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Impacts of Community Gardens on Overall Health Promotion in Regard to Dietary Behaviors and Physical Activities: Emphasis on Moderated Mediation

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IMPACTS OF COMMUNITY GARDENS ON OVERALL HEALTH PROMOTION IN REGARD TO DIETARY BEHAVIORS AND PHYSICAL ACTIVITIES: EMPHASIS ON MODERATED MEDIATION

CHENG YI HO

60 Pages

Introduction: The purpose of this study was to investigate how community gardening participation impacts and benefits the health of various populations on their fresh produce consumption and physical activities. This study was designed to identify innovations to reduce the barriers of participation in community gardening.

Methods: This study was approached via moderated mediation, which identifies the moderating effect on direct and indirect paths among variables. The predictor variable (X) was level of participation in community gardens, and the overall health outcome was regarded as the outcome variable (Y). Between X and Y, the variety of grown produce was considered as the mediator while the highest nutrition education was the moderator.

Results: Analysis revealed that there were no significant statistical relationships regarding moderated mediation. However, the direct moderating effect between X and Y was revealed to be statistically significant ($t = -2.2066$, $p < .05$) at the mean of moderator. Another significant correlation was shown between the level of participation and the overall health outcome (coefficient = -.2716, $p < .05$).

Conclusion: Overall, most regressions, mediation, and moderated mediation among benefits generated by community gardening were not significantly revealed in this study

although the moderating effect of highest nutrition education was revealed. Perhaps the statistical insignificance of the data can be explained by the difference of research settings. Other studies investigating mediation or moderation of community gardens' benefits applied intervention to the same group of individuals and therefore more apparent and clear development shown. Even though this study did not show that overall health outcome can keep improving as participation levels elevated in statistical sense, positive health impacts of community gardening were still revealed via community gardeners' perceptions. This study also showed that nutrition education has potential to be considered as a moderator in community gardening to optimize disease management and prevention with a more comprehensive understanding.
KEYWORDS: moderated mediation; community gardening; disease management; nutrition education; overall health outcome; level of participation; grown produce

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CHAPTER I: IMPACTS OF COMMUNITY GARDENS ON OVERALL HEALTH PROMOTION IN REGARD TO DIETARY BEHAVIORS AND PHYSICAL ACTIVITIES: EMPHASIS ON MODERATED MEDIATION

Introduction

Over the last few decades, the growth of type-2 diabetes has been vigorous among different populations regardless of education levels and ethnic categories. The diagnosed population, which used to be considered older adults, is becoming younger. Present studies revealed a significant increase among the age category 10 to 19 years old, which are typical children and adolescent (Centers for Disease Control and Prevention [CDC], 2020). Research revealed that within the diabetes-diagnosed population of age 18 or older, overweight status was found in 89% along with 38% having physically inactive lifestyles (CDC, 2020). Dietary behaviors and physical activity are critical for the public to manipulate diabetes incidences and to restore the curve of the type-2 diabetes rate.

In the United States, 34.2 million people of all ages have diabetes, which is equal to 10.5% of the US population, and 90 to 95% of these diabetes cases are type-2 diabetes (CDC, 2020). The World Health Organization (WHO), too, indicates that the number of people with diabetes has risen to 422 million globally, which is a significant increase compared to the year 1980 when there were 180 million people with diabetes (WHO, 2016). Besides, approximately 1.5 million deaths in 2019 occurred due to diabetes directly (WHO, 2021).

Patients with type-2 diabetes can experience severe physical changes, and they require rigorous lifestyle control, including healthy eating patterns and managed exercise habits. Some even need certain medications and insulin treatments (American Diabetes Association [ADA], n.d.; WHO, 2016). The WHO suggests that the risk of diabetes can be prevented by proper

vegetable and fruit consumption, practicing regular physical activities, and healthier lifestyles like gardening (WHO, 2016). The prevention and disease management of type-2 diabetes can be extensive and complicated depending on strategies applied. Gardening interventions create significant interactions that impact real-life experiences as well as social interaction. Gardeners can also establish a connection with nature while health is improved (Alaimo et al., 2016). Unlike other novel inventive interventions for type-2 diabetes, gardening infuses new concepts and returns to the most natural way to achieve illness prevention and to develop healthier lifestyles. The public can also benefit by gardening of any scale in the way of increased access to affordable produce (Herrmann, 2015). The purpose is to create establishments of healthier eating patterns, cooperative relationships with nature, and the awareness of where foods come from.

Community gardens will be the focus of the current investigation due to the wide range of social dimensions and more innovative platform for healthier lifestyles to develop (Butterfield, 2020). In terms of type-2 diabetes prevention, the aim of this research is to investigate how gardening experiences impact different populations on their fresh produce consumption and physical activities associated with type-2 diabetes interventions in the way of identifying the mediating and moderating factors to enhance the impact of health promotion through community garden participation.

Literature Review

Horticultural Experience in terms of Health Promotion

Horticulture in nutrition is a concept in which nutrition knowledge, healthy environments, and systematic support are used as means to impact dietary behavior change, and thus, health status is more likely to be promoted. Studies indicate that mediators between programed gardening and the change of dietary eating behaviors include nutrition knowledge,

produce preference, and self-efficacy (Poston et al., 2005; Kim & Park, 2020). Not only are nutrition benefits often reported in studies, but also other behaviors are impacted by gardening intervention. Horticultural experience has been shown to have significant association with humans' behavior change including the increase of satisfaction, social participation, and health as well as the promotion of emotional and cognitive functions (Litt et al., 2015). The improvement of social, physical, and psychological health by the participation of regular gardening were also indicated in research (Soga et al., 2017; Barnidge et al., 2013; Algert et al., 2016; Draper & Freedman, 2010). However, another study revealed that there may be behavior changes after gardening intervention, but the consumption of vegetable and fruit and the participants' nutrition knowledge did not seem to be altered (Poston et al., 2005). Perhaps, the contradictory results from different studies may indicate that there are understudied mechanisms between the gardening participation and the perceived benefits, such as increased physical activities and fresh produce consumption.

The Emphasis of Community Garden Participation and the Benefits of Physical Health

The benefits related to physical health, including increased physical activities and fruit and vegetable consumption, have been widely investigated, and increased understanding has been developed during the last few decades (Barnidge et al., 2013; Algert et al., 2016; Hartwig & Mason, 2016; Bussell et al., 2017; Ornelas et al., 2018; Yip et al., 2019). Besides the overall increased physical health, food knowledge and nutrition intakes were also reported in recent research of participation in community gardens (Malberg Dyg et al., 2020). Algert et al., (2016) additionally indicated that food access becomes more secure due to the development of community gardens. Some studies were conducted to identify more detailed health impacts through community garden intervention. One study indicated that both consumption and

availability of fruits and vegetables were increased due to the intervention. Also, participants' health conditions, such as BMI and obesity, were also reported to be improved (Castro et al., 2013). In terms of type-2 diabetes prevention, HgA1c reduction also takes place within the context of increased access to healthier food and cardiovascular exercise provided by community gardening even though it only represents the impact on a certain population (Weltin et al., 2012).

Despite similar outcomes of physical health promotion such as increased fruit and vegetable consumptions and physical activity from the variety of research, there seems to be a lack of understanding regarding the mediating mechanisms behind the physical health benefits of participating in community garden. For instance, one study indicated that the greater frequency of gardening participation may induce the beneficial effect of reaching adequate natural fruit and vegetable consumptions (Loso et al., 2018). Gunderson & Acheson (2015) also pointed out that the frequency and type of produce may induce different levels of effectiveness of community garden. The research then stated that the result of teaching and growing greens was revealed to be more effective than the outcome of using sweet corn (Gunderson & Acheson, 2015). Moreover, not only the actual consumption of fruit and vegetable was revealed as an increased benefit, but the impact on the perception of the fresh produce consumption was also reported. Barnidge et al. (2015) emphasized that the incorporation of nutrition education and access to fresh produce in community garden intervention has potential to manipulate the perceptions of fruit and vegetable consumptions. Another study reported that the level of participation in gardening should be a consideration that determines the outcomes of community gardens related to healthy behaviors, such as vegetable intakes, although the significant difference was only revealed between occasional participation and non-participation (Booth et al., 2018).

Mediating and Moderating Factors

Since a major population that participates in the development of community gardens tends to be low-income residents or individuals with limited resources as well as minority backgrounds (Butterfield, 2020; Castro et al., 2013; Malberg Dyg et al., 2020), understanding the mediating mechanisms behind the health impacts provided by the participation in community gardens may help enhance the efficacy of the support generated by community gardens and reduce the barriers for the population in need. Regarding the mediating factors between gardening participation and health promotion, little amount of research literature was found. An integrated study conducted by Kim & Park (2020) reported that when dietary self-efficacy, vegetable preference, and knowledge of nutrition and gardening were examined as mediating factors in gardening interventions, a positive correlation with expected outcomes of consumption in fresh vegetables was revealed. However, the existing research of mediating factors in gardening participation tends to focus more on younger ages, such as in school gardening or youth, or on certain populations (Kim & Park, 2020; Barnidge et al., 2015). Besides, most investigations associated with mediating factors were conducted with pre-post-test approach or randomized controlled trials (Kim & Park, 2020; Barnidge et al., 2015; Litt et al., 2018). Even though nutrition education was mentioned in research, most are related to the effect of the additional intervention of nutrition education rather than previous experience in nutrition education (Barnidge et al., 2015; Gunderson & Acheson, 2015). The dimension of social systems in community gardens was discussed in some previous studies. A study conducted by Litt et al. (2018), for instance, investigated three mediators that included self-efficacy, social support, and perceived obstacles in the perspective of potentially influencing fruit and vegetable consumption related to community garden participation, yet the trial is still ongoing. Despite the emphasis of

mediating factors in that study, mediating factors associated with gardening activities itself in community garden are still not clearly addressed. Moderation was shown in previous research as well, but it has not been sufficiently addressed although it was mentioned in some weight managements or nutrition programs (Lautenschlager & Smith, 2007). Other studies also address the moderating effect of participating in community gardening, such as physical influence or dietary impacts, but the moderating effect between gardening participation and its health benefits were not clearly demonstrated (Northrop et al., 2013; Koay & Dillon, 2020). Therefore, the mechanism between the relationship of community gardening participation and increased health outcome still awaits to be answered from the perspectives of agriculture, psychology, education, and nutrition.

Objectives

Therefore, this study focused on the research deficiency of mediating and moderating factors between the participation and physical health promotion within community gardens by investigating changes in gardening behaviors. The behavioral changes in gardening included gardeners' previous nutrition education, their level of participation in gardening, and types of produce grown in their community gardens (Booth et al., 2018; Barnidge et al., 2015; Gunderson & Acheson, 2015), and the mediating as well as moderating factors were tested. Meanwhile, the outcome of health promotion generated by the participation, including fruit and vegetable consumption and physical activity, was examined in this study.

Hypothesis 1. The level of participation in community gardens can provide a statistically significant impact on health status.

Hypothesis 2. Previous nutrition education can perform moderating effects while the variety of grown produce performs mediating impacts to the relationship between the level of participation in community gardens and health status.

Methods

Sample

The sample collection of this study took place from May to October during 2021. The participants were invited through email from community gardens in different areas around the U.S. The connection between gardeners and the researchers was made through administrators of the community gardens. A map on the community garden association's website (n.d.) was employed and referred to for collecting additional contact information of different gardens. The original sample size had 98 responses, but after the data trimming process, there were 74 completed surveys collected to contribute to valid analysis for the present study.

Procedures

The study was conducted in a quantitative approach by using a survey questionnaire which sought to identify the mediating and moderating variables as well as to confirm the outcome variables. The consent form of the survey was included on the first page of the survey which required participants' confirmation to begin the survey (Appendix B). The invitation letter and survey link were first sent to the administrators of the community gardens (Appendix A). Then, the email invitation with a survey link was forwarded by the garden administrators to gardeners of their community gardens. The survey was approved by the institutional research board (IRB) and collected through Qualtrics, an online survey tool. The completion of the survey required 10-15 minutes.

