PILOT STUDY

Pilot Study on Therapeutic Horticulture for Chronic Low Back Pain: A Mixed Methods Study

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ABSTRACT

Background • Chronic low back pain (LBP) is common and associated with disability worldwide. Therapists trained in Therapeutic Horticulture (TH) use gardening activities and proximity to nature for therapy and rehabilitation. Patients seeking care for LBP would benefit physically and psychologically from participating in TH.

Primary study objectives • The first aim of this study was to determine if and which patients who were receiving care for chronic LBP were interested in TH to help manage their pain. The second aim of the project was to quantify changes in LBP, functional tasks and anxiety upon completion of a TH session in patients with LBP.

Methods/Design • This was a 2-part study with a mixed methods design: the cross-sectional survey Group and the pilot experimental Group. The Cross-sectional Survey component comprised a total of 170 patients; age 55.9±17.3 years; 58% women. The Pilot Experimental component comprised a total of 9 patients; age 48±14.7 years; 78% women.

Participants Cross-sectional component • patients receiving medical care for LBP with or without additional joint pain sites (n=170; age 55.9 ± 17.3 years; 58% women.

Participants Pilot experimental component • A total of 9 patients (7 women); mean age 48 ± 14.7 years and mean duration of back pain 12.6 ± 8.1 years.

Setting • Patients were receiving medical care at the University of Florida Health Comprehensive Spine Center in the United States, in the tertiary care health system.

Intervention • 1-hour TH session that involved trained therapists using propagating and harvesting herbs planted at various heights in an outdoor setting for therapy and rehabilitation.

Primary outcome measures • A therapeutic horticulture interest survey, PROMIS Pain Interference and Physical Function scores, functional tests (timed-get-up-and-go [TUG], spine range of motion), Roland Morris Disability Questionnaire (RMDQ), 11-point Numerical Pain Rating Scale (NRS_{pain}), 10-item PROMIS Global Health Questionnaire, Tampa Scale of Kinesiophobia-11 and patient enjoyment.

Results • Cross-sectional survey component: A total of 82% of patients had not previously heard of TH and 68% were interested in learning more about it. Patients who expressed interest in TH reported a higher level of agreement that TH could improve mood, improve muscle strength, lower stress level, increase movement and enable patients to perform self-care activities with less pain (all $P < .001$). PROMIS Pain Interference and Physical Function scores did not differ by interest in TH ($P > .05$). Pilot Experimental component: In the pilot session, 44% reported using pain medication to manage their low back pain and 66% believed gardening could provide pain relief. Improvements were observed in anxiety (55.3%; $P = .017$), spine flexion (31.4%; $P = .003$) and spine rotation to the left (26.7%; $P = .005$). All participants believed that gardening improved overall health and spine motion while reducing low back pain. All patients reported having gardening experience at home and none had TH experience.

Conclusion • Patients presenting to an outpatient spine clinic may be receptive to trying TH in conjunction with or in place of conventional medicine to promote health and well-being. The pilot experimental group data suggested that acute TH is enjoyable and may confer the benefits of reducing anxiety and improving spine motion. Future larger studies could use different dose response approaches, explore different TH activity types and involve participants from different geographic locations while controlling for LBP history and psychological status. (*Altern Ther Health Med.* 2024;30(4):10-17).

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INTRODUCTION

Low back pain (LBP) is a condition that affects roughly 40% of the population of the United States.[1] Individuals who have LBP often face more time away from work, leading to lost wages and opportunities compared with their unaffected peers.[2] Current treatment recommendations for LBP include non-steroidal anti-inflammatory medications in conjunction with nonpharmacological treatments such as cognitive behavioral and physical therapy.[3] Additional nonpharmacological alternative treatment modalities have been studied and published in recent years as well, including acupuncture and cognitive behavioral therapy (CBT), each of which focuses on either physical or psychological aspects of pain management.[4-6] While many treatments are available for LBP, clinicians have little information about combining physical and psychologically informed approaches for

managing pain in individual patients or subgroups of patients.[7] One alternative treatment that includes both physical and mindfulness components is therapeutic horticulture (TH).[8]

The use of horticulture and gardening in healing is an ancient practice. The intentional use of plants and plant-based activities to help people heal and rehabilitate emerged during World War I and II, first as a recreational activity for injured and disabled soldiers, and later as a rehabilitative tool. Horticultural Therapy (HT) and Therapeutic Horticulture (TH) are practiced in a variety of clinical, rehabilitative, vocational and community settings in order to help patients increase or regain physical, cognitive, social and psycho-emotional function, as well as for them to learn or regain vocational skills.[9] While individualized goals are designed within an established treatment plan in patients in HT, TH can be applied in broader and more accessible settings and typically involves group goals, making it more suited to a community setting.[10] Both practices involve active participation in gardening and other horticulture-related activities that are intentionally designed to work toward particular goals based on patient needs.

