Journal of Applied Horticulture, 26(4): 506-512, 2024
https://doi.org/10.37855/jah.2024.v26i04.95
Journal of Applied Horticulture
ISSN: 0972-1045

Evaluating the impact of horticulture interventions on stress reduction in urban workers: A comparative study of natural and simulated environments

Kanimozhi Chakrapani* and B. Kalpana

*School of Public Health, SRM Institute of Science and Technology, Kattankulathur, Chengalpattu, Tamil Nadu, India. *E-mail: kanimozc@srmist.edu.in, kalpanab@srmist.edu.in*

Abstract

The dominant urbanization and work environment, which have imposed stress on individuals and isolated them from nature, prompted this research into alleviating such stress through therapeutic horticulture interventions. The participant's stress levels, engagement with nature, and socio-demographic status were documented by questionnaires and subjective feedback. The natural and simulated environments serve as interventional methods to stimulate the sensory aspects of urban dwellers through visual, aural, gustatory, tactile, and olfactory therapies. The garden configuration, virtual reality devices, fragrant oils, plant-derived beverages, and infinity walking configurations barefoot constitute the intervention measures. The horticulture interventions, both in natural and artificial environments, significantly reduced urban stress levels, yielding a mean value of 17.6±4.44, in contrast to the pre-test value of 20.8±4.14. The inclusion of nature in the self-scale score demonstrates a positive increase from 3.3±1.78 in the pre-test to 5.46±1.07 in the post-test. The Wilcoxon signed-rank test was employed to determine the disparity between the two methods of horticultural therapy. The efficacy of natural and simulated methods for horticulture interventions demonstrated a significantly higher ranking for the natural approach, with a significance level of 1%. The paired t-test was employed to compare the differences between pre-test and post-test data for natural and simulated therapy. The findings indicate that despite residing in a technologically advanced society, there is a preference for the natural world over the simulated one.

Key words: Horticulture intervention, therapeutic horticulture, perceived stress scale, inclusion of nature, urban stress, virtual reality, visual therapy

Introduction

The 2018 revision of UN world urbanization prospects has stated that India will add 416 million urban dwellers and by 2030 the world is projected to have urban agglomerations with cities inhabiting one million people mostly in Asia and Africa. When compared to the forest area the urban sections are a stressful environment (Gidlow *et al.,* 2016) and the European Environment Agency defines urban stress as a state of mental tension caused through city living or the emotional factors that raise the tension. The presence of stress and its impacts on the lives of many people is a foremost health concern in society and it is linked to neoclassical and emotional issues like depression, obesity, and coronary diseases (Iwasaki *et al.,* 2006 and Triguero *et al.,* 2015). Urban areas with a low percentage of green spaces are directly correlated to a high incidence of mental disorders (Tost *et al.,* 2019). According to the World Health Organization, urban development and transformation should focus on establishing healthier cities and fostering a more hospitable urban environment that prioritizes mental health and well-being. This can be accomplished by providing citizens with green areas. The urbanites can find cures in the hands of the natural environments like green spaces which have numerous health benefits for reducing their stress, anxiety, depression, and the risk of chronic diseases (Bezold *et al.,* 2018 and Dzhambov *et al.,* 2018). Horticulture therapy is a magical therapy that encompasses a wide range of activities for both therapeutic and recreational objectives (Dedhia *et al.,* 2024). When conventional medicine does not bring hope to the patient's life, a letter of referral by the doctor is for this complementary medicine and the presence of plants elicits significant changes in brain activity (Hassan *et al.,* 2020). Ulrich *et al.* (1991) proposed a stress reduction theory (SRT) explaining that observing green elements induces positive feelings and soothing effects. The reduced risk of stress between the participants and the natural environment has been reported by Elsadek *et al.* (2019) and it is noted that people are less stressed psychologically and physiologically when subjected to the green environment (Roberts *et al.,* 2019).

Numerous barriers dilute the ability to visit the natural environments which might be personal, interpersonal, and structural (Rushing *et al.,* 2021). To overcome such constraints, the outdoors can be brought indoors through photographs, videos, and virtual reality (VR). The enchanting virtual environment can be a bridge and provide an immense opportunity for the urbanites when exposed to nature (Brivio *et al.,* 2021, Caloguiri *et al.,* 2018; Huang *et al.,* 2021). The nature-based virtual reality environment could be a beneficial activity (Kalantari *et al.,* 2022) when the participants do not have immediate access to nature. Though the overall benefits of horticulture therapy have been established, the effectiveness of the combination of virtual reality and horticulture therapy has yet to be assessed (Lin *et al.,* 2020). Much light has been cast on the health risks and recommends that action must

