enabled sampling a representative sample of household gardeners. Indeed, recent studies show a significant portion of the population (>20 %) engages in household gardening while a much smaller portion of the population engages in community gardening (Das & Ramaswami, 2022; National Gardening Association, 2021).

On the other hand, recruiting community gardeners is also challenging for different reasons. Community gardeners do not have a specific identifiable home location and must be recruited at the community garden locations which they visit at variable times; overall fewer percentages of the population garden in community versus household gardens (Das & Ramaswami, 2022). Community gardeners are also known to be heterogeneous and difficult to characterize from garden to garden (Orsini et al., 2020), making it hard to establish a consistent picture of community gardeners' demographics. Recruitment of community gardens in our study was done by first reaching out to the managers of all the community gardens in the Minneapolis-St. Paul metro area that had available contact information (37), of whom 23 garden managers sent out notice of this study to their members, with 61 respondents enrolling. Despite the smaller sample of community gardeners, we were still able to gain information about both modes of gardening and make direct comparisons by implementing matched OLS regressions. In both surveys, daily activities were logged sequentially and associated EWB was recorded.

The first group (i.e., the household gardeners) was recruited via a general household survey, which was conducted between October 17, 2016 to October 25, 2017. A stratified sampling technique was used to select urban (four) and suburban (two) neighborhoods, in an attempt to cover a range of urban forms. There were 2,443 census blocks located in these six selected neighborhoods, of which 921 were randomly selected for the recruitment of participants to the survey. A postcard, with a brief study description and contact information for the research group, was placed at all homes in the randomly selected blocks. The research team set up an appointment to meet with the participant if they were interested in engaging with the study. Of the 404 recruited participants in the first recruitment class, 370 completed all parts of the study (91.6 % retention). Of this group, 118 engaged in at least one gardening activity over their 7-day study period. Since the survey was designed to collect data on various behaviors in addition to gardening, data was collected over one year. However, for this analysis we focus only on household and community gardeners during the growing season in the Minneapolis-St. Paul Metro area (i.e., between May and September).

Between May 25, 2019 and September 20, 2019 the second group of recruitment was conducted. As this recruitment targeted community gardeners and their EWB while gardening, the recruitment period was selected to reflect the Minneapolis-St. Paul Metro area growing season. First, the research team contacted managers or organizers of 37 community gardens in the metro area via phone and email. Contact information was derived from the cities of Minneapolis and St. Paul's community garden directories as well as the University of Minnesota's Master Gardeners website. Once garden managers or organizers were recruited, they helped set up meetings with the community garden members, where 61 individuals were themselves then recruited. Of the 61 recruited community gardeners, 55 completed all parts of the study (90.2 % retention). Similar to the household survey, the recruitment materials for community gardeners stated the goal of comparing well-being across a spectrum of daily activities. Thus, response bias that favored gardening was reduced for both household and community gardeners. Cluster-based biases from utilizing garden managers to recruit community gardeners were also not seen, wherein the 55 gardeners who completed the study reported involvement in 40 different community gardens across urban and suburban locations.

2.2. Survey design and smartphone implementation

After recruitment, each recruitment class was exposed to the same three-phase interaction approach. In the first phase, the participant was queried on demographics and overall well-being measures (e.g., Diener's Satisfaction with Life (SWL) scale (Diener et al., 1985)). In the second stage, the participant was given a phone for a period of 7 days and queried on six dimensions of their EWB during different daily activities tracked through a smart phone-based Day Reconstruction Method (Daynamica^{TM}) (Fan, Brown, Das, & Wolfson, 2019; Fan, Wolfson, & Adomavicius, 2017). The Daynamica^{TM} application is only offered in English, thus only English speakers participated in the study. The methodology used the geo-location capabilities of loaned cellular phones and short surveys to construct sequenced activity/trip data throughout the day across 12 daily urban activities, including gardening. Based on the app's detection of activities and trips in real time, users completed associated surveys, at their convenience each day, to identify the activity in which they were engaging as well as their emotions during the experience. For each activity, six emotions were evaluated (Happy, Pain, Sad, Tired, Stressed, and Meaningful) and ranked by participants on a seven-point scale.

After this period, the third and exit phase of the survey collected the phone and checked for completion and understanding of the survey. In addition, the exit survey included specific questions pertaining to gardening and their community garden. Community gardeners were asked to identify the community gardens where they had plots to insure diffuse coverage of garden location in the metro area.

Together the two surveys provide unique information about the practices of urban gardening across household and community gardening in the Twin Cities.