Studies in other patient populations demonstrate that TH has been associated with physiological, psychological, social and cognitive benefits, including reducing stress and anxiety,[11,12] enhancing social connectedness,[13-17] improving physical well-being,[18] lowering cortisol levels[11,19] and increasing life satisfaction.[20]and dose-responses were assessed for exercise intensity and exposure duration. Other subgroup analyses included gender, age group, starting health status, and type of habitat. The overall effect size for improved self-esteem was d = 0.46 (CI 0.34-0.59, $P < .00001$ The American Horticultural Therapy Association (AHTA) indicates that TH can improve brain function (memory, task initiation, socialization) and physical function (balance, endurance, muscle strength, coordination).[8] Gardening activities can be used to encourage patient movement via a range of different postures, all of which could provide health benefits in patients with LBP.[21,22] With respect to physical function and mobility, TH includes tasks that require reaching, grasping, transporting, dynamic balance, stepping-stooping, trunk strength control and sit-to-stand coordination.[23] In patients with chronic joint pain, some of these movements are difficult, fear- or anxiety-inducing or impossible. TH can foster improvements in grip strength, trunk movement coordination, balance and self-reported physical function in aspects of self-care.[23] Individuals who have participated in TH exercise trials have reported both social and physical benefits of reduced pain.[24] A small randomized controlled trial performed in an inpatient rehabilitation setting in people with various types of chronic musculoskeletal pain (fibromyalgia, nonspecific back pain) showed that TH improved self-rated physical health, mental health, anxiety and pain behaviors.[25] Furthermore, passive interaction with restorative natural environments has been linked to decreased perception of pain and the regulation of responses to stress.[9,26] TH as a structured intervention using cost-effective and non-intrusive methods has demonstrated efficacy in other patient groups and may potentially represent a novel, unexplored supplemental treatment option in patients with LBP. However, it is unclear whether TH would be of interest to patients with LBP in a community setting, and what acute effects TH would have on physical function, anxiety and pain severity.

Based on clinical observation patterns, we hypothesized that interested patients who would have more severe pain interference and functional limitations (as assessed by the PROMIS pain Interference and Physical Function surveys), are older, female, do not participate in other physical activities, live alone, are retired and low resourced. We hypothesized that individuals would demonstrate improvements in spine mobility and physical function and reduction in spine pain severity from pre- to post-session.

METHODS

This study was reviewed and approved by the University of Florida Human Ethics Research Committee (Application IDs #202102666 survey component and 202201838 pilot experimental component). Written and informed consent was obtained from each participant using project forms that included the research team's names and professional qualifications.

The 2 initial steps toward the adoption of TH as a more well-accepted treatment option for LBP include: (1) determination of patient interest, perceived health and well-being benefits of TH, and (2) understanding the acute effects of TH on LBP severity, physical function, spine motion and enjoyment of the activity. This 2-part study involved a cross-sectional survey and a pilot TH session with individuals who expressed interest and have LBP. Therefore, the first aim of this study was to determine if and which patients who are receiving care for LBP were interested in TH. The second aim of the study was to quantify changes in back pain, functional tasks and anxiety upon completion of a TH session in a group of individuals with LBP.

Design

This study had a mixed methods design, with cross-sectional survey and pilot experimental components.

Patient Samples and Settings

Cross-sectional component. A consecutive sample of patients ≥18 years of age who were receiving medical care for LBP with or without additional chronic musculoskeletal pain (peripheral joints, axial [spine, neck], pelvis-sacrum) were recruited to participate between January 30, 2022 and July 7, 2023. Patients were receiving medical care at the University of Florida (UF) Health Comprehensive Spine Center, in the tertiary care health system with a catchment of more than 2.5 million individuals. Patients were approached during their clinic visits. A total of 170 patients between age 18 and 84 years agreed to complete the surveys.

Pilot experimental component

For the second part of the study, a subgroup of interested patients agreed to participate in a pilot experimental TH session in April 2023. A total of 9 patients (7 women), mean age 48±14.7 years and mean duration of back pain 12.6 ± 8.1 years participated in the pilot study. A total of 44% reported using pain medications to manage LBP, but the specific medication used varied among the participants. All participants reported having gardening experience and almost all performed gardening at home; however, none had TH experience.

Methods in the Cross-Sectional Study Component

TH Survey. A unique survey was developed specifically for the first part of the research. The study team was comprised of fellowship-trained spine physiatrists, physiologists, therapists and researchers, and they first developed the survey content and then drafted several versions of the survey before piloting it. The survey was piloted with clinical researchers to test the face validity of the questionnaire. A survey guide with standard instructions was developed to ensure that surveys were administered in the same manner to all participants. The survey was piloted in a group of patients with back pain to ensure readability.

