The Effects of Greenhouse Activities on Psychological Stress, Depression, and Anxiety among University Students Who Served in the U.S. Armed Forces

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Abstract. The mental health of the men and women who served in the U.S. Armed Forces is an area of great concern in the United States. Studies have shown the mental health of university students is also at a growing need for support services and prevention measures. The main objective of this study was to determine the effects of participation in particular greenhouse activities on depression, anxiety, and stress levels of students who served in the U.S. Armed Forces. The study included a control group and a treatment group. Participants completed a pre- and post-21-item Depression Anxiety and Stress Scale (DASS-21) survey, along with a questionnaire designed to capture participants’ demographic information and information regarding their military service history. The treatment consisted of a 6-week indoor plant care program. Results of the study found that student veterans who participated in the plant care class had decreased levels of depression and stress when compared with the control group. In the post-test open-ended questions, student veterans described a noticeable feeling of reduced stress along with the ability to relax while having feelings of a sense of place (belonging). Participants also indicated that they would continue to grow plants as a hobby.

Mental health disorders, particularly post-traumatic stress disorder or PTSD (an anxiety disorder triggered by a traumatic event), are often cited as conditions where the treatment will result in substantial future costs (Bass and Golding, 2012; Bilmes, 2013) if not treated. The total costs for treating veterans with PTSD during fiscal years 2004–09 at the Veterans Health Administration (VHA) was $1.42 billion (Bass and Golding, 2012). The total cost for treating active service members, reservists, and national guardsmen altogether is unreported. The average cost of treatment for PTSD per veteran in the VHA for the first year of treatment is $8300, whereas treatments for years 2, 3, and 4 are $4200, $3900, and $3800, respectively (Bass and Golding, 2012).

Accounting for and untangling the costs associated with PTSD and other mental illnesses associated with deployment are not easy tasks, nor is determining the total number of those diagnosed with PTSD. During the period of Oct. 2001 through Mar. 2011, military clinicians diagnosed PTSD as one of the more common diagnoses among service members, accounting for ≈75,000 cases (Golding, 2011). During the same period, the VHA diagnosed 187,000 overseas contingency operations (OCO) veterans with PTSD (Golding, 2011). For this period, 15,000 veterans were not treated for PTSD by the VHA system or the vet centers. While these calculations overlap, the total number is undetermined; however, the total number of veterans diagnosed with PTSD is somewhat less than 277,000 (Golding, 2011).

Over the past decade, the United States has deployed over 2.3 million service members to OCO, such as Iraq and Afghanistan, in the post-Sept. 11 “Global War on Terrorism” (Bass and Golding, 2012). In a study conducted in 2010, ≈27% of two million service members had been deployed more than once (Sayer et al., 2010).

Several studies suggest that as time since deployment to Operations Enduring and Iraqi Freedom (OEF/OIF) increases so, too, does the prevalence of poor mental health functioning among the U.S. service members (Falvo et al., 2012; Milliken et al., 2007; Seal et al., 2009; Thomas et al., 2010). Before deployment to Iraq and Afghanistan in support of the OEF/OIF, the U.S. service members reported baseline health functioning superior to that of the general U.S. population (Falvo et al., 2012; Smith et al., 2007). Following deployment, however, veterans reported they had poorer health (Falvo et al., 2012; Milliken et al., 2007; Sayer et al., 2010). In fact, the number of OEF/OIF veterans rating their overall health as fair or poor doubled 6 months after returning home as compared with their initial post deployment assessment (Falvo et al., 2012; Milliken et al., 2007). Studies have shown that the longer a veteran waits after redeployment to seek treatment, the worse his/her symptoms develop (Falvo et al., 2012). A worsening of functioning over time could lead to long-term disability and have numerous public health implications; for example, greater health care utilization and mortality would be especially problematic for this relatively young, working age population (Falvo et al., 2012).

Upon return from deployment, veterans often suffer with mental and physical challenges that interfere with their quality of life. Combat veterans, in general, often have a difficult time reintegrating into society and this is compounded when they are suffering with PTSD (Erickson, 2011). Veterans sometimes return as a different person, especially those who have served multiple deployments, and particularly if they have experienced, witnessed, or were confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others (DSM-IV checklist as cited by DepressionD, 2013). Some veterans have changed in physical ways with physical wounds that can be seen and treated; others have psychological wounds that are invisible and sometimes much more difficult to diagnose and/or for the veteran to ask for help.