Instrumentation

Volunteers' Survey Questionnaire

Within the theoretical framework of mediating and moderating factors between community garden participation and health promotion (Figure 1), the survey questionnaire focused on gardeners 'level of participation, previous experience in nutrition education, and preference of fresh produce to grow. The research also measured how the participation in community gardens influenced the consumption of fruits and vegetables and the level of physical activity among participants. The survey questionnaire with overall 30 questions was developed based on the research purpose along with references which included a previous research questionnaire created by Bussell et al. (2017) and another questionnaire created by Algert et al. (2016).

Demographic. Participants were asked information related to their sex, ethnicity, age, education levels, and household's income levels. They were also asked whether they have had experience in nutrition education previously and where they received it. Their weight and height are also part of the questionnaire which was used to calculate their Body Mass Index (BMI). There were overall 13 demographic questions. Within these questions, their highest nutrition education was applied to be a moderator in the study. The coded scale of this moderator is shown below:

0 = no previous experience; 1 = elementary school; 2 = middle school; 3 = high school; 4 = undergraduate school; 5 = graduate school; 6 = workshops

Then, three variables including overall health outcome, level of participation, and variety of grown fruits and vegetables below were calculated for a z-score and mean value. The

Cronbach's alpha (α) output of these three variables was also calculated to determine the reliability of the combined items within each variable.

Overall Health Outcome. This variable targeted participants' perceived benefits in community gardens. They were first asked to identify perceived benefits in their gardening involvement. They were then asked whether their households had eaten healthier since their participation in community gardens and whether gardening participation increased the consumption of fruits and vegetables in their households. Participants were also asked to describe how their physical activity level was impacted by their participation in the community garden. This variable included four questions overall which were recoded into certain scales. The original Cronbach's alpha (α) was insufficient in regards to the reliability, so one item was then removed to increase the alpha value. The Cronbach's alpha (α) for overall health outcome was .59, and its mean inter-item correlation was .327. Below were the score recoding process for each item in this variable:

"Response to benefit of physical activity level" was coded into: 1= extremely unlikely; 2 = somewhat unlikely; 3 = neither likely nor unlikely; 4 = somewhat likely; 5 = extremely likely

"Response to household eating" was coded into 1 = much worse; 2 = somewhat worse; 3 = about the same; 4 = somewhat better; 5 = much better

"Response to household's consumption of vegetables and fruits" was coded into 1 = much lower; 2 = slightly lower; 3 = about the same; 4 = slight higher; 5 = much higher

"Response to rating overall health" was coded into 1 = terrible; 2 = poor; 3 = average; 4 = good; 5 = excellent

Level of Participation. Participants were asked about their gardening involvement including their gardening experiences and motivations, frequency of attending the garden, and

duration of each gardening activity. This variable contained four questions that were recoded into certain scales. The original Cronbach's alpha (α) was insufficient for acceptable reliability, so one item was removed from the variable to increase the alpha value. In the present study, the Cronbach's alpha (α) for this variable was .70. Below were the score recoding process for each item in this variable:

"Years of gardening at this location" was coded into 0 = N/A; 1 = <1 yrs; 2 = 1-2 yrs; 3 = 3-4 yrs; 4 = 5-6 yrs; 5 = 7-8 yrs; 6 = 9-10 yrs; 7 = more than 10 yrs.

"Numbers of the month during a year" was coded by numbers from 1 to 12 that were entered by the participants.

"Frequency of visiting the garden during the growing season, E.g. everyday, once a week, twice a week, every two weeks" was coded into 1 = less than once a week; 2 = at least once a week; 3 = daily.

"Hours spent in the community garden per week" was coded into 1 = less than 1 hour; 2 = 1-4 hours; 3 = 5-10 hours; 4 = more than 10 hours.

Variety of Grown Vegetables and Fruits. Participants were asked questions that explored the variety of the produce and preferable types of produce grown in community gardens. They were also asked whether they grow herbs and if so, which herbs. There are three questions in this variable. The rationale for testing this variable was to allow participants to list out the preferable or likely grown produce, and the collected data was categorized into groups. Each group were then be recoded different score values for data analysis. The Cronbach's alpha (α) for variety of grown vegetables and fruits is .61, and its mean inter-item correlation value is .353. Below were the score recoding for each item in this variable:

"Different fruits" was coded into 0 = 0 types; 1 = 1-3 types; 2 = 4-6 types; 3 = 7-9 types; 4 = more than 9 types.

"Different vegetables" was coded into 0 = 0 types; 1 = 1-3 types; 2 = 4-6 types; 3 = 7-9 types; 4 = more than 9 types.

"Different herbs" was coded into 0 = 0 types; 1 = 1-3 types; 2 = 4-6 types; 3 = 7-9 types; 4 = more than 9 types.

Data Analysis

The study was conducted via a quantitative methods approach within a theoretical framework associated with mediating and moderating factors between level of participation in a community gardens and health promotion. It was hypothesized that the participation in community garden can positively influence gardeners' health status. Additionally one variable, fruits and vegetables that are grown, was hypothesized to act as mediating factors. Another variable, highest nutrition education, was hypothesized to moderate the direct and indirect relationships between the predictor variable and outcome variable. The data analysis of moderated mediation was used in order to determine if the mediating variable and moderating variable had statistical significance on the outcome variables of health promotion, including increased fruit and vegetable consumptions as well as physical activities.

Each variable contained at least three items or more. Cronbach's alpha (α) values were assessed for each variable in order to determine the reliability. The acceptable Cronbach's alpha value (α) is commonly suggested to be above .7, but fewer items in a variable may result in lower values of Cronbach alpha (Pallant, 2010; DeVellis & Thorpe, 2021; Tavakol & Dennick, 2011; Nunnally, 1978). When .7 of α did not take place, the assessment in this study aimed for

Cronbach's alpha value > .5 to determine the reliability of the test along with the mean inter-item correlation (Pallant, 2010).

To examine the research questions, whether *Vegetables That Are Grown* (mediating variable) mediate, and *Previous Experience in Nutrition Education* (moderating variable) moderate the relationship between *the Level of Participation in Community Gardens* (independent variable) and *Overall Health Outcome* (dependent variable), a moderated mediation following the guidelines established by Baron and Kenny (1986) and the guidelines established by Hayes (2013) was assessed. SPSS 26 was used for statistical analysis.

Then in order to address both question 1 and question 2 in this study, SPSS PROCESS macro model 59 was conducted to assess mediation and moderation effect among variables following the guidelines indicated by Hayes (2013) along with additional guidelines that were indicated by Hayes (2018) and Hayes and Montoya (2017). An alpha of .05 was used when assessing statistical significance, meaning p value < .05. A statistical diagram of the moderated mediation analysis is shown in Figure 2. In Figure 2, there were eight paths to be analyzed for statistical significance. Hypothesis 1 was answered by path C1. Hypothesis 2 was then answered by path A1, A2, A3, B1, B2, C2, and C3.

H1: The level of participation in community gardens is statistically significantly related to participants' health status.

C1: Level of participation is statistically significantly related to overall health outcome.

H2: Previous nutrition education can perform moderating effects while the variety of grown produce performs mediating impacts to the relationship between the level of participation in community gardens and the health status.

A1: Level of participation is statistically significantly associated with variety of grown produce.

A2: Highest nutrition education is statistically significantly associated with variety of grown produce.

A3: The interaction between level of participation and highest nutrition education is statistically significantly associated with variety of grown produce.

B1: Variety of grown produce is statistically significantly associated with overall health outcome.

B2: The interaction between variety of grown produce and highest nutrition education is statistically significantly associated with overall health outcome.

C2: Highest nutrition education is statistically significantly associated with overall health outcome.

C3: Level of participation is statistically significantly associated with overall health outcome.

Results

Descriptive Information

This study indicates the result analyzed from the sample size of N = 74. Table 1 reveals the demographic information of the participants collected around the U.S through a quantitative survey. The demographic characteristics included ages, gender, race, ethnicity, education levels, and household income. Their levels of participation in gardening activities at their current locations were shown in Table 2. According to the survey, their frequency of visiting during the growing season had 83.8% of them answering '*less than once a week*.' 12.2% of them answered '*At least once a week*,' and 4.1% of them did not answer the question.' Additionally, over half of the participants in this study have at least one year of experience in gardening at their current locations. Most of their experience ranged from less than 1 year to 6 years, and there were 30% of them that had experience of more than 10 years.

Table 1. Demographic Characteristics

Total Participant (*N* = 74)		*n*	*N %*
Ages	Under age 21	0	0.0
	Age 21-40	17	23.6
	Age 41-64	31	43.1
	Age 65 and over	24	33.3
	Total	72	100.0
Gender	Male	25	33.8
	Female	49	66.2
	Trans male/ Trans man	0	0.0
	Trans female/ Trans woman	0	0.0
	Genderqueer/Gender non-conforming	0	0.0
	Different identity	0	0.0
	Total	74	100.0
Race	White	70	94.6
	Black or African American	1	1.4
	American Indian or Alaska Native	0	0.0
	Asian	1	1.4
	Native Hawaiian or Pacific Islander	0	0.0
	Mixed Race	2	2.7
	Other	0	0.0
	Total	74	100.0
Ethnicity	Hispanic/Latino	0	0.0
	Non-Hispanic/Latino	64	100.0
	Total	64	100.0
Education Levels	Less than high school	0	0.0
	High school graduated or GED	0	0.0
	Complete some college	4	5.4
	Associated degree	4	5.4
	Bachelor's degree	20	27.0
	Graduate degree/Master's/Ph.D	46	62.2
	Total	74	100.0
Household Income (per month)	$0 - $399	1	1.4
	$400 - $799	1	1.4
	$800 - $1,249	3	4.2
	$1,250 - $1,649	1	1.4
	$1,650 - $2,099	5	6.9
	$2,100 - $2,899	7	9.7
	$2,900 - $3,749	9	12.5
	$3,750 - $4,599	11	15.3
	$4,600 - $5,399	6	8.3
	$5,400 - $6,249	5	6.9
	$6,250 - $8,399	8	11.1
	$8,400 and over	15	20.8
	Total	72	100.0

Table 2. Level of Participation

Total Participant (*N* = 74)		*n*	*N%*
Frequency of visiting during the seasons	N/A	3	4.1
	Less than once a week	62	83.8
	At least once a week	9	12.2
	Total	74	100
Period of gardening at this location	< 1 year	11	15.7
	1-2 years	10	14.3
	3-4 years	13	18.6
	5-6 years	9	12.9
	7-8 years	2	2.9
	9-10 year	4	5.7
	more than 10 years	21	30.0
	Total	70	100

Inferential Analysis

The analysis aimed to interpret two hypotheses in this study. *H1: The level of participation in community gardens can enhance health status. H2: Previous nutrition education can perform moderating effects while the variety of grown produce performs mediating impacts to the relationship between the level of participation in community gardens and the health status.* This study analyzed the statistic relationship between four variables for testing moderated mediation including level of participation (predictor), overall health outcome (outcome), variety of grown vegetables (mediator), highest nutrition education (HNE, moderator). In terms of variable measurement, level of participation (LOP) was measured by frequency and endurance of gardening. Health outcome (OLH) was measured by asking the increase of fruit and vegetable consumption of the household, physical activity levels, eating pattern, and perceived overall health. Grown produce variety (VOG) was measured by types of vegetables, fruits, and herbs grown in participants' gardens. Nutrition education level (HNE) was measured by items related

to previous nutrition education experience. The conceptual diagram of moderated mediation is shown in Figure 1, and the statistical diagram for this moderated mediation is shown in Figure 2.