be taken to explore interdisciplinary cooperation between public health and other disciplines (Schroeder *et al.,* 2022). The working environment, lifestyle, and healthcare services in metropolitan areas are crucial for the development of sustainable urban communities (Deepthi *et al.,* 2024). This study was crucial as it bridged the gap in the body of current literature which frequently ignores the setting of the workplace environment as it strikes a balance between development and well-being. Innumerable academics have previously claimed that a range of workplace elements, such as the nature of the job and the sociocultural features of the organization that is changing, have an impact on employees' level and severity of stress (Belete *et al.,* 2020). Thus, offering insights into the enhancement of workplace environments through horticultural therapies, complemented by targeted interventions, aids urban workers in achieving greater efficacy.

Prior studies focused on facilitating stress alleviation in urban dwellers *via* green spaces or virtual environments. This study focuses on examining the individual effects of various interventional methods on the stress levels of urban residents, enhancing their sensory awareness, and offers a thorough analysis of the sensory attributes of both natural and artificial environments, along with subjective perceptions of nature, stress management, and the integration of nature.

Materials and methods

The research examined the efficacy of natural and simulated horticultural interventions on stress reduction among urban residents using a quantitative methodology. The study employed a quasi-experimental research design including a single cohort of urban workers, who were pre-tested for stress levels and the presence of nature in their work environment. Horticultural therapy was administered as an intervention, followed by a post-test assessment. The baseline measure served as the control period, thereby eliminating the need for a control group; the horticultural intervention was executed, and the post-test measure was regarded as the intervention period for comparative analysis (NCBI books, 2017). The horticultural intervention, contrasting natural and artificial ways that stimulate the senses of urban dwellers, served as the independent variable. The degree of stress and the integration of nature into the urban environment were the dependent variables.

The socio-demographic factors for the study included age, sex, employment status, job nature, and residential location of urban inhabitants. The research was carried out at the Urban Farm Center (UFC), SRM Institute of Science and Technology in Chengalpattu, Tamil Nadu, India. The Urban Farm Centre is an extension facility featuring a distinctive landscape design that includes a waterscape, lawn, fountain, flowering shrubs, aromatic flowers, and herbs. The target market comprises students, urban dwellers, and rural residents engaged in work and study within the urban area. The personnel and students at the SRM Institute in Chengalpattu constitute the accessible population and served as the sample for the study.

The study targeted only the urban people and the number of participants was 42. The criteria for participation were as follows: the participants had to be urban dwellers, with no restrictions as to sex, who were capable of performing their activities without assistance and were either employed or living in an urban setting. Criteria for exclusion excluded those who are not residents or employees of urban areas, those with severe diseases, and 12 participants who failed to attend the sessions. The experimental group comprised 30 participants who were given a pre-experimental one group pre-test and post-test. The first set of outcomes concerned the reduction of stress, general health, and the definition of the strategies that promote the relation with nature. Data collection involved a pre-test (O1) measuring perceived stress levels and the inclusion of nature and a post-test (O2) after horticulture interventions that were offered for three weeks, one hour per day. The sensory interventions were categorized into two environments: A virtual environment with virtual reality visuals, virtual music, processed oil smells, beverages, and pebble touch; and a natural environment that included a garden view, natural sounds, garden smells, plant-based drinks, and an infinity walk on sand. Qualitative data was gathered on the sensory impressions reported on the first day and the last day of the intervention.

Socio-demographic variables: The socio-demographic variables through questionnaire forms were collected for age, sex, marital status, employment, gender, occupation, and place of settlement.

Perceived stress scale developed by Cohen *et al.* (1983)- (10-item scale): The PSS is a 10-item questionnaire to evaluate the degrees to which an individual has perceived his life to be unpredictable, uncontrollable, and overloading for the past month as originally developed by Cohen *et al.* (1983). The PSS assesses the stress level among the population in youth and the adult age group of twelve and above as stated by Kechter *et al.* (2019).

Inclusion of nature scale: This scale was developed by Schmuck, (2002) to assess the extent to which individuals include nature within their view of themselves. The tool is a pictorial question with seven pairs of circles which is like a Venn diagram. The circles indicate a score of one-to-seven-point scale from complete separation to complete overlap.

Horticulture intervention feedback: This scale was developed to get feedback from the participants to assess the natural and simulated horticulture therapy on a five-point Likert scale. The five-point Likert scale included (i) Completely dissatisfied (ii) Dissatisfied (iii) Neither satisfied nor dissatisfied (iv) Satisfied (v) Completely satisfied.

