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Horticultural Therapy Program for Individuals with Substance Use Disorder:
A Mixed-Method Evaluation

A Thesis Presented

by

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To the Keck Science Department
of Claremont McKenna, Pitzer, and Scripps Colleges

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Table of Contents

Abstract.....	Page 3
1. Background.....	Page 4
1.1 Substance Use Disorder.....	Page 4
1.2 Horticultural Therapy.....	Page 6
1.3 Mechanisms of HT.....	Page 8
1.4 Prior Research.....	Page 11
1.5 Study Introduction.....	Page 13
2. Methods.....	Page 13
2.1 Setting.....	Page 13
2.2 Study Participants.....	Page 15
2.3 Study Design.....	Page 15
2.4 Intervention.....	Page 15
2.5 Measurements and Instruments.....	Page 21
2.6 Quantitative Data Analysis.....	Page 23
2.7 Qualitative Data Analysis.....	Page 24
3. Expected Results.....	Page 24
4. Discussion.....	Page 25
4.1 Overview.....	Page 25
4.2 Implications on Current Knowledge.....	Page 26
4.3 Study Limitations.....	Page 29
4.4 Clinical Implications.....	Page 31
4.5 Implications for Future Research.....	Page 31
4.6 Conclusions.....	Page 33

Abstract

Substance Use Disorder (SUD) is a chronic brain disorder caused by both biological and environmental factors. Although there is no panacea for addiction, holistic adjunctive therapies have been found to improve outcomes for this population. Horticultural Therapy (HT) is one such adjunct therapy that may improve treatment outcomes. Although HT has been found to support holistic healing for many mental and physical ailments, the efficacy of this intervention has not been evaluated in patients with a SUD. The goal of this controlled, mixed-method study is to evaluate whether HT could be an effective component of a holistic SUD treatment program. Volunteers recently admitted to residential treatment will be randomized to receive an adjunctive HT or a control condition (additional housework and group therapy) over a 6-month treatment period. This study will compare the change in addiction severity, sense of empowerment, stress, motivation and ability to complete long-term goals and general wellbeing between participants who received HT condition and the control condition. Qualitative interviews will also be completed to understand the most beneficial components of the HT experience. Findings will be used to determine if HT may become a recommended addition to long-term SUD addiction treatment programs.

1. Background:

1.1 Substance Use Disorder

In 2021 there were more than 100 thousand drug overdose deaths in the United States (CDC/National Center for Health Statistics, 2022). According to the 2020 National Survey on Drug Use and Health, around 40 million Americans had a Substance Use Disorder (SUD) in 2020 (Substance Abuse and Mental Health Administration, 2021). SUD is a chronic brain disorder caused by both biological and environmental factors (Volkow et al., 2018). Biological factors include genetics, epigenetics, developmental attributes and neurocircuitry. Environmental factors include social and cultural systems, stress and trauma (Volkow et al., 2018). According to the DSM-5 classification, for an individual to have a SUD diagnosis they must have two or more of the 11 symptoms that characterize problematic substance use. These symptoms include, excessive consumption, inability to stop use, investment of a lot of time acquiring, using and recovering from the substance, cravings, inability to complete responsibilities, passing up on activities to use substances, using substances even when dangerous, tolerance, and withdrawal. Substances that are used by individuals with a SUD diagnosis include: alcohol, caffeine, cannabis, hallucinogens, inhalants, opioids, sedatives, hypnotics or anxiolytics, stimulants, (including amphetamine-type substances, cocaine, and other stimulants) and tobacco.

Individuals with SUD have higher rates of health problems than the general population, including increased risk of psychiatric problems as well as chronic pain, cancer, and heart disease (National Institute on Drug Abuse, n.d.; National Institute of Mental Health (NIMH), n.d.). They are also more likely to experience homelessness, become involved in the criminal justice system, and struggle to maintain employment (Dennis & Scott, 2007). Thus, individuals with SUD are an especially vulnerable population.

Current treatment options for SUD include a range of psychosocial interventions delivered in the outpatient, inpatient or primary care settings (National Institute on Drug Abuse, 2019). Certain substance use disorders, such as opioid, alcohol, and tobacco use disorders can be treated with medication. For most individuals with SUD, recovery follows a non-linear path and includes cycles of symptom remission, relapse and repeated treatments (Dennis et al., 2007). In fact, more than half of patients entering publicly funded SUD treatment programs require several treatment episodes over several years to achieve and maintain a state of recovery (Dennis et al., 2005; Dennis et al., 2007). Longitudinal studies show that average individuals require three to four episodes of different kinds of treatment over several years to sustain abstinence (Anglin, Hser, and Grella, 1997; Dennis et al., 2005; Grella and Joshi, 1999; Hser et al., 1997, 1998; Scott, Dennis, and Foss, 2005; Scott, Foss, and Dennis, 2005). The more often and the longer individuals stay in treatment the less likely they are to relapse, which is why long-term treatment is a critical component of recovery.

