

Assessing Human Health Benefits of Gardening

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ABSTRACT

This project is a follow-on study of an experimental protocol conducted in 2015 that showed when healthy women engaged in gardening, self-report psychometric assessments indicated reductions in depressive symptomatology, anxiety, stress, and mood disturbances. This project was aimed at testing whether the earlier study’s findings could be supported using a more robust experimental design with less inherent bias, with a larger population of study participants, and a second comparable active treatment group involving art activities.

The PI and Co-PI established a collaboration with UFHealth Arts in Medicine Program and the UF Center for Arts in

Medicine to develop and lead an experimental treatment involving a set of art activities that would be an approximate parallel to the experimental gardening treatment. The gardening treatment would be conducted by Mr. Raymond Odeh, the Co-PI, with guidance from the PI in a horticultural therapy greenhouse. The art activities treatment would be conducted by two Artists-in-Residence from the Arts in Medicine Program in a conference center on the same days and at the same time as the gardening sessions. The study was approved by the UF Institutional Review Board before participant recruitment and subsequently, the experiment could begin. Recruitment required two months.

METHODS

Study participants were assessed before the start and following the conclusion of the experimental treatments for mental health status including anxiety, depression symptomatology, psychological stress, mood disturbances, and satisfaction with participation in social activities, in addition to assessment of physical health status, cardiovascular health, and general well-being and quality of life. Cardiovascular health monitoring included taking heart rate and blood pressure measurements at the beginning and end of each individual treatment session for both treatment groups.

The proposal to the FNGLA Endowed Research Fund was to request funds to hire three Federal Work-Study undergraduate students and three undergraduate students not eligible for Federal Work-Study to help the PI and Co-PI conduct the experiment. Obligatory help provided by students was needed to set up for the gardening and art treatment sessions, to help administer and collect psychometric assessment questionnaires, to distribute heart rate and blood pressure monitoring devices, help participants take measurements, and then record the collected data on to preprinted data sheets and assist in post-session clean-up, and transport plant materials to off-site greenhouses and store supplies for the next session. The experiment was conducted during the month of October 2017 and continued until the middle of November 2017. Awarding of the FNGLA research funds was delayed until November 8th due to Hurricane Irma. It was imperative to have the assistance of the students to conduct the experiment, therefore the PI used already existing funds to hire five students, three Federal Work-Study and two non-Work-Study. The experiment generated large amounts of data, and therefore the FNGLA funds were used to pay the students to enter the collected data from the completed questionnaires and forms into electronic databases for subsequent statistical analyses. The extensive data entry process required several months to complete. This significantly accelerated the completion of the project.

The experimental design is shown below in Figure 1. Forty healthy women were enrolled in the study and randomly assigned to the gardening (20) treatment group or the art activities treatment group (20).

A total of 32 women (15 in the gardening group and 17 in the art group) completed all aspects of the study. The gardening treatment involved four major horticultural activities: planting seeds, transplanting, vegetative propagation, and simulated harvest (Table 1), each repeated twice.