The final survey consisted of 4 main domains: (1) social determinants of health (age, race, ethnicity, working status, insurance status, annual income, marital status, home living status); (2) current musculoskeletal pain status (location[s] of musculoskeletal/joint pain, use of medication for pain and number of medications, use of assistive devices for mobility, previous treatments for pain or functional difficulties, current physical activities and frequency of physical activity); (3) awareness, interest level and beliefs about TH; and (4) level of agreement with the impact of TH on well-being. Domains 1-3 used checkboxes or fill-in spaces for answers. A checklist of reasons for interest or disinterest was provided from which respondents could choose their responses. Domain 4 used a Likert scale list of 5 questions and asked about the level of agreement with statements relating TH to health benefits of mood, strength, stress, movement ability and self-care. This survey took about 7 minutes to complete. The survey is in Supplemental File 1.

PROMIS measures

The National Institutes of Health (NIH) invested in the development of the Patient-Reported Outcome Measurement Information System (PROMIS) for clinicians and researchers to measure health status across multiple domains of quality of life (QoL) in various health conditions. A total of 2 paper item banks were provided to characterize the patients: the Pain Interference short form 4a and the Physical Function 10a. Pain Interference was selected to characterize the level of impairment due to pain symptoms on daily functioning (day-to-day activities, work around the home, participation in social activities and household chores). The Physical Function 10a form was selected to characterize the level of difficulty with a variety of physical tasks ranging from athletic (sport engagement, lifting heavy objects), daily life (carrying groceries, vacuuming, yardwork), functional ability (walking more than 1 mile, bending-kneeling-stooping) and self-care (shampooing hair, dressing self, toileting). These PROMIS short-form versions have construct validity and high reliability (r ≥0.9).[27] These 2 surveys took about 4 minutes to complete.

Methods for the Pilot Experimental TH Session

The Experimental session was comprised of pre-TH surveys and functional measures and TH activity and post-session surveys and functional measures.

Surveys. A total of 4 brief surveys were administered before the TH activity to characterize the patients who participated.

Roland Morris Disability Questionnaire (RMDQ). This well-established instrument is comprised of 24 items and is designed to capture the impact of back pain on everyday functioning, with emphasis on physical functioning such as pain intensity, self-care, social life, walking, sitting, standing, sleeping, bending, stairs, general activity, appetite, household chores.[28,29] Scores ranged from 0 (minimum) to 24 points (maximum). This questionnaire has content validity and reliability among individuals with LBP (ICC >.070).[28,30,31]

10-item PROMIS Global Health form. The Global Health 10-item survey (v. 1.0, paper-based) includes questions related to physical, mental and social health, fatigue, pain and overall quality of life (QoL). A T-score of 50 represents the mean of the general population, and higher scores indicate better physical and mental health. This instrument has been used in individuals with LBP in different settings, including outpatient therapy, and validated for use in this population.[32,33]

Tampa Scale of Kinesiophobia 11 (TSK-11). The TSK is a 11-item survey that classifies patients' fear of movement or physical activity as it relates to pain.[34]there is relatively little data to support the psychometric properties of the English version of this scale. This study investigated the psychometric properties of the English version of the TSK in a sample of chronic low back pain patients. Item analysis revealed that four items possessed low item total correlations (4, 8, 12, 16 The TSK can be further categorized into 2 domains: Activity Avoidance (due to potential increase in pain or potential of causing injury) and Somatic Focus (which aims to reflect patients' beliefs about how serious their condition is). The TSK-11 is very responsive to CBP, has good internal consistency (α=0.79), test-retest reliability (α=0.81) and responsiveness in people with back pain.[34,35]there is relatively little data to support the psychometric properties of the English version of this scale. This study investigated the psychometric properties of the English version of the TSK in a sample of chronic low back pain patients. Item analysis revealed that four items possessed low item total correlations (4, 8, 12, 16 Scores range from 11 points (no fear) to 44 points (highest possible fear), with higher scores indicating greater fear of movement.

11-point Numerical Rating Scale for Pain (NRS_{pain}) and Anxiety. This survey includes 3 separate items. Participants self-rated the average intensity of back pain over the "past week" and the current intensity at the time of the TH session on a scale from 0 to 10 points. NRS_{pain} ratings are supported for use in this population as this has minimal recall bias, ease of administration, good test-rest reliability, construct validity and responsiveness.[36,37]describe, and evaluate common outcome measures in patients with chronic low back pain (CLBP The third item also uses an NRS scale for participants to rate their current level of anxiety from 0 to 10 points.

Functional Measures. A total of 2 brief tests were conducted to represent spine movement and potential impairment of pain on mobility.