There is no one way to “cure” addiction. However, there are many ways to improve the quality of life for those with this chronic disorder. For example, patients are more likely to experience long-term sobriety when SUD is treated alongside co-occurring psychiatric conditions (National Institute of Mental Health, n.d.). Additionally, occupation-based interventions, such as, physical exercise, mindfulness, interventions to improve employment outcomes, and peer recovery support have all been found to be holistic ways to improve overall wellbeing and treatment efficacy for patients in recovery (Wasmuth et. al, 2016; Giménez et. al, 2020; Sancho et. al, 2018; Magura et. al, 2020; Harrison et. al 2019; Reif et. al 2014). One study found that patients enrolled in a compensated work program in which they were provided with wages, hours, and responsibilities were more likely to initiate outpatient addiction treatment,

experience fewer symptoms of their SUD and experience fewer episodes of homelessness and incarceration (Kashner et al., 2002). Holistic programming that not only targets problematic behavior regarding substances but also aims to improve one's overall quality of life is a valuable piece of addiction treatment.

1.2 Horticultural Therapy

Recent studies have shown the efficacy of Horticultural Therapy (HT) to support holistic healing for many mental and physical ailments, however the impact of HT on SUD outcomes has not been widely explored. This study will propose an experiment to determine if HT could be an effective component of a substance use treatment program. The American Horticultural Therapy Association (AHTA) defines HT as “the participation in horticultural activities facilitated by a registered horticultural therapist to achieve specific goals within an established treatment, rehabilitation, or vocational plan.” Most broadly HT is a practice where patients are guided by a therapist as they participate in nature-based activities. HT can include, but is not limited to, gardening, taking nature walks, and spending time with plants. HT practices can be modified to serve people of varying abilities, ages and cognitive functioning (Freid & Wichrowski, 2008; Williams, n.d.-a). The proposed study will evaluate HT through the medium of gardening.

While humans have been aware of the healing powers of being in nature for many centuries, the field of HT is relatively new. The practice of using nature as formal therapy started in psychiatric care in the early 1900's. Horticultural therapy gained greater social presence in the 1940's and 1950's when the practice was used to rehabilitate veterans (Watson, 1960). The AHTA formed in 1997, and since then has been working to establish centralized guidance for the field of HT and bring together those who practice it. In 2013, the organization adopted a

Standards of Practice for Horticultural Therapy to define the role of horticultural therapists in a variety of program settings (Williams, n.d.-b).

Horticultural therapy has been used in a variety of healthcare, rehabilitative, and residential settings to provide a space for people to heal (Linden & Grut, 2002). Studies have shown that HT can help improve a wide array of health outcomes for diverse populations. Here are just a few examples of the health benefits of HT; studies have shown that HT improves psychological functioning and mental health in older adults, has positive effects on mood and heart rate for patients recovering from cardiopulmonary disease and improves the emotional well-being of elementary school students (Lin et al., 2022; Wichrowski et al., 2005; Oh et al., 2020).

HT is a healing process. Therapeutic gains are made through engaging with HT and the final product, such as how much one has gardened or engaged with nature, is not as important as the process (Williams, n.d.-a). The main goals of HT are to increase well-being and self-growth, and to support emotional health through connection with the environment (Detweiler & Warf, 2005).

Research on HT also shows the ability for the practice to positively impact symptoms of mental health disorders, such as PTSD, anxiety, and depression, improve general wellbeing, empower individuals, provide a space for learning new skills and mediate stress. In order to determine if these healing aspects of HT are applicable to SUD, I will explore possible therapeutic mechanisms as evidenced by the previous studies and discuss how those may relate to treatment of SUDs.

1.3 Mechanisms of HT

1.3a Stress Mediation

Stress is a major environmental risk factor for addiction, and HT has the potential to address this. One of the benefits of HT is stress relief: studies have shown that gardens and gardening decrease stress as shown through reduced cortisol and saliva amylase levels (Howarth et al., 2020). Further, regular contact with nature can lead to long-lasting reductions in symptoms of depression and anxiety (Beyer et al., 2014). Exposure to nature has also been found to mediate stress through reducing negative mood and enhancing positive effects (Ulrich et al., 1991; Ulrich 1991). The psycho-physiological stress reduction framework suggests that humans are biologically attuned to have a positive response from safe natural environments, especially ones whose components are associated with survival, such as trees and water. Stress reduction is especially important for individuals with SUD as studies have found that stress reduction reduces cravings and promotes abstinence for this population (Goeders, 2003). HT may be an effective component of SUD treatment due to the stress relieving properties of the practice.

1.3b Mental Illness: Post Traumatic Stress Disorder (PTSD), Anxiety and Depression

Gardening and HT have positive impacts on populations living with mental illnesses, including PTSD, anxiety, and depression. This research may be applicable to patients with SUD since approximately half of the populations with SUD have a co-occurring mental health disorder (National Institute on Drug Abuse, n.d.). Additionally, people with PTSD, anxiety and depression are more likely to be diagnosed with substance use disorder (National Institute of

Mental Health (NIMH), n.d.; Magidson et al., 2012). A recent meta-analysis evaluated HT programs for people with a variety of mental illnesses and reported that HT increases mental wellbeing, engagement and accomplishment in participants (Siu et al., 2020). A study done on earthquake-related PTSD in elderly women who live in disaster areas of the Pacific coast found that HT helped improve mental and physical functioning for these women (Kotozaki, 2013). These results validate prior findings about the benefits of HT on individuals with trauma (Linden & Grut, 2002). Another study found that a farm-based horticultural intervention helped to reduce depression scores for the patients; these reduced depression scores were maintained at follow-up (Gonzalez et al., 2009). Several other studies have found that HT interventions reduce depression, anxiety and stress (Gonzalez et al., 2011b, Kam and Siu, 2010, Son et al., 2004). HT may be effective for patients with SUD as the practice may mediate the effects of PTSD, anxiety and depression.

