

# The Connection between Gardening and Outdoor Activity during the COVID-19 Pandemic and Perceptions of Hope, Hopelessness, and Levels of Stress, Anxiety, and Depression

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**KEYWORDS.** DAS-21, Depression Anxiety and Stress Scale, horticultural therapy, human issues in horticulture, mental health, quality of life, sociohorticulture, well-being

**ABSTRACT.** During the past few years, Americans have experienced a wide variety of stressors, including political tensions, racial/civil unrest, and the coronavirus disease 2019 (COVID-19) pandemic. All of these have led to uncertainty within society. Chronic feelings of helplessness can lead to depression or feelings of hopelessness in those who perceive their situation as unchanging. The purpose of this study was to evaluate the impacts of gardening and outdoor activities during the COVID-19 pandemic on perceptions of hope, hopelessness, and levels of depression, stress, and anxiety. Participants of this study were recruited through online social media platforms such as Facebook and Instagram; 458 participants completed the 21-item Depression Anxiety and Stress Scale inventory as well as the Hope Scale. Our data indicated that individuals who self-reported themselves as gardeners had significantly more positive scores related to levels of stress, anxiety, and depression and a sense of hope. Furthermore, gardeners had lower levels of self-reported depression, anxiety, and stress when compared with those who did not identify themselves as gardeners. The gardeners also had a more positive outlook regarding hope for the future. Additionally, a significant positive correlation was found between the number of hours spent participating in gardening and a sense of hope, and a negative correlation was found between the number of hours gardening and stress levels. Similarly, there was a significant negative correlation between the number of hours spent participating in any outdoor activity and self-reported levels of stress, anxiety, or depression; however, there was a positive correlation between the number of hours spent participating in any outdoor activity and a sense of hope. Our data suggested that more hours spent outside gardening or participating in recreational activities led to less perceived stress, anxiety, and depression and greater levels of hope for the future.

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market rebounded to 11 million lost jobs by August (US Department of Labor 2020). Unemployment increased from 6 million in Feb 2020 to 23 million in Apr 2020, before settling at 11 million in Nov 2020 (Handwerker et al. 2020). In Apr 2020, there was an unemployment rate of 14.8%, which was the highest since 1948 (Falk et al. 2021).

COVID-19 had physical and psychological effects on individuals worldwide (Ettman et al. 2020; Wang et al. 2020, 2021). Levels of stress experienced by individuals were heightened during the COVID-19 pandemic (O'Byrne et al. 2021; Wang et al. 2020). Stress is defined as anxiety or discomfort resulting from the perception of a threat (Selye 1976). The COVID-19 pandemic brought with it extensive mediating measures that disrupted the daily lives and impacted the mental health of adults and children. A study performed by Araby et al. (2021) demonstrated that COVID-19 had a significant impact on daily life patterns of children, with 96.4% of participants in the study reporting changes in sleeping patterns, 77.8% reporting changes in eating patterns, and 70.5% reporting mood and behavior changes, particularly increased aggressive behavior.

Additionally, other stressful current events occurred simultaneously with COVID-19, including political tensions and racial/civil unrest. During 2020, the United States presidential election occurred. Approximately 78% of polled psychiatrists noted that their patients were very concerned about the outcome of the 2020 presidential election between Donald Trump and Joe Biden. The same study found that 66% of Biden supporters said they were scared about the future of the country, and that 33% of Trump supporters said the same (Czeisler et al. 2020). In 2020, 68% of adults reported that the United States presidential election was a source of significant stress, which was an increase from 52% recorded during the 2016 election (American Psychological Association APA 2020).

During the past 10 years, the American Psychological Association conducted annual surveys regarding stress levels of United States citizens. Increased levels of stress were reported by women and racial and ethnic minority groups (American Psychological

In late 2019 and early 2020, the World Health Organization (WHO) was informed of cases of pneumonia of unknown cause in Wuhan City, Hubei Province of China. The first reported case of coronavirus disease 2019 (COVID-19) arrived in the United States in the state of Washington (WHO 2020) on 23 Jan 2020. By Oct 2021, a total of 43,792,254 confirmed cases of COVID-19 had been reported in the United States, resulting in a total of 703,599 deaths (WHO 2022).