Timed Up and Go (TUG) test. This test has been used among people with LBP.[38]decreased balance ability, impaired proprioception, and lower strength compared to asymptomatic persons. The aim of this study was to investigate the differences between LBP patients and healthy controls in terms of several physical abilities. Based on the premised that different biomechanical and physiological causes and consequences could be related to different types of LBP, a secondary exploratory attempt of the study was to examine the differences between LBP subgroups based on the pain location (local or referred Participants were instructed to stand up from a chair, walk as fast as possible for 3 meters, turn around and return to a sitting position in the chair as fast as possible. The starting and final positions were with the patient sitting in the chair and touching the backrest. The time for test completion was measured manually with a stopwatch. This test was repeated 3 times, with a 30-second break between the repetitions. The fastest time was taken as the score. This test is responsive to back pain severity.[39]chronic low back pain (CLBP In the clinical setting, patients scoring a TUG test time of >12 seconds can represent functional impairment.[40]

Spine Rotation Range of Motion

This is the spine motion in all 3 planes while participants were seated. Each participant performed trunk rotation (to the left, to the right), lateral bending (to the left, to the right) and spine flexion and extension. The spine exertions were measured using a digital goniometer (WR300 angle gage; Wixey Development, Sanibel, Florida USA).

TH Session

The TH session lasted approximately 1 hour. The content was informed by the physiatrist and structured by the HT practitioners to help patients safely achieve acute improvements in spine mobility. The main objectives were to inspire patients to move the spine in all planes of movement, with motions that may otherwise be avoided in daily life due to pain. The activity was the creation of an herb bowl and involved greenhouse and outdoor gardening activity. The session included greenhouse preparations (gathering materials, reaching and lifting light loads, pushing bins), moving about the garden to collect plant cuttings at different levels (above the head, at ground level, at eye level), digging up roots for planting, standing and working the soil, planting the herbs, emptying compost buckets, washing tools and cleaning the work areas. The physiatrist was present for the session and monitored patients for safety and any adverse responses.

Data was processed to determine the maximum and minimum spine exertion values achieved during the different phases of the herb bowl preparation. A study-specific 5-item survey was utilized to determine patient enjoyment of the TH session. The following statements were provided: (1) I found this horticultural activity to be fun; (2) I felt more relaxed after the activity than before the activity; (3) I feel that this kind of gardening activity can help my back health; (4) I would do more horticultural activities if given the chance; (5) I enjoyed experiencing plants in a social setting with others who have similar back pain. Participants agreed with the statement using the Likert scale: 0=did not agree, 1=agree a little bit, 2=somewhat agree, 3=agree and 4=strongly agree.

STATISTICAL CONSIDERATIONS

Statistical analyses were performed using IBM SPSS software version 28.0 (IBM, Armonk, New York USA). Normality of the cross-sectional data was determined using Shapiro-Wilk tests, and descriptive statistics were calculated for all study variables and demographics. Descriptive statistics were applied to characterize the respondents from the cross-sectional component.

Cross Sectional Survey Component

Respondents were grouped into "interested" and "not interested" in TH. Mann Whitney U tests were applied to determine whether groups differed by baseline categorical characteristics (sociodemographic data, assistive devices and therapies used, physical activity participation, painful sites) and level of agreement with statements relating TH to health benefits. Group differences in continuous variables (age, active days per week, PROMIS scores for Pain Interference and Physical Function) were tested using a one-way analysis of variance. Significance was established at $P < .05$ for all statistical tests.

Pilot Experiment Component

Descriptive statistics were calculated for all patient characteristics, demographics and pre-TH surveys (TSK-11, RMDQ and PROMIS Global Health 10). Pre-post TH values in physical function, pain and anxiety were analyzed using Mann Whitney U tests and paired t tests. Effect sizes of TH on TUG and trunk motion were determined, and size was ranked by the method of Cohen (Cohen's d*)* as small, moderate and large, where 0.2 was small, 0.5 was moderate and 0.8 was large.[41]Patient Enjoyment Questionnaire scores were characterized using descriptive statistics.

RESULTS

Cross-sectional Component

Upon review, some respondents indicated on the survey that they were not experiencing joint pain at the moment, but

Table 1. Characteristics of the Respondents from the Cross-Sectional Survey Component