2.3. Analysis

For each of five EWB measures (average scores for net affect, average positive emotions of happiness and meaningfulness, and frequency of experiencing peak positive emotion (i.e., happiness and meaningfulness)), means were calculated across all 12 daily urban activities. Each measure is defined as follows:

- **Average Net Affect-** an aggregated EWB measure, which is the average of positive emotions (i.e., happiness, meaning) minus the average of negative emotions (i.e., tired, stress, pain, sad) as reported for the identified activity (Krueger and Stone, 2014). Net affect is represented on a scale of −6 to 6.
- **Average Emotion-** the mean of happiness or meaningfulness emotions reported for each activity an individual engages in over the one-week period across the identified population. Average emotion is represented on a scale from 1 to 7.
- **Peak Emotion-** for each participant, a 90th percentile of happiness and meaningfulness was calculated across all activities of the seven-day-period when the participant was enrolled in the study. This value is thus considered the threshold for significant happiness or meaningfulness. Peak emotion is the proportion of times participants experience significant happiness or meaningfulness while engaging in the activity over the seven-day period (Ambrose, Das, Fan, & Ramaswami, 2020). Peak emotion is represented as a proportion from 0 to 1.

These measures of EWB were then analyzed for difference across activities using ANOVA tests and post-hoc Tukey HSDs to calculate the p-value and 95 % confidence intervals. t-tests were performed to compare the EWB differences between household and community gardeners while gardening, considering all five measures. In addition, multiple matched OLS regressions were used to strengthen results first established through these *t*-tests.

When making direct comparisons between household and

community gardeners, a pre-processing matching was used. Matching is used to reduce variability caused by extraneous variables and balances populations based on key variables of interest (i.e., household income, greatest obtained education, race/ethnicity, and SWL score) as previous and ongoing research has shown a large demographic heterogeneity across community gardeners (Das & Ramaswami, 2022; Orsini et al., 2020). For all nominal variables (i.e., household income, greatest obtained education, and race/ethnicity), an exact-match matching scheme was used, whereas a nearest-neighbor matching scheme was used for the continuous variable (i.e. SWL score). For each matched regression, we conducted three models: (1) a pair-wise OLS regression of the binary independent variable of interest (representing the household gardener and community gardener groups for the regression), (2) a regression model including the independent variable of interest as well as the four parameters used in the matching, and (3) a robust model using all probed demographic parameters. Model #2 and model #3 were conducted for all matched regressions to evaluate the robustness of the matching protocol and the OLS regression results. Satisfaction With Life (SWL) scores are included as a general proxy for overall well-being. All components other than SWL scores and age are dummy variables, and thus the first component in each group is dropped.

In addition, matched OLS regressions are conducted to compare net affect outcomes given differences in companionship and demographics (e.g., household income, gender, urban-suburban) across household and community gardeners. These matched regressions are conducted with the same procedure as outlined in the previous paragraph, but variables are removed from the matching protocol when they are the variable of interest. For example, when comparing low-income household gardeners to mid- and high-income household gardeners, household income is removed from the matching parameters. This is done to retain income related variation in the OLS regression while balancing the population across the remaining key variables of interest (i.e., greatest obtained education, race/ethnicity, and SWL score). In all companionship and demographics matched OLS regressions, regressions are ran at the gardening event level.

3. Results

3.1. Interactions with Gardens, among household and community gardeners

Table 1 expresses the demographic breakdowns of the two gardening groups of interest and the sample in full compared to the Minneapolis-St. Paul Metro area (ACS 2016 5-year Estimates). While the sampling for this study trends wealthier and more female than the Minneapolis-St. Paul Metro demographics reported by the ACS 2016 5-year estimates, Pearson's Chi^2 tests for independence show no significant demographic differences between the household and community gardeners sampled (Household Income: p-value = 0.173; Race/Ethnicity: p-value = 0.127; Education: p-value = 0.136; Gender: p-value = 0.053; Neighborhood Type: p-value = 0.167; Age: p-value = 0.105; SWL Score: p-value = 0.761).

Table 2 depicts how the household and community gardeners interact with their gardens, in terms of frequency and duration of gardening. There is no significant difference in average count of gardening events per week (household: 3.0 events/wk; community: 3.6 events/wk), average duration of a single gardening event (household: 1.45 hr; community: 1.84 hr), nor average time spent gardening per week (household: 3.78 hr/wk; community: 5.30 hr/wk) across household and community gardeners sampled in this study.

By asking participants who they were with while engaging in an activity, the study can compare the proportion of times gardeners are gardening alone or with company. This is important since gardens, particularly community gardens, are often touted as places for constructive socio-communal interactions (Petrovic et al., 2019, Egerer et al., 2019). We found the opposite was occurring – household

Table 1
Demographic comparison of household agriculture gardeners, community agriculture gardeners, and study population versus ACS 2016 5-year population estimates for the Minneapolis-St. Paul Metro Area.