COVID-19 heavily impacted the United States economy and job market. Between Feb 2020 and Apr 2020, 22 million jobs were lost. The job

Association 2017). Racial unrest stemming from police violence toward non-white civilians was prominent during the early months of the pandemic. The year 2020 included several high-profile police incidents, which sparked Black Lives Matter protests around the country and included millions of people. Protesting en masse posed immediate and unprecedented health risks related to the spread of COVID-19 as well as risks of violence (Cobbina et al. 2021). Previous data indicated that perceived racism is associated with depression, substance abuse, and psychological distress (Perry et al. 2013).

Stress and anxiety affect people in countless ways and can manifest in various forms. Stress is a response to a threat, whereas anxiety is a reaction to stress (American Psychological Association 2020). Anxiety disorders are the most common mental illnesses diagnosed in the United States (Anxiety and Depression Association of America 2022). The average reported stress levels of adults in the United States based on a 10-point scale were 5.0 in 2020, 4.9 in 2019, and 4.9 in 2018. Adults who are part of Generation Z (age 18–23 years) reported increased stress levels over the past 2 years (from 5.6 in 2018 and 5.8 in 2019 to 6.1 in 2020 using the same 10-point scale) (Anxiety and Depression Association of America PA 2020). Stress and the associated feelings of anxiety and depression are associated with burnout, which is otherwise known as an exhausted state emerging from desires that are not met (Jones 1981), and burnout negatively affects job satisfaction (Demir 2018).

Stress can be characterized as environmental factors that strain individuals past their adaptive capacity, resulting in biological or physiological changes that place them at higher risk for illness or disease (Cohen et al. 1997). Stress is defined as “the nonspecific response of the body to any demand” (Fink 2010). There are three general theories related to the effects of stress on individuals. First, the environmental theory focuses on stress that is objectively associated with the increased demand for one to adapt. Second, the psychological theory is related to one’s subjective assessment of one’s capacity to cope with the demands imposed by others. Finally, the biological theory refers to physiological systems that are known to be modified

by both environmental and psychological stressors (Cohen et al. 1997).

During the COVID-19 pandemic, those who experienced symptoms of COVID-19 also experienced higher levels of stress and related anxiety (Wang et al. 2020). Anxiety and other adverse mental health conditions, including substance abuse and suicidal ideation, reported by adults in the United States were three-times higher in Jun 2020 than it was during the second quarter of 2019, and the prevalence of depressive disorders was approximately four-times higher than that reported during the second quarter of 2019 (Czeisler et al. 2020). Stress levels were higher for those with self-reported chronic conditions and disabilities, and coping strategies were positively associated with this stress. These strategies include behavioral disengagement, self-blame, self-distraction, substance use, and denial (Umucu and Lee 2020).

Hopelessness is connected to depression and suicide, and those experiencing hopelessness may increase one’s wish to cease living (Downman 2008). According to the Centers for Disease Control and Prevention, in 2019, suicide was the tenth most common cause of death for Americans of all ages (Centers for Disease Control and Prevention 2020). Hallensleben et al. (2019) reported that hopelessness has the most robust and largest effect on suicidal ideation and noted the importance of assessing hopelessness as a risk factor. The hopelessness theory of depression argues that repeated exposure to uncontrollable or adverse environmental stimuli gradually leads to the belief that the adverse situation is inescapable, rendering the person helpless. This helplessness leads to depression for those who perceive their situation as unchanging (Abramson et al. 1989). An estimated 7.1% of adults in the United States experienced at least one major depressive episode in 2017 (National Institute of Mental Health 2022). The prevalence of depression symptoms for residents of the United States was higher in every category of the Life Stressors Impact on Mental Health and Well-being survey during COVID-19 than before COVID-19 (Ettman et al. 2020).

Hopeful is defined as having the qualities of “desire accompanied by expectation of or belief in fulfillment” (Merriam-Webster 2021a). Hope com-

prises a positive outlook on life, which is not necessarily sustained at all times but is experienced periodically (Downman 2008). On the contrary, hopeless is defined as “having no expectation of good or success” (Merriam-Webster 2021b). Hope is important to study because it relates to one’s sense of the future and one’s place within that future (Downman 2008). Feelings of hope result in strong motivating power in terms of economic behavior. Additionally, the effects of hope seem to be positive and include increases in innovation, consumer satisfaction, and well-being (Pleeging and Burger 2020). Hope has an important role in the lives of people, especially when illness and recovery are present. Despite uncertainty, illness, or the frailty of life, hope is possible (Moore 2005). Hope is linked with the human ability to adapt and live meaningful lives (Jevne et al. 1999).