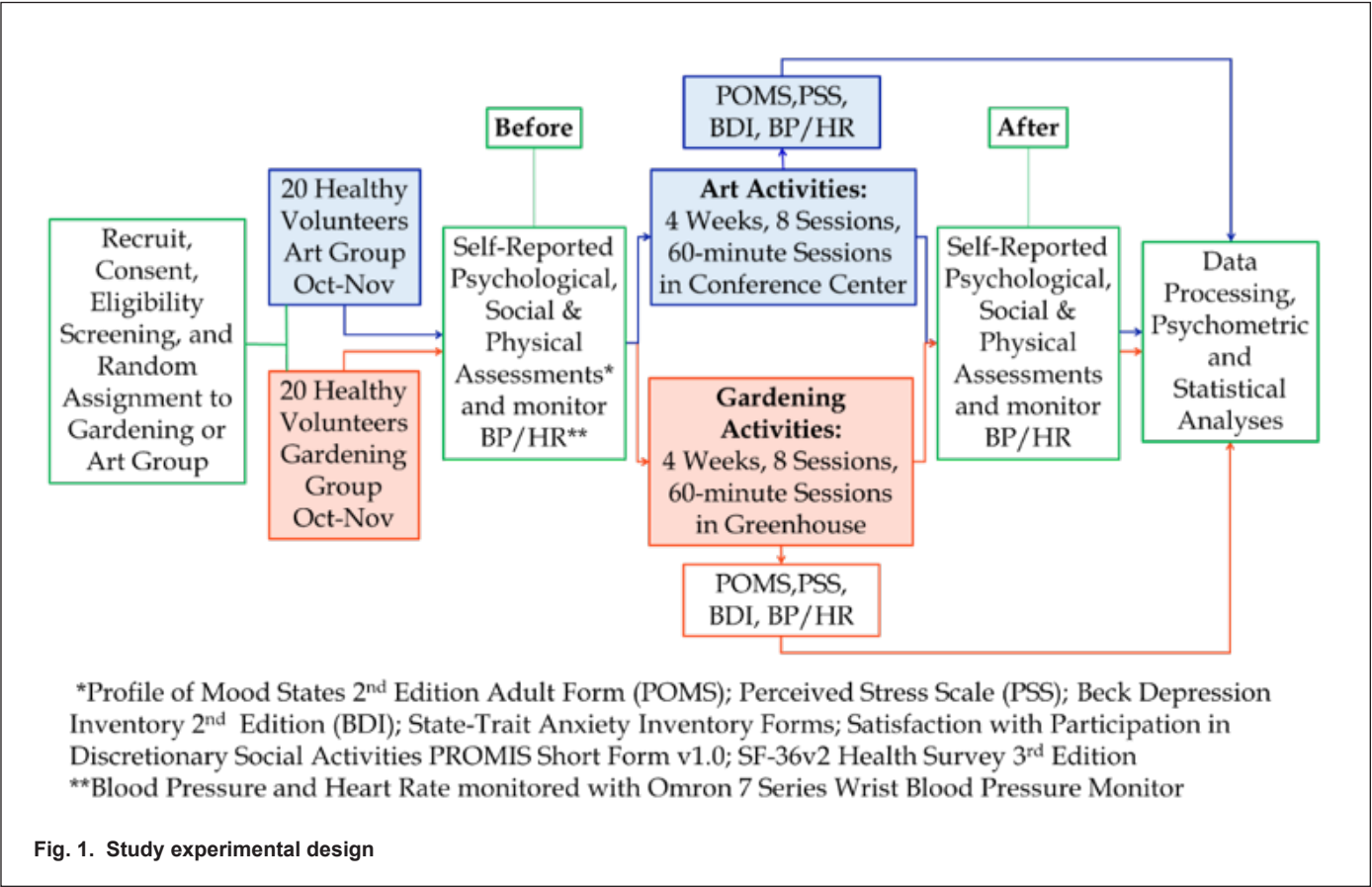


Table 1. List of gardening and art treatment intervention sessions with associated visit numbers.

Visit Number ^a	Session Number	Art Activity	Gardening Activity
3	1	Papermaking	Comparing, Planting Herb Seeds
4	2	Image Transfer	Propagation of Herb & Sensory Plants
5	3	Visual Storytelling	Transplanting Succulent Plants
6	4	Linocut Printmaking: Part 1	Propagation of Ornamental Plants
7	5	Linocut Printmaking: Part 2	Simulated Harvest: Tasting Herbs
8	6	Paper Batik	Seeding Fast Germinating Vegetables
9	7	Mixed Media Collage	Transplanting Herbs & Lettuce
10	8	Sensation Drawing	Simulated Harvest: Tasting Microgreens

^aVisit 1 was the initial screening and consenting, and Visits 2 and 11 were the pre-intervention and post-intervention evaluations, respectively.

RESULTS & CONCLUSIONS

Given FNGLA's support here is what it allowed us to discover. Evaluation of 17 demographic and health-related parameters demonstrated that random assignment of the participants to the gardening or art treatments resulted in two nearly identical experimental groups on which to adjudicate whether the two different treatments produced equal or differential therapeutic outcomes. The gardening and art groups were, on average, young (early 30s), highly educated, had household incomes above the local and State of Florida median, approximately half of the participants were single, cared for on average less than one child, cared for about 2 plants, used alcohol in low amounts, none smoked, exercised about three times a week, had BMI in the normal range, had heart rate and systolic and diastolic blood pressures in the recently updated and current normal range, and self-rated current physical and mental health status between 7.6 and 8.3 out of 10 with 10 being optimum. The study population was 50% White, 25% Asian, 17.5% other, 5% African-American, and 2.5% Native American.