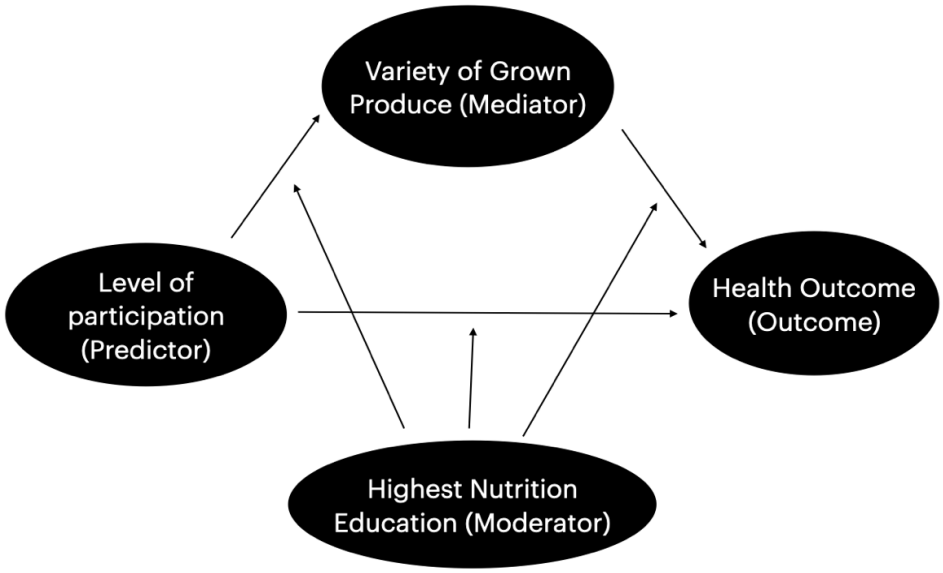

Figure 1. Conceptual Diagram for Moderated Mediation Analysis. M mediating the relationship between IV and DV while W moderating paths a, b, and c using the guidelines of Hayes (2013).

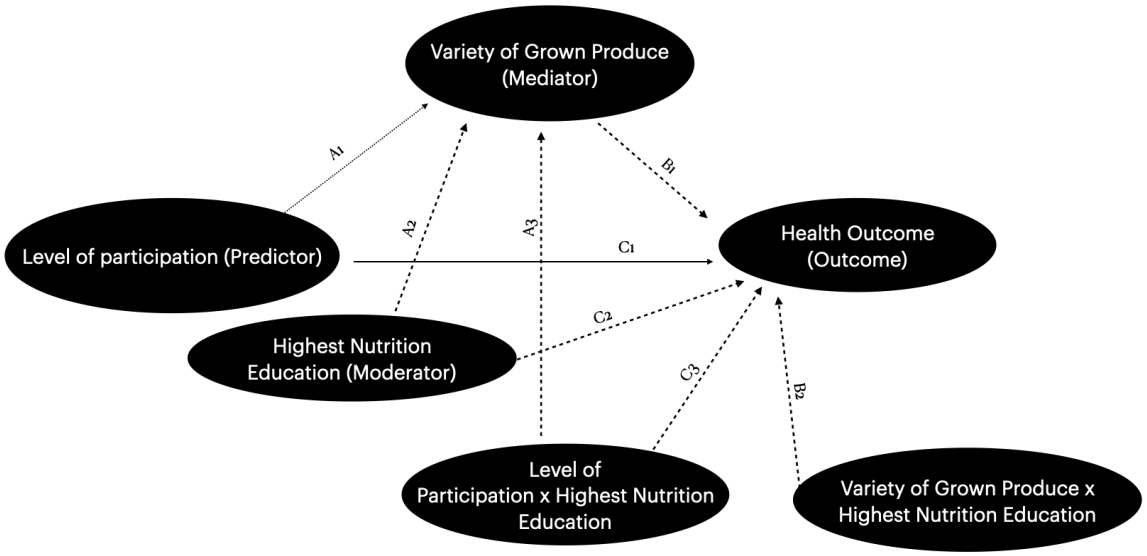

Figure 2. Statistical Diagram for Moderated Mediation. Using the guidelines of Hayes (2013).

Moderated Mediation

Moderated mediation indicates the relationship between variables in the way that the paths are moderated under mediation. The results were analyzed by SPSS macro PROCESS model 59, which tests whether both direct and indirect paths are statistically significantly affected by moderators. The statistical diagram for this moderated mediation is shown in Figure 2, and the result is summarized and presented in Table 3. As a result, no statistical significance was shown based on the analysis in terms of moderated mediation. The only statistical significance took place between level of participation (predictor variable) and overall health outcome (outcome variable). The results showed that the coefficient between X (predictor variable) and Y (outcome variable) is statistically significant and negative (C1 = -0.2716, p = 0.0312), meaning that the overall health outcome decreases while the level of participation in community gardening increases. On the other hand, result showed that path A1, A2, A3, B1, B2, C2, and C3 were statistically insignificant (Table 3).

Despite the fact that there were only a few statistically significant regressions within the moderated mediation model, deeper understanding of the moderating effect in the model can be revealed in Figure 3. The pick-a-point approach was employed for describing the conditional effect and interaction in these regressions within the research model (Bauer & Curran, 2005; Hayes, 2013; Hayes 2018; Hayes & Montoya, 2017; Hayes & Rockwood, 2017; Rogosa, 1980). The slopes in plot A indicate that LOP and VOG are positively correlated even though their relationship is not statistically significant (p = .2826). The moderating effect also does not exist between the relationship of LOP and VOG. Likewise, plot C indicates neither correlations nor moderated mediation taking place. The slopes in plot B show that the relationship between LOP and OLH is negative and when moderator (HNE) is higher, the slope tends to be more negative.

From these three plots shown in Figure 3, the interaction from the moderator (HNE) can be observed although they are not statistically significant except for plot B. According to Table 3, *p* values and coefficient values show that there are no significant regressions between these four variables except for the relationship between level of participation (LOP) and overall health outcome (OLH). Even though statistical significance was not revealed in any interactions between moderator (HNE) and other variables, highest nutrition education (HNE) had a statistical significant effect on the direct path between level of participation (LOP) and overall health outcome (OLH) at the mean of moderator (HNE) (b = -.2716, s.e. = .1231, $p < .05$) (Table 4). Moderation is statistically significant between X and Y, whereas moderated mediation was not shown in the result. In other words, highest nutrition education (HNE) can be regarded as a moderator between X and Y. However, this moderator does not affect the mediation in the model.

Table 3. Result of Moderated Mediation

	Variety of Grown Produces (Mediator)					Overall Health (Outcome)				
		coeff	se	*p*	Result		coeff	se	*p*	Result
Level of Participation (Predictor)	A1	0.1374	0.1267	0.2826	Not significant	C1	-0.2716**	0.1231	0.0312	Significant
Highest Nutrition Education (Moderator)	A2	0.0785	0.0429	0.0720	Not significant	C2	0.0115	0.0418	0.7848	Not significant
Level of Participation x Highest Nutrition Education (Predictor x moderator)	A3	-0.0625	0.0495	0.2113	Not significant	C3	-0.0389	0.0489	0.4303	Not significant
Variety of Grown Produces (Mediator)		—	—	—	—	B1	-0.0211	0.1227	0.8643	Not significant
Variety of Grown Produces x Highest Nutrition Education (Mediator x moderator)		—	—	—	—	B2	-0.0169	0.0510	0.7413	Not significant

** ***P*** **< .05**

Table 4. Conditional Direct and Indirect Effect (s) of X on Y
Conditional direct effect (s) of X on Y:

	HNE	Effect	se	t	P	LLCI	ULCI
Mean - SD	-1.0001	-0.1833	0.1432	-1.2802	0.2054	-0.4697	0.1031
Mean	0.0000	-0.2716**	0.1231	-2.2066	0.0312	-0.5179	-0.0254
Mean + SD	1.0001	-0.3600	0.1860	-1.9359	0.0576	-0.7320	0.0120

Conditional indirect effect (s) of X on Y
LOP —> VOG —> OLH

	HNE	Effect	BootSE	BootLLCI	BootULCI
Mean - SD	-1.0001	0.0049	0.0867	-0.2187	0.1399
Mean	0.0000	-0.0029	0.0288	-0.0799	0.0413
Mean + SD	1.0001	0.0003	0.0273	-0.0588	0.0551

**** $p < .05$; X = Level of Participation (LOP); Y = Overall Health Outcome (OLH); HNE = Highest Nutrition Education**

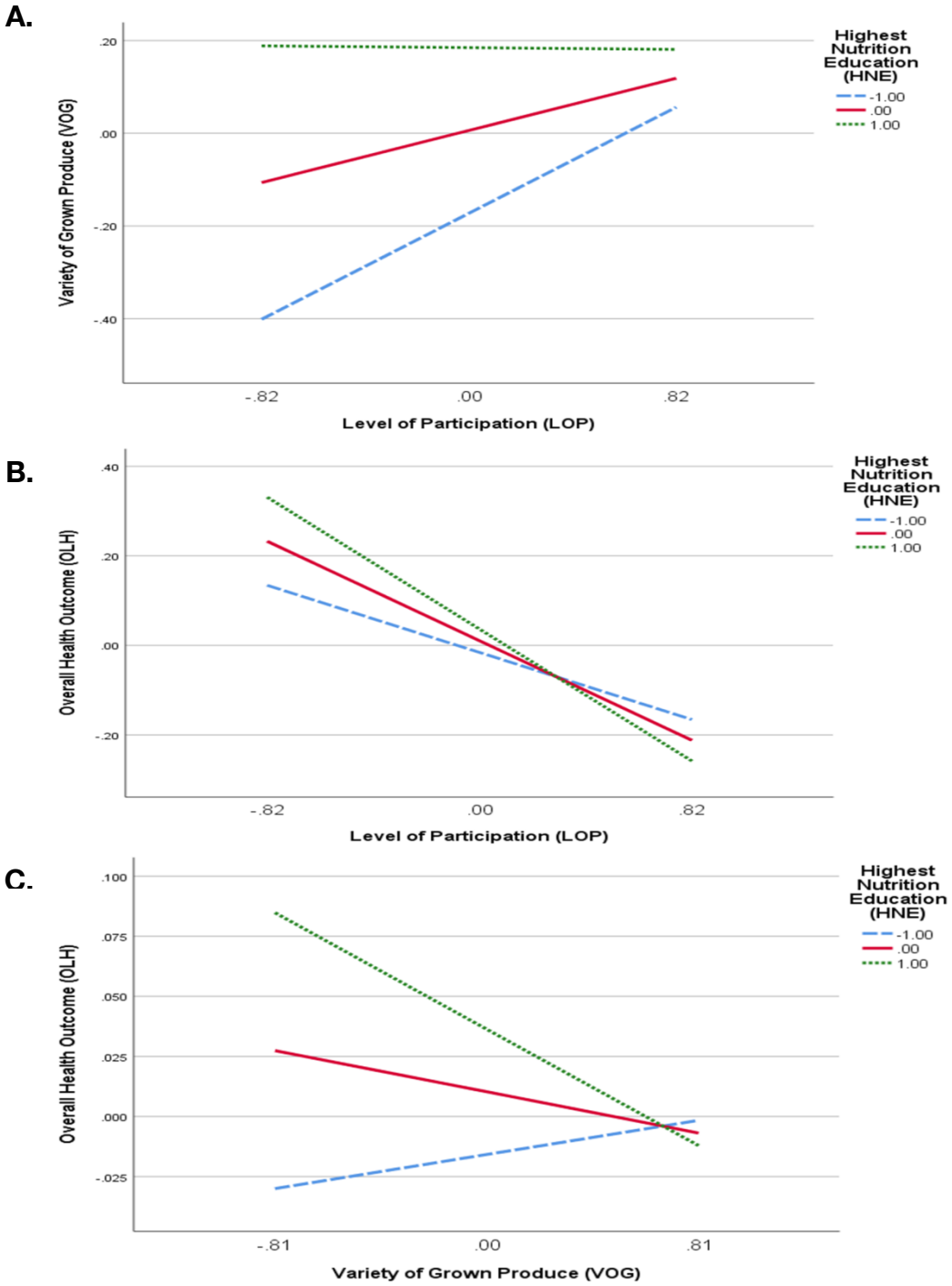

Figure 3. Plot A, B, and C for Moderated Mediation. Plot A describes the relationship between X and mediator. Plot B describes the relationship between X and Y. Plot C describes the relationship between mediator and Y. All three plots have highest nutrition education (HNE) as a moderator that defines the lines in each plot. Level of Participation (LOP); Variety of Grown Produce (VOG); Overall Health Outcome (OLH); Highest Nutrition Education (HNE).