Previous research demonstrated that interactions with nature have positive effects on health and well-being (Ulrich et al. 1991). Multiple studies have shown that gardening is a restorative activity that can help individuals recover from stress and the effects of stress on the body (Kaplan and Kaplan 1989; Milligan et al. 2004). Gardening promotes physical well-being by reducing stress and potentially promoting an increase in social cohesion (Elings 2006). Furthermore, gardening is an accessible resource for disease prevention (Van Den Berg and Custers 2011) and a creative outlet that positively impacts those with stress-related illnesses when used as a rehabilitation technique (Eriksson et al. 2010). Interacting with plants in a garden setting promoted an atmosphere that prepared participants for therapy as well as an opportunity for thorough recovery from illness induced by stress (Adevi and Lieberg 2012). Participation in a 6-week indoor plant care program resulted in reductions of stress and depression for veterans with posttraumatic stress disorder (Kelley et al. 2017). Additionally, gardeners older than age 50 years reported greater reduced levels of stress compared with those using other methods of stress reduction (Hawkins et al. 2011).

Gardening has been associated with greater well-being and happiness. For example, Waliczek et al. (2005) reported that gardeners perceived a

greater quality of life than nongardeners and more positively rated their energy levels, optimism, zest for life, and physical self-concept. Gardeners also had higher self-ratings of their overall health and physical activity levels (Waliczek et al. 2005). Sommerfeld et al. (2010) found similar results when comparing gardeners and nongardeners who were older than age 50 years, with greater overall life satisfaction levels observed for gardeners. Community gardeners reported that gardening positively impacted their lives in areas related to all levels of Maslow's hierarchy of human needs (Waliczek et al. 1996).

**PROBLEM STATEMENT.** The purpose of this study was to evaluate the impact of gardening and outdoor activities during the COVID-19 pandemic on perceptions of hope and hopelessness and levels of anxiety, stress, and depression.

## Materials and methods

**SAMPLE.** Participants were recruited using a convenience sampling method. Advertisements asking for participation were posted on online social media platforms such as Facebook® (Meta Platforms, Inc., Menlo Park, CA, USA) and Instagram® (Meta Platforms, Inc.). To attract gardeners, social media posts and advertisements of the survey were posted on various houseplant and gardening threads and social groups. Nongardeners were recruited through general online social networking. Seed packets were offered as incentives for participating.

**INSTRUMENT.** The entire instrument contained a total of 55 questions. Participants completed the 21-item Depression Anxiety and Stress Scale (DASS-21) inventory (Lovibond and Lovibond 1995a), which is a well-established psychometric instrument used for clinical and non-clinical samples. The DASS-21 is a short form of the standard DASS-42, which is a 42-item scale. Both the DASS-21 and DASS-42 inventory are formatted and used as a self-reported 4-point Likert scale designed to measure three sets of emotional states: depression, anxiety, and stress (Lovibond and Lovibond 1995a). Participants respond to statements regarding their feeling over the course of the previous week, with options ranging from zero to four. Answers included "did not

apply to me at all," "applies to me to some degree or some of the time," "applies to me to a considerable degree or good part of the time," and "applies 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 highest score for each individual section is 48 points, whereas the lowest is 7 points. Overall, the highest score possible for DASS-21 is 84 points, whereas the lowest possible score is 21 points. The DASS-21 has been examined among clinical and nonclinical samples and was found to have reliability values 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, and the inability to experience activities that were 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 becoming easily upset, agitated, irritable, over-reactive, and impatient (Mahmoud et al. 2010). Scores were interpreted using distributions based on the DASS-21 scoring system and severity score ranges (Lovibond and Lovibond 1995a) (Table 1).

The survey also incorporated the Hope Scale (Snyder 1995), which is a 12-point instrument that allows participants to answer question using a 4-point scale. Answers included "definitely false," "mostly false," "mostly true," and "definitely true." Examples of statements included, "I energetically pursue my goals" and "I've been pretty successful at life." Higher scores indicate greater hopefulness. The highest score for the Hope Scale is 48 points, and the lowest score is 12 points. The instrument was validated by previous studies and had a reliability value of at least 0.80 according to previous research (Hellman et al. 2013).