Statistical analyses of the self-report psychometric assessments revealed important therapeutic effects and outcomes resulting from the four-week gardening and art treatments. Scores for total mood disturbance (POMS TMD), perceived psychological stress (PSS), and depressive symptomatology (BDI-II) were all statistically reduced (p<0.05) for both gardening and art treatments. Note the substantial percent change values ranging from -37 to -67 percent. The score for Trait-anxiety (STAI-Trait) was also statistically reduced (p<0.05) following completion of the treatment for the gardening group only. The reduction in State-anxiety score (STAI-State) for the gardening group only was very close to being statistically significant (p=0.057). Small changes resulting from the treatments in physical health, general mental health, and satisfaction with discretionary social interactions were found not to be statistically significant for either the gardening or art treatment groups.

Clinical trial-like human subject studies evaluate treatment efficacy using a second statistical approach, that of calculating treatment “*effect size*,” the idea being small treatment effects that are statistically highly significant from a probability standpoint may have little to no therapeutic benefit or value. Cohen’s *effect size* statistic (*d*) indicates the magnitude of change imposed by a treatment on a group or population. Table 2 shows that both gardening and art treatments produced medium to large *effect size* outcomes for total mood disturbance, psychological stress, and depressive symptomatology. Gardening also had a small to medium effect size impact on anxiety while art did not.

The Profile of Mood States (POMS) self-report psychometric assessment not only indicates total mood disturbance (TMD) as shown in Table 2 but provides indications for seven mood-related subscales as listed in Table 3. Both gardening and art treatments resulted in statistically significant reduced scores for Confusion, Fatigue, and Tension subscales.

The gardening treatment also resulted in statistically significant reduced scores for Anger. Calculation of Cohen’s *effect size* statistic revealed that the gardening and art interventions imposed medium to large treatment *effect sizes* for Anger, Confusion, Fatigue, and Tension.

A major understudied aspect of gardening or horticultural therapy relates to treatment dosage effects. It is understood that very often a single dose of a medication is insufficient to adequately treat a given medical problem. There are very few studies of gardening or horticultural therapy interventions that explore dosage effects. An objective of the gardening and art study was to examine dosage effects on TMD, psychological stress and depressive symptomatology.

Table 2. Treatment *effect size* calculations using Cohen's *d*_{RM} for repeated measures.

Assessment Instrument	Intervention	Percent Change Pre-to Post-Intervention	Effect Size, Cohen's <i>d</i> _{RM}	Effect Size, Category
POMS TMD (T-score)	Gardening	-66	-0.7	Medium
	Art	-67	-0.6	Medium
PSS	Gardening	-37	-1.2	Large
	Art	-37	-0.8	Large
BDI-II	Gardening	-66	-0.7	Medium
	Art	-43	-0.8	Large
STAI-State	Gardening	-15	-0.6	Medium
	Art	0	0.0	No Effect
STAI-Trait	Gardening	-10	-0.4	Small
	Art	-1	-0.1	No Effect
SF-36 Mental (Norm-based)	Gardening	7	0.4	Small
	Art	4	0.2	Small
SF-36 Physical (Norm-based)	Gardening	2	0.2	Small
	Art	0.01	0.1	No Effect
SPDSA	Gardening	9	0.4	Small
	Art	9	0.3	Small

Table 3. Treatment *effect size* calculations for POMS 2 subscales using Cohen’s *d*_{RM} for repeated measures.