Despite the challenges veterans have in readjusting and transitioning from military life to civilian life, a little more than a million veterans and military service members have made the transition to campus life (NCSL, 2014). While all students have to adjust to campus life, student veterans have to balance a wide range of other challenges which range from coping with service-related injuries, the lack of camaraderie and understanding among other students and faculty, difficulty obtaining academic credit for military training and experiences, concerns about targeted recruiting by for-profit institutions, and/or state residency requirements (NCSL, 2014). In 2012, veteran undergraduates made up ≈4% of the nation’s student body. Sixty-two percent of veterans are the first in their family to attend college, compared with 43% of nonmilitary students (McBain et al., 2012). The average age of student veterans enrolling in a four-year university is 33 years (McBain et al., 2012), of which 85% are 24 years of age, and 47% have families, either a spouse and/or children (NCSL, 2014). Females make up 27% of the veterans enrolled in post-secondary education; however, they only make up 10% to 12% of the total military personnel (NCSL, 2014).
Transition to college life can be difficult and challenging for traditional and nontraditional students. Bayram and Bilgel (2008) conducted a study to determine the correlations of depression, anxiety, and stress among university students. While using the Depression Anxiety and Stress Scale-42 (DASS-42), their results indicated depression, anxiety, and stress levels of moderate severity or higher were found in 25% to 47% of the respondents. First and second year students had higher depression, anxiety, and stress scores. Their study found an alarmingly high prevalence of issues of depression, anxiety, and stress among college students indicating a need for the development of prevention measures and support services for college students (Bayram and Bilgel, 2008).

The Center for Collegiate Mental Health’s 2015 report found in students’ self-report surveys of distress over a 6-year period that the average raw scores continue to increase for depression, generalized anxiety, and social anxiety. The level of academic distress also had a slight increase. Furthermore, the report found an increase in students seeking mental health services and a steady increase in self-harm (intentionally cut, burned, bruised, or otherwise injured themselves) among students who sought out services, with 32.9% of the students seriously considering suicide in 2015, compared with 23.8% in 2010 (Center for Collegiate Mental Health, 2016).

Gonzalez et al. (2011) conducted a study using therapeutic horticulture to assess changes in psychological distress and social participation in adults who were diagnosed with clinical depression. Therapeutic horticulture is a plant-based activity that includes participation in enjoyable activities, behavioral activation, and a moderate amount of physical activity in a pleasant, plant-based environment (Gonzalez et al., 2011). The study found that depression severity declined significantly after 4 weeks of therapeutic horticulture interventions and continued to decline in the following 4 weeks (Gonzalez et al., 2011).

The purpose of this study was to determine the effects of participation in particular greenhouse activities on depression, anxiety, and stress levels of students who served in the U.S. Armed Forces.

### Materials and Methods

#### Sample.
Participants in both the treatment and control groups were self-selected from the Texas State University student population for inclusion in the study. Flyer and e-mail advertisements were disseminated to the student body inviting military veteran students to participate. Interested participants chose to participate in either the treatment group or the control group. Because of contracted activity space, limited availability of time in the greenhouse and the potential need for somewhat individualized attention during treatment sessions, the treatment group size was limited to no more than 15 participants. Therefore, a control group of a similar size was recruited and the study was capped at 30 participants.

#### Instrument.
Participants completed the DASS-21 inventory (Lovibond and Lovibond, 1995a), a well-established psychometric instrument used in clinical and nonclinical samples. The DASS-21 is a short form of the standard DASS which is a 42-item scale. Both the DASS-21 and DASS-42 inventory are formatted and used as a self-report 4-point Likert scale designed to measure three sets of emotional states: depression, anxiety, and stress (Lovibond and Lovibond, 1995a). Participants responded to statements regarding how they felt over the course of the previous week with options ranging from zero (did not apply to me at all) to three (applied to me very much). The intensity of the emotional states is determined by the sum of scores, with higher scores indicating greater severity of the emotional states of depression, anxiety, and stress. The DASS-21 has been examined in clinical and nonclinical samples and found to have a reliability of 0.94 for DASS-D (depression), 0.87 for DASS-A (anxiety), and 0.91 for DASS-S (stress) (Mahmoud et al., 2010).