Virtual reality tool: The equipment was purchased for research purposes by the SRM College of Agricultural Sciences, and the features of the equipment include the Meta Quest 3 headset featuring updated hardware with the elements of Quest Pro. The headset has thinner, additional sensors, and colors pass through the camera which was intended for mixed reality software. It can be attached to a personal computer connected *via* cable or through an air link (wirelessly).

The procedure of data collection: The participation information sheet was provided and informed consent was obtained from each subject. On the first day of the program, the socio-demographic variables, participants' stress levels, scale of inclusion of nature, and feedback for interventions were collected as pre-tests. The post-test was conducted at the end of one month and the data were collected for one month from March to May 2024. Fig. 1 reveals the natural and simulated therapy procedure used in this research for kindling the five senses.

Visual: The therapy was designed with the intent to stimulate the participant's visual sense through a natural garden view with virtual reality (VR) nature-based videos.

Fig. 1. Natural and simulated therapy procedure used in this research for kindling the five senses.

Auditory: The sound therapy was focused on using the inbuilt VR video along with the sound and the nature garden view, fountain sound, breeze sound, and bird chirps.

Olfactory: The olfactory sense was stimulated by providing various processed essential oils and by crushing the aromatic plant leaves.

Taste: The art of taste sense is enhanced by providing with them regular beverages and herbal tea drinks.

Tactile: The sense of tactile is observed and recorded through the participants walking over the pebbles and walking over the eight pathways on the sand, both barefooted.

Apart from the sense-stimulating elements in the garden, the participants engaged themselves in various garden activities like flower plucking, planting, sowing, irrigation, adding fertilizers, and feeding birds and were asked to select the best activity amongst them.

Statistical analysis: The data collected was evaluated by descriptive statistics and inferential statistics. Descriptive statistics were used for analyzing the frequency and percentage distribution to portray the socio-demographic variables of the stressed subjects. The mean and standard deviation were used to compute the stress among the subjects. The inferential statistics of the Paired t-test were used to examine the effectiveness of horticulture therapy on stress and inclusion of nature among the urbanites. The Wilcoxon signed-rank test was used to find the difference between the two approaches to horticulture therapy.

Results

A total of thirty people completed the intervention program. The socio-demographic variables, the comparison of the pre-test and post-test for the stress scale, and the inclusion of the nature scale are presented in tables. The comparison between the natural way of intervention and simulated interventions was assessed through the Wilcoxon signed-rank test and presented.

Socio-demographic variables: The frequency and percentage of the socio-demographic variables were assessed (Table 1) and it was found that the major participants (36.3%) were in the age group of 41 to 50 years. The gender of the urbanites group included a greater number of female participants (56.1%). The place scored a value of 52.8 % for the urbanites and 23.1 % of rural residents working in urban environment and most of the participants were married with a score of 75.9%. The nature of profession revealed that 69.3 % were doing technical work followed by non-technical (16.5%), students (6.6%), others with 6.6%, and their affiliation to their working environment is permanent jobs with a score of 69.3% and holding non-permanent jobs (29.7%).

Effect of intervention on the stress level: The frequency and the distribution of the urbanites according to the stress level are depicted in Fig. 2. It was observed that none of them reported under the category of high stress and among the 30 urbanites 87 % of them had a moderate level of stress and 13 % were having low stress level. The interventions were provided, and the post

Table 1. The frequency and the percentage distribution of the urbanites according to the socio-demographic variables, n=30

Socio-demographic variables		F	%
Age	20-30 Years	10	33.33
	31-40 Years	06	20.00
	41-50 Years	11	36.67
	51-60 Years	03	10.00
Sex	Male	13	43.33
	Female	17	56.67
Place	Rural	13	43.33
	Urban	17	56.67
Marital status	Unmarried	07	23.33
	Married	23	76.67
Profession	Technical	21	70.00
	Non-technical	05	16.67
	Students	02	06.67
	Others	02	06.67

