**Horticultural Therapy Types for Outdoor Rehabilitation Landscapes in Urban Comprehensive Hospitals: A Study Based on Patient Preferences and Needs**

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**Abstract**

As the healthcare system undergoes continuous optimization, comprehensive hospitals aim to transition from traditional medical models to more comfortable and effective alternatives. Horticultural therapy, an emerging auxiliary treatment method, offers benefits such as safety, comfort, economy, and effectiveness. However, research on horticultural therapy is mostly in preliminary stages, limited to theoretical and experimental phases, and not formally implemented in medical institutions globally. This study focuses on enhancing universality in comprehensive hospitals, integrating existing research on horticultural therapy, rehabilitation landscape, and related theoretical hypotheses. It addresses patient preferences and needs for various horticultural therapy types. Utilizing a mixed-methods approach involving field research and personal questionnaire interviews, the study explores the design adaptability of outdoor rehabilitation landscapes for horticultural therapy in urban comprehensive hospitals. Four comprehensive hospitals and five tertiary A-level hospitals in Chengde City, Hebei Province, China, underwent field research, with 359 respondents surveyed. Data analysis utilized SPSS 23.0 and Excel software tools. The study examines the relationship between patients' willingness to participate in horticultural therapy and specific therapy forms. Preferences in comprehensive hospitals rank as follows in correlation with overall participation willingness: sensory horticultural therapy, interactive horticultural therapy, and creative horticultural therapy. This research offers valuable insights for implementing horticultural therapy in comprehensive hospitals, fostering the development of therapeutic landscapes in healthcare facilities.

**Keywords**: Horticultural Therapy; Rehabilitation Landscape; General Hospital; Patient Preferences; Healthcare Optimization

**Introduction**

The global healthcare system is currently undergoing a continuous process of optimization and reform across various countries, with the primary goal of enhancing the quality, accessibility, and affordability of health services for the population. In line with this transformation, comprehensive hospitals, recognized as the principal providers of health care, actively seek to revamp their traditional medical models (Baum, Epstein, & Kelleher, 2013). Criticized for their fragmentation, inefficiency, and impersonal nature, these hospitals aim to transition into more comfortable and effective care environments (Fouad & Abdullah, 2021).

Amidst these changes, horticultural therapy emerges as a promising alternative—a concept defined as using plants and gardening activities to promote the physical, mental, and social well-being of individuals or groups. Extensive research has highlighted the manifold benefits of horticultural therapy, including stress reduction, mood enhancement, improved cognitive function, increased physical activity, and the facilitation of social interaction (Suchocka, Kosaka-Beck, & Niewiarowska, 2019). Moreover, horticultural therapy can potentially mitigate healthcare costs and enhance health outcomes, particularly for vulnerable populations such as the elderly, susceptible to chronic diseases and social isolation (Lin et al., 2021). Therefore, horticultural therapy is a promising and innovative approach that complements conventional medical treatment and improves healthcare quality in comprehensive hospitals.

Horticultural therapy has been widely practiced and studied in many countries, especially the United States, Europe, and Japan (Zhang, 2009). The existing literature covers various aspects of horticultural therapy, such as its definition, history, mechanisms, outcomes, and applications. However, there are still some gaps and challenges in the research and practice of horticultural therapy, especially in China. First, there needs to be more empirical studies on the effects and mechanisms of horticultural therapy for different patient groups and medical settings in China (Li, 2000). Second, there is a need for more design guidelines and strategies for creating outdoor rehabilitation landscapes that are suitable and adaptable for horticultural therapy in urban comprehensive hospitals (You et al., 2020). Third, there is a scarcity of qualified and registered horticultural therapists and standardized training programs in China, which limits the quality and accessibility of horticultural therapy services (Lin & Jin, 2009).

This study used the method of on-site observation and questionnaire survey to observe patients' actual behavior habits and needs in 5 general hospitals in Chengde City, Hebei Province. Chengde, one of China's most representative garden cities, has been strengthening regional public services and medical systems in recent years. The selected five general hospitals covered a wide range of patients in the central area of Chengde City and had a strong interest in horticulture therapy and certain early experience. The questionnaire framework was designed based on existing literature to explore the preferences and needs of different patient groups for horticultural therapy and their overall willingness to participate in horticultural therapy activities. Descriptive statistics, correlation analysis, and cluster analysis were used to examine the relationship between types of horticultural therapy and patient characteristics.

**Basic Characteristics and Needs of the Patient Population Bas**

The patients who come to the hospital for medical treatment are the main audience group for the hospital's outdoor rehabilitation landscape, and the construction of any kind of landscape should have special pertinence. Therefore, this study analyzed various characteristics and landscape needs of the patients who come to the hospital for medical treatment through the field counting method, field investigation method, and interview method in the PSPL investigation method.