	Agricultural Gardeners		All Participants	Metro-MSP ACS 2016 5-year Estimates
	Household	Community		
Number of Participants	118	55	425	
Household Income				
Low (less than $50,000)	16 (14 %)	11 (20 %)	84(20 %)	36 %
Medium ($50,000-$100,000)	44 (37 %)	23 (42 %)	153 (36 %)	32 %
High (greater than $100,000)	58 (49 %)	21 (38 %)	188 (44 %)	25 %
Race and/or Ethnicity				
White	90 (76 %)	39 (71 %)	313 (74 %)	81 %
Hispanic	6 (5 %)	2 (4 %)	23 (5 %)	
Asian	5 (4 %)	2 (4 %)	16 (4 %)	6 %
Black	7 (6 %)	9 (16 %)	44 (10 %)	8 %
Other	10 (8 %)	3(5 %)	28 (7 %)	4 %
Education				
Less than a Bachelors	26 (22 %)	12 (22 %)	120 (28 %)	
Bachelors	51 (43 %)	31 (56 %)	154 (36 %)	
More than a Bachelors	41 (35 %)	12 (22 %)	151 (36 %)	
Gender				
Male	45 (38 %)	12 (22 %)	138 (32 %)	49 %
Female	73 (62 %)	43 (78 %)	287 (68 %)	51 %
Neighborhood Type				
Urban	85 (72 %)	46 (84 %)	310 (73 %)	
Suburban	33 (28 %)	9 (16 %)	115 (27 %)	
Average Age	51.6	47.1	49.5	37
Average Satisfaction with Life Score	26.8	27.0	26.4	

Table 2
Reported interactions with the garden: Community and Household Gardeners.

		Agricultural Gardeners		Sig. Diff.
		Household	Community	p-values
Number of Gardeners Participating		118	55	
Average Count of Gardening Events per week		3.0	3.6	0.249
Average Duration of a Single Gardening Event (hr)		1.45	1.84	0.233
Average Time spent Gardening per week (hr)		3.78	5.30	0.317
Companionship (percentage of events) φ				0.000***
	By One's Self	82 (32 %)		84 (51 %)
	With Someone	176 (68 %)		82 (49 %)
When 'With Someone', those people are: (percentage of events) φ				0.000***
	Family	144 (82 %)		29 (35 %)
	Friends	21 (12 %)		42 (51 %)
	Neighbors	31 (18 %)		38 (46 %)

*: p-value < 0.05; **: p-value < 0.01; ***: p-value < 0.001; φ: Pearson's Chi^2 tests for independence.

gardeners are significantly more likely to garden with company (p-value < 0.001) than community gardeners in our study. Household gardeners reported gardening with someone 68 % of the time compared to only 49 % of the time for community gardeners. Additionally, there is a difference in who gardeners garden with (Pearson's Chi^2 tests for independence: p-value < 0.001). Community gardeners are more likely to be with friends and neighbors (51 % and 46 %, respectively) than household gardeners (12 % and 18 %, respectively). Conversely, household gardeners are more likely to be with family members (82 %) than community gardeners (35 %).

3.2. Household and community gardeners across 5 EWB scores

Fig. 1 compares the rank of gardening events in the context of 11 other daily activities, corresponding to the identified EWB measure and gardening group. It also offers a comparison of household and community gardeners' EWB scores across all five measures while gardening. The five EWB measures are identified as column heads, and the two gardening groups are labelled at the left in Row 1 & Row 2. All significant difference indications within individual charts represent a significant difference from gardening, the reference activity. The bottom row of Fig. 1 identifies significant difference when comparing the respective EWB measure score between community and household gardeners while engaging in gardening events.

While gardening ranks in the top five across all five EWB measures for household gardeners in the context of the other 11 daily events reported, it is noteworthy that community gardeners report gardening in the top two. Using an ANOVA post-hoc Tukey HSD test, we show household gardeners only report two EWB measures where biking and walking are significantly different than gardening (i.e., average net affect: biking is greater than gardening; average meaningfulness: gardening is greater than walking). Biking and walking are used as a reference point as they are, in other literature, associated with increases in EWB (Smith, 2017) and are commonly funded infrastructure in city livability plans (City of Phoenix, 2021; New York City, 2021; Infrastructure Australia, 2018). For community gardeners, in contrast, gardening is significantly higher than both walking and biking across average net affect, average happiness, and average meaningfulness. Additionally, community gardeners are significantly more likely to report peak meaningfulness while gardening than walking. Across all five EWB measures, community gardeners report statistically similar scores between gardening and events participants reported as 'other leisure and recreation.'

In addition to comparing gardening events to other activities, the analysis finds community gardeners report significantly higher mean net affect (0.30 points higher) than household gardeners while engaged in gardening events. Community gardeners, on average, also report experiencing significantly higher peak meaningfulness (i.e., 14.8 % more often). Emotional well-being while gardening of community gardeners is different than household gardeners, as community gardeners report gardening as one of their most significant EWB activities as well as obtain greater EWB from gardening events than their home gardening counterparts. These comparison results are later supported by matched regression analysis (Table 3 & Table 4).