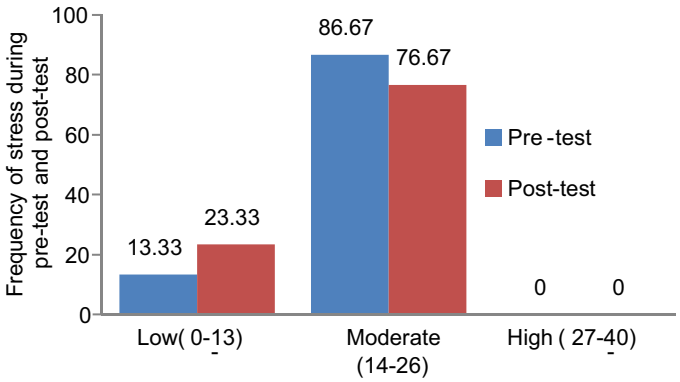

Fig. 2. The frequency and distribution of urbanites according to the stress level

level of stress was assessed, we could observe that there was a gradual reduction in the stress score at the moderate level, and for a few, it was observed to lower to the low-stress score which is a positive sign for the therapy. As indicated in Table 2, the stress mean level before the intervention was 20.8 with a standard deviation of ±4.14 which is in the category of moderate stress, and after intervention, a post-test after one month of intervention showed a score mean value of 17.6 ±4.44. It showed it's on the edge of moderate stress and in the margin of low-stress category. The paired t-test showed a 't' value of 5.6 and *P*= 0.0002.

Table 2. The pre and post-test mean score for the effect of horticultural interventions on stress and Inclusion of nature (self) among urbanites

Variables	Mean ± SD	Mean difference	't' value	*P* value
Stress				
Pre-test	20.8±4.14	3.2	5.6	0.0002
Post-test	17.6±4.44			
INS Score				
Pre-test	3.3±1.78	2.1	6.8	0.0007
Post-test	5.46±1.07			

Effect of horticulture intervention on inclusion of nature scale (INS): The INS scale helps to assess the connection to nature. The circles in the form of Venn diagrams are provided to allow the participants to choose between complete separations (1) to complete overlap (7). The inclusion of nature in the self-scale has a great positive score between the pre-test and the post-test. As observed in Fig. 3, the values during the pre-test seem to be uniformly distributed in the seven levels of scale which depicts the level of intimation between the urbanite and nature. There is a major percentage of distribution in levels 2 and 3. During

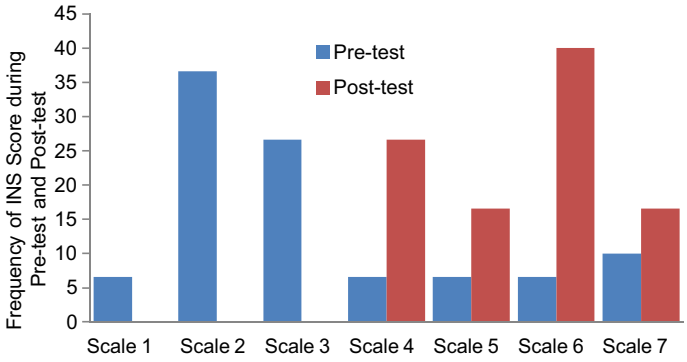

Fig. 3. The frequency and distribution of urbanites according to INS scoring

the post-test, it was observed that the green space in the form of interventions has increased intimation and thus the score was distributed to the last four levels which indicates a greater attachment to nature. The comparison shows a pre-test value of 3.3±1.78 and 5.46±1.07 and the mean difference is 2.16 with the *P*=0.0072 and the 't' value is 6.88 which is presented in Table 2.

Horticulture interventions through natural and simulated approaches

Visual therapy through virtual reality and garden view: Virtual therapy was provided to participants working in an urban environment with enclosed doors. A garden view was provided to participants, allowing them to experience a 360-degree perception of various elements, including plant components such as lawns, climbers, hedges, edges, trees, shrubs, palms, foliage, and non-foliage plants, as well as non-plant components like pathways, fountains, birdbaths, arches, and pebble arrangements. To reproduce the garden effect, the virtual reality video encompassed natural elements like gardens, mountains, and sea views with a realistic mixture of birdsongs, rippling water, animal sounds, and waves.

A comparison was made to identify which form of intervention is best at the visual level. It was conducted on the first day, with the mean value being 4.26±1.04 for the natural garden view, compared to a mean value of 3.66±1.37 for virtual reality videos. After the intervention on the 30th day, the values were 4.8±0.34 for the garden view, compared to 2.7±0.74 for virtual reality videos. The result indicates that participants favored the natural way of seeking sight (Table 4). The mean difference values were 0.6 and 1.7, which are statistically significant, with t values of 1.90 and 7.03 and P-values of 0.03 and 0.01, which are significant at 5%.

Table 3 and Fig. 4 show the result of the Wilcoxon signed-rank test conducted to determine whether a statistical difference was observed for garden and virtual reality therapy. Out of 30 participants for the visual parameters, 2 participants showed negative ranks, 23 showed positive ranks, and 5 showed a tie, favoring the garden view therapy. The test statistics show a z-value of -4.23 with a significance of <0.001.