**Patient population classification**

Patients who come to the hospital for medical treatment can be divided into different categories according to the purpose of medical treatment and their self-care ability, and the specific situation is shown in Table 1.

**Table 1** Patient population classification

|  |  |  |
| --- | --- | --- |
| **Classification** | **Type** | **Classification declaration** |
| Purpose of medical treatment | examination | Patients who come to see a doctor for medical examination. Such people stay in the hospital for a short time and need a beautiful, clean, and convenient medical environment. In addition, a rest space with a good view should be set up for such groups to stay while waiting for the test results. |
|  | physiotherapy | Patients who seek medical treatment for medical physiotherapy or rehabilitation training stay in the hospital for a slightly longer period, and some need to travel to and from the hospital for several consecutive days for healing activities. Providing quiet, comfortable, and private outdoor rehabilitation space for such patients is necessary. |
|  | hospitalization | A patient whose condition requires hospitalization. Such patients must live in the hospital for a long time, often in poor physical conditions, limited physical strength, a small range of outdoor activities, and even difficulty going outdoors. Need safe, comfortable, beautiful, close outdoor rest space. |
| Self-care ability | self-care | Patients who can complete daily activities alone without relying on the help of anyone or equipment have higher requirements for the interactive and interesting landscape. |
|  | assistance | Semi-disabled patients who need to be supported by others or who need to use instruments such as crutches, wheelchairs, and hearing AIDS to perform daily activities have higher requirements for the safety and accessibility of the landscape. |
|  | care | Patients with total disability who rely on others for all their daily activities, including physical disability and intellectual disability, have higher requirements for the safety and visibility of the landscape. |

**Physical and mental characteristics of patients**

The patient's physiological characteristics include declining sensory systems in all five senses, making them more sensitive to adverse stimuli. Their nervous and immune systems have also become fragile, resulting in higher susceptibility to stress, infection, and inflammation. Therefore, they have higher environmental requirements for comfort, safety, and hygiene.

In terms of the psychological characteristics of the patients, they often experience negative emotions such as anxiety, depression, anger, and loneliness, which affect their mood, cognition, and behavior. They also have lower self-esteem, self-efficacy, and social support, which reduce their coping ability and quality of life. Therefore, they need more psychological intervention and emotional support to enhance their mental well-being and resilience.

The patients' social characteristics include various challenges and difficulties in their interpersonal relationships, family roles, work responsibilities, and social participation. They may encounter stigma, discrimination, isolation, and conflict from others, which impair their social functioning and integration. Therefore, they seek social interaction and communication to improve their social skills and networks.

**Behavioral characteristics of the patient population**

**Types of Behavior**

Outdoor public space activities can be divided into three types: necessary, spontaneous, and social activities (Gehl, 1996). Corresponding to the patient groups who come for medical treatment, necessary activities are those that patients have to do regardless of the outdoor environment, such as registration, examination, medication, food, and shopping. Spontaneous activities occur only when people's wishes and all external conditions are suitable. For example, outdoor walking, meditation, sunbathing, and scenery viewing are key reference factors for evaluating the design quality of a public space. Social activities involve others, such as talking, chatting, greeting, or simply observing or listening to others as bystanders. Unlike the other two types of activities, social activities are developed from the previous two. When people perform necessary and spontaneous activities in the same space, even without a specific purpose, their encounters will lead them to start social activities.

**Behavioral Portrayal**

Whether patients are willing to undergo horticultural therapy in the outdoor rehabilitation landscape largely depends on whether the outdoor rehabilitation landscape space can meet the needs of the patients. Therefore, the study of the application of horticultural therapy in the outdoor rehabilitation landscape design of comprehensive hospitals must also start from the connection between patient behavior and their needs. The author visited several comprehensive hospitals in Chengde City, took pictures and recorded different activities of patient groups in outdoor spaces, analyzed the potential landscape needs behind these behaviors, and summarized them as follows:

① Visiting and Consulting

During the field visit, the author recorded that the most common behaviors in the hospital's outdoor environment were mainly necessary activities with strong purpose, such as registration, consultation, picking up patients, and visiting relatives. Among them, the behavior of registration and consultation had the highest frequency. Except for a few elderly people, children, or patients with serious conditions whom relatives and friends accompanied, most patients went to the hospital for medical examination alone. Patients are physically weak, and their sensory and cognitive abilities decline during illness, so they have higher requirements for the continuity, safety, and accessibility of the road in the hospital's outdoor environment.

  ② Walking and Exercising

Inpatients like to walk and exercise on the pebble trails in the hospital's outdoor green landscape or around the hospital building. The author found in the survey that patients with severe conditions or older age generally only activity in a small space adjacent to the hospital building and only choose to go to a farther space when accompanied by caregivers. Patients who walk around the building or go to a farther landscape space for activities are usually younger people with mild conditions. When asked why they were reluctant to leave the building and go to a distant place for activities, most patients said that they had limited physical strength and that some activity venues were not easy to reach. Too many vehicles were in the hospital, and the roads were uneven and unsafe. In addition, the key factors considered by the patients are the lack of rest points along the way to the activity venue, the uncomfortable seats at the rest points, the poor overall outdoor landscape quality of the hospital, and the lack of suitable activity spaces.