3.3. EWB difference between household and community gardeners

Table 3 reports the direct comparison of reported EWB while gardening, of the household and community gardeners in our study, using a matched OLS regression. The first model compares the net affect scores reported while gardening between household and community gardeners after the two gardening groups have been matched across

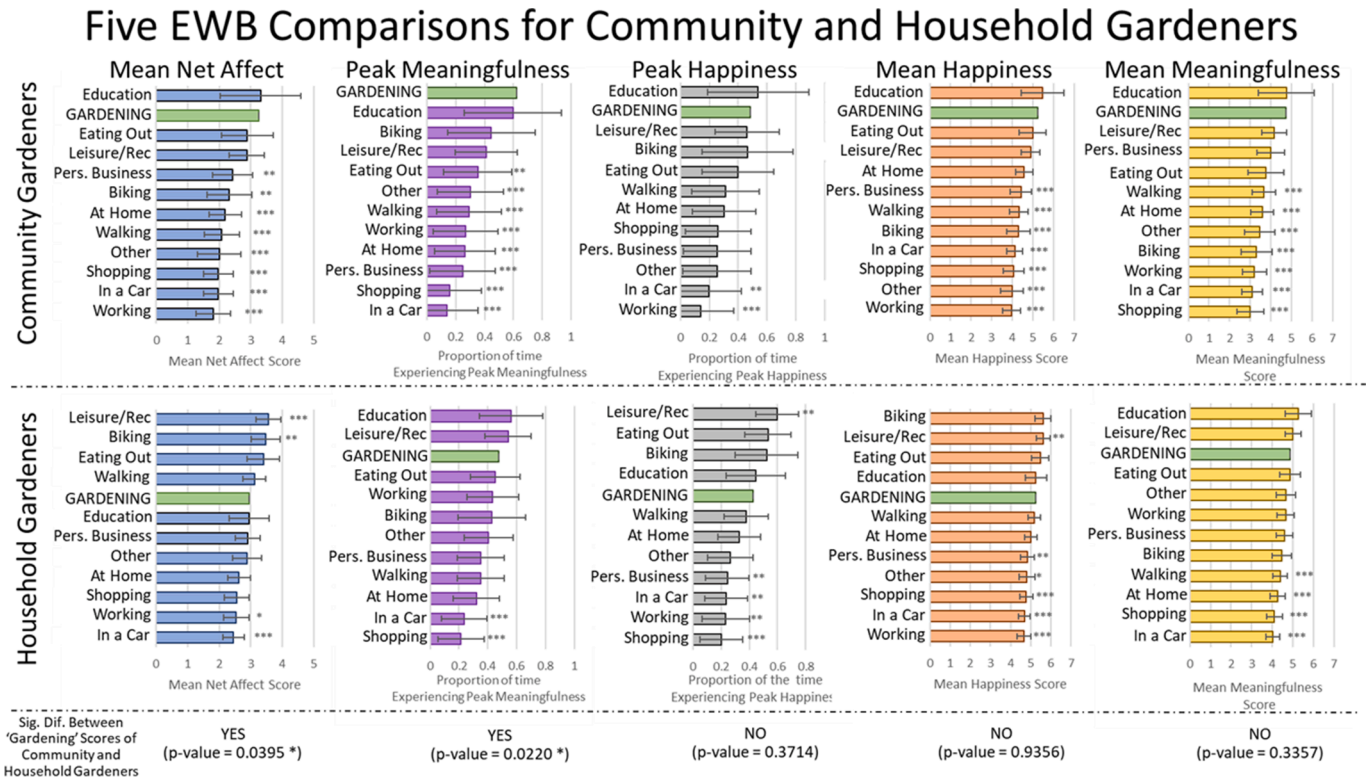

Fig. 1. Within each chart, gardening and the other 11 daily activities are reported in rank order given the respective EWB measures and gardening group. The five EWB measures are identified as column heads, and the two gardening groups are labeled at the left in Row 1 & Row 2. All significant difference indications within individual charts represent a significant difference from gardening, the reference group. The error bars denote the 95 % confidence interval in the estimation of the mean. Row 3 identifies significance difference when comparing the respective EWB measure score between community and household gardeners while engaging in gardening. These comparisons are made via individual t-tests. *: p-value < 0.05; **: p-value < 0.01; ***: p-value < 0.001.

Table 3
Matched OLS regression results for mean net affect while gardening by community and household gardeners given three models: a pair-wise model, a model using the matched variables, and a robust model using all probed demographic parameters.

	Model #1		Model #2		Model #3	
	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	2.885	0.000 ***	0.101	0.925	−0.236	0.844
Garden Location						
Household Garden	–		–		–	
Community Garden	0.662	0.0322 *	0.656	0.029 *	0.664	0.034 *
SWL Score (5–35)	–		0.086	0.024 *	0.089	0.031 *
Household Income						
Low (<$50 k)	–		–		–	
Medium ($50 k–$100 k)	–		0.588	0.226	0.576	0.249
High (>$100 k)	–		0.151	0.768	0.121	0.832
Race/Ethnicity						
White	–		–		–	
Black	–		0.834	0.186	0.754	0.262
Hispanic	–		−1.191	0.262	−1.103	0.323
Other	–		1.058	0.186	1.126	0.144
Education						
Less than Bachelor's	–		–		–	
Bachelor's	–		0.057	0.918	0.020	0.972
More than Bachelor's	–		−0.084	0.895	−0.094	0.886
Gender						
Male	–		–		–	
Female	–		–		−0.076	0.839
Neighborhood Type						
Suburban	–		–		–	
Urban	–		–		0.081	0.846
Age	–		–		0.006	0.533
Fit Statistics						
r^2	0.050		0.183		0.188	
r^2_{adj}	0.039		0.093		0.065	

*: p-value < 0.05; **: p-value < 0.01; ***: p-value < 0.001; N = 92.