The participants' mean score for the garden view was 13.83 compared to the virtual reality score of 3.5, with p<0.01. This finding revealed the potential of the garden view as visual therapy.

Sound therapy through virtual music and garden sound (Auditory): Virtual music was played along with the virtual

Table 3. Wilcoxon test comparison of the natural and simulated approach of interventions after horticulture therapy.

Ranks	N	Mean Rank	Sum of Ranks	Z- Value	Significance (2-tailed)
Visual: Garden & VR Therapy					
Negative Ranks	2	3.5	7	-4.23	<0.001
Positive Ranks	23	13.8	318		
Equal	5				
Total	30				
Auditory: Garden & VR Music					
Negative Ranks	0	0	0	-4.85	<0.001
Positive Ranks	30	15.5	465		
Equal	0				
Total	30				
Visual: Garden & VR Therapy					
Negative Ranks	0	0	0	-4.92	<0.001
Positive Ranks	30	15.5	465		
Equal	0				
Total	30				
Visual: Garden & VR Therapy					
Negative Ranks	5	8.7	43.5	-3.77	<0.001
Positive Ranks	24	16.3	391		
Equal	1				
Total	30				
Visual: Garden & VR Therapy					
Negative Ranks	2	5	10	-4.41	<0.001
Positive Ranks	23	13.70	315		
Equal	5				
Total	30				

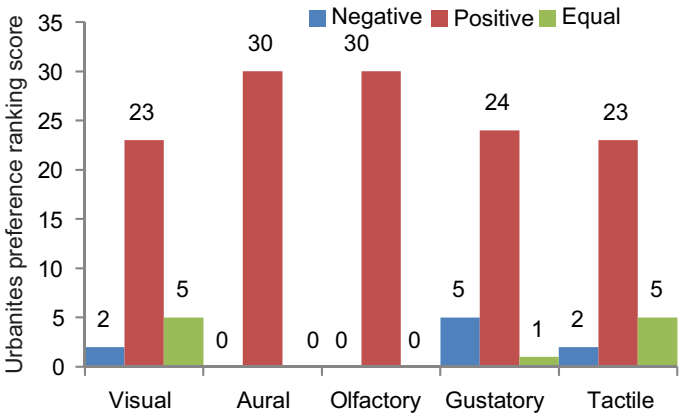

Fig.4. Results of Wilcoxon signed-rank test

view, with either pleasant music, speech, or no sound, based on the preference given by the participants. The volume was mostly kept at a medium level, with most of the volume modulated according to the video content. For the sounds of nature along with the garden view, participants were asked to observe the sounds of nature, including the twittering and chirping of birds, rippling water from the fountain, and the sound of the breeze. The participants' feedback on hearing pleasant music in virtual reality was compared against the garden sounds of the mild fountain, bird chirping, and breeze. The results in Table 4 showed a mean value of 3.03±1.18 on the first day and 2.7±0.74 at the end of the session, compared to garden sound values of 4.26±0.94 and 4.8±0.34. The paired t-test showed that this difference was significant at both 1% and 5%, with values of 0.01 and 0.0049, respectively. Table 3 shows the result of the Wilcoxon signed-rank test conducted to determine whether a statistical difference was observed for the auditory therapies involved. Out of 30 participants in the aural parameters, all 30 showed positive ranks, and none showed negative or tie ranks. The test statistic value showed a z-value of -4.85 with a significance of <0.001.

Therapy through oil and garden fragrance (Olfactory): Participants were allowed to enjoy the fragrance of different essential oils. These included rosemary oil, rose oil, holy basil, lemongrass oil, and lavender. Participants were asked to rate the fragrance based on their oil preferences. The garden also contained different flowering and non-flowering plants with varying fragrances and aromatic smells, including scented roses, allspice, holy basil, lavender, and coleus. Participants were allowed to rate and scale the fragrance based on their preference while crushing the leaves and flowers themselves. The mean value for the horticultural intervention, involving exposure to processed essential oils and the crushed leaves of aromatic plants, was 3.6±0.72 on the first day and 3.2±0.66 on the 30th day. The comparative values were 4.46±0.73 and 4.8±0.34, respectively. The *P*-value proves to be statistically significant at a 1% level of significance (Table 4).