Variable	Interested (n=116)	Not Interested (n=44)	*P* value
Female (#, %)	84 (73)	21 (47)	.003
Age (years)	55.4 ± 16.7	56.1 ± 17.7	.030
Race (#, %)			.371
Black/African American	22 (19)	7 (17.1)	
White/Caucasian	85 (75)	30 (73)	
Other	5 (4.4)	3 (7.3)	
Ethnicity (#, %)			.235
Hispanic	10 (11.9)	1(2.8)	
Non-Hispanic	74 (88)	34 (97.1)	
Working status (#, %)			.620
Working	44 (39.3)	14 (34.1)	
Retired	43 (38.4)	13 (31)	
Disabled	13 (11.6)	8 (19.5)	
Not working	12 (10.7)	6 (14.6)	
Insurance status (#, %)			.798
Insured	105 (97.2)	39 (95.5)	
Not insured	3 (2.7)	1 (2.5)	
Annual income (#, %)			.663
<$50,000	47 (45.2)	17 (50)	
>$50,000	55 (52.8)	17 (50)	
Marital status (#, %)			.788
Married	52 (45.6)	22 (51.2)	
Widowed	10 (8.7)	4 (9.3)	
Single	52 (45.6)	17 (39.5)	
Live alone (#, %)	34 (29)	9 (20)	.398
Joint pain >6 months (#, %)	69 (54.8)	49 (52.1)	.345
Other pain sites (#, %)			
Neck	55 (47.8)	16 (39)	.331
Spine	70 (60.1)	23 (56.1)	.593
Knee	44 (38.3)	17 (42.5)	.718
Hip	59 (51.3)	17 (42.5)	.279
Ankle	29 (25.2)	11 (26.8)	.839
Shoulder	41 (35.6)	16 (39)	.700
Elbow	24 (22)	5 (12.2)	.220
Wrist	34 (29.6)	7 (17.1)	.119
Regularly taking pain medication for low back pain (#, % yes)	58 (50.9)	22 (53.6)	.807
Pain medications used on a regular basis (#, %)			.551
None	37 (34.9)	12 (32.4)	
1	29 (27.3)	14 (37.8)	
2	27 (25.5)	6 (16.2)	
≥3	13 (12.3)	5 (13.5)	
Use of assistive device (#, %)			.360
No	91 (81.2)	32 (82)	
Cane	11 (9.8)	5 (12.8)	
Walker	7 (6.2)	0 (0.0)	
Wheelchair/scooter	3 (2.8)	2 (5.1)	
Adjunct therapy obtained (#, %)			
Physical therapy	81 (71)	31 (73.8)	.734
Acupuncture	21 (18.4)	5 (11.9)	.333
Meditation	24 (21)	7 (16.6)	.534
Massage	42 (36.8)	13 (30.9)	.495
Participation in physical activity (# times/week)	4.4 ± 2.2	4.5 ± 2.3	.750
Joint pain prevents participation in enjoyable activities (#, %)	79 (68)	27 (64.3)	.425

Note: Values are number and percentage of the group; values are mean ± SD.

Table 2. Percentage of Patients Who Agreed with the Following Statements Relating Therapeutic Horticulture to Health Benefits

I believe that therapeutic horticulture might:	Interested	Not interested	*P* value
Put me in a better mood	113 (99)	29 (82.8)	<.001
Help me get stronger muscles	109 (96.5)	31 (86)	<.001
Lower my stress level	111 (99.1)	32 (88.8)	<.001
Help me move my body around with less joint pain	108 (92.5)	25 (71.4)	<.001
Help me do my self-care activities with less pain (washing, dressing, brushing teeth, combing hair)	95 (86.4)	26 (74.3)	<.001

Note: Values are number of "yes" responses and percentage of the group.

Table 3. Functional Measures and Numerical Rating Scales for Pain and Anxiety Before and After the TH Pilot Session.

Outcomes	Pre-TH	Post-TH	*P* value	Cohen's *d*
Physical Function Tests				
Timed up and go (s)	8.1 ±3.8	8.4 ±4.9	.311	.6
Spine extension (°)	20.9 ± 12.8	30.5 ± 14.4	.003	.7
Spine flexion (°)	45.7 ± 24.6	52.7 ± 25.8	.116	.3
Rotation, right (°)	21.9 ± 20.3	24.0 ± 13.7	.385	.1
Rotation, left (°)	18.6 ± 9.4	25.4 ± 11.0	.008	.5
Lateral bend, right (°)	35.6 ± 10.4	37.1 ± 18.4	.403	.1
Lateral bend, left (°)	40.0 ± 18.2	38.6 ± 22.2	.311	.1
11-point NRS Rating Scales				
Over the last week, on average, how severe has your back pain been? (points)	5.1 ± 2.1	5.4 ± 2.3	.178	.8
Right now, how severe is your back pain? (points)	4.7 ± 2.4	4.7 ± 1.6	.500	.0
Right now, how high is your level of anxiety? (points)	4.7 ± 3.3	2.1 ± 1.7	.017	1.0

Note: Values are means ± SD.

Abbreviations: °, degrees; NRS, Numerical Rating Scale; s, seconds; TH, Therapeutic Horticulture.

Table 4. Responses to the Enjoyment Questionnaire Post-Therapeutic Horticulture Session

Question	Mean ± SD	Range
I found this horticultural therapy activity to be fun.	3.9 ± 0.4	3-4
I felt more relaxed after the activity than before the activity.	3.1 ± 1.5	0-4
I feel that this kind of gardening activity can help with my back health.	3.3 ± 0.9	2-4
I would do more horticultural therapy if given the chance.	3.9 ± 0.4	3-4
I enjoyed experiencing plants in a social setting with others who have similar back pain.	3.7 ± 0.5	3-4

Note: Answers were in Likert form with the following choices: 0=do not agree, 1=agree a little bit, 2=somewhat agree, 3=agree and 4=strongly agree

they listed pain in at least 1 joint or specified the duration of their joint pain symptoms. This was noted as patients' pain being well-managed at this visit and included in the statistical analysis. A total of 170 survey sets were completed. Overall, the respondent pool (N=170) was 58% female, 68% white and age 55.9±17.3 years. A total of 82% of patients had not previously heard of TH and 68% indicated they would be interested in learning more about it. Supplementary Table 1 provides the breakdown of reasons related to interest and disinterest in TH as an option to help manage pain and functional difficulties.