1.3c General Wellbeing

HT is a holistic form of healing and helps participants experience a general sense of wellbeing. Wellbeing can be defined as the presence of positive emotions and moods, satisfaction with life, fulfillment and positive functioning (Andrew et al., 1976; Diener, 2000; Ryff et al., 1995; Diener et al., 1997; Veenhoven, 2008). Gardening and horticultural activities, including horticultural therapy, help create a sense of wellbeing (Soga et al., 2017). A study in patients with dementia found that there were high levels of wellbeing during HT interventions as well as long lasting impacts (Hall et al., 2018). Gardening also enables social interaction and physical activity, which then contributes to increased wellbeing (Howarth et al., 2020). These data suggest that HT may be an effective component of SUD treatment as the practice increases general wellbeing.

1.3d Self-Esteem

Self-esteem is an important target for holistic substance use treatment. Low self-esteem impedes recovery as it results in poor treatment utilization (Corrigan, 2007; Fung et al., 2008; Marlatt et al., 1985). SUD patients are more likely to maintain recovery when they experience high self-esteem and believe progress is possible (Dennis et al., 2007). The process of caring for plants in a HT setting can improve self-esteem (Matsuo, 1998). A study done examining a program for women with PTSD in Korea found that HT significantly increased the self-esteem and mental health of these women (Lee et al., 2016). Additionally, an observational study conducted at the Florida Alcoholism Treatment Center found that their HT program improved patients' self-esteem and helped the participants see that they could have a positive impact on their environment (Cornille et al., 1987). Therefore there is promising evidence that HT may also help empower patients with SUD.

1.3e Goal Setting

Addiction disrupts neurocircuitry in the brain that mediates reward and motivation, executive control, and emotional processing. As a result, individuals with addiction have more difficulty with decision making, such as prioritizing behavior that results in long-term benefit versus those that provide short-term rewards, even when the short-term “rewards” are harmful (Volkow et al., 2018). Working in the garden alongside a horticultural therapist may provide patients in recovery with a space to practice prioritizing long-term benefits. The process of gardening is one of patience: sowing seeds to harvest fruit requires planning for the long-term. HT prompts individuals to respond to successes or failures, be able to make a plan and adjust it

as needed and manage frustration tolerance (Richards et al., 1999). Gardening provides a safe space to practice making and carrying out long-term goals.

1.4 Prior Research

There have only been a few documented studies on the impacts of HT on populations with SUD, the three I will discuss in this paper were conducted by Horton et al. (2021), Detweiler et al. (2015), and Richards et al. (1999).

The most recent study was conducted at “Above and Beyond”, a substance use treatment program in Chicago (Horton et al., 2021). This program utilizes a therapeutic garden to supplement their recovery programs. Authors used qualitative methods to analyze patients' experiences in the space. They found high patient enthusiasm for engaging with the garden and participating in interviews. Participants reported increased mindfulness, reduced stress, increased sensory awareness & personal transformation. These results validate that HT may aid in recovery by increasing self-esteem, reducing stress, and improving general wellbeing.

Another study looked at the impact of HT in modulating cortisol levels and indices of substance craving, posttraumatic stress disorder, depression, and quality of life in veterans (Detweiler et al., 2015). The group assigned to the HT treatment experienced reduced stress, as evidenced by decreased cortisol levels and depressive symptoms, and improved quality of life. These results validate that HT may aid in recovery by decreasing stress and improving overall wellbeing.

One other formalized study has been conducted to examine the efficacy of HT for SUD treatment. This study was conducted in the Patuxent Institution which is a part of the Maryland Department of Public Safety and Correctional Services (Richards et al., 1999). I want to note that

there are deep ethical concerns in conducting an experiment in a prison as people who are incarcerated are not in a position to consent due to power imbalances. This study looked at the changes in vulnerability to addiction (VTA) and resistance to addiction (RTA) in volunteers who engaged in an 8-month HT program. The study hypothesized that HT would reduce VTA, including reductions in psychological symptoms, tension, and distress, and increase RTA measures such as a higher sense of self-efficacy, positive expectations, and confidence in one's coping skills. Significant decreases in the VTA measures were observed, but there were no significant increases in the RTA measures. It is important to note that these results are influenced by the fact that the study was done in a prison—the lack of increases in the RTA may be due to the individual's experience of incarceration. Anecdotally, individuals in the study who had not profited from verbal therapy alone, due to introversion or suspiciousness, became more open to discussions surrounding gardening topics. These observations were supported by a decrease in these patients' scores on the CRAVE Detached Position scale indicating that the participants were more engaged and less psychologically withdrawn. These results suggest that HT may aid in recovery by increasing self-esteem, reducing stress and increasing motivation and goal setting.

In summary, available studies suggest that some of the mechanisms of action by which HT works are through increasing patients' sense of empowerment, decreasing stress, increasing motivation and providing a place to practice goal setting, as well as increasing general wellbeing. There is evidence that HT could be an effective component of SUD treatment, but more experimental evidence is needed. If HT is an effective component of SUD therapy, more research is needed to understand the mechanism by which HT provides a healing experience.

1.5 Study Introduction

The goal of the proposed experiment is to evaluate whether HT could be an effective component of a holistic SUD treatment program. My proposed project will use a randomized controlled trial combined with qualitative analysis to examine the therapeutic impacts of HT in adults with SUD.