③ Sitting and Resting

While waiting for the order of medical treatment or the examination results, most patients will sit and rest or meditate near the hospital building to pass the time. At this time, patients usually sit and rest at the edge of the space junction with a good view because these positions are convenient for observing the surrounding situation. This gives patients a sense of security while satisfying people's social psychology of watching others.

④ Social Chatting

Social chatting between patients in the hospital's outdoor environment is usually fixed at the edge of the open space or the rest point in the semi-enclosed space according to the number of participants. Patients who participate in social activities in the open space can maintain a relaxed posture throughout and maintain a comfortable social distance without being cramped due to too many people. Positive and benign social activities can increase the attractiveness of the landscape space in reverse and increase the utilization rate of the hospital's outdoor rehabilitation landscape.

**Activity Time**

Through field observation and random interviews of several hospitals, it was found that the activities of patient groups in the hospital's outdoor environment were greatly affected by the season and weather, except for the examination-type patients whose activity time for visiting and consulting was almost unaffected by external environmental factors. Other patients will only choose to go to the outdoor landscape when the weather is clear, and the temperature is suitable. Generally speaking, the activity time of patient groups is from 8:30 to 11:30 in the morning. When the weather is warm, and the sun is strong in summer, the morning activity time is advanced by an hour on average. 15:00-18:00 in the afternoon is the peak period of activities. Most inpatients go outdoors for ventilation, chatting, and other social activities after a nap. In summer, when the sunset is late and the temperature is high, some patients with better physical conditions or fear of high temperatures will also go outdoors for digestion and walk from 18:30 to 20:30 after dinner. Attention should be paid to the lighting design and road continuity of the hospital's outdoor landscape for these patients.

**Spatial Distribution Characteristics**

① Fixedness

Different types of activities usually have their fixed activity spaces, such as visiting and consulting activities will be fixed at the medical point, social chatting activities are generally concentrated around the rest points in the outdoor spacious space, and walking and viewing activities are mostly fixed in the hospital's outdoor beautiful green space. If you want to meet the needs of patient groups for a certain type of activity, focus on improving the humanized design of the corresponding activity space.

② Edginess

When patients are active in a certain outdoor space, they prefer to choose the edge of the space, such as resting and chatting on both sides of the road, the edge of the flower bed, or the fence wall. These spaces have a good view and do not have to worry about hidden dangers that are not noticed, which can give people a sense of security while satisfying people's needs to observe the environment and pedestrians and enable patients who are active alone to indirectly engage in social activities.

③ Shelteredness

The field survey found that compared with completely open spaces, patient groups prefer to be close to the building and have sheltered porch gray spaces. As a transitional area between indoor and outdoor, this part of the space can make patients fully feel the outdoor environment that is different from the indoor and can also be as close as possible to the indoor, with the advantages of easy arrival and return at any time. Patients can get close to the indoor medical staff when they rest and chat in the porch gray space and observe the crowds coming and going, so this kind of space has a high utilization rate among various types of patient groups.

**Environmental needs of the patient population**

Based on the above analysis of the physiological and psychological characteristics of patient groups in general hospitals, combined with the observation and record of the behavior characteristics of patient groups' activities in the outdoor space of hospitals in field investigations and interviews, the factors of patient groups' demand for outdoor landscape environment in general hospitals are summarized in Table 2 based on relevant theoretical basis.

**Table 2** Keyword analysis of the environmental needs of the patient population

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Physiological feature | Sensory asthenia |  | Environmental demand factor | cyberinfrastructure |  | Environmental demand characteristics | safety |
| be in poor health | leisure facilities | recognizable |
| Decline in flexibility | Spatially identifiable | reachable |
| neurasthenia | Microclimate construction | comfort |
| decrease in immunity | Quiet isolation space | Confining |
| Mental profile | fear | high contact with the environment | dimensions |
| loneliness | social space | functionality |
| disability | Plant interaction | participation |
| impatient | private space | visibility |
| self-abasement | natural landscape | privacy |

Based on this, the study hypothesized that the patient groups in the comprehensive hospitals might differ in their acceptance of different forms of horticultural therapy.

Patient population preference for horticultural therapy

If the patient groups have different preferences for different horticultural therapy methods, blindly conducting horticultural therapy that the patients are not interested in or unwilling to participate in will inevitably fail to achieve the best adjuvant therapy effect. Therefore, the key to solving the problem is to analyze and select the best horticultural therapy form suitable for general hospitals in combination with the patients' real physical and mental state and preferences.