Table 4
Matched OLS regression results for peak meaningfulness while gardening by community and household gardeners given three models: a pair-wise model, a model using the matched variables, and a robust model using all probed demographic parameters.

	Model #1		Model #2		Model #3	
	Estimate	p-value	Estimate	p-value	Estimate	p-value
Intercept	0.409	0.000***	0.887	0.0028*	1.124	0.000**
Garden Location						
Household Garden	–		–		–	
Community Garden	0.237	0.003**	0.238	0.002**	0.254	0.001**
SWL Score (5–35)	–		−0.022	0.023*	−0.019	0.047*
Household Income						
Low (<$50 k)	–		–		–	
Medium ($50 k–$100 k)	–		0.179	0.150	0.177	0.147
High (>$100 k)	–		0.181	0.169	0.169	0.224
Race/Ethnicity						
White	–		–		–	
Black	–		0.106	0.508	0.164	0.318
Hispanic	–		−0.338	0.155	−0.361	0.188
Other	–		0.137	0.470	0.102	0.585
Education						
Less than Bachelor's	–		–		–	
Bachelor's	–		−0.041	0.771	−0.011	0.937
More than Bachelor's	–		−0.008	0.959	0.024	0.879
Gender						
Male	–		–		–	
Female	–		–		−0.078	0.391
Neighborhood Type						
Suburban	–		–		–	
Urban	–		–		0.010	0.919
Age	–		–		−0.006	0.014 *
Fit Statistics						
r^2	0.094		0.221		0.284	
r^2_{adj}	0.084		0.124		0.175	

*: p-value < 0.05; **: p-value < 0.01; ***: p-value < 0.001; N = 92.

SWL score, household income, race/ethnicity, and education, with no other explanatory variables. The second model includes the variables used in the matching protocol to ensure that successful balancing of the two populations was achieved (we anticipate that these variables would not be statistically significant, and the analysis is done as a verification). Finally, the third model includes all demographic parameters probed in

the study, such as gender and urban versus suburban, to offer a robust check of the matched regression.

Our matched OLS regression results (Table 3) confirm the net affect *t*-test comparisons results reported earlier (Fig. 1). Across all three models the estimate for community garden remains consistent in statistical significance and in magnitude; thus, our results suggest gardening at community gardens is associated with significantly higher average net affect. This result is supported across all three models in Table 4. In the most robust model (i.e., Model #3) gardening at a community garden is associated with a 0.664 higher net affect score than gardening at home (p-value = 0.034).

While the net affect difference between household and community gardeners is noteworthy, the difference between peak meaningfulness is even starker (Table 4). In the most robust model (i.e. Model #3), community gardeners report a Peak Meaningfulness score while gardening that is 0.254 points higher than household gardeners (p-value = 0.001). This suggests community gardeners, on average, experience peak meaningfulness while gardening 25.4 % more often than household gardeners. In addition, gardeners with lower SWL scores are experiencing Peak.

Meaningfulness more often (-0.019; p-value = 0.047). In other words, with a 10-point lower SWL Score (which is measured on a scale from 5 to 35) a gardener is expected to experience peak meaningfulness 19 % more often while gardening. This suggests gardeners with the lowest satisfaction with life are experiencing peak meaningfulness the most often regardless of gardening at home or at a community garden.

In contrast to net affect and peak happiness, other measures of EWB such as mean happiness, mean meaningfulness, and peak happiness were not statistically different across community gardeners and household gardeners.

3.4. Demographic and companionship associations with gardening EWB

In addition to using a matched regression to compare community and household gardeners across all five EWB measures, a matched OLS regression was used to better understand how gardener demographics and companionship associated with reported mean net affect among community and household gardening while gardening. While we acknowledge the sample size is small, we believe our matched regression offers significant insights into household income, gender, company while gardening, and urban versus suburban location of the gardener. Here, race/ethnicity's association with reported net affect while gardening is not included in the matched regression analysis, because the sample size was too small post matching to offer reliable results. Table 5 is an abbreviated table showing the independent variable of interest in the pair-wise matched OLS regression model (i.e., Model #1) and in the most robust matched OLS regression model (i.e., Model #3).

For both household and community gardeners, there is no significant association between urban and suburban gardeners, suggesting urban form likely has no association on reported net affect while gardening.

Low-income and female, household gardeners are associated with higher net affect than medium- and high-income gardeners (1.516, p-value = 0.009) and male gardeners (0.389, p-value = 0.037) respectively in the most robust model. Meanwhile income and gender variables are not significantly different for community gardeners in the most robust matched OLS regression model. This might suggest that gardening at home offers greater well-being to low-income and female gardeners, whereas income and gender are not associated with any change in reported net affect for community gardeners.