Table 1 provides the characteristics of the participants by interest in TH. Participants who reported interest in TH had an average of 3.5 years longer duration of LBP symptoms than patients who were not interested (P =.093). A total of 37% more women than men were interested in TH (P <.001). There were no group differences in preferred physical activities; the 5 most common regular physical activities in both groups were walking (72.4-76.2%), weight-lifting (12.1-19.0%), yoga (11.9-13.8%), jogging (9.5-1.3%) and cycling (6.9-7.1%). PROMIS Pain Interference and Physical Function scores did not differ by interest in TH (Pain Interference: 12.8±4.7 points [interested] and 13.0±5.0 points [not interested]; Physical Function: 35.9±7.9 points [interested] and 35.0±8.3 points [not interested]; P >.05).

Table 2 provides the percentage of patients who agreed with statements about possible positive benefits of TH. For all statements, interested patients reported a higher level of agreement that TH could improve mood, improve muscle strength, lower stress level and enable them to move about and perform self-care activities with less pain (all P <.001).

Pilot Experiment Component

A total of 9 patients (48 ± 14.7 years; 78% female) participated in the pilot experiment. A total of 44% reported using pain medication to manage their LBP. All participants reported having gardening experience and almost all performed gardening at home; however, none had TH experience. All participants also believed that gardening improves overall health and spine motion while reducing LBP. A majority (66%) believed gardening can provide pain relief.

Pre-TH Surveys and Physical Function

A group mean PMDQ score of 11 ± 6.7 points out of 24 indicated high impact of back pain on everyday functioning. The group mean PROMIS Score indicated lower physical and mental health among our participants compared with the general population (32.7±6.7 points, range 22-44 points), which typically averages around 50 points. The group mean TSK-11 score was 27.7 ±7.7 points out of 44 possible points (range 13-41 points). TSK Activity Avoidance scores were 14.6 ± 5.0 points (range 6-23 points) and for Somatic Focus were 12.4 ± 3.5 points (range 8 to 18 points).

Post-TH Surveys and Physical Function

Table 3 provides the physical function (spine motion, TUG) and NRS ratings for pain and anxiety. Improvements were detected from pre- to post-TH for some but not all measures. Moderate to large TH effects were found on NRS scores for anxiety (P =.017), back extension excursion (P =.003) and spine rotation to the left (P =.005). Patient Enjoyment Questionnaire scores (Table 4) show that on a 4-point scale, patients average enjoyment scores were 3.1 to 3.9 points for all 5 items (Found TH to be fun; Felt more relaxed after the activity; This kind of gardening activity can help with my back health; Would do more TH if given the chance; Enjoyed experiencing plants in a social setting with others who have similar back pain).

DISCUSSION

The first aim of this project was to determine if and which patients were interested in TH. As we hypothesized, some but not all patients, and more women, were interested in TH, but PROMIS Pain Interference and Physical function scores were not different based on TH interest. The second aim of the study was to quantify changes in back pain, functional tasks and anxiety upon completion of a TH session in a group of individuals with LBP. We detected changes in a few markers of physical function, including spine extension, and spine rotation movement and perceived anxiety after completion of the TH session. Effect sizes for these specific significant changes were moderate to large.

Cross-sectional study component

The majority of patients in the cross-sectional study component were not aware of TH, but 68% indicated interest in the therapy to manage LBP. Exploring the interest in and enjoyment of this therapy was performed in other studies with small samples of patients (n=16-22) with psychological diagnoses[42] and pre-frail and frail elders in nursing homes.[43] The context of TH deployment for other populations has largely focused on psychological outcomes and mental well-being in institutional settings with the elderly. In our study, we assessed the interest level of TH in patients receiving care for chronic LBP. Despite very different health conditions, the level of interest in our study is comparable with the high interest rates previously reported.[42] Aside from the "interested" group consisting of more women, there were no other distinguishing sociodemographic traits. Self-reported pain interference or physical function did not differ according to interest in TH. This is an important finding, in that women may be more receptive to trying TH as part of LBP management, independent of other individual characteristics or LBP history and perceived pain interference and functional status. An unexpected finding was that even among patients initially disinterested in TH, 71% to 88% agreed that TH might provide multiple health benefits (Table 2) These findings show that providers may have a large and unrealized opportunity to inform patients about this therapy option.