**Horticultural therapy form screening**

There are two main methods to determine the form factors of horticultural therapy. First, the author analyzes and summarizes the existing literature on the therapeutic effects of horticultural therapy and selects the form suitable for general hospitals from the mentioned times of various forms of horticultural therapy application as the preliminary reference for factor selection. As shown in some studies shown in Table 3, most studies on horticultural therapy-assisted therapy have chosen horticultural operation, flower arrangement, plant art production, natural landscape appreciation, and natural interaction, all of which are hands-on and have certain ornamental or artistic application forms. The second method is to conduct field research in selected general hospitals, as mentioned above, to understand the current situation of the outdoor space environment in various aspects, and then use the user behavior observation method and interview method to extract the factors of patients' demand for space environment from their physiological, psychological and behavioral characteristics, and select the appropriate form factors of horticultural therapy according to the current environment. Finally, the common horticultural therapy morphological elements that were most frequently applied or mentioned in the first two steps were communicated with several experts, and the communication results were used as the basis for the third screening of horticultural therapy morphological elements.

**Table 3** A partial literature review of horticultural therapy form factors and locations

|  |  |  |  |
| --- | --- | --- | --- |
| **Primary resources** | **Form** | **Massive Developer** | **Massive Developer** |
| Effects of painting combined with horticultural therapy on clinical symptoms and HAMD score in patients with depression.  (in Chinese) | Painting, handicraft making, indoor and outdoor planting | Depression  Patient | Rongfu Soldiers Second Hospital of Shaanxi Province |
| Effects of horticultural therapy on glucose and lipid metabolism, physical dysfunction and mental state in patients with cerebral infarction. (in Chinese) | Ornamental plants, horticultural operation, achievements display, flower arrangement and micro landscape making, fruit and vegetable picking, salad making. | Cerebral infarction  patient | The second Affiliated Hospital of Nanyang Medical College |
| The relieving effect of different indoor gardening activities on the negative emotions of the elderly. (in Chinese) | Grow succulent plant combinations and flower arrangements. | The aged | Beijing Qinghe Nursing Home |
| Study on the influence of gardening course based on "five senses" stimulation on negative psychology of hemodialysis patients.  (in Chinese) | Landscape interaction: Make seed stickers, smell flowers, and taste fruit salad. | Landscape interaction,  make seed stickers, smell flowers, make  and taste fruit salad | Ningbo a  third-class  A hospital |
| Evaluation of rehabilitation effectiveness of horticultural therapy on mentally disabled people in the community.  (in Chinese) | Plant growing, landscape painting, making embossed and dried flowers, growing succulents | Patients with intellectual disabilities  or mental disabilities | Nanjing Gulou district Phoenix Nursing Center |
| Nursing effect of horticultural therapy combined with exercise nursing intervention in elderly patients with depression and its influence on agitated behavior. (in Chinese) | Horticultural operation, flower arrangement, and plant specimen preparation | Elderly  depressed  patients | Wuhan Wudong Hospital |
| **Table 3** (Continued) |  |  |  |
| **Primary resources** | **Form** | **Massive Developer** | **Massive Developer** |
| Analysis of the effect of comprehensive intervention with landscape convalescence in diabetes rehabilitation treatment. (in Chinese) | Nature tour | Diabetic | Strategic support Force Xingcheng special service recuperation center |
| Application status and popularization of horticultural therapy  in college students.  (in Chinese) | The gardening operation, making plant micro landscapes, making and tasting plant food materials, smelling plant fragrance, and  making sachet,  flower arrangement,  and dried flower production, natural landscape interaction | Undergraduate | Baoding City University |
| Study on the psychological state of advanced skin cancer patients with psychological nursing combined with horticultural therapy.  (in Chinese) | Gardening,  plant preparation,  and flower arrangement | Advanced skin cancer patients | Henan Provincial People's Hospital |
| Application of horticultural therapy in rehabilitation of upper limb hand function.  (in Chinese) | Horticultural  operation | Patients with nervous system damage | Zhengzhou Cigarette Factory Rehabilitation Hospital |

According to the theory of planned behavior, people's behavior is controlled by their behavioral intention, which means that patients' willingness to adopt horticultural therapy as an adjunctive treatment during medical treatment is inevitably influenced by their attitude and perceived behavioral control toward the selected form of horticultural therapy. Therefore, based on the above research, this paper identifies five latent variables and 13 observed variables. The first-level latent variable categories are "operational horticultural therapy," "fruit and vegetable edible horticultural therapy," "artistic horticultural therapy," "scenic horticultural therapy," and "herbal aromatic horticultural therapy." The patients' experience intention of horticultural therapy is used as the dependent variable, and the analytical framework of this paper is constructed to study the influence of different types of horticultural therapy factors on the preference intention of patients in comprehensive hospitals to choose horticultural therapy as an adjunctive treatment. The specific research model analytical framework is shown in Figure 1.