This study will recruit participants from a group of patients engaged with long-term residential care through Phoenix House Residential Treatment Program located in New York City and Long Island. Individuals will be invited to volunteer for the six-month long study where they will be randomized to a horticultural therapy intervention or a control condition— additional housework. The primary outcome of this study is to determine if HT can have a positive impact on the severity of a SUD. Treatment surveys as well as structured interviews will assess the changes in severity of several dimensions of addiction, as well as changes in sense of empowerment, stress, motivation and ability to complete long-term goals, and general wellbeing. We hypothesize that participants assigned to HT will have greater reduction in the severity of addiction as compared to participants assigned to the control group, and that these changes in severity of addiction will be mediated by increased sense of empowerment, motivation, ability to complete long-term goals, and general wellbeing, as well as by decreased stress.

2. Methods

2.1 Setting

This study will partner with the Phoenix House, an organization that offers long-term (6-24 month) residential drug treatment programs. Phoenix House provides comprehensive

treatment within a safe, structured, and supportive living environment in several locations in Long Island and NYC including: Hauppauge, NY, Long Island City, NY, Springfield Gardens, NY and Wainscott, NY (Phoenix House NY, n.d.). These residential facilities provide services for both men and women. Phoenix House was chosen for the study as it is a comprehensive program that offers:

- Medication for addiction treatment
- Healthy dining
- Workout facilities
- Individual counseling
- Group counseling covering topics such as relapse prevention, anger management, building health social networks, mindfulness techniques and Cognitive Behavioral Treatment (CBT).
- Recreational activities including outdoor walks, sporting events, planting and gardening, yoga and knitting.
- Vocational and educational support

Two important considerations for the study location include time of patient stay and integration of nature-based programming. Since the study intervention will take place over 6 months, it is important that participants are living at the residential treatment center for at least this long. Phoenix House also acknowledges that effective treatment for SUD must be holistic, and they offer several holistic support structures including recreational activities, vocational support and educational support. Phoenix House also has infrastructure in their locations for gardening activities.

2.2 Study Participants

Participants will be recruited through the Phoenix House counseling staff. Eligible participants will meet the DSM-5 criteria for any substance use disorder (e.g., alcohol, opioid, or stimulant use disorder). Participants will be able to provide informed consent and comply with study procedures.

Participants will be excluded if they are not able to commit to stay in treatment for 6 months following the study initiation or if they have an acute unstable psychiatric illness that will interfere with study participation, including psychosis, suicidality or major neurocognitive disorders.

2.3 Study Design

The study will be a parallel group, randomized control trial comparing a standard treatment + horticultural therapy (HT condition) with standard treatment + additional housework (control condition). Patients in the experimental group will engage with the Horticultural Therapy programming for 6 months. Patients in the control condition will complete additional household chores and have an additional group therapy session for 6 months. Patients will be randomly assigned to the experimental or control group for the duration of the trial, with a target of 50 participants assigned to each study condition.

2.4. Intervention

Patients assigned to the HT condition will be separated into cohort groups consisting of 7- 10 study participants and a HT therapist, with the goal to remain with the same group of peers for an extended period of time. This small and stable group will allow for close group dynamics

and close contact with the horticultural therapist. The HT program will be developed in conjunction with graduates of the Horticultural Therapy Institute, a 501(c)3 non-profit organization, providing HT certification through AHTA (Horticultural therapy institute, 2014). This institute was chosen as it is one of the leading training centers for horticultural therapists.

The treatment goals for this HT program are to: provide a space for patients to heal from their SUD, learn new skills, find connection with nature, and interact with others.

Participants in the HT group will participate in the program for at least five hours per week. Participants will spend four hours a week working in the garden and attending classes with their cohort and horticultural therapist (garden activities will change month to month).

Participants will meet with the HT cohort to participate in group therapy with a horticultural therapist for one hour once a week.

Below is a guide for monthly classes and garden work:

<p>Month 1: April</p>	<p>Participants will attend classes to learn:</p> <ol style="list-style-type: none"> 1. Basic gardening principles: including how plants grow, how to use garden tools and more 2. How to plan a crop rotation 3. How to cultivate seedlings 4. How to weed 5. How to build structures needed in the garden <p>Garden work will consist of:</p> <ol style="list-style-type: none"> 1. Creating a growing plan for the season. 2. Planting and caring for seedlings in the greenhouse 3. Preparing the land including weeding, constructing rows, and building growing beds 4. Building any extra structures that are
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	<p>needed</p> <p>Group therapy will focus on:</p> <ol style="list-style-type: none"> 1. Initial feelings about HT 2. Setting goals for the program
<p>Month 2: May</p>	<p>Participants will attend classes to learn:</p> <ol style="list-style-type: none"> 1. How to transplant seedlings 2. How to direct seed 3. About compost: how its used and how to make it 4. How to care for plants early in their growth <p>Garden work will consist of:</p> <ol style="list-style-type: none"> 1. Weeding 2. Prepping the land for planting 3. Direct seeding and transplanting crops <p>Group therapy will focus on:</p> <ol style="list-style-type: none"> 1. Reflections on work in the garden 2. Reflections on working in a team 3. Reflections on the connection between HT and treatment 4. Reflections on the beginning stages of growing crops 5. Assessing participants progress on their goals
<p>Month 3: June</p>	<p>Participants will attend classes to learn:</p> <ol style="list-style-type: none"> 1. How to care for crops including how to manage weeds, fertilize plants, deal with crop diseases, trim plants and more. 2. How to cook the crops they harvest <p>Garden work will consist of:</p> <ol style="list-style-type: none"> 1. Harvesting 2. Treating plants for disease 3. Weeding