Discussion

Recent research has been validating the positive health impact on community garden participants, including enhanced physical activity and fruit and vegetable consumption (Barnidge et al., 2013; Algert et al., 2016; Hartwig & Mason, 2016; Bussell et al., 2017; Ornelas et al., 2018; Yip et al., 2019). Different from most previous studies, this study did not apply the comparison between pre- and post- tests (Kim & Park, 2020; Barnidge et al., 2015; Litt et al., 2018). In other words, intervention was not provided to the participants, and they were also gardeners with certain levels of experience. Thus, individuals in this study might instead have different starting points in their experience of community gardening, and this difference was likely to result in deviation when analyzing the evaluation of the benefits and the difference between each participant's perceptions on their experience in community gardening.

The result of this study indicates that the relationship between level of participation in community gardening and overall health outcome is statistically significant and negative. In turns, previous research revealed that the participation of community gardening can positively impact the physical activity level and consumption of fresh produce (Barnidge et al., 2013; Algert et al., 2016; Hartwig & Mason, 2016; Bussell et al., 2017; Ornelas et al., 2018; Yip et al., 2019). Despite the statistical significance of the data in this study, the result however may not necessarily be concluded as a contradicting finding against previous studies by considering the differences of research settings and of sample sizes. Furthermore, it might be suspected that the overall health outcome may not keep increasing as the level of participation in community gardening elevates. The moderating effect of highest nutrition education was validated in this study despite the negative coefficient, and it also did not moderate the mediation within each variable.

From the analysis of this study, there was additional information provided through the survey questionnaire regarding participants' responses toward community garden enhancement (Figure 4). As presented in Figure 4, chart A shows that when the participants were asked about the enhancement of their own health brought by community gardening, 58.1% of *"somehow agree"* and 20.3% of *"strongly agree"* were reported. In terms of family health, 41.1% of *"somehow agree"* and 15.1% of *"strongly agree"* were reported in chart A. That is, over 50% of them believed that there are certain levels of health improvement provided by community gardening. Moreover, their physical activity levels, eating patterns, and F/V consumptions were revealed to be more positively influenced. Chart B shows that 88.0% of them perceived physical activity levels elevated through the participation in community gardening. According to chart C, 55.0% of them reported that better eating patterns developed in their household. Higher consumption of fruit and vegetable was reported by 74.0% of them as shown in chart D. Therefore, although the statistical regressions and research models did not reveal a positive relationship between level of participation and overall health outcome, the improvement of participants' health and community gardening's benefits can still be observed through participants' direct responses (Figure 4).

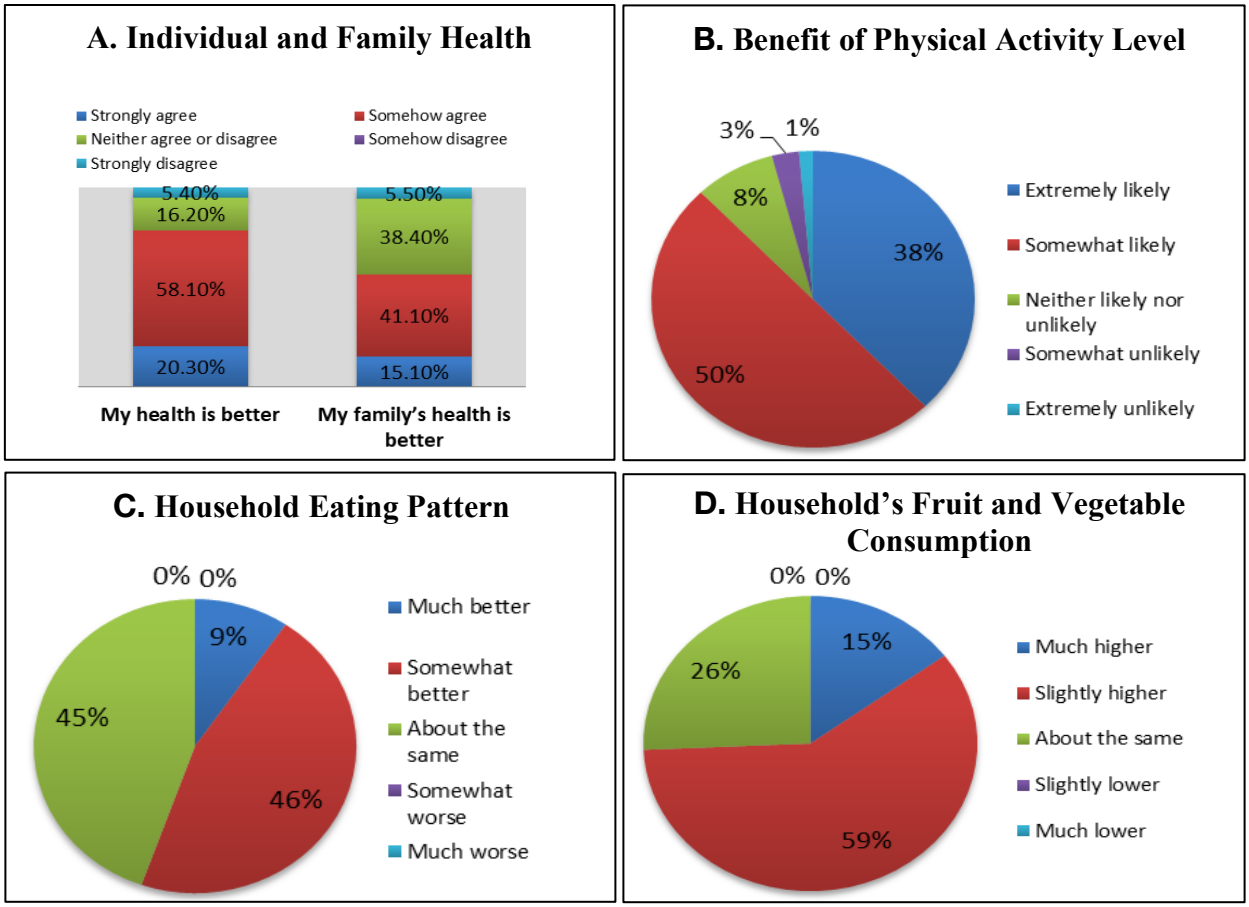

Figure 4. Participants' Responses Toward Community Garden Enhancements. (A) Individual and Family Health; (B) Benefit of Physical Activity Level; (C) Household Eating Pattern; (D) Household's Fruit and Vegetable Consumption.

The mechanism of level of participation leading to health benefits among community gardening has not been clearly demonstrated in this study despite participants' positive perceptions toward their physical health based on their gardening experiences. In previous research, only one study indicated the change of effectiveness of community gardening based on different frequency and types of grown produce (Gunderson & Acheson, 2015). This study however failed to validate that the overall health outcome will increase as the level of participation is elevated. In this case, the small sample size may be considered as a part of difficulty to present statistical regressions over the moderated mediation model, meaning that sample sizes can be a factor that produces impacts on the result predictions and coefficients

(Knofczynski & Mundfrom, 2008). Therefore, greater levels of participation do not reflect a better health outcome. Considering the differences between this study and other previous studies, there can be another aspect. Previous literatures reported that a major population having support from community gardens tends to be individuals with lower incomes and limited resources (Butterfield, 2020; Castro et al., 2013; Malberg Dyg et al., 2020). Based on the participants in this study, 62.2% of them obtain high education levels with master or PhD, and 27.0% are college-graduated (Table 1). Their income levels are mostly over $2900 - $3749 per month. When they were asked the enhancement of participating in community gardening, 68.5% of them strongly agreed with *"enjoy spending time outdoor"* as well as *"relaxation"* with 50%. Additionally, when they were asked the reasons of joining community gardening, less than 30% of them answered *"strongly agree"* on either improving their own health or family health. Therefore, it can be suspected that benefiting health through food and nutrition may not be most of their priority in community gardening, and their healthy food resources may not be highly dependent on community gardens. This study was also participated by different age groups, including 23.6% for *"age 21-40"*, 43% for *"age 41-64"*, and 33.3% for *"age 65 and over"*. It is different from previous studies investigating mediating factors which mostly focused on younger age groups (Benkowitz et al., 2019; Kim & Park, 2020; Landry et al., 2019). This difference may also help explain the statistical insignificance in data analysis regarding meditation.

In addition, this report tends to be more self-assessment oriented, so the standard of their perceptions can be fluctuating. Then it leads to a consideration of the result that each individual does not have the same settings in the research, such as locations, age groups, and environments. That is, in order to validate the linear relationship between level of participation and elevation of overall health outcome, more conditions may need to be taken into account. A relatively smaller

amount of studies investigated the detailed mechanism of how community gardening facilitates health development and internal relationships between different health benefits. This study addressed the potential of nutrition education being incorporated to navigate healthy lifestyles via community gardening although more research needs to be conducted.

Conclusion

This study aimed to explore deeper understanding toward disease management and prevention within the community gardening establishments. The major finding of this study was regarding how the mediating and moderating effects can affect among various benefits of community gardening. These two combined factors may then reveal how current educational systems, community organizations, or local support systems can be developed and improved in the way that people in need can be supported more effectively. Moreover, this study revealed that the variety of produce grown by participants does not have statistical significance on mediating the relationship between level of participation and overall health outcome. This result may imply impacts from agricultural aspects. For instance, the way of growing fruits is widely different from growing vegetables and herbs in regard to weather, technique, space, and knowledge. Therefore, the mediating effect of variety of grown produce in this study tended to be statistically insignificant. Another finding of this study showed that highest level of nutrition education can statistically significantly moderate the relationship between level of participation and overall health outcome. However, due to the statistical difficulty, it is debatable to conclude whether higher nutrition education can lead to greater health enhancement in the participation of community gardening. Gardening activities alone was positively impactful for individual health but limited in terms of positive relationship between levels of participation and health outcomes as well as moderating effect of nutrition education levels.

This study suggests that there can be interactions shown between level of participation, nutrition education, and overall health outcome, so it may be concluded that participants in community gardening can alter the time and direction on their participation to optimize the their physical health impacts from gardening experience. Overall, community gardening surely has potential to play a significant role in improving healthy lifestyles and therefore provides positive impacts on disease management and prevention; from the perspective of moderating effect, nutrition knowledge and education should be taken into account in the way of achieving optimized health impacts generated by community gardening.

Limitations and Implications

This study is limited in ways of describing the more specific changes in benefits of community gardening because it does not provide the comparison between pre- and post-test through interventions. This study also did not further categorize the type of community gardens, and it may result in deviations because the functions of the community garden can vary when different populations are served. For instance, community gardens are designed for purposes of securing food resources, enhancing agricultural benefits, or promoting food education. The survey of this study was also answered by several types of community gardens and that may create differences from studies which focus more on one or a few gardens in a same area. Since the variety of participants in this study is greater than other studies, the assessment of the benefits in community gardening can be more specific and reliable by collecting bigger sample size, controlling more participants' characteristics (e.g. geographical areas, health status, gardening experience, or education levels). Additionally, having similar starting points may facilitate the way that researchers review changes of the post-participation in community gardens. This study also did not investigate different activities operated in their community

gardens, and that may be another reason that the influence of level of participation was not shown because community gardening is not only about gardening activities alone. There can be more dimensions that fluctuate members' participation and health outcomes, such as cooking lessons or any other educational sessions. Therefore, further research should consider other additional activities that may provide benefits to the participation other than gardening activities to enhance the accuracy of the measurement on the interaction between their participation levels and health outcome enhancement.

This study aimed to develop a different lens in community health and further promote changes in community garden settings that can create more practical impacts in individuals' healthy lifestyles. Another important value of this study is that further research may focus on identifying the barriers and strengths by using community gardening as a means to benefit illness management and prevention. In terms of viewing community gardening in different dimensions, the health of the ecosystem may also be considered in future research. The result of this study revealed that participants generally have positive feelings toward their health regarding eating patterns, physical activities, and fruit and vegetable consumption, but the result was not able to verify that more participation can lead to better health outcome. Other side activities should be taken into account because the moderated mediation in this study only demonstrates gardening activities alone. Perhaps, side activities such as sessions of food or other social activities can result in greater influence in their health along with gardening activities. Therefore, exploring a healthy environment as a whole for the community may show health impacts in more different and comprehensive aspects.