**Fig. 1** A framework for the analysis of horticultural therapy preference and willingness of patients in general hospitals

**Questionnaire design and distribution**

This questionnaire consists of three parts: the patients' personal situation, their preference level for different forms of horticultural therapy, and their subjective reasons for refusing to try horticultural therapy as an adjunctive treatment.

The first part of the questionnaire investigates the personal social attributes of the patients, including five variables: gender, age, education level, care situation, and physical condition during illness.

The second part is a Likert scale questionnaire that measures the patients' preference and acceptance of horticultural therapy, involving 13 factors. Each question has five options, ranging from 1 to 5, indicating "very unwilling," "unwilling," "no feeling," "somewhat willing," and "very willing," respectively. The higher the score, the higher the preference level of the patients.

The third part is a multiple-choice question that collects information only from patients who have a participation intention of less than 4 points for horticultural therapy. It is intended as a feedback reference for improving the form factors of horticultural therapy.

Normally, the sample size should be five times the estimated variables in the research model. Still, if the data collected by the survey shows skewness, kurtosis, or other non-normal distributions, or if there is some missing data, the sample size should be much larger than five times the number of variables. The number of variables in a research model should not exceed 20, and the number of latent variables should not exceed 6 (Bentler et al., 1987). The number of latent variables designed in this study is 6, and the total number of variables is 19, within a reasonable range. Based on the research theory, the author set the sample size of this survey questionnaire between 190 and 380.

I conducted field research on five campuses of four selected tertiary hospitals from mid-April to early June 2021. The research time was chosen in late spring and early summer, which is suitable for outdoor activities. Considering that some patients with mild symptoms who needed examination or physiotherapy would concentrate on visiting the hospital on rest days and that hospitalized patients were more likely to engage in outdoor activities during the visits of their relatives and friends on rest days, this research was mostly carried out on rest days and the days before and after. The questionnaire survey was conducted by randomly interviewing patients in the hospital. Based on the analysis of the behavioral characteristics of the patients observed in the preliminary field research, the questionnaire survey was conducted between 7:30 a.m. and 8:30 p.m., when the patients who engaged in outdoor activities were more concentrated. The research sites were selected from the selected hospitals' outdoor spaces and indoor-outdoor transition areas, including the entrance and exit spaces, waiting and resting places, main traffic routes, and shaded leisure spaces. The questionnaires were distributed according to the proportion of patients in each hospital's outdoor space, and 380 questionnaires were randomly distributed. The final number of valid questionnaires collected was 359, with a recovery rate of 94.47%.

**Descriptive statistics**

Table 4 shows the overall personal social attributes of the 359 respondents obtained from the questionnaire survey. The distribution of the individual social attributes of the respondents involved in this questionnaire survey is consistent with the current situation of the patients in the outdoor space of the comprehensive hospital obtained from the field research, which meets the research requirements.

**Table 4** Statistical table of personal social attributes of patients surveyed.

|  |  |  |  |
| --- | --- | --- | --- |
| **Project** | **Classification** | **Frequency** | **Proportion** |
| Gender | Female | 206 | 57.38% |
| Male | 153 | 42.62% |
| Age | Under 18 years old | 7 | 1.95% |
| 18-44 years old | 97 | 27.02% |
| 45-65 years old | 234 | 65.18% |
| Over 65 years old | 21 | 5.85% |
| Schooling | Junior high school or below | 42 | 11.70% |
| High school/technical secondary school | 72 | 20.06% |
| Bachelor/College | 231 | 64.34% |
| Master’s degree or above | 14 | 3.90% |
| Care received | Cannot | 16 | 4.46% |
| Occasionally | 150 | 41.78% |
| Always | 193 | 53.76% |
| Physical condition | It was so bad that he had to stay indoors | 14 | 3.90% |
| Needs improvement. We do not leave the house unless we have to | 22 | 6.13% |
| Generally, a moderate number of outdoor activities can be carried out | 71 | 19.78% |
| Not bad, can accept regular outdoor activities | 189 | 52.65% |
| Good. Hope to promote recovery through outdoor activities | 63 | 17.55% |

There are also significant differences in the overall preference of patients among the latent variables. As shown in Table 5, the overall preference of patients for the first-level category factors is ranked from high to low as follows: scenic horticultural therapy (4.35) > herbal aromatic horticultural therapy (4.01) > fruit and vegetable edible horticultural therapy (3.76) > operational horticultural therapy (3.46) > artistic horticultural therapy (3.18). Moreover, the variance and standard deviation of the internal observation variables of the scenic horticultural therapy, which has the highest overall preference, are also at the lowest level compared to the overall. The variance and standard deviation of the three observation variables are all less than 1, which indicates that patients' preferences for this latent variable do not fluctuate much overall. Scenic the patient group generally welcomes scenic horticultural therapy in comprehensive hospitals. On the other hand, the variance and standard deviation of the internal observation variables of the artistic horticultural therapy, which has the lowest overall preference, are also at the highest level compared to the overall, which means that there is a large difference in the overall preference of patients for this latent variable, and whether to accept horticultural therapy in the form of flower arrangement, landscape painting, and handicraft making varies from person to person. Artistic horticultural therapy is unsuitable for indiscriminate promotion and application among the patient group in comprehensive hospitals.