Directly comparable data of the benefits of TH on anxiety, musculoskeletal pain and physical function in the patient population with LBP are limited. However, a 6-month study comparing the benefits of TH to social activities on anxiety in adults age 61 to 77 years did not detect differences in this outcome[44]with 29 randomly assigned to the HT intervention and 30 to the waitlist control group. The participants attended weekly intervention sessions for the first 3 months and monthly sessions for the subsequent 3 months. Biological and psychosocial data were collected. Biomarkers included IL-1β, IL-6, sgp-130, CXCL12/SDF-1α, CCL-5/RANTES, BDNF (brain-derived neurotrophic factor; the weekly and monthly 1-hour instructor-led sessions involved a variety of activities from growing, maintaining, harvesting and cooking vegetables to guided walks in parks and flower pressing. These participants were not characterized by chronic pain, which may explain the lack of a significant effect on anxiety compared with our acute effects in people with LBP. One prospective study focused TH effects on various functional, health and physical activity outcomes in patients with cancer diagnoses.[21,45] The impact of master gardeners mentoring the planning, planting and maintaining of 3 seasonal gardens over the course of 1 year was examined in relation to a variety of outcomes; participants interfaced bimonthly with the gardeners and received materials for garden growing. After the intervention, participants' 2-minute step scores and TUG scores were improved by 39% and 13%, respectively, with no difference in perceived emotional well-being (waitlist controls improved 11% and 13%, respectively, in these functional scores).[21]

Using a different set of TH activities in our pilot session, we did not show a significant improvement in TUG test time despite moderate effect size, but we did find moderate improvement in spine extension and rotation. Wahnefred, et al.[45] found that cancer survivors participating in a home gardening intervention reported 15.5% lower physical pain scores, but no other significant changes in mental well-being. It is possible that the different diagnoses (cancer vs LBP) may have differentially affected anxiety responses. This study may have included active participants who had already been doing some gardening and the intensity of movement may not have been challenging enough to induce significant changes in some of the functional metrics or LBP severity. Alternatively, with additional sessions, higher dose exposure or additional lateral bending and flexion movements, TH may have induced improvements in function. Subsequent studies of TH frequency, dose and activities performed are needed to address this issue.

It is important to note that the herb bowl activity in the pilot session is only one of many TH options that can be designed for this population. TH can involve a variety of activities such as sensory stimulation, plant propagation and maintenance, plant art, garden design, garden bed production, harvesting and cooking, among other nature- and horticulture-related activities. Because growing plants has inherent meaning and purpose, participants may feel more motivated to participate in physical activity because it is enjoyable and involves social interaction.[46]older adults are vulnerable to physical deterioration and psychological problems. There is evidence that horticultural therapy (HT Based on the variable responses to the TSK-11, RMDQ and PROMIS Global Health 10, our participants were experiencing variable levels of kinesiophobia, back disability and health impacts from LBP. An important point to note is that all participants performed all herb bowl-related activities and no one experienced a worsening of LBP severity. There is the strong possibility, as with other interventions in chronic musculoskeletal pain, that there are "responders" and "non-responders" to this intervention. Thus, some participants may have responded more favorably to the herb bowl activity than others based on their disability perceptions and fear of movement.

STUDY Limitations and Strengths

There are limitations to this study that deserve comment. First, our cross-sectional survey component involved only 1 outpatient spine center and included only patients who agreed to complete the survey. We are unable to account for the interest level among patients who did not agree to participate, and therefore non-response bias may exist in these results. However, all consecutive patients were approached during the data collection period, and the respondents represented a wide age range, gender and ethnicity distribution, returning and new patients and socioeconomic profiles, which overall represented the composition of our institutional clinic. Second, in our pilot TH session, we did have a small sample size, but we were able to obtain effect sizes for powering subsequent interventions. Moreover, the pilot session involved 1 type of TH activity; while the activity was designed to encourage spine movement in all 3 planes, it is possible that future sessions could be comprised of movements requiring more spine exertion (reaching up and over, flexion and bilateral rotation). Future larger studies could use dose response approaches (single, multiple, long-term or periodic sessions), different TH activity types and involve participants from different geographic locations (rural, suburban, urban), while controlling for LBP history and psychological status.

CONCLUSIONS

Among patients treated for LBP in an outpatient spine clinic, there is considerable interest in TH to help manage pain, independent of current perceptions of pain interference and physical function. The pilot data suggests that acute TH was enjoyable and may confer benefits of reducing anxiety levels and improving spine motion.

Supplementary File 1. Horticultural survey provided to patients receiving care in the institutional outpatient spine care center.

Horticultural Therapy for Your Health: A Survey of Patient Interest

What is it? Horticulture is the art and science of growing plants. Horticultural therapy uses plants and gardening to improve bodies, minds and spirits by connecting with nature. A therapist that uses horticultural therapy helps others participate in plant-based activities to help reach specific goals, heal and rehabilitate. By helping to care for plants in a garden, science suggests that there are possible health benefits.

By completing this survey, you can help The Department of Physical Medicine and Rehabilitation find out how this therapy may serve our patients in the UF Health system. Thank you!