CHAPTER II: EXTENDED LITERATURE REVIEW

The Variety of Gardening Intervention

Various environments are constantly used for gardening programs associated with illness prevention and management. These environments include school, family, and community, and therefore, people are able to participate in gardening activities in either the individual or group level. However, the impact between each type of environment may vary and can influence individuals differently despite the same promotion of vegetable and fruit intake. Home gardening was indicated to have significant positive impacts on vegetable and fruit intake regarding their nutrition values (Faber et al., 2002). Community gardens are also regarded as means for people to enhance health status and contribute to other social benefits (Litt et al., 2011). Then School gardening has been a focus currently because obesity and type-2 diabetes have been affecting younger generations more than they used to. School garden has also been reported to provide development of motivating children for gardening and consuming vegetables according to Nury et al. (2017). Social interactions with peers, teachers, and parents are also shown to have improvement in the study (Nury et al., 2017).

Additionally, the gardening experience during college is shown to be related to fruit and vegetable consumption; however, the reoccurring gardening experience seems to be the essential factor that provides sustained benefit (Staub et al., 2019; Loso et al., 2018). Indeed, it is mostly clear that fruit and vegetable consumption is associated with having gardening experience; however, other areas including the length of the gardening experience, the type of produces being grown, and the style of gardening setting seem to need more research. In order to understand the relationship between plant-based food consumption and gardening experience,

more supportive settings and accurate tools are necessary (Benkowitz et al., 2019; Davis & Brann, 2017).

Social Isolation and Psychological Conditions Associated with Type-2 Diabetes Dealt with by Gardening Interventions

There is a myth that an individual's personality can be changed over ages. However, social isolation and interpersonal experience seem be the more related factors that influence a person's perceptions and communication to a social environment rather than personality change (Kornadt et al., 2018; Berg & Johansson, 2014). Elders also tend to encounter depression when they start isolating themselves from involving with groups due to the changes of sensory abilities and a lack of social involvement. Research indicated that the factors of causing social isolation not only include aging but also poor health conditions and unhealthy behaviors (Hämmig, 2019). Isolation can then be associated with depressed feelings, eating disorders, and other behavior changes leading to obesity, but they can be preventable if it is paid sufficient attention to (Martyn-Nemeth et al., 2009). In terms of prevention and management, social interactions and dietary behaviors were shown to be improved by participating in gardening programs (Nury et al., 2017). The benefit of physical activity is another reason that elders are recommended to be engaged with gardening experience. Soga et al. (2017) revealed that physical, psychological, and social health can be positively impacted by being involved in urban allotment gardening activities.

Implication of Gardening Activity - Family Factors and Functionality

Family involvement is essential in the success of disease management among patients with type-2 diabetes or other chronic conditions (Rosland et al., 2010). Family has different construction than other social relationships regarding the same spatial and cultural environments.

The guidelines indicated by Fisher et al. (1998) for type-2 diabetes or other chronic illnesses management highlights the importance of family beliefs, attitudes, behaviors, and characteristics. The family contexts can also be categorized into several types and functions in order to identify the effectiveness of family context toward type-2 diabetes managements (Fisher et al., 1998). Type-2 diabetes or other chronic conditions should not be regarded as an individual problem. Instead, the disease management should be viewed in the lens of the family context, relationship of family members, and the individual patient. The way that type-2 diabetes patients interact with family is critical when patients' lifestyles and dietary managements change (Bennich et al., 2017; Fisher et al., 1998; Fisher et al., 2004). Social factors are indeed influential. It was demonstrated that social-cultural and family factors are highly effective on improving type-2 diabetes disease managements among African-American women (Samuel-Hodge et al., 2000). Family, cultural, and structural influence in disease self-management were also pointed out in another Latino-family-based research (Carbone et al., 2007). Furthermore, the differences between patients and providers in the family were addressed by Fitzgerald et al., (2008), regarding that perceptions toward diseases. The patients perceived diabetes more as meaning associated with personal social-cultural concepts, whereas the providers tend to have more perceptions toward medical meanings directly and precisely (Fitzgerald et al., 2008). These studies infer that family-based disease managements are beneficial for type-2 diabetes patients. Family and peers are also mentioned as the major part of family intervention for type-2 diabetes disease managements (Jones et al., 2008). However, frustration and confusion are reported as negative reactions among family care, and family barriers to patients managements can be shown regarding education levels, age, and gender (Rosland et al., 2010). Overall, when family contexts are studied, other components, such as each member's perceptions, family cultures, gestures, and salient roles,

should be taken into account. Then understanding more details related to social interactions within a family can help seek for more specific improvement for type-2 diabetes disease managements.

Gardening's Role in Eco-system for Community Health Regarding Local Food Systems

Organic food, sustainable farms, and ecological friendly products are the milestones of modern healthy lifestyle principles. The trend of dietary styles and behaviors shows that people pursue foods that are more organic-related and environmentally sustainable. Accordingly, urban gardening is an important approach for healthier life. In addition, connecting with local food systems can also help with modern food issues, including food insecurity, environmental pollution, and community health. Indeed, farming systems can be designed and developed at to the regional level. Okinawan longevity is deeply associated with their local food system that retains food diversity, certain food culture, and healthy eating habits to secure the society's long-term health (Wahlqvist & Lee, 2007; Sho, 2001). Regarding local food systems, one example is that community gardens may provide impacts on senior food insecurity in the way that nutrition and food access are secured while local food economics are established (Tim et al., 2021). Litt et al. (2011) suggests that it is more beneficial if community gardens have connections with local food systems. Farmer markets and establishing healthy local food cultures may be the critical link that can help differentiate the impacts of home gardening, school gardening, and community gardening.

Potential Environment Impacts of Community Gardens

Green industry has been thriving over years as increasing numbers of pollutants were addressed in various fields regarding food, agriculture, and fuel and energy. Community gardens have potential to be considered as an effective connection between society and nature so that

people eventually become more aware of the environment and understand the urgency of pursuing sustainability. That is, community gardens can be more influential to the environment than they have been known to be. Connection between cultural influence and agrodiversity was revealed in Philadelphia's community gardens by considering institutional context that includes social and cultural factors (Pearsall et al., 2017). In other words, the food habit and preference, cultural impact on food, and social status may fluctuate the composition and biodiversity of the community garden despite the fact that cultural diverse does not significantly indicate greater species richness (Pearsall et al., 2017).

Moreover, the connection between diversification of all kind and sustainability has been indicated in research of urban community gardens' development frequently. For instance, Birky & Strom (2013) mentioned that more diverse gardeners and their gardening motivations are key to approach a sustainable community garden movement in modern environments. They then regarded that the essential chief factor for sustaining the growth of urban community gardens is related to the increasing awareness of local and global environmental changes (Birky & Strom, 2013).

Innovative Connection with Community Health Program

There can be benefits with community gardens from different perspectives. Education purposes can be served in the community garden by enhancing knowledge of food and building connection with nature. Innovation of food or horticulture education can be applied to practical levels so that children's learning will no longer be limited in conventional education, and they can instead be given better opportunities to learn from different spacial environments which may enhance their awareness of diversity and may benefit their understanding of science and environment (Datta, 2016). Datta (2016) mentioned that community garden settings can be a

means that integrates education patterns by providing formal as well as informal learning at the same time for urban children in terms of environment and science. This innovative connection between urban education and farming indeed encourages the community to develop in diverse ways regarding students' education, food growing, and cross-cultural learning without the restricted perspectives in the classroom learning.

Moreover, there are also therapeutical concepts involved in the community garden participation. Stress management was mentioned as a potential effect from community garden participation (Hayashi et al., 2008). Hayashi et al. (2008), demonstrated psychological improvement in a study that community gardens can provide stress reduction as well as promote mood state. Community gardens have become one important component in community programs with different aims. The therapeutical effect of the community garden has also been recognized by other studies. Findings related to end-of-life care research revealed that community gardens function as a social support space and opportunities for people with life-limiting illness deal with emotions of grief and bereavement (Marsh et al., 2017).

Urban Perspectives of Community Gardening

Community gardens can also be considered as resources for urban food provisioning. Urban food systems have been facing various issues regarding energy waste, food distribution, and agricultural capacity. The food system nowadays is developing by employing the use of local, organic, and regional relationships with food (Hynes & Howe, 2004). The existence of community gardens also secures food resources for households in need (Hynes & Howe, 2004). However, the role of the community gardens is considered as a critical intervention in different ways worldwide. In Australia, community gardens were regarded as a means to mitigate health challenges (Kingsley et al., 2019). Research in Australia indicated that the participation in

community gardens provided encouragement for various domains regarding ancestral, social, environmental, and political factors. In other words, community gardens not only promote physical health of the public but also develop effects that may alter the health of the society as a whole (Kingsley et al., 2019). Community gardens have been supporting for diverse populations and families in many different ways, and it will be important for the modern society to sustain the growth of communal gardening to amplify the positive impacts of community gardens.

Increasing Interest in Urban Farming

Farming systems and gardening techniques have been developing, and it is not surprising that people can engage in gardening activities in various ways. Urban farming and technological support that develop over time, such as vertical farming, aquaponic system, and community gardening, have been making a vast influence on people's lives (Gustavsen et al., 2022; Nogeire-McRae et al., 2018; Artmann & Sartison, 2018). From the perspective of promoting and supporting this development for the environment and humans' need of food and health, these urban movements of sustainability are also associated with local citizens' willingness and contribution. In Oslo, Norway, the citizens have increased willingness of contributing more tax payments for the purpose of urban farming development (Gustavsen et al., 2022). Meadow (2013) also mentioned community gardens as an alternative food system that provides resources for communities to achieve goals of securing food and improving social integration. Overall, developing a more comprehensive understanding of community gardens' benefits and functions seems to be key to encourage people to invest in gardening activities of all kinds regarding their time and financial support.

More than Individuals' Health

Food security and physical activities are well-known benefits provided by community gardening. Additionally, there can be more insightful impacts that community gardening generates to individuals as health outcomes from physical to psychological influence. With participation in community gardening, therapeutic impacts can be created due to the connection between the environment and individuals, and therefore, individuals are encouraged to pursue healthier lifestyles (Hale et al., 2011). However, the beneficial impacts of community gardening are not limited to individual's health, but there may instead be a larger scale of influence, from individuals to a whole ecosystem. From the perspective of community gardens' comprehensive functions, Hou (2017) mentioned that urban gardening is significantly beneficial to the community in ways that exceed the provision of food resources and recreation. It allows individuals in the community to be exposed to social and intercultural interactions and to share a cultural and democratic space. Additionally, the community can be protected from environmental and economic disadvantages (Hou, 2017). Community gardens' democratic practices and reproduction were also pointed out by Glover et al. (2005) in the way of indicating the significant connection of the garden space and public effects within the community. Besides the social effect of community gardens, the ecological innovation was also considered as a strategic strength that may assist the achievement of sustainable development in both cities and remote areas (Rusciano et al., 2020). As more values of community gardens are constantly being discovered, having a deeper understanding of them may become a strength for the society to move toward a more sustainable and healthier future.

Mitigation on Food Waste from Food Service Settings

Regarding sustainability, it has been known that the appearance of community gardens can be the means that helps develop biodiversity and therefore the prevention of unwanted environmental changes (Clarke & Jenerette, 2015; Pearsall et al., 2017). However, food waste management and reduction are other important parts for ensuring a sustainable eco-system within a community that might be overlooked while community gardens are also regarded as a way to provide food access. These food waste contributors include food service, retail, and household. According to the U.S. Department of Agriculture (USDA, n.d.; Hall et al., 2009; Buzby et al., 2014), the estimation of food waste is between 30 to 40 percent of the food supply overall. Local community gardens may play a mitigating factor in this scenario and therefore become more effective in utilizing food resources in a way that creates balance for the current food supply chain. A concept of integrating food waste from the hospital into a community garden was indicated by Galvan et al. (2018). The research pointed out that a sustainable innovation for constant food waste can be achieved by utilizing food waste as composting purposes in the community garden, and this method was shown to positively influence the environment, institutions, and community (Galvan et al., 2018). In addition to the food production provided by community gardens, managing food waste through the help of community gardens may help the society utilize resources more wisely and essentially achieve sustainability along with urbanization.