Table 4. Comparison of natural and manmade approach of horticulture intervention during pre-test and post-test

Variables	Mean		Mean difference	't' Value	*P* Value
Visual	VR	Garden view			
Pre-test	3.66±1.37	4.26±1.04	0.6	1.90	0.03
Post-test	3.1±1.26	4.8±0.46	1.7	7.03	0.01
Auditory	Virtual music	Garden sound			
Pre-test	3.03±1.18	4.26±0.94	1.23	4.48	0.01
Post-test	2.7±0.74	4.8±0.34	2.10	14.48	0.04
Olfactory	Essential oil	Aromatic plants			
Pre-test	3.6±0.72	4.46±0.73	0.86	4.60	0.011
Post-test	3.2±0.66	4.8±0.34	1.60	10.68	0.013
Gustatory	Beverages	Plant based drink			
Pre-test	3.3±1.20	3.66±1.18	0.36	1.18	0.11 (NS)
Post-test	2.5±1.16	4.3±1.05	1.80	6.20	0.02
Tactile	Hardscape	Softscape			
Pre-test	3.06±4.5	1.43±0.77	1.63	4.80	0.005
Post-test	3.0±1.23	4.7±0.79	1.70	6.35	0.017

Table 3 show the results of the Wilcoxon signed-rank test conducted to determine whether a statistical difference was observed for the olfactory therapies involved. Out of 30 participants in the fragrance therapy, all 30 showed positive ranks, and none showed negative or tie ranks. The test statistic value showed a z-value of -4.92 with a *P* <0.001.

Taste therapy through beverages and plant-based drinks (Gustatory): The participants were provided with beverages, including tea and coffee, at the start of the session. Later, at the end of the session, participants were given plant-based drinks, including herbal tea, while they were filling in the feedback form. They were allowed to rate the beverages and plant-based drinks based on their taste preferences. To enhance the taste buds of

the participants, the herbal tea and the normal beverages were compared on the 1st day before the intervention and on the 30th day after the intervention. The values were 3.3±1.20 and 2.5±1.16, compared to 3.66±1.18 and 4.3±1.05, respectively. The values were not significant with a *P*=0.11 on the 1st day of observation and were significant at the 1% level with a value of 0.02 on the 30th day (Table 4). Table 3 shows the result of the Wilcoxon signed-rank test conducted to determine whether a statistical difference was observed for the gustatory therapies involved. Out of 30 participants in the taste therapy, 5 showed negative ranks, 24 showed positive ranks, and 1 showed a tie rank. The test statistic value showed a z-value of -3.79 with a significance of <0.001.

Touch therapy for softscape and hardscape elements (Tactile): The participants were provided with pebble mats to stand on in groups and discuss the intervention activity, and were asked to step barefoot to walk on the infinity walk. To activate the touch therapy, walking over the pebbles was compared with walking along eight paths in the sand. This was evaluated with a mean value of 3.06±4.5 and 3±1.23 on the 1st day and 30th day, compared with softscape elements, which had a mean value of 1.43±0.77 and 4.7±0.79. These results are significant, with values of 0.0053 and 0.017 (Table 3). Out of 30 participants in tactile therapy, 2 showed negative ranks, 23 showed positive ranks, and 5 showed tie ranks. The test statistic value showed a z-value of -4.14 with a significance of <0.001.

Discussion

The study evaluated the psychological impacts of urban dwellers exposed to natural and artificial horticultural interventions. The findings of this study indicate that recovery from stress was more effective and comprehensive when participants engaged in horticultural therapy as a nature-based intervention for enhancing mental health. Nature, being a benign environment, captivates participants and fosters tranquility (Harris, 2017). The majority of participants favored the natural environment over the simulated or virtual alternatives, as the enclosed setting prompted a preference for green spaces rather than artificial greenery. This can be further elucidated by noting that virtual reality constitutes a digital, fictional realm with environments or scenarios that may or may not resemble actual reality, as it is fundamentally a computer program. The assertion that the authentic will invariably triumph suggests that the original will consistently demonstrate superiority and attain dominance. Research indicates that genuine spatial environments facilitate physical movement and connection with surroundings, and their absence may restrict therapeutic outcomes (Chun *et al.*, 2016). The virtual environment is crafted by a computer programmer, offering a passive experience in contrast to the natural garden created by a landscaper. The primary benefit of the virtual realm is its absence of constraints regarding accessibility and temporal factors. Particularly, a limited number of subjects have expressed a strong preference for virtual reality tools due to their easy accessibility from metropolitan environments. Many individuals favor natural spaces, perceiving them as a kind of escape that alleviates stress from their surroundings. Consequently, VR technology can enhance the quality of life for those with disabilities (Pak *et al.*, 2018) and for elderly individuals (Cheng *et al.*, 2016). Conversely, natural proponents (Thaneshwari *et al.*, 2018) contend that the presence of plants is directly beneficial to environmental health. In addition to their aesthetic appeal, foliar plants may serve as adjunctive therapy for patients. The urban participants in the interventional program exhibited a statistically significant reduction in stress levels post-program, indicating the efficacy of horticultural therapy, whether natural or simulated. Upon additional examination, the majority of urban residents favored natural intervention options positively. The study's strength lies in identifying a research gap in horticultural intervention programs, which predominantly utilize either garden treatment or virtual therapy, with a lack of comparative studies to ascertain the preferred interventions among subjects. This study concentrated on stress reduction via horticultural therapy, specifically examining the influence of natural versus synthetic environments. The study results indicate a good correlation between nature and health (Park *et al.*, 2010).