**Table 5** Descriptive statistics of preference for various forms of horticultural therapy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Latent variable** | **Observational variable** | **Mean value** | **Standard deviation** | **Variance** | **Dimensional mean** | **Dimensional ranking** |
| Operational horticultural therapy | X1 Planting and curing | 3.61 | 1.2112 | 1.467 | 3.46 | 4 |
| X2 Planting and curing | 3.30 | 1.2653 | 1.601 |  |  |
| Fruit and vegetable edible horticultural therapy | X3 Planting and curing | 4.12 | 1.071 | 1.147 | 3.76 | 3 |
| X4 Mushroom picking | 3.73 | 1.2622 | 1.593 |  |  |
| X5 Dish cooking | 3.38 | 1.2734 | 1.621 |  |  |
| Artistic horticultural therapy | X6 Make lower arrangement bonsai | 3.40 | 1.303 | 1.698 | 3.18 | 5 |
| X7 Make plant crafts | 3.13 | 1.3267 | 1.76 |  |  |
| X8 Landscape painting | 3.00 | 1.3485 | 1.818 |  |  |
| Landscaped horticultural therapy | X9 Landscape painting | 4.28 | 0.9974 | 0.995 | 4.35 | 1 |
| X10 Open water feature | 4.44 | 0.8564 | 0.733 |  |  |
| X11 Flower Sea landscape | 4.32 | 0.9776 | 0.956 |  |  |
| Landscaped horticultural therapy | X12 Meditate in fragrant plants | 4.19 | 1.0603 | 1.124 | 4.01 | 2 |
| X13 Aromatherapy essential oil massage | 3.83 | 1.2902 | 1.665 |  |  |

**Reliability and validity analysis**

The second part of the questionnaire's data was subjected to reliability verification to test its reliability. As shown in Table 6, the total scale Cronbach's alpha coefficient of this questionnaire was 0.916, indicating that its overall reliability was excellent, and the research results were credible.

**Table 6** Total table reliability test

|  |  |
| --- | --- |
| **Cronbach's alpha** | **Klonbach Alpha based on standardized terms** |
| 0.916 | 0.92 |

The data of each part of the questionnaire were analyzed for reliability separately, and the results showed that the questionnaire data had good reliability in the four dimensions of operational horticultural therapy, fruit and vegetable edible horticultural therapy, artistic horticultural therapy, and scenic horticultural therapy, with Cronbach’s alpha coefficients all greater than 0.7. The Cronbach’s alpha coefficient of the herbal aromatic horticultural therapy dimension was relatively low, but it was between 0.6 and 0.7, and the reliability was acceptable. This proves that the internal reliability of the questionnaire was ideal, and the overall reliability of the questionnaire was good.

**Table 7** Reliability test of subscales

|  |  |  |
| --- | --- | --- |
| **Latent variable** | **Observational variable** | **Cronbach's alpha** |
| Operational horticultural therapy | X1-X2 | 0.826 |
| Fruit and vegetable edible horticultural therapy | X3-X5 | 0.765 |
| Artistic horticultural therapy | X6-X8 | 0.893 |
| Landscaped horticultural therapy | X9-X11 | 0.883 |
| Herbal aromatic horticultural therapy | X12-X13 | 0.656 |

The validity test results of the total amount table are shown in Table 8, and the KMO value is 0.884, which proves that this questionnaire's validity is relatively ideal. At the same time, the significance Sig of the Bartlett sphericity test was 0.000, which was much lower than the standard significance level of 0.05, further proving that the scale was suitable for factor analysis.

**Table 8** Total table KMO and Bartlett test

|  |  |  |
| --- | --- | --- |
| KMO sample appropriateness measure |  | 0.884 |
| Bartlett sphericity test | Approximate chi-square | 3090.023 |
|  | degree of freedom | 78 |
|  | significance | 0.000 |

**Factor analysis**

Table 9 shows the exploratory factor analysis results of this study. Three common factors were finally extracted from the 13 observed variables in this scale, and their contribution rates were 26.279%, 24.564%, and 20.866%, respectively. The total contribution rate of common factors with an eigenvalue greater than 1 was 71.709%, indicating the three extracted factors' good explanatory ability.