Urban Food System and Farming in Terms of Food Sovereignty

Community gardening provides space, opportunities, social connection, and cultures for communities to grow along with food and becomes more impactful in the way of building systematic support. As the modern food system evolves, community gardening and urban

farming concepts play an essential role to integrate human health with the sustainable development of the ecosystem. Ethical food movement, food sovereignty, or other urban food movements induced the value of community gardening that may provide assistance for the modern food system to surpass the barrier between producers and consumers and therefore overall lead to social impacts (Barron, 2017; Block et al., 2012; Davila & Dyball, 2015). That is, the food system associated with the community and people within it can be defined by their own identity and reaction (Patel, 2009; Hoover, 2017). Food sovereignty is pursued in urban food movement and is highly engaged in the transformation of modern food system. Consumers can contribute to food production in the way that they pursue their understanding and belief of food, environment, and people and therefore result in better ecosystem that best benefit the community (Block et al., 2012; Hoover, 2017). Community gardens can become the vehicle carrying this development by not only assisting the food system evolution but also other aspects, such as social issues, environmental issues, or even ecological issues (Gregory et al., 2016; Anderson et al., 2019). Regarding urban food system, the trend of the movement is toward ideas of supporting organic, fresh, affordable, safe, and transparent qualities while productivity is retained. New farming concepts in urban context is no longer associated with only individual health by generating social force of food sovereignty. While farming starts to be transferred to more urban areas, people's lives may be more involved in where their food comes from. That indicates that greater potential that community gardening becomes a more crucial part in modern food system. Community gardening provides the connection for urban population to approach food system and environment. Additionally, deeper understanding of mechanism in community gardening may strengthen and facilitate the way that community gardening is connected to people. Those paths may include school systems, agricultural aspects, or even city planning, and

therefore community gardening is in fact involved in larger scales depending on how the community interacts and how they are educated.

Insight of Understanding Mechanisms in Soil Quality

The unique social systematic support and ecosystem service from community gardening play a critical role in urban agricultural settings (Anderson et al., 2019; Alaimo et al., 2016). Additionally, it was shown in previous research that there can be connections between biophysical features and dimensions regarding agricultural establishments in urban areas; the quality of the neighborhood and the environment can then influence the community members in the way of their health, resources, and social network (Egerer et al., 2018). Meanwhile, soil contamination was also demonstrated as an issues in different studies in terms of participants' health community gardens (Kim et al., 2014; Sangster et al., 2012; Cooper et al., 2020). The fact that enhanced soil quality and reduced energy consumption are taken into account means that the expansion of people understanding toward community gardening has created the social context that creates more opportunities to support justice on food security, equality, and other social issues within the community.

Building Connections with Indigenous Cultures

Community gardens have been known in many previous studies as a space that enhance social support and community connection while it also provides positive outcomes on physical health (Byrne et al., 2017). Cultural influence was indicated in Māori Community gardens where cultural activities were provided for the community and therefore created opportunities for connecting with ancestral knowledge and tribal link (Hond et al., 2019). In different areas, cultural influence can be provided to participants in community gardens in various ways. For instance, community gardening is regarded as a social bridge for the community in Saskatoon,

and this sharing space provides opportunities for different immigrants and indigenous populations to interact in the way of cross-cultural learning (Datta, 2018). Moreover, the gap between different generations regarding traditional food cultures was also addressed. Fieldhouse and Thompson (2012) indicated that engaging young people is a critical point of making change in local food production and traditional diet's reintroduction. Regarding the influence on indigenous food and cultures, community gardening indeed has potential to be a significant communicator in urban society. As more mechanism of community gardening is discovered in the future, it may show that this urban green space not only serves as a place to provide health and social benefits but also as a bridge to connect different generations and cultures.

Community Garden in Different Lens and Scales

The impact of community gardening is not only shown in the U.S., but there is evidence in different corners of the world that indicates the importance of this urban green space to community members including UK, Australia, Hong Kong, or Japan, and there can be from physical impacts to psychological influence within the context of individualistic or collectivistic (Spano et al., 2020). That is, each area may have different cultural influence, agricultural systems, and social contexts and therefore more perspectives and managements of community gardening are needed. The fact that gardeners have potential to understand each other's cultures or values can provide various developments within different communities. The intrinsic value of sharing and learning among community gardening activities or participations has been shown to be a means that connects individuals or a whole ecosystem across social barriers (Moquin et al., 2016). While food resources and physical health impacts are major outputs that community gardening contributes to this urban lifestyle, more intrinsic values regarding environment or social connections are revealed in the way of focus health benefits more toward the direction of

the entire society. Then this shifting of focus on community gardening's benefits indeed amplifies the lens and scales for health improvements in a community or even larger groups of people. Additionally, different health issues and barriers can align with certain strategies to achieve successful changes. Studies reports that in order to pursue healthier lifestyles, there can be educational systems, family interactions, or cultural influence that contribute to desired outcomes of their lifestyles in terms of local food growth (Lombard et al., 2014). Further impacts can be made through educational changes by interactions between systematic components in a community and a social-ecological connection. Education plays a critical role in the whole ecosystem in ways that city planning, cultural influence, and social interactions to essentially create impacts on environmental movements or policies (Tidball & Krasny, 2010; Heerink et al., 2021).

REFERENCES

Alaimo, K., Beavers, A. W., Crawford, C., Snyder, E. H., & Litt, J. S. (2016). Amplifying health through community gardens: A framework for advancing multicomponent, behaviorally based neighborhood interventions. *Current environmental health reports*, *3*(3), 302-312. https://doi.org/10.1007/s40572-016-0105-0

Algert, S., Diekmann, L., Renvall, M., & Gray, L. (2016). Community and home gardens increase vegetable intake and food security of residents in San Jose, California. *California Agriculture*, *70*(2), 77-82. https://doi.org/10.3733/ca.v070n02p77

American Community Garden Association (n.d.). *Find a Garden.* Retrieved August 12, 2021, from https://www.communitygarden.org/garden

American Diabetes Association. (n.d.). *Life doesn't end with type 2 diabetes.* Retrieved March 10, 2022, from http://www.diabetes.org/diabetes-basics/type-2

Anderson, E. C., Egerer, M. H., Fouch, N., Clarke, M., & Davidson, M. J. (2019). Comparing community garden typologies of Baltimore, Chicago, and New York City (USA) to understand potential implications for socio-ecological services. *Urban Ecosystems*, *22*(4), 671-681. https://doi.org/10.1007/s11252-019-00855-9

Artmann, M., & Sartison, K. (2018). The role of urban agriculture as a nature-based solution: A review for developing a systemic assessment framework. *Sustainability*, *10*(6), 1937. https://doi.org/10.3390/su10061937

Barron, J. (2017). Community gardening: cultivating subjectivities, space, and justice. *Local Environment*, *22*(9), 1142-1158. https://doi.org/10.1080/13549839.2016.1169518

Barnidge, E. K., Hipp, P. R., Estlund, A., Duggan, K., Barnhart, K. J., & Brownson, R. C. (2013). Association between community garden participation and fruit and vegetable consumption in rural Missouri. *International Journal of Behavioral Nutrition and Physical Activity*, *10*(1), 1-8. https://doi.org/10.1186/1479-5868-10-128

Barnidge, E. K., Baker, E. A., Schootman, M., Motton, F., Sawicki, M., & Rose, F. (2015). The effect of education plus access on perceived fruit and vegetable consumption in a rural African American community intervention. *Health education research*, *30*(5), 773-785. https://doi.org/10.1093/her/cyv041

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51 (6), 1173-1182. https://doi.org/10.1037/0022-3514.51.6.1173

Bauer, D. J., & Curran, P. J. (2005). Probing interactions in fixed and multilevel regression: Inferential and graphical techniques. *Multivariate behavioral research*, 40(3), 373-400. https://doi.org/10.1207/s15327906mbr4003_5

Bennich, B. B., Røder, M. E., Overgaard, D., Egerod, I., Munch, L., Knop, F. K., Vilsbøll, T., & Konradsen, H. (2017). Supportive and non-supportive interactions in families with a type 2 diabetes patient: an integrative review. *Diabetology & Metabolic Syndrome*, *9*(1), 57. https://doi.org/10.1186/s13098-017-0256-7

Benkowitz, D., Schulz, S., & Lindemann-Matthies, P. (2019). The impact of gardening experiences on children's intake of vegetables. *The Journal of Health, Environment & Education*, *11*, 1-5. https://doi.org/10.18455/19001

Berg, A. I., & Johansson, B. (2014). Personality change in the oldest-old: Is it a matter of compromised health and functioning?. *Journal of Personality*, *82*(1), 25-31. https://doi.org/10.1111/jopy.12030

Birky, J., & Strom, E. (2013). Urban perennials: How diversification has created a sustainable community garden movement in the United States. *Urban Geography*, *34*(8), 1193-1216. https://doi.org/10.1080/02723638.2013.784086

Block, D. R., Chávez, N., Allen, E., & Ramirez, D. (2012). Food sovereignty, urban food access, and food activism: Contemplating the connections through examples from Chicago. *Agriculture and Human Values*, *29*(2), 203-215. https://doi.org/10.1007/s10460-011-9336-8

Booth, J. M., Chapman, D., Ohmer, M. L., & Wei, K. (2018). Examining the relationship between level of participation in community gardens and their multiple functions. *Journal of Community Practice*, *26*(1), 5-22. https://doi.org/10.1080/10705422.2017.1413024

Bussell, M., Bliesner, J., & Pezzoli, K. (2017). UC pursues rooted research with a nonprofit, links the many benefits of community gardens. *California Agriculture*, *71*(3), 139-147. https://doi.org/10.3733/ca.2017a0029

Butterfield, K. L. (2020). Neighborhood Composition and Community Garden Locations: The Effect of Ethnicity, Income, and Education. *Sociological Perspectives*, *63*(5), 738-763. https://doi.org/10.1177/0731121420908902

Buzby, J. C., Farah-Wells, H., & Hyman, J. (2014). The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States. *USDA-ERS Economic Information Bulletin*, (121). http://dx.doi.org/10.2139/ssrn.2501659

Byrne, J. A., Pickering, C. M., Guitart, D. A., & Sims-Castley, R. (2017). *A political ecology of community gardens in Australia: form local issues to global lessons.* In A. M. G. A. Winklerprins (Ed.), *Global urban agriculture* (pp. 118-133). CABI. http://doi.org/10.1079/9781780647326.0118

Carbone, E. T., Rosal, M. C., Torres, M. I., Goins, K. V., & Bermudez, O. I. (2007). Diabetes self-management: perspectives of Latino patients and their health care providers. *Patient education and counseling*, *66*(2), 202-210. https://doi.org/10.1016/j.pec.2006.12.003

Castro, D. C., Samuels, M., & Harman, A. E. (2013). Growing healthy kids: a community garden–based obesity prevention program. *American journal of preventive medicine*, *44*(3), S193-S199. https://doi.org/10.1016/j.amepre.2012.11.024

Centers for Disease Control and Prevention. (2020). *National diabetes statistics report, 2020.* Centers for Disease Control and Prevention, US Department of Health and Human Services. https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf

Clarke, L. W., & Jenerette, G. D. (2015). Biodiversity and direct ecosystem service regulation in the community gardens of Los Angeles, CA. *Landscape Ecology*, *30*(4), 637-653. https://doi.org/10.1007/s10980-014-0143-7

Cooper, A. M., Felix, D., Alcantara, F., Zaslavsky, I., Work, A., Watson, P. L., ... & Schroeder, J. I. (2020). Monitoring and mitigation of toxic heavy metals and arsenic accumulation in food crops: A case study of an urban community garden. *Plant Direct*, *4*(1), e00198. https://doi.org/10.1002/pld3.198

Datta, R. (2016). Community garden: A bridging program between formal and informal learning. *Cogent Education*, *3*(1), 1177154. https://doi.org/10.1080/2331186X.2016.1177154

Datta, R. (2018). Traditional storytelling: An effective Indigenous research methodology and its implications for environmental research. *AlterNative: An International Journal of Indigenous Peoples*, *14*(1), 35-44. https://doi.org/10.1177/1177180117741351

Davila, F., & Dyball, R. (2015). Transforming food systems through food sovereignty: An Australian urban context. *Australian Journal of Environmental Education*, *31*(1), 34-45. https://doi.org/10.1017/aee.2015.14

Davis, K. L., & Brann, L. S. (2017). Examining the benefits and barriers of instructional gardening programs to increase fruit and vegetable intake among preschool-age children. *Journal of environmental and public health*, *2017*. https://doi.org/10.1155/2017/2506864

DeVellis, R. F., Thorpe, C. T. (2021). *Scale Development: Theory and Applications* (5th ed.). SAGE Publications.