When comparing companionship while gardening to gardening by oneself, both household gardener models show no significance across all three types of companionship (i.e., family member, friend/acquaintance, neighbor). While the three types of companionship for community gardeners nearly show significance in the pair-wise model, gardening with a family member is significantly lower than gardening by one's self (-0.660; p-value = 0.038) and gardening with a neighbor was higher (0.945; p-value = 0.009) in the most robust model. These household and community gardening results offer insight into the social components often associated with community gardens.

Table 5
Summary of matched OLS regression results for net affect while gardening by gardener demographics & companionship given two models: a pair-wise model and a robust model using all probed demographic parameters.

	Community Garden		Household Garden	
Household Income	Estimate	p-value	Estimate	p-value
MODEL #1	N = 22		N = 74	
Mid- & High-Income (>50 K)	–		–	
Low-Income (<50 K)	−0.834	0.287	0.951	0.011 *
MODEL #3				
Mid- & High-Income (>50 k)	–		–	
Low-Income (<50 K)	−0.787	0.272	1.516	0.009 **
Gender				
MODEL #1	N = 50		N = 190	
Male	–		–	
Female	−0.205	0.540	0.386	0.040 *
MODEL #3				
Male	–		–	
Female	−0.214	0.511	0.389	0.037 *
Companionship				
MODEL #1	N = 148		N = 212	
With One's Self	–		–	
Family Member	−0.456	0.140	0.007	0.975
Friend/Acquaintance	0.523	0.089	0.310	0.443
Neighbor	0.510	0.145	0.061	0.904
MODEL #3				
With One's Self	–		–	
Family Member	−0.660	0.038 *	−0.037	0.877
Friend/Acquaintance	0.491	0.113	−0.047	0.908
Neighbor	0.945	0.009 **	0.416	0.408
Urban v. Suburban				
MODEL #1	N = 62		N = 172	
Suburban	–		–	
Urban	−0.291	0.364	−0.154	0.461
MODEL #3				
Suburban	–		–	
Urban	0.320	0.349	0.103	0.651

*: p-value < 0.05; **: p-value < 0.01; ***: p-value < 0.001; regressions represent the gardening event level. The first variable in each model is dropped as it is the reference group.

4. Discussion

4.1. Significance of results

Despite the interest of government, non-profits and researchers in the well-being benefits of urban agricultural gardening, few studies have directly assessed the EWB associated with household and community gardening, and none, to the knowledge of the researchers, have compared these groups in the same study. To address this research gap, we recruited 118 household gardeners and 55 community gardeners, in the Minneapolis-St. Paul metro area. This direct comparison offers valuable insights to researchers and practitioners, discussed below in four main takeaways.

4.1.1. Both community and household gardening rank in top five across 12 probed urban activities

This paper makes significant contributions to literature as it demonstrates gardening at both household and community gardens ranks amongst the highest reported EWB across 12 daily, urban activities. Across all EWB measures, gardening is ranked in the top two of assessed activities for community gardeners and is ranked in the top five for household gardeners. First, this indicates gardening at a community garden as one of the most significant EWB activity for the community gardener her/himself. Community gardeners report significantly higher EWB than other daily leisure activities, such as biking and walking

(across average net affect, average happiness, and average meaningfulness). In contrast, household gardening ranks no different or less than biking and walking (i.e., significantly less regarding average net affect). Despite community gardening's and household gardening's EWB scores being ranked higher or similar to walking and biking, cities give greater attention and investment to the latter two activities (City of Phoenix, 2021; New York City, 2021; Infrastructure Australia, 2018).

Our study finds that both community and household gardening are associated with high levels of EWB comparable or greater than biking and walking in cities, making a case for urban planners to support both modes of gardening. However, surveys suggest a larger proportion of the population engages in household gardening (25 %) compared to community gardening (National Gardening Association, 2021), where less is known about the populations and demographics due to the spatially heterogeneous nature of community gardens (Das & Ramaswami, 2022; Orsini et al., 2020). Hence, urban planners will have to give consideration to both the EWB benefits and the populations engaging in household and community gardens. An urgent research priority is to conduct larger scale surveys to better understand who gardens at these two different modes.

4.1.2. *Community gardening is associated with higher net affect and peak meaningfulness than household gardening*

While household and community gardening are both associated with EWB score similar or greater than other urban leisure activities, the community gardeners of this study reported significantly greater EWB benefits than their counterparts gardening at home. The significant difference between household and community gardeners' net affect and peak meaningfulness scores are supported by initial *t*-tests (Fig. 1) as well as matched OLS regressions (Table 3 & Table 4). Through the matched OLS regressions, community gardeners are associated with a 0.664 higher net affect score (p-value = 0.034) than household gardeners and experience peak meaningfulness 25.4 % more often (p-value = 0.001).

4.1.3. *Companionship type impacts community Gardeners' EWB, but not household gardeners*

In addition to community gardens being associated with higher net affect and peak meaningfulness, companionship while at the garden, for community gardeners, is significantly associated (both positively and negatively) with reported net affect. In an interesting finding, when community gardeners are with family members, there is a negative association to their reported net affect while at the garden (Δ = -0.660, p-value = 0.038). Conversely, when community gardeners are with neighbors there is a positive association (Δ = 0.945, p-value = 0.009). In contrast, household gardeners' net affect showed no correlation with companionship. While companionship was only associated with community gardeners' EWB in our study population, household gardeners were more likely to have company while gardening (68 % of the time). This company is often family members (82 % when gardening with company). Conversely, community gardeners are with company a lower percentage of time (49 % of the time) but are more often with friends and neighbors (51 % and 46 % when gardening with company). These results in tandem offer interesting insights into companionship while gardening and supports the specific role of community gardens as a community meeting place.