Participants were asked whether they perceived themselves to be a

gardener or nongardener by responding to the question, "Do you garden?". A follow-up question with multiple choice options regarding the type of gardening in which they participate (e.g., community, home vegetable, landscape, houseplants) was also asked. Participants were also asked about their other outdoor hobbies and the amount of time typically spent outdoors weekly during those activities. The respondents chose activities from the following list of outdoor activities that they participated in: walking/jogging/hiking; boating; yoga/tai chi; biking; tennis; archery; sports (soccer, baseball); and skating/skateboarding. They also had the option to provide other types of outdoor activities in which they may have participated.

The survey also collected participants' demographic information such as ethnicity, age, highest level of completed education, average household income, and place of residence. Before administration, the overall survey was reviewed for validity for this study by a panel of horticultural and social scientists.

**SURVEY ADMINISTRATION.** The survey was posted online using a survey collection website (SurveyMonkey; Momentive Inc., San Mateo, CA, USA) from Oct 2020 through May 2021; respondents required ~15 min to complete the survey.

**DATA ANALYSIS.** Data were entered into a spreadsheet and scored (Microsoft Excel; Microsoft Corp., Redmond, WA, USA); then, they were analyzed using statistical software (IBM SPSS Statistics version 20.0; IBM Corp., Armonk, NY, USA). A statistical analysis of quantitative data included descriptive statistics, frequencies, multivariate analysis of variance (MANOVA), and Pearson product-moment correlations. The alpha level for statistical significance was set at 0.10. This level of significance is considered conventional in the social sciences (Noymer 2008).

## Results and discussion

An exemption request for this research was approved by the Texas State University Institutional Review Board (7516).

**DEMOGRAPHICS.** There were 458 total participants included in the study, with 299 self-reporting as gardeners and 159 self-reporting as nongardeners. The sample included 247

**Table 1. Depression Anxiety and Stress Scale (DASS-21) (Lovibond and Lovibond 1995b) cutoff scores for conventional severity levels during the study of the effect of gardening and outdoor activities on the depression, anxiety, stress, and levels of hope of gardeners and nongardeners during the COVID-19 pandemic.**

DASS-21	Cutoff scores		
	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+

(82.6%) gardeners who identified as female, 38 (12.7%) who identified as male, and 13 (4.3%) who identified as nonbinary. However, 124 (78.6%) nongardeners identified as female, 33 (20.8%) identified as male, and 1 (0.6%) identified as nonbinary. Women represented a higher percentage of gardeners, which is consistent with other research, suggesting that women participate in gardening more often than men (Blaine et al. 2010; Schrock et al. 1999; Takle et al. 2017).

Nongardeners surveyed included 103 (64.8%) individuals who were younger than age 25 years, whereas 122 (40.8%) gardeners were younger than age 25 years. The sample included 90 (30.2%) gardeners who were between ages 41 and 70 years, whereas only 33 (20.7%) in the same age group were nongardeners. The median age of the samples in previous studies that investigated the impact of the COVID-19 pandemic was 42 years (Fratello et al. 2022). In this study, 122 (40.8%) gardeners were younger than age 25 years. An increased interest in gardening occurred during the COVID-19 pandemic, and younger people have taken more of an interest in gardening (National Garden Association 2021). These results could be partly attributable to the fact that the survey was distributed using social media, which has the potential of reaching a younger audience. For instance, the average age of social media users who use Facebook is 40.5 years (Phillips 2016), and 62% of Instagram users are younger than age 35 years (Aslam 2022).

Full-time or part-time employees accounted for 110 (69.1%) nongardeners, whereas full-time or part-time employees accounted for only 153 (51.1%) gardeners. In contrast, 3 (1.9%) nongardeners were homemakers, whereas 34 (11.4%) gardeners were homemakers.

Additionally, 46 (28.9%) nongardeners were either retired or not currently working, whereas 112 (37.5%) gardeners reported they were either retired or not currently working. A larger portion of the gardener sample included older individuals, which is consistent with the typical gardener demographics reported previously (Blaine et al. 2010; Schrock et al. 1999; Takle et al. 2017).