	<ol style="list-style-type: none"> 4. Prepping the land for planting 5. Direct seeding and transplanting crops <p>Group therapy will focus on:</p> <ol style="list-style-type: none"> 1. Reflections on work in the garden 2. Reflections on working in a team 3. Reflections on connection between HT and treatment 4. Reflections on caring for growing crops 5. Assessing participants progress on their goals
<p>Month 4: July</p>	<p>Participants will attend classes to learn about and review:</p> <ol style="list-style-type: none"> 1. How to care for crops including how to manage weeds, fertilize plants, deal with crop diseases, trim plants and more. <p>Garden work will consist of:</p> <ol style="list-style-type: none"> 1. Harvesting 2. Treating plants for disease 3. Weeding 4. Prepping the land for planting 5. Direct seeding and transplanting crops <p>Group therapy will focus on:</p> <ol style="list-style-type: none"> 1. Reflections on work in the garden 2. Reflections on working in a team 3. Reflections on connection between HT and treatment 4. Reflections on caring for growing crops 5. Assessing participants progress on their goals
<p>Month 5: August</p>	<p>Participants will attend classes to learn about and review:</p> <ol style="list-style-type: none"> 1. How to care for crops including how

	<p>to manage weeds, fertilize plants, deal with crop diseases, trim plants and more.</p> <ol style="list-style-type: none"> 2. How to preserve the harvest <p>Garden work will consist of:</p> <ol style="list-style-type: none"> 1. Harvesting 2. Treating plants for disease 3. Weeding 4. Prepping the land for planting 5. Direct seeding and transplanting crops 6. Preserving the harvest <p>Group therapy will focus on:</p> <ol style="list-style-type: none"> 1. Reflections on work in the garden 2. Reflections on working in a team 3. Reflections on connection between HT and treatment 4. Reflections on caring for growing crops and preservation 5. Assessing participants progress on their goals
<p>Month 6: September</p>	<p>Participants will attend classes to learn about and review:</p> <ol style="list-style-type: none"> 1. How to care for crops including how to manage weeds, fertilize plants, deal with crop diseases, trim plants and more. 2. How to preserve the harvest 3. How to transition the garden to winter <p>Garden work will consist of:</p> <ol style="list-style-type: none"> 1. Harvesting 2. Weeding 3. Prepping the land for winter, including planting cover crops 4. Preserving the harvest <p>Group therapy will focus on:</p>

	<ol style="list-style-type: none"> 1. Reflections on work in the garden 2. Reflections on working in a team 3. Reflections on connection between HT and treatment 4. Reflections on caring for growing crops 5. Analyzing goal completion
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There are standardized and customizable parts of the HT program. Standardized treatment includes that participants will follow at least two crops through the entire growing process, from planning to harvesting, and will attend all informational gardening classes. All participants will attend the classes and required gardening activities in their cohort. Gardening activities will occur in two-hour blocks spread out throughout the week. The program will be customizable in that all participants will be able to choose activities they want to engage with and which crops to grow. Participants will also be allowed to work in the garden for more hours than required if they wish.

The control group will engage with household chores and partake in an additional group therapy session. The household chores will occur for the same duration and intensity of physical activity as HT treatment group.

Participants in the control group will:

1. Spend 4 hours a week completing housekeeping chores.
2. Meet with 7- 10 participants in the control group cohort for group therapy one hour once a week. The group will discuss ongoing and future housekeeping projects and participant reflections on their experience completing housekeeping work.

The study will take place over six months, which is similar to the study design of a previous study about HT and SUD done by Richards et al. (1999). The Horticultural Therapy

Program will be offered beginning in April and ending in September, coinciding with the growing season. A six-month timeline was chosen due to the long-term nature of gardening.

2.5 Measurements and Instruments

Study data will come from patient self-assessments and face-to-face interviews.

Assessments will be conducted at baseline and conclusion of the study enrollment by trained interviewers. Baseline medical history and clinical information will be extracted from the patient charts.

Patients who meet the inclusion criteria and consent to the study will participate in a baseline assessment. The baseline assessment will include the Addiction Severity Index (ASI), The Health Education Impact Questionnaire (HeiQ), The Perceived Stress Scale (PSS-10), Situational Motivation Scale (SIMS) and The Quality of Life Scale (QOLS).

As the primary outcome measure, addiction severity status will be determined using the Addiction Severity Index (ASI) (McLellan et al., 1992). Administered under confidential circumstances ASI is a valid measure of addiction severity. ASI is a semi-structured interview that aims to provide a holistic measurement of addiction severity. The instrument measures medical status, employment and support, drug use, alcohol use, legal status, family/social status and psychiatric status to provide a comprehensive measure of the severity of an individual's addiction (Samet et al., 2007). ASI scores will be collected at the beginning and end of the experiment. We hypothesize that ASI scores will decrease over the duration of the experiment significantly more in the HT group as compared to the control group.