Each of the three DASS-21 scales contains seven items divided into subscales with similar content. The depression scale assesses dissatisfaction, hopelessness, devaluation of life, self-deprecation/criticism, lack of interest or involvement, or the inability to experience activities once found to be enjoyable (Mahmoud et al., 2010). The anxiety scale assesses involuntary arousal, skeletal muscle effects, situational anxiety, and subjective experience of uneasiness. The stress scale is sensitive to levels of ongoing stress. It assesses difficulty relaxing, nervous arousal, and being easily upset, agitated, or irritable, over-reactive, and impatient (Mahmoud et al., 2010).

The presurvey also collected participants’ demographic information and information regarding their military service history and qualitative information regarding the reason(s) participants decided to participate in the study. The postsurvey qualitative information was gathered regarding any information they wanted to provide on the impact the study had on their psychological stress, depression, and anxiety that the structured survey questions may have missed. Scores were interpreted using distributions based on the DASS scoring system and severity score ranges (Lovibond and Lovibond, 1995b) (Table 1).

#### Survey administration.
Control and treatment group participants were pretested before the onset of the study. At the conclusion of the 6-week treatment, participants in both groups completed a posttest survey. The pretest was administered 2 weeks before midterm exam week and the posttest was administered 4 weeks before final exam week during the fall semester.

Researchers used a 6-week greenhouse-based program composed of a pretest, a 2-week treatment period, and a posttest. The pretest was administered 2 weeks before midterm exam week and the posttest was administered 4 weeks before final exam week during the fall semester. Researchers conducted the study using therapeutic horticulture to assess changes in psychological distress and social participation in adults who were diagnosed with clinical depression. Therapeutic horticulture is a plant-based activity that includes participation in enjoyable activities, behavioral activation, and a moderate amount of physical activity in a pleasant, plant-based environment (Gonzalez et al., 2011).

### Table 1. DASS-21 cutoff scores for conventional severity levels in the study of the effect of greenhouse activities on the depression, anxiety, and stress of university students who served in the U.S. Armed Forces.

| DASS-21* | Depression | Anxiety | Stress |
|----------|------------|---------|--------|
| Normal   | 0–9        | 0–7     | 0–14   |
| Mild     | 10–13      | 8–9     | 15–18  |
| Moderate | 14–20      | 10–14   | 19–25  |
| Severe   | 21–27      | 15–19   | 26–33  |
| Extremely Severe | 28+ | 20+  | 34+    |

*Lovibond and Lovibond (1995b).

### Table 2. Outline of treatment activities included in the 6-week plant class in the study of the effect of greenhouse activities on the depression, anxiety, and stress of university students who served in the U.S. Armed Forces.

| Week | Topic | Activity | Materials used |
|------|-------|----------|----------------|
| 1    | Pretest; overview of the plant care class | Create first hypertufa; start various types of succulents; cut and stick succulent’s leaves in sand/perlite mix under-timed watering mist system | Portland cement, perlite, peat, mixed succulents, sand, and perlite mix |
| 2    | Hypertufa; asexual propagation | Create second hypertufa; stem cutting and leaf cutting | Portland cement, peat, rooting hormone, and various tropical plants |
| 3    | Air layering, scarify, and stratify | Air layer indoor plants and propagate native plants from seed | Rooting hormone, sphagnum moss, plastic wrap, foil, hot water, metal mill file, various native plant seeds, and indoor tropical plants |
| 4    | Grocery store propagation | Propagate items participants brought from the grocery store | Various fruit, vegetable, and herb plants |
| 5    | Indoor plants | Starting and caring for indoor plants including identifying pests and diseases | Various indoor plants |
| 6    | Mixing media, potting plants, and posttest | Mix succulent and cacti media. Filling and arranging succulents in hypertufa. Potting and taking home the plants grown during the class | Sand, perlite, peat, and potting media |
administered all questionnaires. The surveys took ≈5–10 min to complete.