**DESCRIPTIVE STATISTICS DESCRIBING GARDENING ACTIVITIES.** During the survey, participants were asked which type of garden they worked in and to indicate all types of gardens that applied to them. Home gardens comprised

191 (41.3%) of the responses. Community gardens comprised 12 (2.6%) of the responses. Additionally, 205 (44.3%) participants responded that they had interior plants, and 115 (24.8%) respondents indicated that they had a container garden. Results indicated that 199 (43.0%) people had ornamental plants and 243 (52.5%) had houseplants at their residence. Other gardens included vegetable and fruit gardens (178; 38.4%) and herb gardens (153; 33.0%). When participants were asked how many hours per week they spent tending to their gardens during the growing season, most respondents (99; 32.7%) spent 1 h, 93 (20.2%) spent 2 h, and 52 (11.2%) spent 3 h per week in their gardens. Most people spent an additional 1 h (48; 15.7%), 2 h (44; 14.4%), 3 h (62; 20.3%), or 4 h (54; 17.6%) gardening every week during the COVID-19 pandemic. Interestingly, 69 (22.5%) participants reported they spent 7 h more per week gardening compared to past years.

Gardeners were asked why they chose to garden and could choose multiple responses from a list of answers: 227 (75.9%) reported that they

**Table 2. Multivariate analysis of variance comparisons of gardeners' and nongardeners' depression scores, anxiety scores, stress scores, overall Depression Anxiety and Stress Scale (DASS-21) (Lovibond and Lovibond 1995b) scores, and the Hope Scale (Snyder 1995) scores during the study of the effect of gardening and outdoor activities on the depression, anxiety, stress, and levels of hope of gardeners and nongardeners during the COVID-19 pandemic.**

Instrument and group	n	Mean score <sup>i</sup>	SD	df	F	P
Overall						
Depression <sup>i</sup>						
Gardeners	299	12.565	4.868	4	8.115	0.001*
Nongardeners	159	12.692	5.148			
Anxiety <sup>i</sup>						
Gardeners	299	11.354	4.313	4	14.318	0.001*
Nongardeners	159	11.560	4.473			
Stress <sup>i</sup>						
Gardeners	299	14.204	4.466	4	12.572	0.001*
Nongardeners	159	14.491	4.696			
Overall DASS-21 <sup>ii</sup>						
Gardeners	299	38.123	12.161	4	13.851	0.001*
Nongardeners	159	38.742	13.249			
Hope Scale <sup>iii</sup>						
Gardeners	299	33.729	4.992	4	8.404	0.001*
Nongardeners	159	33.434	4.629			

<sup>i</sup> The mean score was calculated from the sum scores of the responses to the seven-item subscale questions and by multiplying the score by two to determine the intensity of the condition. A higher score indicates a higher degree of severity of the emotional state.

<sup>ii</sup> The DASS-21 score was calculated from the sum of scores of the responses to the seven-item subscale questions and by multiplying the score by two to determine the intensity of the condition. A higher score indicates a higher degree of severity of the emotional state.

<sup>iii</sup> The Hope Scale score was calculated from the sum of scores of the responses to a 12-point instrument that allowed participants to answer using a 4-point scale. Higher scores indicate greater hopefulness, with the highest score for the scale being 48 and the lowest score being 12.

\*Statistically significant at  $P \leq 0.10$ .

**Table 3. Correlation matrix indicating the Pearson's product-moment correlation between time spent gardening, Depression Anxiety and Stress Scale (DASS-21) (Lovibond and Lovibond 1995b) score, depression score, anxiety score, stress score, and the Hope Scale (Snyder 1995) score during the study of the effect of gardening and outdoor activities on the depression, anxiety, stress, and levels of hope of gardeners and nongardeners during the COVID-19 pandemic.**

Variables		Time spent gardening <sup>i</sup>
DASS-21 <sup>ii</sup>	Pearson correlation	-0.073
	<i>P</i>	0.211
	<i>N</i>	299
Depression <sup>iii</sup>	Pearson correlation	-0.040
	<i>P</i>	0.492
	<i>N</i>	299
Anxiety <sup>iii</sup>	Pearson correlation	-0.057
	<i>P</i>	0.322
	<i>N</i>	299
Stress <sup>iii</sup>	Pearson correlation	-0.099
	<i>P</i>	0.088*
	<i>N</i>	299
Hope Scale <sup>iv</sup>	Pearson correlation	0.103
	<i>P</i>	0.076*
	<i>N</i>	299

<sup>i</sup> Participants responded to the question, "How many hours do you spend gardening weekly during the growing season?".

<sup>ii</sup> The DASS-21 scoring was calculated from the sum scores of the responses to the seven-item subscale questions and by multiplying the score by two to determine the intensity of the condition. A higher score indicates a higher degree of severity of the emotional state.