Indeed, many studies have identified community gardening as an integral social setting for communities, keystones of community building and organization, and vital to an individual's social connectivity (Booth et al., 2018; Van Holstein, 2017; Beckie & Bogdan, 2010; Teig et al., 2009; Holland, 2004; Litt et al., 2015). While the community gardening companionship results of this study are supported by other qualitative results (Petrovic et al., 2019, Egerer et al., 2019), this study is the first, to the researchers' knowledge, to explore companionship's association with EWB outcomes utilizing quantitative methods. Additionally, the comparison to household gardeners offers insight into the unique companionship benefits to EWB observed specifically at community gardens. These results support previous literature identifying the importance of community gardens as a neighborhood hub and a place of social connectivity (Petrovic et al., 2019, Egerer et al., 2019). It is noteworthy the EWB benefits of companionship at community gardens are constrained to neighbors, whereas EWB penalties are paid when gardening with family members. This nuanced result is unique, as other studies have shown EWB benefits extend to both family and friends, when compared with being by oneself, during activities identified as trips (Fan, Brown, Das, & Wolfson, 2019). More work is needed to better understand how EWB is associated with specific companionship while gardening.

4.1.4. *Equity impacts of household gardening vs community gardening*

In the context of social equity, our study shows only among household gardeners do women and low-income participants report greater EWB benefits than men and more wealthy gardeners. These results suggest that household gardening can offer more equitable well-being especially if outreach is made in underserved neighborhoods (e.g., Homegrown program of Phipps Conservatory—Pittsburgh, USA). However, the literature primarily highlights community gardens' importance to equity (Alaimo et al., 2016; Golden, 2013). Our study suggests that both modes of gardening can play an important role in advancing social equity, but in different ways.

Our study results show low-income and female household gardeners report higher net affect while gardening than their middle- and high-income and male counterparts, respectively. This difference is expressed in the matched regressions (Table 5; Household Income and Gender). Our matched regression results show low-income household gardeners report having 1.516 higher net affect scores than middle- and high-income household gardeners and female household gardeners reported 0.389 higher net affect than male household gardeners while gardening. Despite significant net affect differences while gardening at home, there is no difference between income groups and gender for community gardeners (Table 5; Household Income and Gender). While literature has worked to parse the association between demographic characteristics and EWB, new work suggests income and gender differences are most clearly observed when considering the volatility and frequency of EWB (i.e., experiencing emotional ups and downs between activities rather than observations of EWB generally), in which case low-income and female participants are observed to have greater EWB volatility and lower EWB frequency than high-income and males respectively. (Pirla & Quoidbach, 2021; Jachimowicz, Mo, Greenberg, Jeronimus, & Whillans, 2021). While these results suggest why low-income and female gardeners might experience EWB benefits while gardening at home, more work exploring the intensity and frequency of EWB for matched events across gender is needed to understand why these benefits are observed at home and not at community gardens.

It is noteworthy that these income- and gender-related equity outcomes are only correlated with EWB when gardening at home. However, many gardening programs targeting these groups focus on community gardens and not household gardens (Palar et al., 2019; Alaimo et al., 2016; Garcia, Ribeiro, Germani, & Bógus, 2018). Yet, researchers suggest that the political connection needed to start a community garden (Cohen & Reynolds, 2015), access to public resources (Cohen & Reynolds, 2015; Wakefield, Yeudall, Taron, Reynolds, & Skinner, 2007), and the time commitment required to maintain a community garden (Kingsley, Townsend, & Henderson-Wilson, 2009) have increased equity gaps rather than reducing them. Furthermore, an important consideration is the larger number of people that can potentially be reached through household gardening interventions with respect to gardening for food (Das & Ramaswami, 2022; National Gardening Association, 2021). Furthermore, literature has shown community gardens utilizing public land and vacant lots are often not safe from development in cities experiencing urbanization and densification (Bailey & Kingsley, 2022). While resource and land access barriers must be recognized, household

gardening potentially represents a more stable means for gardening access. While more research is needed to evaluate the specific barriers to household gardening as well as effectiveness of household gardening policies and programs, the results from this study suggests equitable EWB benefits can be achieved when household garden policy initiatives specifically target low-income and female residents contingent on the equity of homeownership and availability of space to garden at home. Furthermore, while these benefits are identified, we are not making any claims regarding the rate at which different racial/ethnic and income groups as well as genders actually engage in household or community gardening.