**Treatment.** A 6-week treatment was designed exclusively for the study and included indoor/outdoor plant care, plant propagation activities, and a plant project (Table 2). The 6-week treatment was selected based on the Gonzalez et al.’s (2010, 2011) therapeutic horticulture research which found that during a 12-week therapeutic horticulture program, depression severity declined significantly after each 4-week interval period of therapeutic horticulture intervention. The researchers in this study extended the study by 2 weeks to measure and determine any effects this may have on anxiety and stress. As part of the study agreement, participants were required to attend the treatment sessions at least once per week for 1-h group sessions. Attendance was taken at each session to document participation by each student. In addition, participants were allowed time to follow-up on the progress of their plant(s) between sessions.

The 6-week treatment sessions focused on the participants creating a small hypertufa planter, propagating cacti and succulents, designing a containerized design and creating a follow-up plant care plan for the cacti and succulent garden. In addition, other activities were included, such as growing microgreens, air layering, propagating outdoor native plants, propagating indoor/outdoor ornamental plants, and propagating items from the grocery store (Table 2). Hypertufa is a term used for a type of artificial stone; the word “tufa” means volcanic rock. Hypertufas were first created in the mid-19th century by mixing sand, peat, various volcanic aggregates, and cement (Shieh et al., 2006).

**Data analysis.** Data were entered and scored using Microsoft Excel (Seattle, WA) and then analyzed using the SPSS® Version 20.0 (Chicago, IL). Statistical analysis of quantitative data included descriptive statistics, frequencies, paired t tests, analysis of variance (ANOVA), and Wilcoxon signed-rank tests. The alpha level for statistical significance is considered conventional in social sciences and with smaller data sets (Noymer, 2008). Post-treatment, open-ended qualitative questions were evaluated so as to analyze and develop possible themes. Each participant’s response was tabulated accordingly. The results were summarized by the frequency of response for the various themes developed (Waliczek et al., 2003).

**Results**

**Sample.** Of the 21 participants who originally entered the study, 17 completed the study. At the beginning of the study, there were 10 (47.6%) participants in the treatment group and 11 (52.3%) participants in the control group. The treatment group provided 10 (47.6%) pretest responses and 8 (47%) posttest responses, whereas the control group included 11 (52.3%) pretest responses and 9 (52%) posttest responses. There were two participants in the treatment group who did not complete the plant care program because of various personal reasons.

The mean age group of the treatment group was 31–35 years, whereas the mean age group of the control group was 26–30 years. The range age for the treatment group was 21–53 years, whereas the age range of the control group was 21–40 years. The mean length of service for the treatment group was 7–8 years, and the mean length of service for the control group was 4–6 years. The treatment group included three veterans whose length of service was greater than 20 years. Most veterans in the study were working toward an undergraduate degree. The treatment group consisted of six (60%) undergraduate and four (40%) graduate students, whereas the control group consisted of 10 (91%) undergraduates and one (9%) graduate student. Participants reported a range of different majors: 13 (61%) reported studies related to “helping” professions and 5 (23%) reported environmental-related fields of study. The remaining fields of study consisted of two (1%) studying biology and one (0.5%) computer information science major. Demographic comparisons of the study group found that the sample was slightly different from the veteran student body at Texas State University, but similar to the population of student veterans in the overall United States (Texas State University Institutional Research, 2017). Of the 1263 student veterans enrolled at Texas State University, 861 (68.17%) are males and 402 (31.82%) are females. The study consisted of 16 (76.2%) males and five (23.8%) female

| Table 3. The Wilcoxon signed-rank test comparison of treatment group pretest vs. posttest and the control group pretest vs. posttest depression, anxiety, and stress scores in the study of the effect of greenhouse activities on the depression, anxiety, and stress of university students who served in the U.S. Armed Forces. |
|-----------------|--------|--------|--------|---|---|
| Category Severity | Mean score | SD | Z | P |
| Depression treatment | | | | | |
| (pretest) Mild | 11.75 | 11.44 | -2.03 | 0.04* |
| (posttest) Normal | 5.75 | 6.54 | 0.29 | 0.77 |
| Anxiety score treatment | | | | | |
| (pretest) Moderate | 10.75 | 9.85 | -1.08 | 0.28 |
| (posttest) Normal | 6.75 | 6.04 | 0.53 | 0.60 |
| Stress score treatment | | | | | |
| (pretest) Normal | 10.75 | 9.85 | -0.14 | 0.89 |
| (posttest) Normal | 11.50 | 7.23 | 1.47 | 0.14 |
| Depression score control | | | | | |
| (pretest) Normal | 9.56 | 11.17 | -0.96 | 0.34 |
| (posttest) Mild | 10.67 | 8.89 | 0.53 | 0.59 |
| Anxiety score control | | | | | |
| (pretest) Moderate | 11.78 | 10.97 | 0.00 | 1.00 |
| (posttest) Moderate | 11.78 | 10.22 | 0.53 | 0.59 |
| Stress score control | | | | | |
| (pretest) Mild | 17.78 | 9.19 | -0.63 | 0.53 |
| (posttest) Moderate | 19.11 | 10.11 | 0.89 | 0.37 |