<sup>iii</sup> The mean score was calculated from the sum scores of the responses to the seven-item subscale questions and by multiplying the score by two to determine the intensity of the condition. A higher score indicates a higher degree of severity of the emotional state.

<sup>iv</sup> The Hope Scale score was calculated from the sum of scores of the responses to a 12-point instrument that allowed participants to answer using a 4-point scale. Higher scores indicate greater hopefulness, with the highest score for the scale being 48 and the lowest score being 12.

\*Statistically significant at  $P \leq 0.10$ .

participated in gardening for mental health reasons; 226 (75.5%) said they gardened for self-expression; 208 (69.5%) said they gardened for recreation; and 119 (66.5%) stated they gardened to obtain produce. Other answers included gardening for spiritual reasons (167; 55.8%), for physical health/exercise (96; 32.1%), and for economic reasons (56; 18.7%). These findings align with reasons why people gardened before the COVID-19 pandemic. During a research study that investigated the current gardeners' reasons for gardening that was published before the COVID-19 pandemic, it was found that people gardened for unseen benefits, for relaxation, as a therapeutic way to be close to nature, and because gardening "spoke to their soul" (McFarland et al. 2018).

**COMPARISONS OF GARDENERS AND NONGARDENERS USING THE DASS-21 AND HOPE SCALE.** Multivariate analysis of covariance tests were used to compare the gardeners' and nongardeners' scores on the overall DASS-21 or their individual depression, anxiety, stress, or Hope Scale scores (Table 2).

Because of the confounding demographic gender identification, age, and employment level differences between groups within the sample, these variables were covaried out statistically during the multivariate analysis of variance comparisons.

A significant correlation was found when comparing gardeners' and nongardeners' scores on the overall DASS-21 or the individual depression ( $P = 0.001$ ), anxiety, ( $P = 0.001$ ), stress ( $P = 0.001$ ), and Hope Scale ( $P = 0.001$ ) scale scores. Nongardeners' scores were higher for each of the inventories; therefore, they indicated more depression, anxiety, and stress in comparison with gardeners' scores. Gardeners scored an average of 12.56 on the depression portion, 11.35 on the anxiety portion, and 14.20 on the stress portion, ranking them as mild, moderate, and normal, respectively (Lovibond and Lovibond 1995b). Nongardeners scored an average of 12.69 on the depression portion, 11.55 on the anxiety portion, and 14.49 on the stress portion, which ranked them similarly as mild, moderate, and normal

(Lovibond and Lovibond 1995b), but not as positively when compared with gardeners' scores. Gardeners also had significantly more positive Hope Scale scores; they scored an average of 33.72 on the Hope Scale, whereas nongardeners scored an average of 33.34 (Table 2).

**CORRELATIONS REGARDING TIME SPENT GARDENING AND LEVELS OF DEPRESSION, ANXIETY, STRESS, AND HOPE.** One question asked gardeners how many hours per week they spent participating in gardening activities. A statistically significant correlation was found: those who reported gardening more often weekly during the COVID-19 pandemic had scores indicating lower levels of stress ( $P = 0.088$ ) as well as greater Hope Scale scores ( $P = 0.076$ ) (Table 3). No significant correlations were found for the other variables related to depression, anxiety, or the overall DASS-21 score. This is consistent with previous research that demonstrated that interactions with nature have positive effects on health and well-being (Ulrich et al. 1991) and aid in recovery from stress (Kaplan and Kaplan 1989).

**CORRELATIONS REGARDING TIME SPENT OUTSIDE AND LEVELS OF DEPRESSION, ANXIETY, STRESS, AND HOPE.** One question asked respondents how many hours per week were spent participating in outdoor activities during the pandemic. Descriptive statistics indicated that 43 (9.3%) of the sample reported participating in no outdoor activities, whereas 420 (90.7%) of the sample participated in some sort of outdoor activity. When asked, 180 (38.9%) participants described spending at least 1 h outside participating in hobbies. Outdoor activities comprised 2 h of 134 (28.9%) of the participants' day, whereas 88 (19.0%) reported they spent 3 h doing the same. Participants were asked to describe which types of outdoor activities in which they participated. Responses indicated that 353 (76.2%) walked, 55 (11.9%) participated in boating, 71 (15.3%) practiced yoga, 85 (18.4%) biked, 26 (5.6%) played tennis, 23 (5.1%) competed in archery, and 83 (17.9%) participated in sports such as soccer, baseball, or skating.