**Table 9** Total variance interpretation

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Initial eigenvalue** | | | **Extract the sum of**  **squared loads** | | | **Rotating load sum**  **of squares** | | |
| Ingredien**t** | aggregate | variance percentage | accumulation% | aggregate | variance percentage | accumulation% | aggregate | variance percentage | accumulation% |
| 1 | 6.387 | 49.131 | 49.131 | 6.387 | 49.131 | 49.131 | 3.416 | 26.279 | 26.279 |
| 2 | 1.751 | 13.468 | 62.598 | 1.751 | 13.468 | 62.598 | 3.193 | 24.564 | 50.843 |
| 3 | 1.184 | 9.11 | 71.709 | 1.184 | 9.11 | 71.709 | 2.713 | 20.866 | 71.709 |
| 4 | 0.701 | 5.394 | 77.103 |  |  |  |  |  |  |
| 5 | 0.657 | 5.051 | 82.154 |  |  |  |  |  |  |
| 6 | 0.528 | 4.059 | 86.213 |  |  |  |  |  |  |
| 7 | 0.435 | 3.345 | 89.558 |  |  |  |  |  |  |
| 8 | 0.3 | 2.308 | 91.867 |  |  |  |  |  |  |
| 9 | 0.276 | 2.125 | 93.991 |  |  |  |  |  |  |
| 10 | 0.251 | 1.934 | 95.926 |  |  |  |  |  |  |
| 11 | 0.204 | 1.571 | 97.496 |  |  |  |  |  |  |
| 12 | 0.172 | 1.321 | 98.817 |  |  |  |  |  |  |
| 13 | 0.154 | 1.183 | 100 |  |  |  |  |  |  |

Orthogonal rotation was performed on the variance interpretation results of each observed variable. The rotation converged after 6 iterations, and the resulting component matrix is shown in Table 10.

**Table 10** The composition matrix after rotation

|  |  |  |  |
| --- | --- | --- | --- |
| **Observational variable** | **Ingredient** | | |
| **1** | **2** | **3** |
| X1 Observational variable | 0.205 | 0.259 | **0.825** |
| X2 Thin the seedlings and change the POTS | 0.073 | 0.346 | **0.747** |
| X3 Fruit and vegetable picking | 0.497 | 0.18 | **0.662** |
| X4 Mushroom picking | 0.337 | 0.173 | **0.704** |
| X5 Dish cooking | 0.228 | **0.695** | 0.304 |
| X6 Make flower arrangement bonsai | 0.159 | **0.811** | 0.293 |
| X7 Make plant crafts | 0.17 | **0.872** | 0.233 |
| X8 Landscape painting | 0.139 | **0.831** | 0.194 |
| X9 scarce forest and grassland landscape | **0.772** | 0.093 | 0.317 |
| X10 Open water feature | **0.843** | 0.088 | 0.294 |
| X11 Flower Sea landscape | **0.827** | 0.2 | 0.221 |
| X12 Meditate in fragrant plants | **0.781** | 0.27 | 0.161 |
| X13 Aromatherapy essential oil massage | **0.531** | 0.473 | -0.093 |

The actual relationship between the latent factors and the observed variables had some errors compared to the questionnaire's original hypothesis, but the observed variables still fit the original hypothesis overall. The final data analysis results showed that all the observed variables were reclassified and renamed for the three latent factors. Factor 1 was named "sensory horticultural therapy," factor 2 was named "creative horticultural therapy," and factor 3 was named "interactive horticultural therapy."

The results of confirmatory factor analysis are shown in Table 11. The combined reliability of the three potential factors is all above 0.8, and the average variance extracted is all greater than the test standard of 0.5. Therefore, it can be proved that there is a high degree of correlation between the potential factors and their corresponding observed variables, and the three explored potential factors all have good convergence validity. It can be determined that the current potential factors and their range of variables are reasonable and valid.

**Table 11** Combination reliability and mean-variance extraction analysis

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Latent Factor** | **Observational**  **variable** | **Observational**  **variable** | **CR** | **AVE** |
| Sensory  horticultural  therapy | X9 Scarce Forest and grassland landscape | 0.772 | 0.869 | 0.576 |
| X10 Open water feature | 0.843 |
| X11 Flower Sea landscape | 0.827 |
| X12 Meditate in fragrant plants | 0.781 |
| X13 Aromatherapy essential oil massage | 0.531 |
| Creative  gardening  therapy | X5 Dish cooking | 0.695 | 0.880 | 0.648 |
| X6 Make flower arrangement bonsai | 0.811 |
| X7 Make plant crafts | 0.872 |
| X8 Landscape painting | 0.831 |
| Interactive horticultural  therapy | X1 Planting and curing | 0.825 | 0.825 | 0.543 |
| X2 Thin the seedlings and change the POTS | 0.747 |
| X3 Fruit and vegetable picking | 0.662 |
|  | X4 Mushroom picking | 0.704 |

**Correlation analysis**

To explore the relationship between the three forms of horticultural therapy factors and the overall willingness of patients in comprehensive hospitals to participate in horticultural therapy, a correlation analysis was conducted between sensory horticultural therapy, creative horticultural therapy, and interactive horticultural therapy and the willingness to participate in horticultural therapy, respectively. The results are shown in Table 12.