*Statistically significant at Z = 0.10.

Table 4. A one-way analysis of variance comparison of treatment vs. control group posttest depression, anxiety, and stress scores in the study of the effect of greenhouse activities on the depression, anxiety, and stress of university students who served in the U.S. Armed Forces.

| Instrument and group | n | Mean score | SD | df | F | P |
|---------------------|---|------------|---|---|---|---|
| Overall Depression Treatment | 8 | 5.75 | 6.54 | 1 | 1.65 | 0.219 |
| Control | 9 | 10.67 | 8.89 | 1 | 1.65 | 0.219 |
| Anxiety Treatment | 8 | 6.75 | 6.04 | 1 | 1.47 | 0.244 |
| Control | 9 | 11.78 | 10.22 | 1 | 1.47 | 0.244 |
| Stress Treatment | 8 | 11.50 | 7.23 | 1 | 3.11 | 0.098* |
| Control | 9 | 19.11 | 10.11 | 1 | 3.11 | 0.098* |

*Statistically significant at P = 0.05.
Table 5. One-way analysis of variance comparisons of treatment vs. control group posttest scores comparisons of individual DASS item response scores in the study of the effect of greenhouse activities on the depression, anxiety, and stress of university students who served in the U.S. Armed Forces.

| Statements                                                                 | n | Mean score$^c$ | SD  | df | $F$  | $P$  |
|----------------------------------------------------------------------------|---|----------------|-----|----|------|------|
| **Item response scores for depression questions**                          |   |                |     |    |      |      |
| I couldn’t seem to experience any positive feelings at all.                |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.25           | 0.46| 1  | 3.50 | 0.08*|
| Control                                                                    | 9 | 0.78           | 0.67|    |      |      |
| I found it difficult to work up the initiative to do things.              |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 1.13           | 0.64| 1  | 1.66 | 0.22 |
| Control                                                                    | 9 | 1.56           | 0.73|    |      |      |
| I felt that I had nothing to look forward to.                              |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.50           | 0.76| 1  | 0.02 | 0.89 |
| Control                                                                    | 9 | 0.56           | 0.88|    |      |      |
| I felt down-hearted and blue.                                             |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.50           | 0.93| 1  | 0.36 | 0.56 |
| Control                                                                    | 9 | 0.78           | 0.97|    |      |      |
| I was unable to become enthusiastic about anything.                        |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.13           | 0.35| 1  | 4.21 | 0.058*|
| Control                                                                    | 9 | 0.78           | 0.83|    |      |      |
| I felt I wasn’t worth much as a person.                                   |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.13           | 0.35| 1  | 1.27 | 0.28 |
| Control                                                                    | 9 | 0.45           | 0.73|    |      |      |
| I felt that life was meaningless.                                          |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.25           | 0.46| 1  | 0.42 | 0.53 |
| Control                                                                    | 9 | 0.45           | 0.73|    |      |      |
| **Item response scores for Anxiety questions**                             |   |                |     |    |      |      |
| I was aware of dryness of my mouth.                                       |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.88           | 0.84| 1  | 0.25 | 0.62 |
| Control                                                                    | 9 | 0.67           | 0.87|    |      |      |
| I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion). |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.25           | 0.46| 1  | 0.96 | 0.34 |
| Control                                                                    | 9 | 0.67           | 1.12|    |      |      |
| I experienced trembling (e.g., in the hands).                             |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.50           | 1.07| 1  | 0.65 | 0.43 |
| Control                                                                    | 9 | 0.89           | 0.93|    |      |      |
| I was worried about situations in which I might panic and make a fool of myself. |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.63           | 0.52| 1  | 1.40 | 0.26 |
| Control                                                                    | 9 | 1.11           | 1.05|    |      |      |
| I felt I was close to panic.                                              |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.50           | 0.53| 1  | 0.51 | 0.49 |
| Control                                                                    | 9 | 0.78           | 0.97|    |      |      |
| I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat). |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.38           | 0.74| 1  | 2.05 | 0.17 |