Study limitations: The research utilized a pre-test and post-test design, and to enhance its quality, it did not account for the second pre-test time, hence reducing the likelihood of a low medication error rate in the initial pre-test period. Despite the focus on stress alleviation via horticultural therapy, the inquiry pertains to the relationship between stress and the unique environmental configurations employed for its mitigation. The study's findings indicate that including a natural setting is more beneficial in alleviating stress than a simulated, virtual artificial environment. Nature-based horticultural treatment is essential, and integrating this technology-driven approach may yield profound insights into managing stress by incorporating nature into daily living. Considering the substantial benefits associated with nature-based activities, practitioners should view these methods as a vital and promising health intervention.

Ethical approval: The study was approved by the institutional ethics committee (IEC), School of Public Health, SRM Medical College Hospital and Research Institute, Kattankulathur, Chengalpattu district, with a reference number 0043/IEC/2023, dated 11.12.2023.

References

Belete, H., T. Ergetie, T. Ali, S. Birhanu and T. Belete, 2020. Work-related stress and associated factors among textile factory employees in Northwest Ethiopia: A cross-sectional study. *Psychol. Res. Behav. Manag.*, 13: 1071-1078.

Bezold, C.P., R.F. Banay, B.A. Coull, J.E. Hart, P. James, L.D. Kubzansky, S.A. Missmer and F. Laden, 2018. The association between natural environments and depressive symptoms in adolescents living in the United States. *J. Adolesc. Health.,* 62(4): 488-95.

Brivio, E., S. Serino, C.E. Negro, A. Zini, G. Riva and G. De Leo, 2021. Virtual reality and 360° panorama technology: A media comparison to study changes in sense of presence, anxiety, and positive emotions. *Virtual Real.*, 25(2): 303-311.

Calogiuri, G., S. Litleskare, K.A. Fagerheim, T.L. Rydgren, E. Brambilla and M. Thurston, 2018. Experiencing nature through immersive virtual environments: Environmental perceptions, physical engagement, and affective responses during a simulated nature walk. *Front Psychol.*, 8: 2321

Cheng, V. Y., C.M. Huang, J.Y. Liao, H.P. Hsu, S.W Wang, S.F. Huang and J.L. Guo, 2020. Combination of 3-dimensional virtual reality and hands-on aromatherapy in improving institutionalized older adults' psychological health: Quasi-experimental study. *J. Med. Internet Res*., 22(7): 17096.

Chun, H and S. Lee, 2016. A study on the design guidelines of healing landscape in housing complexes. *J. Korean. Inst. Landsc. Archit.,* 44(5): 26-37.

Cohen, S., K. Tom and M. Robin, 1983. A global measure of perceived stress. *J. Health. Soc. Behav.,* 24(4): 385.

Dedhia, L., Maya Priya, Anjali Kumari Jha and Nishant. 2024. Role of horticulture therapy in floriculture. *Floriculture and Landscaping Chronicles-A collaborative insight,* 1-21.

Deepthi, M., R. Mamta, H. Ganesan, S. Sukhpreet, S. Deepak, C. Ramesh, J.V. Muruga Lal Jeyan and K. Abhinav. 2024. An assessment of work-related stress under sustainable urban areas and causes among working women performance. *Int. J. Sustain. Build. Technol. Urban Dev.,*15(2):261-271.

Dzhambov, A.M., I. Markevych, T. Hartig, B. Tilov, Z. Arabadzhiev, D. Stoyanov, P. Gatseva and D. Dimitrova, 2108. Multiple pathways link urban green- and bluespace to mental health in young adults. *Environ Res,* 166: 223-233.

Elsadek, Mohamed, Binyi Liu, Zefeng Lian, and Junfang Xie, 2019. The influence of urban roadside trees and their physical environment on stress relief measures: A field experiment in Shanghai. *Urban Forestry & Urban Greening,* 42: 51-60.