The secondary objectives of the study are to further research and understand the mechanism by which HT is healing. As prior mentioned there are several hypotheses that

speculate how HT may support patients with SUD. These exploratory outcomes will include an assessment of changes in empowerment, stress levels, motivation and ability to complete long-term goals, and overall quality of life.

HeiQ will be used to determine changes in empowerment for the participants (Osborne et al., 2007). This instrument was developed to measure empowerment-based interventions for people with chronic conditions. HeiQ is a 42-item scale measuring positive and active engagement in life, health directed behavior, skills and technique acquisition, constructive attitudes and approaches, self-monitoring and insight, health services navigation, social integration and support and emotional wellbeing. HeiQ scores will be collected at the beginning and end of the experiment. We hypothesize that HeiQ scores will significantly increase over the duration of the experiment in the HT condition as compared to the control condition.

PSS-10 will be used to measure changes in stress for the participants. This 10-item questionnaire was developed in 1983 and is a reliable measure of overall stress (Cohen et al., 1983). It measures the degree to which an individual perceives life as unpredictable, uncontrollable and overloading. PSS-10 scores will be collected at the beginning and end of the experiment. We hypothesize that the PSS-10 scores will significantly decrease over the duration of the experiment in the HT condition as compared to the control condition.

To assess the change in motivation and ability to complete long-term goals this study will use the SIMS. This scale measures constructs of intrinsic motivation, identified regulation, external regulation, and amotivation (Guay et al., 2000). SIMS scores will be collected at the beginning and end of the experiment. We hypothesize that over the course of the experiment, SIMS scores will increase significantly in the HT condition as compared to the control condition.

To measure general wellbeing we will use the QOLS scale (Burckhardt & Anderson, 2003). This instrument has been used since the 1970's to measure quality of life. The scale contains 16 items in five areas: material and physical well-being, relationships with other people, social, community and civic activities, personal development and fulfillment, recreation and independence. The QOLS scores will be collected at the beginning and end of the experiment. We hypothesize that QOLS scores will increase from the inception to the end of the experiment, significantly more in the HT group as compared to the control group.

Additionally, researchers will conduct qualitative interviews with the participants in the experimental group. The interview will explore the client's experience in the program, how they perceived the impact and outcomes of horticulture therapy, and the mechanism of action by which HT is healing. A semi-structured interview guide, with suggested questions, will be used to interview each participant. Interviews will explore the following themes: (1) Motivation to join horticultural therapy; (2) HT structure and process; (3) group structure and process; (4) how the individual changed as a result of the program; (5) and how the program was healing. The interview will take about 20-30 minutes and will be recorded.

2.6 Quantitative Data Analysis

We will use a 2-way analysis of variance (ANOVA), with Time and Treatment Group as independent variables, to determine if there have been significant changes in ASI global and component scores. If we find significance, we will use Multilevel Modeling (MLM) to explore both pre and post outcomes along with mediators of the outcomes. SAS statistical software package will be used.

2.7 Qualitative Data Analysis

We will use the protocol developed by Rabiee (2004) as a guide in data analysis. This framework has been used in similar studies examining the impact of HT (Rabiee 2004, Siu et al., 2020). The voice recordings of the interview will be transcribed, and we will conduct a content analysis to identify key themes in the responses. The transcribed text of the interview will be coded and grouped in relation to the guided questions about (1) Motivation to join horticultural therapy; (2) HT structure and process; (3) group structure and process; (4) how the individuals changed as a result of the program; (5) and how the program was healing. The meaning of the coded text will be summarized. The key takeaways from the qualitative data analysis will be triangulated with the results of quantitative analysis, when applicable.

3. Expected Results

The primary hypothesis of this experiment is that severity of addiction as measured by the ASI will significantly improve in the HT experimental group as compared with the control group. We expect there will be significant differences in the ASI scores over time between the control and experimental groups.

Our secondary hypotheses relate to the mechanism of action by which HT is healing. We expect that participants will:

- a) Feel more empowered, as measured by significant increases in HeiQ scores over time in the experimental group as compared to the control group.
- b) Have lower stress levels, as measured by significant decreases in PSS-10 scores over time in the experimental group as compared to the control group.

- c) Gain a greater capacity for motivation and ability to complete long-term goals, as measured by significant increases in SIMS scores over time in the experimental group as compared to the control group.
- d) Experience improved general wellbeing, as measured by significant increases in QOLS scores over time in the experimental group as compared to the control group.

Semi-structured interviews with participants will be analyzed to describe which patients join the program, participant thoughts about the structure of the program, self-reports of participants growth and self-reports of the healing properties of HT. We expect participants will enjoy their experiences participating in HT. Individuals with prior farming experiences or those who already have a prior connection to nature may be more willing to join the study. We expect participants will grow through learning new skills, spending time outside, working in a cohort and participating in group therapy, as similar results were found in another study that looked at the impact of HT on patients with mental illness (Siu et al., 2020). We expect that patients will find that caring for the environment while caring for themselves will be a healing experience.

4. Discussion

4.1 Overview

The study will recruit participants from the Phoenix House treatment center. Volunteers will be assigned to the experimental or control condition for 6 months of programming. The experimental condition consists of four hours of gardening and classes a week as well as group therapy once a week. The control condition consists of four hours a week of additional household chores and group therapy once a week. The study aims to examine the effectiveness and

therapeutic mechanisms of HT. We expect to observe decreases in severity of addiction, as measured by the ASI, in the HT group as compared with the control group. We expect participants will feel more empowered, have lower stress levels, gain a greater capacity for motivation and ability to complete long-term goals and experience improved wellbeing. The semi-structured interviews with participants will reveal that participants will have enjoyed and learned from the program. This feedback will provide guidance to improve HT programs moving forward. Overall we hope to determine if HT could be recommended as an adjunctive component of SUD treatment.