| Control                                                                    | 9 | 1.11           | 1.27|    |      |      |
| I felt scared without any good reason.                                    |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.25           | 0.46| 1  | 1.16 | 0.30 |
| Control                                                                    | 9 | 0.68           | 1.00|    |      |      |
| **Item response scores for Stress questions**                              |   |                |     |    |      |      |
| I found it hard to wind down.                                             |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.75           | 0.71| 1  | 1.88 | 0.19 |
| Control                                                                    | 9 | 1.33           | 1.00|    |      |      |
| I tended to overreact to situations.                                       |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 1.13           | 0.64| 1  | 1.06 | 0.32 |
| Control                                                                    | 9 | 1.56           | 1.01|    |      |      |
| I felt that I was using a lot of nervous energy.                          |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.63           | 0.74| 1  | 1.39 | 0.26 |
| Control                                                                    | 9 | 1.11           | 0.93|    |      |      |
| I found myself getting agitated.                                          |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.88           | 0.64| 1  | 6.69 | 0.02*|
| Control                                                                    | 9 | 1.89           | 0.93|    |      |      |
| I found it difficult to relax.                                            |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.75           | 0.71| 1  | 3.51 | 0.08*|
| Control                                                                    | 9 | 1.56           | 1.01|    |      |      |
| I was intolerant of anything that kept me from getting on with what I was doing. |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.88           | 1.13| 1  | 0.001| 0.97 |
| Control                                                                    | 9 | 0.89           | 0.60|    |      |      |
| I felt that I was rather touchy.                                          |   |                |     |    |      |      |
| Treatment                                                                  | 8 | 0.75           | 0.71| 1  | 1.28 | 0.28 |
| Control                                                                    | 9 | 1.22           | 0.97|    |      |      |

$^c$Scores range from 0 to 3 where 0 = “Did not apply to me at all,” 1 = “Applied to me to some degree, or some of the time,” 2 = “Applied to me to a considerable degree or a good part of the time,” and 3 = “Applied to me very much or most of the time.”

*Statistically significant at $P \leq 0.10$. 

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participants. Compared with the overall Texas State University student veteran population, the study group underrepresented African Americans and Hispanics and overrepresented White, non-Hispanics, and Asians. There are 1013 (80.2%) undergraduate and 173 (13.69%) master’s student veterans at the university. The study group had 16 (76%) undergraduate and five (23.8%) master’s participants.

Comparisons of Depression, Anxiety, and Stress scores. Descriptive statistics were used to make comparisons of the treatment and control group depression, anxiety, and stress scores (Table 3). The mean treatment group posttest score for depression was mild (11.75) at the onset of the study, whereas the anxiety severity was moderate (10.75) and stress was in the normal range (10.75) (Tables 1 and 3). However, at the conclusion of the study, the mean treatment group posttest scores for depression and anxiety both dropped into the normal range. By contrast, the control group mean scores and severity for the pretest and posttest showed little change over the course of the 6-week treatment time period and the severity levels remained unchanged for each category (Tables 1 and 3). The control pretest severity level of depression was normal (9.56) at the onset of the study; it increased to mild (10.67) at the post-test, whereas the level of severity of anxiety remained moderate (11.78), and the stress severity increased from mild (17.78) to moderate (19.11) range (Tables 1 and 3).

However, when comparisons were made using the Wilcoxon signed-rank test between pretest and posttest treatment and control group depression, anxiety, and stress scores, there were no differences in anxiety and stress scores of either the treatment and control pretest vs. posttest scores (Table 3). There was a significant positive difference found within the comparison of the treatment group’s pretest and posttest depression scores (Table 3). These findings are in line with the results of Gonzalez et al.’s (2011) therapeutic horticulture research which found that the depression severity declined significantly after 4 weeks of horticulture therapy.