Community gardens also offer access points to food production, overcoming barriers due to ownership, contaminated soil, inadequate resources, and a lack of initial knowledge (Golden, 2013; Firth et al., 2011). Thus, community gardens can also improve equity outcomes in their own way. Yet, literature suggests these equity outcomes should not be assumed, as community gardens have been identified as places of exclusion (e.g., across income and race/ethnicity) as well as inclusion (Kingsley, Foenander, & Bailey, 2020; Egerer & Fairbairn, 2018; Diaz, Webb, Warner, & Monaghan, 2018). Thus, urban planners need to consider the different mechanisms and benefits offered by both modes of gardening to plan large scale interventions. Programs and investments must be made based on the context of the city and the target population of the EWB benefits.

4.2. Limitations

This study makes key contributions to the understanding of household and community gardening's association to EWB in the context of other daily activities; yet there are some limitations. First, while the sample of the study demographics closely reflects the ACS 2016 5-year estimates for the Minneapolis-St. Paul metro area, the relatively small sample size means the results must be interpreted with caution. Small sample sizes are noted in many other studies of gardening because of the recruitment difficulties noted previously. Second, while the team worked to overcome selection bias in the recruitment process, there are a few potential sources of bias. In the first recruitment class (household gardeners), potential participants who were not comfortable reaching out to the research team may have been excluded, as they were prompted to contact the team and were not recruited directly. In the second recruitment class (community gardeners), since participants were mainly recruited through garden managers or organizers, potential participants who did not already belong to one of these gardens may have been excluded, but this risk is minimized since of the 55 community gardeners included in the study 40 different community gardening locations were represented. Third, since the study utilized the phone-based app Daynamica™, potential participants uncomfortable with the use of smartphones may also have been excluded from the sample population.

4.3. Future work

Future work should focus on three avenues. First, studies should advance and replicate the work presented here to see if similar patterns are seen more broadly. Second, our discussion has revealed that the choice between community gardeners and household gardeners are influenced by the number of people and their demographics for which there is a dearth of data. Future studies aimed at collecting more fundamental data regarding the prevalence of engagement in both community and household gardening across socio-demographic characteristics will be needed to understand the representativeness of this study across differing populations and to orient studies replicating this methodology. By first better understanding who is gardening where, researchers can better understand the benefits (EWB and otherwise) they are gaining through gardening. New ways to engage community gardeners while alleviating concerns regarding garden-level and/or individual-level sampling bias will also need to be addressed.

Finally, this paper opens up new lines of enquiry for the link between gardening and EWB outcomes vis a vis companionship and more fundamental questions as to why people garden. Companionship has been emphasized as one of the key factors associated with community gardening; however, our study shows that community gardeners garden with company less frequently than household gardeners. The lower frequency of companionship observed for community gardeners might also be indicative of the allotment-style of the gardens, where individuals are not gardening one plot communally but are gardening individual plots at the site. Future work could explore this phenomenon more closely to better understand how the EWB benefits of community gardens are associated with the communal aspect of the garden. This can be achieved, in part, by qualitatively studying and comparing the motivations of each type of gardener.

5. Conclusion

Urban food production has been associated with economic, sustainability and social benefits, but health and well-being benefits have been suggested as the clearest benefits of urban food production (Bailey & Kingsley, 2020; Booth et al., 2018; Santo et al., 2016; Alaimo et al., 2016). As cities begin to include livability goals in their strategic plans and sign on to the Milan Urban Food Pact to capture these benefits, there is little empirical data on the influence of spatial scale—whether community or household gardening—on EWB benefits of gardening; therefore, this study directly compared household and community gardeners across their demographics and interactions with the garden; five EWB measures while gardening in the context of daily activities; and demographics and companionship associations with EWB scores while gardening. This resulted in five main takeaways:

- Both household and community gardens have similar or greater happiness benefits compared to biking and walking.
- Compared to household gardeners, community gardeners report significantly higher net affect and peak meaningfulness while gardening.
- Community gardening net affect is negatively correlated with family-companionship and positively correlated with neighbor-companionship; household gardening net affect showed no correlation with companionship.
- For household gardeners, low-income and female participants reported significantly higher net affect scores than their counterparts, but not for community gardeners.
- Both household and community gardens can advance social equity, although in different ways.

Therefore, household and community gardens should be considered among other more traditional, urban, leisure-activity infrastructure such as biking and walking. Despite their similar levels of EWB compared to other leisure-activities, biking and walking currently have greater attention from policy makers looking to invest in infrastructure. Additionally, the EWB benefits of both household and community gardening investments should be seen as complementary, not competing especially in situations where urban densification is expected (Bailey & Kingsley, 2022; UN International Resource Panel, 2021). While many practitioners point to community gardening as a means to advance equity (regarding land access and social connectivity), household gardens show significant EWB benefits for low-income and female gardeners, proving to be an additional source for potential equitable EWB benefits.

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.

Data availability

Data is available from authors upon reasonable request.

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Author Contributions

AR and GA conceptualized and led the gardening aspects of the study; YF and KD conceptualized and led the emotional wellbeing aspects of the study; GA and KD implemented the project; GA and AR conducted a majority of the analysis and wrote the bulk of the paper; YF and KD reviewed and participated in the editing of the paper.

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