A statistically significant correlation was found: those who reported being involved more often in an outdoor hobby during the COVID-19 pandemic also had lower depression

( $P = 0.014$ ), anxiety ( $P = 0.071$ ), stress ( $P = 0.048$ ), and overall DASS-21 scores ( $P = 0.021$ ) as well as greater Hope Scale scores ( $P < 0.001$ ) (Table 4). The correlations indicated that people who spent more time outdoors had lower scores for depression, anxiety, and stress and higher scores for hope. These findings support similar studies that showed that urban neighborhoods with more green space were linked to lower levels of perceived stress and improved physiological stress when measured by levels of cortisol (Roe et al. 2013).

## Conclusions

People in the United States have experienced considerable stressful events in recent years. These events, general uncertainty, and isolation have been linked with higher levels of stress, anxiety, and depression. To enable full participation in day-to-day life, it is imperative to explore mental health management strategies. This study suggested that more hours spent outside gardening or participating in recreational activities led to improvements in levels of stress, anxiety, and depression as well as greater levels of hope for the future. This research supported other research conducted during the pandemic that called for further studies to understand the impacts of COVID-19 on food systems, including the impact of gardening (Egerer et al. 2022; King et al. 2022; Sia et al. 2022). Results such as these should encourage more people to make a purposeful effort to incorporate time outside as part of their general approach to healthy living. The results indicate a need for policies and city planning that increase opportunities for quality time outdoors; furthermore, a special focus should be on policies making outdoor activities more available during times of crisis, such as a global pandemic, because more frequent viral outbreaks are expected in the future (Mora et al. 2022). The results showed that active engagement with plants and nature through gardening helped increase benefits compared with those of nongardeners. Additionally, these results could encourage a more comprehensive approach and varied strategies for the treatment of stress-related conditions in the future.

This research highlights the importance of access to green space and outdoor activities such as gardening.

**Table 4. Correlation matrix indicating the Pearson's product-moment correlation between time spent outdoors, Depression Anxiety and Stress Scale (DASS-21) (Lovibond and Lovibond 1995b) score, depression score, anxiety score, stress score and the Hope Scale (Snyder 1995) score during the study of the effect of gardening and outdoor activities on the depression, anxiety, stress, and levels of hope of gardeners and nongardeners during the COVID-19 pandemic.**

Variables		Time spent outdoors <sup>i</sup>
DASS-21 <sup>ii</sup>	Pearson correlation	-0.109
	<i>P</i>	0.021*
	<i>N</i>	454
Depression <sup>iii</sup>	Pearson correlation	-0.115
	<i>P</i>	0.014*
	<i>N</i>	454
Anxiety <sup>iii</sup>	Pearson correlation	-0.085
	<i>P</i>	0.071*
	<i>N</i>	454
Stress <sup>iii</sup>	Pearson correlation	-0.093
	<i>P</i>	0.048*
	<i>N</i>	454
Hope Scale <sup>iv</sup>	Pearson correlation	0.180
	<i>P</i>	<0.001*
	<i>N</i>	454

<sup>i</sup> Participants responded to the question, "How many hours do you participate in an outdoor hobby weekly on average recently?"

<sup>ii</sup> The DASS-21 score was calculated from the sum scores of the responses to the seven-item subscale questions and by multiplying the score by two to determine the intensity of the condition. A higher score indicates a higher degree of severity of the emotional state.

<sup>iii</sup> The mean score was calculated from the sum scores of the responses to the seven-item subscale questions and by multiplying the score by two to determine the intensity of the condition. A higher score indicates a higher degree of severity of the emotional state.

<sup>iv</sup> The Hope Scale score was calculated from the sum of scores of the responses to a 12-point instrument that allowed participants to answer using a four-point scale. Higher scores indicate greater hopefulness, with the highest score for the scale being 48 and the lowest score being 12.

\*Statistically significant at  $P \leq 0.10$ .

This is particularly important for those living in metropolitan areas, where green space might be less available with the development of housing, commerce, and transportation. Access to outdoor green spaces and activities may be reconsidered as more important for residential care facilities, prison systems, and schools.

This study was limited to those who volunteered to participate in the study and to those who had access to a computer and internet connection during the course of the study, which was performed during the COVID-19 pandemic.

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