Treatment versus control group posttest score comparisons. An ANOVA comparison of posttest scores of the treatment vs. the control group scores found no differences of the overall depression (P = 0.219) or anxiety scores (P = 0.244) (Table 4). However, statistically significant differences were found in comparisons of the overall stress scores (P = 0.098) (Table 4) with the treatment group score being lower and in the DASS range of normal (11.50) levels of stress compared with the control group score within the moderate (19.11) range (Table 4). This is supported by the studies of Kaplan and Kaplan (1994) who found that working with plants is recognized as a restorative activity that provides effective relief from stress and mental fatigue.

Individual statement comparisons. Because some differences were found in comparisons of overall scores, researchers made comparisons of the individual DASS statement scores. Results of the ANOVA comparisons of the treatment vs. control group posttest scores of individual DASS item responses found significant differences amongst four questions (Table 5). Two of the four questions related to depression and the other two questions related to stress. The two depression subscale questions included: “I couldn’t seem to experience any positive feelings at all” (P = 0.081) and “I was unable to become enthusiastic about anything” (P = 0.058). In both comparisons, the treatment group scores were lower, indicating a more positive outlook. The stress subscale statement, “I found myself getting agitated” was also significant in comparisons (P = 0.021) and was similarly answered more positively by the treatment group. Lastly, for the second stress subscale question, “I found it difficult to relax,” comparisons showed more positive answers from the treatment group and comparisons significantly different from the control group’s responses (P = 0.080). This supports the study by Van Den Berg and Custers (2011) who found that those who suffer from stress-related illness and depression can benefit by being involved in activities, such as gardening. Results also support overall score results which found differences occurring in the areas of stress and depression.

Qualitative response results. In response to the open-ended questions, the participants’ responses were tabulated. The participants described two main themes including a noticeable reduction in (feelings of) stress and (having found) a place to which they looked forward to coming each week. When participants were asked the question of what the plant care class meant to them and how it has impacted their overall feelings, eight (100%) of the participants said the classes reduced their stress and helped them to relax. Five of the eight participants (62.5%) said the greenhouse plant class gave them someplace or something to look forward to attending each week. With regard to the closed-ended items about continuing to grow plants as a hobby and/or would they consider a career in the field of horticulture, eight (100%) of the participants selected yes, that they would continue to grow plants as a hobby, and six (75%) said they would consider a career in horticulture.

Discussion

Results of this study indicated that student veterans who participated in the plant care class noticed decreased levels of depression and stress. This suggested that working with plants can be a beneficial supplementary experiential intervention for veterans and students experiencing stress in a university setting. The findings of this experiment are in line with studies completed by Gonzalez et al. (2010, 2011) which found the severity of depression, anxiety, and stress declined during the therapeutic horticulture interventions. Student veterans in the treatment group’s self-report at the conclusion of the study noted a moderate improvement in emotional states, especially within the areas of depression and stress. The responses to the open-ended questions about the treatment group participants’ experiences affirmed positive conclusions that working with plants can be a beneficial intervention for veteran students experiencing stress.

A plant care program, designed to teach students new skills, such as growing and propagating various plants, may help students who are undecided on a field of study to select horticulture or agriculture as a career. When asked after learning different methods of plant propagation and growing plants if they thought they would consider a career in the field of horticulture, 75% of the participants indicated they would.

The study was limited to 30 participants because of the nature of the treatment activities, space, and personnel requirements. Recommendations for future research include offering the treatment to a larger sample with small session groups of three to seven participants. In addition, Gonzalez et al.’s (2010, 2011) research indicated continued improvement in the weeks following a similar type of treatment. Future research should have a longitudinal measurement approach with the veteran. After treatment to gather data on the long-term effects of treatment. Furthermore, control group participants’ scores were worrisome such that future studies should develop a plan to offer some treatment to the control group participants, such as offering a wait-list or restorative therapy or delayed treatment for interested participants in the control group. Revisions to the demographic portions of the survey should include a clarification or differentiation between the terms “overseas deployment” and “deployment to combat or hostile fire zones,” distinctions which are specific, and often different, to each branch of service.

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