Mohamed, E., B. Liu, Z. Lian and J. Xie, 2019. The influence of urban roadside trees and their physical environment on stress relief measures: a field experiment in Shanghai. *Urban For. Urban Green.,* 42: 51-60.

Gidlow, C.J., M.V. Jones, G. Hurst, D. Masterson, D. Clark-Carter, M.P. Tarvainen, G. Smith and M. Nieuwenhuijsen, 2016. Where to put your best foot forward: psycho-physiological responses to walking in natural and urban environments. *J. Environ. Psychol.,* 45: 22-29.

Harris, H. 2017. The social dimensions of therapeutic horticulture. *Health Soc. Care Community,* 25(4): 1328-36.

Hassan, D. 2020. Do plants affect brainwaves? Effect of indoor plants in work environment on mental stress. *Eur. J. Hortic. Sci.,* 85: 279-83.

https://www.eea.europa.eu/help/glossary/gemet-environmental-thesaurus/urban-stress.

Huang, C.M., J. Liao, T. Lin, H. Hsu, T.C. Lee and J. Guo. 2021. Effects of user experiences on continuance intention of using immersive three-dimensional virtual reality among institutionalized older adults. *J. Adv. Nurs.,* 77(9): 3784-96.

Iwasaki, Y. 2006. Counteracting stress through leisure coping: A prospective health study. *Psych. Health. Med.,* 11(2): 209-20.

Kalantari, S., T.B. Xu, A. Mostafavi, A. Lee, R. Barankevich, W.R. Boot and S.J. Czaja, 2022. Using a nature-based virtual reality environment for improving mood states and cognitive engagement in older adults: A mixed-method feasibility study. *Innov. Aging,* 6(3): igac015.

Kechter, A., D.S. Black, N.R. Riggs, C.M. Warren, A. Ritt-Olson, C. Chou and M.A. Pentz, 2019. Factors in the perceived stress scale differentially associate with mindfulness disposition and executive function among early adolescents. *J. Child. Fam. Stud.,* 28(3): 814-21.

Lin, R., S. Chiang, M.M. Heitkemper, S. Weng, C. Lin, F. Yang and C. Lin, 2020. Effectiveness of early rehabilitation combined with virtual reality training on muscle strength, mood state, and functional status in patients with acute stroke: A randomized controlled trial. *Worldviews Evidence-Based Nursing,* 17(2): 158-67.

Park, B.J., Y. Tsunetsugu, T. Kasetani, T. Kagawa and Y. Miyazaki, 2010. The physiological effects of shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. *Environ. Health Prev. Med.,* 15(1): 18-26.

Roberts, H., C.V. Lissa, P. Hagedoorn, I. Kellar and M. Helbich, 2019. The effect of short-term exposure to the natural environment on depressive mood: A systematic review and meta-analysis. *Environ. Res.,* 177: 108606.

Rushing, J.R., M.D. Needham, A. D'Antonio and E.C. Metcalf, 2019. Barriers to attachment? Relationships among constraints, attachment, and visitation to urban parks. *J. Outdoor Recreat. Tour.,* 27: 100228.

Schmuck, P., and W.P. Schultz, 2002. Psychology of sustainable development. Boston, MA: *Springer USA*, 3-17.

Schroeder, A.H., J.M. Bogie, T.T. Rahman, A. Thérond, H. Matheson and S. Guimond, 2022. Feasibility and efficacy of virtual reality interventions to improve psychosocial functioning in psychosis: systematic review. *JMIR Mental Health,* 9(2): 28502.

Tost, H., M. Reichert, U. Braun, I. Reinhard, R. Peters, S. Lautenbach, A. Hoell, E. Schwarz, U. Ebner-Priemer, A. Zipf and A. Meyer-Lindenberg, 2019. Neural correlates of individual differences in affective benefit of real-life urban green space exposure. *Nat. Neurosci.,* 22(9): 1389-93.

Triguero-Mas., M. Dadvand, M. Cirach, D. Martínez, A. Medina, A. Mompart, X. Basagaña, R. Gražulevičienė and M.J. Nieuwenhuijsen, 2015. Natural outdoor environments and mental and physical health: relationships and mechanisms. *Environ. Int.,* 77: 35-41.

Ulrich, R.S., R.F. Simons, B.D. Losito, E.F. Mark, A. Miles and M. Zelson. 1991. Stress recovery during exposure to natural and urban environments. *J. Environ. Psychol.,* 11(3): 201-30.

Received: September, 2024; Revised: September, 2024; Accepted: October, 2024