About You Survey #: _____

Your age: _____

I am	male	female	prefer not to answer	
Race	black/ African American	Asian	white/ Caucasian	Indian
	Pacific Islander	Alaskan	More than one	Other
Ethnicity	Hispanic	Not Hispanic		
Working status	working	retired	disabled	volunteer not working
Insurance status	Insured	Medicare	Medicaid	Not insured
Annual income	<$50,000	>$50,000		
Marital status	Married	Widowed	Single	
Living status	Lives with spouse/partner	Lives alone	Lives with family/ support	Other

Your Health

Do you currently suffer from joint pain? Yes No

If yes, where? Neck Spine Knee Hip Ankle/ foot Shoulder Elbow Wrist/ Hand

How many years have you suffered from joint pain? _____

Do you take medicines regularly for your pain? Yes No

How many pain medicines do you use on a regular basis? 0 1 2 3 or more

Do you use an assistive device? No Cane Walker Wheelchair/ scooter

Have you tried any of the following treatments for your pain or functional difficulties?

Physical therapy Acupuncture Meditation Massage

What physical activities do you do regularly?

Walking	Jogging	Dancing
Walking briskly or hiking	Bowling	Yoga
Yardwork	Kayaking/ canoeing	Team sports
Gardening	Cycling	Pickleball
Golf	Tennis	Lift weights, use weight machines

Other: _____

On average, how many times a week do you do some physical activity? _____

Does joint pain often stop you from participating in the physical activities you enjoy? Yes No

Horticultural Therapy

Have you heard of horticultural therapy before today? Yes No

Would you be interested in hearing more about this kind of therapy to help manage your pain or functional difficulties? Yes No

If yes, why might this therapy be interesting to you? *Check all that apply*

_____ I enjoy handling plants and being outdoors
_____ I believe that nature can have healing benefits
_____ It may be relaxing
_____ It may be a form of exercise I can tolerate
_____ I may feel a sense of accomplishment and purpose
_____ I might get to meet different people socially
_____ It might help my joints move more easily
_____ It might be fun

If no, why not? *Check all that apply*

_____ I am not interested in working with plants
_____ It would be messy and a lot of work to clean up
_____ It would be too hot outside
_____ I don't think this therapy would help my health issues
_____ I don't think I could do it based on my pain level or pain location on my body
_____ I don't think I could move around outside well with my assistive devices
_____ This activity would not give me the same benefits as regular physical therapy for my joint pain, strength or functional difficulties

Please rate your agreement in the following statements using the following answers, where 1 = "do not agree at all" and 5 = "strongly agree".

Horticultural therapy might:	1	2	3	4	5
Put me in a better mood	☐	☐	☐	☐	☐
Help me get stronger muscles	☐	☐	☐	☐	☐
Lower my stress level	☐	☐	☐	☐	☐
Help me move my body around with less joint pain	☐	☐	☐	☐	☐
Help me do my self-care activities with less pain (washing, dressing, brushing teeth, combing hair)	☐	☐	☐	☐	☐

If offered at UF, would you participate in horticultural therapy research to learn more about benefits to physical health and pain? Yes No

If offered at UF, would you participate in horticultural therapy as part of your health management plan? Yes No

Supplementary Table 1. Responses to Reasons for Interest and Disinterest in Therapeutic Horticulture to Manage Low Back Pain

I am interested in TH because:	**Interested**	**Not interested**	***P* value**
I enjoy handling plants and being outside.	86 (74.1)	3 (7.3)	<.001
I believe that nature can have healing benefits.	83 (71.5)	2 (4.9)	<.001
It may be relaxing	92 (49.3)	2 (4.9)	<.001
It may be a form of exercise I can tolerate.	76 (65.5)	0 (0.0)	<.001
I may feel a sense of accomplishment and purpose.	67 (57.7)	0 (0.0)	<.001
I might get to meet different people socially.	41 (35.3)	0 (0.0)	<.001
It might help my joints move more easily.	72 (62.1)	0 (0.0)	<.001
It might be fun.	81 (69.8)	0 (0.0)	<.001
I am not interested in TH because:	**Interested**	**Not interested**	***P* value**
I am not interested in working with plants.	0	16 (39)	<.001
It would be messy and a lot of work to clean up.	2 (1.7)	4 (9.7)	<.001
It would be too hot outside.	9 (7.7)	12 (29.3)	<.001
I don't think this therapy would help my health issues.	0 (0.0)	14 (34.1)	<.001
I don't think I could do it based on my pain level or pain location.	4 (3.4)	7 (17.7)	<.001
I don't think I could move around outside well with my assistive devices.	1 (0.8)	6 (14.6)	<.001
This activity would not give me the same benefits as regular physical therapy for my joint pain, strength or functional difficulties.	3 (2.6)	11 (26.8)	<.001

Note: Values are positive agreement answers and percentage of the group.

Abbreviations: NRS, 11-point Numerical Rating Scale for Pain and Anxiety

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