4.2 Implications on Current Knowledge

If we find that ASI scores significantly decrease in the experimental group as compared to the control group, it will support the hypothesis that HT is an effective component of SUD treatment. These results would corroborate and bolster previous literature on the topic that states HT has a positive impact on patients with SUD (Horton et al., 2021; Detweiler et al., 2015; Richards et al., 1999).

Our study is the first to look at the impact of HT on addiction severity. Prior studies have relied on qualitative and observational evidence as well as secondary measurements, such as stress levels, quality of life, and depressive symptoms to understand the impact of HT on SUD (Horton et al., 2021; Detweiler et al., 2015). These measurements reveal that HT has a positive impact on the holistic health of patients with a SUD but they do not show the impact of HT on addiction severity. Our study is novel as it uses a validated measure of addiction severity, to show the effectiveness of HT on intensity of addiction.

If we find that HT significantly decreases ASI, more analysis is needed to understand the mechanisms by which HT works. Our MLM analysis may provide important insight on these mechanisms, which would allow future researchers to modify HT programs to make them more effective for people with SUD.

Previous literature demonstrates that HT increases participant self-esteem (Lee et al., 2016; Cornille et al., 1987). Specifically it is important that individuals in SUD treatment feel empowered as low-self esteem results in poor treatment utilization and lower rates of recovery maintenance (Corrigan, 2007; Fung et al., 2008; Marlatt et al., 1985; Dennis et al., 2007). If we find that both HeiQ scores, which measure changes in empowerment, increase and ASI decrease over the duration of the experiment for the HT group, MLM analysis may demonstrate that HT works through empowering participants.

These findings would both support and challenge previous research on the topic. The data would add quantitative evidence to support the conclusions in the study done at “Above and Beyond”. This aforementioned study found that patients experienced increased empowerment, including increased mindfulness and personal transformation, after HT (Horton et al., 2021). On the other hand, our findings would disprove conclusions from a study done by Richads et al. (1999). That study found no significant increases in the Resistance To Addiction (RTA) measures, which include self-efficacy, positive expectations, and confidence in one’s coping skills. Yet it is important to note that since the Richads et al. (1999) study was done in a prison, which is in and of itself a place with a deep lack of humanity, it may not have been possible to see empowerment increase in this setting.

We expect PSS-10 scores to decrease in participants in the experimental group as compared to those in the control group over the duration of the experiment. If these findings are

true it will support previous studies on HT and SUD that show HT works to reduce stress in this population (Horton et al., 2021; Detweiler et al., 2015; Richards et al., 1999). This is especially important as stress reduction initiatives reduce cravings and promote abstinence for people with SUD (Goeders, 2003).

Individuals with an SUD have difficulty prioritizing behavior that results in long-term benefits. This is a result of disruption in neurocircuitry that mediates reward and motivation, executive control, and emotional processing (Volkow et al., 2018). We expect that HT will help individuals with an SUD to increase their motivation and ability to complete goals, as demonstrated by significant increases in SIMS scores for the treatment as compared to the control group. Our findings will validate similar conclusions that state that HT provides a safe space to practice goal setting, increase motivation and engage with the world in new ways. HT requires individuals to respond to successes or failures, be able to make a plan and adjust it as needed, and manage frustration tolerance (Richards et al., 1999). The study by Richards et al. (1999) further reports anecdotal evidence that individuals who were introverted or suspicious, and who were not profiting from verbal therapy alone became more open to general discussion when reflecting on their experiences in the garden. We hope to find that our HT program similarly benefits our participants.

We expect that participants will experience a greater quality of life over the course of the experiment, as indicated by significant increases in QOLS scores in the treatment group as compared to the control group. One of the main goals of HT is to holistically increase one's quality of life. HT helps create a sense of wellbeing through increasing one's exposure to nature, social interactions, and physical activity (Soga et al., 2017; Howarth et al., 2020). Our findings

would corroborate previous studies that have found that HT increases quality of life for populations with SUD (Detweiler et al., 2015).

The qualitative interviews will provide more evidence about the patient's subjective experience of the program. Researchers will gain knowledge about patients' motivation to join horticultural therapy, their perspective on the structure and process of the intervention, how they changed as a result of the program, and how the program was healing. Since there is so little research in the applications of HT on populations with SUD, collecting information about patient experience is a critical part of increasing the efficacy and accessibility of this new therapeutic approach.

These interviews will illuminate the attributes of an individual that may lead to a higher likelihood of them joining a HT program, and who might benefit the most. For example we may see that younger patients find the program most helpful or that individuals with a background in gardening may choose to participate in HT. Reviewing patient experiences of the HT and group process will allow for future HT experiments to be adjusted to create the best possible patient experience. Data about how the participants believe they changed as a result of the program and how they found the program to be healing will help researchers understand the mechanism of action by which HT works.

4.3 Study Limitations

Since this is not a longitudinal study, the researchers will not be able to know if HT confers long-term benefits and increases long-term sobriety. The research only shows the immediate impacts of HT on ASI.