Draper, C., & Freedman, D. (2010). Review and analysis of the benefits, purposes, and motivations associated with community gardening in the United States. *Journal of Community Practice*, *18*(4), 458-492. https://doi.org/10.1080/10705422.2010.519682

Egerer, M. H., Philpott, S. M., Liere, H., Jha, S., Bichier, P., & Lin, B. B. (2018). People or place? Neighborhood opportunity influences community garden soil properties and soil-based ecosystem services. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *14*(1), 32-44. https://doi.org/10.1080/21513732.2017.1412355

Faber, M., Phungula, M. A., Venter, S. L., Dhansay, M. A., & Benadé, A. S. (2002). Home gardens focusing on the production of yellow and dark-green leafy vegetables increase the serum retinol concentrations of 2–5-y-old children in South Africa. *The American journal of clinical nutrition*, *76*(5), 1048-1054. https://doi.org/10.1093/ajcn/76.5.1048

Fieldhouse, P., & Thompson, S. (2012). Tackling food security issues in indigenous communities in Canada: The Manitoba experience. *Nutrition & Dietetics*, *69*(3), 217-221. https://doi.org/10.1111/j.1747-0080.2012.01619.x

Fisher, L. W., Chesla, C. A., Bartz, R. J., Gilliss, C., Skaff, M. A., Sabogal, F., Kanter, R. A., & Lutz, C. P. (1998). The family and type 2 diabetes: a framework for intervention. *The Diabetes Educator*, *24*(5), 599-607. https://doi.org/10.1177/014572179802400504

Fisher, L., Chesla, C. A., Chun, K. M., Skaff, M. M., Mullan, J. T., Kanter, R. A., & Gardiner, P. S. (2004). Patient-appraised couple emotion management and disease management among Chinese American patients with type 2 diabetes. *Journal of Family Psychology*, *18*(2), 302. https://doi.org/10.1037/0893-3200.18.2.302

Fitzgerald, J. T., Stansfield, R. B., Tang, T., Oh, M., Frohna, A., Armbruster, B., Gruppen, L., & Anderson, R. (2008). Patient and provider perceptions of diabetes: measuring and evaluating differences. *Patient education and counseling*, *70*(1), 118-125. https://doi.org/10.1016/j.pec.2007.09.005

Galvan, A. M., Hanson, R., & George, D. R. (2018). Repurposing waste streams: Lessons on integrating hospital food waste into a community garden. *Journal of community health*, *43*(5), 944-946. https://doi.org/10.1007/s10900-018-0509-x

Glover, T. D., Shinew, K. J., & Parry, D. C. (2005). Association, sociability, and civic culture: The democratic effect of community gardening. *Leisure Sciences*, *27*(1), 75-92. https://doi.org/10.1080/01490400590886060

Gregory, M. M., Leslie, T. W., & Drinkwater, L. E. (2016). Agroecological and social characteristics of New York city community gardens: contributions to urban food security, ecosystem services, and environmental education. *Urban ecosystems*, *19*(2), 763-794. https://doi.org/10.1007/s11252-015-0505-1

Gunderson, D., & Acheson, G. (2015). Community Gardening in St. Louis: A MicroScale Analysis of What Was Grown. *Papers in Applied Geography*, *1*(1), 28-33. http://dx.doi.org/10.1080/23754931.2015.1009293

Gustavsen, G. W., Berglann, H. B., Jenssen, E., Kårstad, S., & Rodriguez, D. G. P. (2022). The Value of Urban Farming in Oslo, Norway: Community Gardens, Aquaponics and Vertical Farming. *International Journal on Food System Dynamics*, *13*(1), 17-29. https://doi.org/10.18461/ijfsd.v13i1.A2

Hale, J., Knapp, C., Bardwell, L., Buchenau, M., Marshall, J., Sancar, F., & Litt, J. S. (2011). Connecting food environments and health through the relational nature of aesthetics: Gaining insight through the community gardening experience. *Social science & medicine (1982)*, *72*(11), 1853. https://doi.org/10.1016/j.socscimed.2011.03.044

Hall, K. D., Guo, J., Dore, M., & Chow, C. C. (2009). The progressive increase of food waste in America and its environmental impact. *PloS one*, *4*(11), e7940. https://doi.org/10.1371/journal.pone.0007940

Hartwig, K. A., & Mason, M. (2016). Community gardens for refugee and immigrant communities as a means of health promotion. *Journal of community health*, *41*(6), 1153-1159. https://doi.org/10.1007/s10900-016-0195-5

Hayashi, N., Wada, T., Hirai, H., Miyake, T., Matsuura, Y., Shimizu, N., Kurooka, H., & Horiuchi, S. (2008). The effects of horticultural activity in a community garden on mood changes. *Environmental Control in Biology*, *46*(4), 233-240. https://doi.org/10.2525/ecb.46.233

Hämmig, O. (2019). Health risks associated with social isolation in general and in young, middle and old age. *PLoS One*, *14*(7), e0219663. https://doi.org/10.1371/journal.pone.0219663

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.

Hayes, A. F. (2018). Partial, conditional, and moderated moderated mediation: Quantification, inference, and interpretation. *Communication monographs*, *85*(1), 4-40. https://doi.org/10.1080/03637751.2017.1352100

Hayes, A. F., & Montoya, A. K. (2017). A tutorial on testing, visualizing, and probing an interaction involving a multicategorical variable in linear regression analysis. *Communication Methods and Measures*, *11*(1), 1-30. https://doi.org/10.1080/19312458.2016.1271116

Hayes, A. F., & Rockwood, N. J. (2017). Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and implementation. Behaviour research and therapy, 98, 39-57. https://doi.org/10.1016/j.brat.2016.11.001

Heerink, S., Sinclair-Phillips, V., Jagger, A., & Hay, K. (2021). Expanding field education: Hope trust community garden. *Aotearoa New Zealand Social Work*, *33*(1), 112-115. https://search.informit.org/doi/10.3316/informit.827732500363809

Herrmann, M. M. (2015). The Modern Day "Victory Garden". *Procedia engineering*, *118*, 647-653. https://doi.org/10.1016/j.proeng.2015.08.498

Hond, R., Ratima, M., & Edwards, W. (2019). The role of Māori community gardens in health promotion: a land-based community development response by Tangata Whenua, people of their land. *Global Health Promotion*, *26*(3_suppl), 44-53. https://doi.org/10.1177/1757975919831603

Hou, J. (2017). Urban community gardens as multimodal social spaces. *Greening Cities*, 113-130. https://doi.org/10.1007/978-981-10-4113-6_6

Hoover, E. (2017). "You can't say you're sovereign if you can't feed yourself": defining and enacting food sovereignty in American Indian community gardening. *American Indian Culture and Research Journal*, *41*(3), 31-70. https://doi.org/10.17953/aicrj.41.3.hoover

Hynes, H. P., & Howe, G. (2004). Urban horticulture in the contemporary United States: personal and community benefits. *Acta Horticulturae*, *643*, 171-181. https://doi.org/10.17660/ActaHortic.2004.643.21

Jones, R. A., Utz, S. W., Williams, I. C., Hinton, I., Alexander, G., Moore, C., Blankenship, J., Steeves, R., & Oliver, N. (2008). Family interactions among African Americans diagnosed with Type 2 diabetes. *The Diabetes Educator*, *34*(2), 318–326. https://doi.org/10.1177/0145721708314485

Kim, B. F., Poulsen, M. N., Margulies, J. D., Dix, K. L., Palmer, A. M., & Nachman, K. E. (2014). Urban community gardeners' knowledge and perceptions of soil contaminant risks. *PloS one*, *9*(2), e87913. https://doi.org/10.1371/journal.pone.0087913

Kim, S. O., & Park, S. (2020). Garden-based integrated intervention for improving children's eating behavior for vegetables. *International journal of environmental research and public health*, *17*(4), 1257. https://doi.org/10.3390/ijerph17041257

Kingsley, J., Foenander, E., & Bailey, A. (2019). “You feel like you’re part of something bigger”: exploring motivations for community garden participation in Melbourne, Australia. *BMC Public Health*, *19*(1), 1-12. https://doi.org/10.1186/s12889-019-7108-3

Knofczynski, G. T., & Mundfrom, D. (2008). Sample sizes when using multiple linear regression for prediction. *Educational and psychological measurement*, *68*(3), 431-442. https://doi.org/10.1177/0013164407310131

Koay, W. I., & Dillon, D. (2020). Community gardening: Stress, well-being, and resilience potentials. *International Journal of Environmental Research and Public Health*, *17*(18), 6740. https://doi.org/10.3390/ijerph17186740

Kornadt, A. E., Hagemeyer, B., Neyer, F. J., Kandler, C., & Back, M. (2018). Sound body, sound mind? The interrelation between health change and personality change in old age. *European Journal of Personality*, *32*(1), 30-45. https://doi.org/10.1002/per.2135

Landry, M. J., Markowitz, A. K., Asigbee, F. M., Gatto, N. M., Spruijt-Metz, D., & Davis, J. N. (2019). Cooking and gardening behaviors and improvements in dietary intake in Hispanic/Latino youth. *Childhood Obesity*, *15*(4), 262-270. https://doi.org/10.1089/chi.2018.0110

Lautenschlager, L., & Smith, C. (2007). Beliefs, knowledge, and values held by inner-city youth about gardening, nutrition, and cooking. *Agriculture and Human Values*, *24*(2), 245-258. https://doi.org/10.1007/s10460-006-9051-z

Litt, J. S., Alaimo, K., Buchenau, M., Villalobos, A., Glueck, D. H., Crume, T., Fahnestock, L., Hamman, R.F., Hebert, J.R., Hurley, T.G., Leiferman, J., & Li, K. (2018). Rationale and design for the community activation for prevention study (CAPs): A randomized controlled trial of community gardening. *Contemporary clinical trials*, *68*, 72. https://doi.org/10.1016/j.cct.2018.03.005

Litt, J. S., Schmiege, S. J., Hale, J. W., Buchenau, M., & Sancar, F. (2015). Exploring ecological, emotional and social levers of self-rated health for urban gardeners and non-gardeners: A path analysis. *Social science & medicine (1982)*, *144*, 1–8. https://doi.org/10.1016/j.socscimed.2015.09.004

Litt, J. S., Soobader, M. J., Turbin, M. S., Hale, J. W., Buchenau, M., & Marshall, J. A. (2011). The influence of social involvement, neighborhood aesthetics, and community garden participation on fruit and vegetable consumption. *American journal of public health*, *101*(8), 1466-1473. https://doi.org/10.2105/AJPH.2010.300111

Lombard, K. A., Beresford, S. A., Ornelas, I. J., Topaha, C., Becenti, T., Thomas, D., & Vela, J. G. (2014). Healthy gardens/healthy lives: Navajo perceptions of growing food locally to prevent diabetes and cancer. *Health Promotion Practice*, *15*(2), 223-231. https://doi.org/10.1177/1524839913492328