POMS Subscale	Intervention	Percent Change Pre-to Post-Intervention	Effect Size, Cohen's <i>d</i> _{RM}	Effect Size, Category
Anger	Gardening	-9	-0.7	Medium
	Art	-5	-0.5	Medium
Confusion	Gardening	-7	-0.7	Medium
	Art	-12	-0.8	Large
Depression	Gardening	-7	-0.4	Small
	Art	-7	-0.4	Small
Fatigue	Gardening	-15	-0.8	Large
	Art	-11	-0.5	Medium
Tension	Gardening	-14	-0.9	Large
	Art	-9	0.5	Medium
Vigor	Gardening	-2	-0.1	No Effect
	Art	7	0.3	Small
Friendliness	Gardening	1	0.1	No Effect
	Art	1	0.1	No Effect

Figures 2, 3, and 4 show a highly robust progression of dosage effects for gardening and art on TMD, stress, and depressive symptomatology. All of the progressions can be modeled by logistic functions which would be anticipated from a process that was proceeding asymptotically towards lower or lowest possible scores on the assessments as in this case. These data clearly support dosage effects and provide compelling data for larger studies.

Each study participant’s blood pressure (BP) and heart rate (HR) was measured three consecutive times at the beginning and at the end of every treatment session and during the pre-intervention and post-intervention assessments. Our hypothesis was that gardening and art treatments would result in lower BP and HR. We did not find any reductions in BP and HR for either gardening or art, and therefore the hypothesis is rejected (data not shown). Our findings are contrary to many reports of lower BP and HR by other studies. Our data on BP and HR are based on over 1900 measurements and seems to be rather robust. We do not have an unambiguous explanation at this time why there was no reduction in these physiological responses to the treatments.

The BP for the art group was slightly higher than that of the gardening group at the start of the experiment and generally fluctuated above that of the gardening group throughout the treatment all the way to the post-intervention assessments. It is possible that the activities in the art treatment created some degree of anxiety on the part of some participants, especially for those without artistic skills.

Millions of gardeners when asked why they garden, give answers like: it makes me happy, it is my therapy, it takes away my stress and anxiety, and I have more energy. This study provides quantitative evidence to validate these anecdotal explanations of why such a large number of individuals engage in gardening. The same benefits appear to apply to healthy women that engage in art activities.

The findings from this small study are very important because they show that when healthy women engage in gardening it can positively influence their psychological well-being. This can be a huge outcome of the study, and once published it can be a basis for demonstrating in marketing campaigns the health benefits that gardening and engaging in horticultural activities can provide.

The support provided by the FNGLA Endowed Research Fund enhanced the quality of the experimental treatments, data collection, data entry, and the therapeutic outcomes that were ultimately realized in this study.

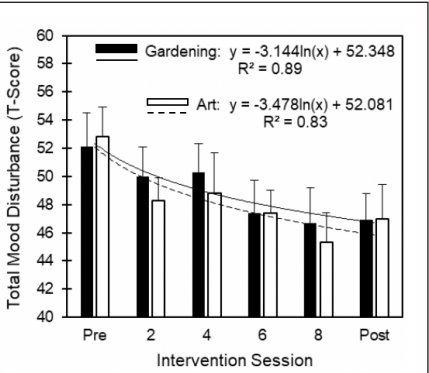


Fig. 2. Gardening and art dosage responses for total mood disturbance.

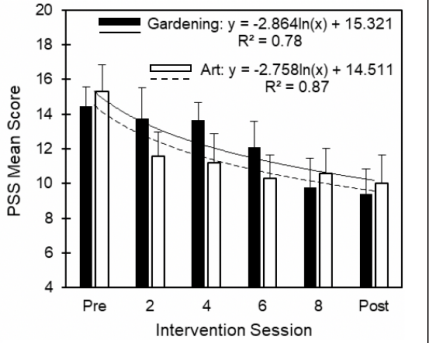


Fig. 3. Gardening and art dosage responses for psychological stress.

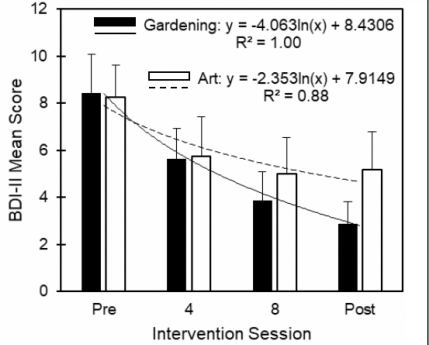


Fig. 4. Gardening and art dosage responses for depression symptoms.