The size, geographical scope and population of the study is limiting. Since this study will be conducted in NYC the population will be urban– HT may be more or less effective for urban populations than rural ones. Sample sizes are dependent on the size of the Phoenix House treatment programs, which are relatively small. The study will need to be repeated with more participants.

Another potential limitation is that a gardening HT intervention may not be helpful for individuals who have a strong aversion to gardening. Other forms of HT, such as therapeutic walks or sitting in nature, may be more effective and should be explored.

This study will recruit participants with a wide array of substance use disorders, each of whom has a unique prognosis. This could be a limiting factor for the experiment: HT may be effective for one SUD and not another. Future studies should tailor the HT program for each specific SUD and perform experiments delineated by SUD type.

Additionally, not all participants will engage in exactly the same activities. There is no set curriculum for HT programs, as the practice is meant to be customizable for each patient's treatment goals. Participants will be allowed to garden for additional hours if desired, so some participants may engage more with the garden than others. Since participants have a choice in the type of activities they want to do, each individual will have a different experience in the program. In the early months, some individuals may spend a lot of time building garden beds and others may focus on seeding. In the later months, some individuals may want to focus on preserving foods and others on harvesting. While these activities are all necessary, the subjective experience of where a participant chooses to focus may have an impact on their treatment.

4.4 Clinical implications

This study aims to provide more data to support the use of HT in SUD treatment. It is clear that HT works as a holistic mode of healing for a variety of physical and mental illnesses. However in order to support the clinical use of HT as an adjunct treatment for SUD there must be evidence that shows HT improves conditions for those with the disorder. If there are no decreases ASI found then this study can not recommend use of HT for SUD treatment. The results of this study can also be used to craft more effective programs for patients with SUD. For example, depending on the findings, HT programming can be modified to focus on empowerment or stress relief or another mechanism of action.

Additionally, the qualitative interviews will help researchers understand which populations benefit most from this adjunct therapy. Previous studies have found that HT can be a way for reclusive and closed off patients to open up, in this way HT may be most effective for disempowered patients who need capacity building support (Richards et al., 1999). Additionally, if the interviews find that many individuals were drawn to participate in the program due to past farming experiences, this therapeutic form may be more applicable in farming communities. On the other hand, since this study will be conducted in NYC, the qualitative interviews may show that patients were drawn to participate in the intervention due to a lack of nature in their lives. In this case HT may be more effective for urban populations. Overall this experiment will help increase knowledge about the potential to utilize HT in SUD treatment.

4.5 Implications for future research

Hopefully this study is the first of many in the field. Since this will be a small NY based study, the research will need to be replicated in other communities and geographic areas.

This research may find that HT decreases ASI, but it may not illuminate the mechanism for this improvement. In this case, more research will be needed to determine the mechanisms of action by which HT is healing.

This study may also set groundwork for the ways in which the effectiveness of HT programs are measured for this population. Previous studies have used a variety of different measurements to determine the impacts of HT on patients with SUD but none have used ASI as an instrument. ASI may become a standard measuring tool to understand the efficacy of HT on this population. On the other hand, future studies may create more tailored tools to better measure HT programs in SUD treatment.

Researchers will need to conduct more studies with a longitudinal design and MLM to collect data over time and determine the most effective dose of HT on this population. We may find that six months is not enough time for the treatment to have an impact or conversely that three months could confer the same benefits as longer programming. For example, future researchers may administer the ASI Composite Score test. This test was developed to measure treatment outcomes as it includes questions that pertain to the previous 30 days (Addiction Severity Index (ASI), 2019). This information will show monthly changes in ASI and may provide insight on the time it takes for the intervention to become effective. Future research may also compare the outcomes of patients who engage with HT for one hour a week, five hours a week and ten hours a week to further elucidate the most effective dosing of HT.

It will also be important to conduct more experiments that look at the effectiveness of the HT intervention on patients with a variety of SUDs. Studies may find that participants with a certain SUD benefit most, which would thus suggest that HT is more applicable to some types of

SUD over others. Future experiments and statistical analysis may be done to compare the effectiveness of HT between individuals with different SUDs.

4.6 Conclusions

This study will help to determine if HT could be an effective component of SUD treatment. This parallel group, randomized control trial will compare the HT condition, standard treatment and HT, to the control condition, standard treatment and additional housework. The study will compare changes over time and changes between groups in participants' addiction severity, sense of empowerment, stress levels, ability to complete long-term goals and general wellbeing as measured by ASI, HeiQ, PSS-10, SIMS and QOLS respectively.

We expect that participants assigned to HT will have greater reduction in the severity of addiction as compared to participants assigned to the control group. We expect that these changes in severity of addiction may be mediated by an increase in sense of empowerment, motivation, ability to complete long-term goals and general wellbeing as well as a decrease in stress in participants in the experimental condition as compared to participants in the control condition. Additionally, interviews will give the researchers insight into which participants are more likely to join the program, how participants feel about the structure of the program, how participants describe their self growth as a result of the program, and the ways in which the participants believe the program was healing.

These data and interviews will provide critical knowledge to understand the efficacy of HT. If HT decreases ASI we can determine that HT is an effective component of SUD treatment. In this case, clinicians will be able to implement HT as a tool to improve outcomes for their patients. Additionally, qualitative interviews will provide feedback on how to improve HT

programs for this population moving forward. Ultimately, this study will add to current knowledge about which holistic adjunct treatments may be most effective for patients with SUD.

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