Loso, J., Staub, D., Colby, S. E., Olfert, M. D., Kattelmann, K., Vilaro, M., Colee, J., Zhou, W., Franzen-Castle, L., & Mathews, A. E. (2018). Gardening experience is associated with increased fruit and vegetable intake among first-year college students: A cross-sectional examination. *Journal of the Academy of Nutrition and Dietetics*, *118*(2), 275-283. https://doi.org/10.1016/j.jand.2017.09.005

Malberg Dyg, P., Christensen, S., & Peterson, C. J. (2020). Community gardens and wellbeing amongst vulnerable populations: A thematic review. *Health promotion international*, *35*(4), 790-803. https://doi.org/10.1093/heapro/daz067

Martyn-Nemeth, P., Penckofer, S., Gulanick, M., Velsor-Friedrich, B., & Bryant, F. B. (2009). The relationships among self-esteem, stress, coping, eating behavior, and depressive mood in adolescents. *Research in nursing & health*, 32(1), 96-109. https://doi.org/10.1002/nur.20304

Marsh, P., Gartrell, G., Egg, G., Nolan, A., & Cross, M. (2017). End-of-life care in a community garden: findings from a participatory action research project in regional Australia. *Health & Place*, *45*, 110-116. https://doi.org/10.1016/j.healthplace.2017.03.006

Meadow, A. M. (2013). Alternative food systems at ground level: The Fairbanks community garden. *Journal of Ecological Anthropology*, *16*(1), 76-84. http://dx.doi.org/10.5038/2162-4593.16.1.6

Moquin, R., Diduck, A. P., Sinclair, A. J., & Davidson-Hunt, I. J. (2016). Cultivating community through gardening in Kenora, Ontario. *Canadian Food Studies/La Revue canadienne des études sur l'alimentation*, *3*(2), 70-103. https://doi.org/10.15353/cfs-rcea.v3i2.167

Nogeire-McRae, T., Ryan, E. P., Jablonski, B. B., Carolan, M., Arathi, H. S., Brown, C. S., Saki, H. H., McKeen, S., Lapansky, E., & Schipanski, M. E. (2018). The role of urban agriculture in a secure, healthy, and sustainable food system. *BioScience*, *68*(10), 748-759. https://doi.org/10.1093/biosci/biy071

Northrop, M. D., Wingo, B. C., & Ard, J. D. (2013). The perceptions of community gardeners at Jones Valley urban farm and the implications for dietary interventions. *The Qualitative Report*, *18*(27), 1-11. https://doi.org/10.46743/2160-3715/2013.1495

Nunnally, J.D. (1978). *Psychometric Theory* (2nd ed.). McGraw-Hill.

Nury, E., Sarti, A., Dijkstra, C., Seidell, J. C., & Dedding, C. (2017). Sowing seeds for healthier diets: Children's perspectives on school gardening. *International journal of environmental research and public health*, *14*(7), 688. https://doi.org/10.3390/ijerph14070688

Ornelas, I. J., Osterbauer, K., Woo, L., Bishop, S. K., Deschenie, D., Beresford, S. A., & Lombard, K. (2018). Gardening for health: patterns of gardening and fruit and vegetable consumption among the Navajo. *Journal of community health*, *43*(6), 1053-1060. https://doi.org/10.1007/s10900-018-0521-1

Pallant, J. (2010). *Spss survival manual : A step by step guide to data analysis using spss* (4th ed.). McGraw-Hill Education.

Patel, R. (Ed.). (2009). Food sovereignty. *The journal of peasant studies*, *36*(3), 663-706. https://doi.org/10.1080/03066150903143079

Pearsall, H., Gachuz, S., Rodriguez Sosa, M., Schmook, B., Wal, H., & Gracia, M. A. (2017). Urban community garden agrodiversity and cultural identity in Philadelphia, Pennsylvania, US. *Geographical Review*, *107*(3), 476-495. https://doi.org/10.1111/j.1931-0846.2016.12202.x

Poston, S. A., Shoemaker, C. A., & Dzewaltowski, D. A. (2005). A comparison of a gardening and nutrition program with a standard nutrition program in an out-of-school setting. *HortTechnology*, *15*(3), 463-467. https://doi.org/10.21273/HORTTECH.15.3.0463

Rogosa, D. (1980). Comparing nonparallel regression lines. *Psychological bulletin*, 88(2), 307. https://doi.org/10.1037/0033-2909.88.2.307

Rosland, A. M., Heisler, M., Choi, H. J., Silveira, M. J., & Piette, J. D. (2010). Family influences on self-management among functionally independent adults with diabetes or heart failure: do family members hinder as much as they help?. *Chronic illness*, *6*(1), 22-33. https://doi.org/10.1177/1742395309354608

Rusciano, V., Civero, G., & Scarpato, D. (2020). Social and ecological high influential factors in community gardens innovation: An empirical survey in Italy. *Sustainability*, *12*(11), 4651. https://doi.org/10.3390/su12114651

Samuel-Hodge, C. D., Headen, S. W., Skelly, A. H., Ingram, A. F., Keyserling, T. C., Jackson, E. J., Ammerman, A.S., & Elasy, T. A. (2000). Influences on day-to-day self-management of type 2 diabetes among African-American women: spirituality, the multi-caregiver role, and other social context factors. *Diabetes care*, *23*(7), 928-933. https://doi.org/10.2337/diacare.23.7.928

Sangster, J. L., Nelson, A., & Bartelt-Hunt, S. L. (2012). The occurrence of lead in soil and vegetables at a community garden in Omaha, Nebraska. *International Journal for Service Learning in Engineering, Humanitarian Engineering and Social Entrepreneurship*, *7*(1), 62-68. https://doi.org/10.24908/ijsle.v7i1.4231

Sho, H. (2001). History and characteristics of Okinawan longevity food. *Asia Pacific journal of clinical nutrition*, *10*(2), 159-164. https://doi.org/10.1111/j.1440-6047.2001.00235.x

Soga, M., Cox, D. T., Yamaura, Y., Gaston, K. J., Kurisu, K., & Hanaki, K. (2017). Health Benefits of Urban Allotment Gardening: Improved Physical and Psychological Well-Being and Social Integration. *International journal of environmental research and public health*, *14*(1), 71. https://doi.org/10.3390/ijerph14010071

Spano, G., D'Este, M., Giannico, V., Carrus, G., Elia, M., Lafortezza R, Panno A, Sanesi G. (2020). Are community gardening and horticultural interventions beneficial for psychosocial well-being? A meta-analysis. *International Journal of Environmental Research and Public Health*, *17*(10), 3584. https://doi.org/10.3390/ijerph17103584

Staub, D., Colby, S. E., Olfert, M. D., Kattelmann, K., Zhou, W., Horacek, T. M., Greene, G. W., Radosavljevic, I., Franzen-Castle, L., & Mathews, A. E. (2019). A Multi-Year Examination of Gardening Experience and Fruit and Vegetable Intake During College. *Nutrients*, *11*(9), 2088. https://doi.org/10.3390/nu11092088

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International journal of medical education*, *2*, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

The U.S. Department of Agriculture (n.d.). *Food Waste FAQs.* Retrieved March 10, 2022, from https://www.usda.gov/foodwaste/faqs

Tidball, K. G., & Krasny, M. E. (2010). Urban environmental education from a social-ecological perspective: Conceptual framework for civic ecology education. *Cities and the Environment (CATE)*, *3*(1), 11. http://doi.org/10.15365/cate.31112010

Tims, K., Haggerty, M., Jemison, J., Ladenheim, M., Mullis, S., & Damon, E. (2021). Gardening for change: Community giving gardens and senior food insecurity. *Journal of Agriculture, Food Systems, and Community Development*, *10*(4), 85–101. https://doi.org/10.5304/jafscd.2021.104.030

Wahlqvist, M. L., & Lee, M. S. (2007). Regional food culture and development. *Asia Pacific journal of clinical nutrition*, *16*(S1), 2-7 https://doi.org/10.6133/apjcn.2007.16.s1.02

Weltin, A. M., & Lavin, R. P. (2012). The effect of a community garden on HgA1c in diabetics of Marshallese descent. *Journal of Community Health Nursing*, *29*(1), 12-24. https://doi.org/10.1080/07370016.2012.645724

World Health Organization (2016). *Global report on diabetes.* https://apps.who.int/iris/bitstream/handle/10665/204871/9789241565257_eng.pdf;jsessionid=D61910C41F15C4BCEF1D8758B8316B0D?sequence=1

World Health Organization (2021, November 10). *Diabetes.* https://www.who.int/news-room/fact-sheets/detail/diabetes

Yip, C. S. C., Chan, W., & Fielding, R. (2019). The associations of fruit and vegetable intakes with burden of diseases: a systematic review of meta-analyses. *Journal of the Academy of Nutrition and Dietetics*, *119*(3), 464-481. https://doi.org/10.1016/j.jand.2018.11.007

APPENDIX A: RECRUITMENT EMAIL

Subject: Request for Participation in Survey on Community Garden and Health Advancement

Content:

Dear Community Garden,

We are writing to you to request your participation in a brief survey on the relationship between community gardens and wellness. We would appreciate your completion of the survey, but also request you forward this email to gardeners or individuals associated with daily gardening activities at your community gardens.

We are interested in learning more about how gardening participation is capable of increasing health advancements in diverse ways. The research is especially pertinent, as we attempt to gain a better understanding of variables that may optimize these advancements as a direct result from participating in community gardens.

Please click the link below to go to the survey website or copy and paste the link into your internet browser.

Survey link: (Please complete the survey by Sept 10th)

The Institutional Review Board (IRB) at Illinois State University has approved this study. If you have any comments or questions, please feel free to contact us at (970)-889-4293 or cho12@ilstu.edu; (309)-438-7031 or jmraede@ilstu.edu.

Thank you very much for your time and cooperation. Your feedback is important.

Sincerely,

Cheng-Yi Ho, Masters Student in Family & Consumer Sciences

Dr. Julie Raeder Schumacher, Professor of Food, Nutrition, & Dietetics

APPENDIX B: INFORMED CONSENT

You are being asked to participate in a research study conducted by Cheng-Yi Ho, Masters students, under the direction of Dr. Julie Raeder Schumacher, Professor at Illinois State University in the Department of Family & Consumer Sciences. The purpose of this study is to investigate how gardening experiences impact different populations on their fresh produce consumption and physical activities to enhance the impact of health promotion through community garden participation.

Why are you being asked?

You have been asked to participate because you have been participating in any community gardens.

Your participation in this study is voluntary. You will not be penalized if you choose to skip parts of the study, not participate, or withdraw from the study at any time.

What would you do?

If you choose to participate in this study, you will be completing a set of survey questions. In total, your involvement in this study will last approximately 10 - 15 minutes.

Are any risks expected?

We do not anticipate any risks beyond those that would occur in everyday life.

Will your information be protected?

We will use all reasonable efforts to keep any provided personal information confidential. The identifiable information will only be used by the research team. All identifiable information will be protected from any unauthorized use. After a period of time, identifiable information will be removed from the dataset. Information that may identify you or potentially lead to reidentification will not be released to individuals that are not on the research team.

However, when required by law or university policy, identifying information (including your signed consent form) may be seen or copied by authorized individuals.

Could your responses be used for other research?

We will not use any identifiable information from you in future research, but your deidentified information could be used for future research without additional consent from you.

Who will benefit from this study?

This study is designed to identify ways that enhance the efficiency of the health promotion led by community gardens' participation for the gardeners and to seek for innovations to reduce the barriers for the population in need, such as low income households or minority groups, beside the general public.

Whom do you contact if you have any questions?

If you have any questions about the research or wish to withdraw from the study, contact Dr. Julie Raeder Schumacher, Principal Investigator (PI), at (309)-438-7031 or jmraede@ilstu.edu; Cheng-Yi Ho, Researcher, at (970)-889-4293 or cho12@ilstu.edu.

If you have any questions about your rights as a participant, or if you feel you have been placed at risk, contact the Illinois State University Research Ethics & Compliance Office at (309) 438-5527 or IRB@ilstu.edu.

Documentation of Consent

Check *"Agree"* and click *"Next"* if you are 18 or older and willing to participate in this study.