**Table 12** Correlation analysis between willingness to horticultural therapy and form factors

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Factor** | **Willingness to engage in horticultural therapy** | **Sensory horticultural therapy** | **Sensory**  **horticultural**  **therapy** | **Interactive horticultural**  **Therapy** |
| Willingness to engage in horticultural therapy | 1 | — | — | — |
| Sensory horticultural therapy | 0.707\*\* | 1 | — | — |
| Sensory horticultural therapy | 0.450\*\* | 0.504\*\* | 1 | — |
| Interactive horticultural therapy | 0.544\*\* | 0.579\*\* | 0.574\*\* | 1 |
| \*\*. At level 0.01 (two-tailed), the correlation was significant. | | | | |

The P values of the three groups of factors all reached a significant correlation of 0.01. This proves that the three forms of horticultural therapy factors are positively correlated with the willingness to participate in horticultural therapy, and sensory horticultural treatment has a strong correlation with the patient’s willingness to participate in horticultural therapy, which should be given priority in the design process.

**Discussion**

After investigating the effects of three types of horticultural therapy on the willingness of general hospital patients to participate in such activities, the results of the study showed that:

Sensory horticultural therapy had the strongest positive correlation with patient participation willingness, indicating that patients affected by physical conditions and pain preferred passive sensory stimulation over active involvement. Among the five senses, visual stimulation with expansive views was the most preferred, as shown by the high correlation coefficients of flower sea landscapes (0.605) and open water landscapes (0.601). According to our reluctance survey, patient fatigue (38.46%) was the main factor that reduced the willingness to participate in other types of activities. Therefore, planners should prioritize the environmental needs of sensory horticultural therapy when designing outdoor rehabilitation landscapes, emphasizing open spaces and diverse sensory elements.

Interactive horticultural therapy had the second-highest positive correlation with patient participation willingness, implying that patients favored interactive activities with quick and substantial achievements. The correlation was stronger when the achievements were edible, such as fruit and vegetable picking (0.598), indirectly affirming the patient group's preference for horticultural therapy with sensory stimulation. In contrast, mountain treasure collection (0.403) had a lower impact than planting and maintenance (0.449) due to its higher physical demand and the inedibility of the harvested wild vegetables and mushrooms. Recognizing the overall acceptance of interactive horticultural therapy, landscape designers should consider its environmental space needs as a focal point, ensuring optimal balance and design quality.

Creative horticultural therapy had a generally low positive correlation with patient participation willingness, but this does not mean it was unsuitable for comprehensive hospital patient groups. The stronger associations with art indicated influences from personal talents and interests. The independence of creative horticultural therapy from the outdoor environment in specific processes may have contributed to a weaker inclination of the interested group toward outdoor activities. Therefore, in shaping outdoor rehabilitation landscapes, the spatial considerations for creative horticultural therapy should be auxiliary, addressing the specific needs of individuals inclined toward such activities in terms of space form, and distance.

**Conclusion**

Our investigation delved into the diverse forms of horticultural therapy, examining their correlation with patients' willingness to engage in these activities within comprehensive hospitals. The findings revealed a robust positive correlation, with sensory horticultural therapy emerging as the most favored, followed by interactive and creative horticultural therapy. While the latter exhibited a smaller correlation, the notable preference divergence among patient groups underscored the need for a nuanced approach.

The ranking of horticultural therapy types by their correlation with patient willingness is as follows: sensory horticultural therapy > interactive horticultural therapy > creative horticultural therapy. The inference from loadings on observed variables suggests a patient preference for forms with less physical activity and lower technical difficulty. Specifically, patients preferred sensory treatment with a comprehensive view, rich sensory stimulation, and interactive therapy that provided quick, tangible achievements, especially when reflected in edible ingredients.

However, this study also had some limitations and shortcomings due to the subjectivity and bias of the researcher's understanding and analysis of the objective phenomena and the proposed viewpoints, as well as the restriction of the researcher's scientific research ability. Therefore, further research is needed to supplement and improve the study. The main limitations and suggestions for future research are as follows:

Sample Size and Seasonal Constraints: The study's limited sample size and seasonal focus in late spring and early summer restrict its generalizability. Future research should encompass larger, more diverse samples and explore year-round patient behavior.

Subjectivity and Data Collection Challenges: The inherent subjectivity in patient preferences and the limitation of not basing preferences on real experiences underscore the need for future studies to incorporate firsthand experiences and employ more objective data collection methods.

Patient Group Representation: The exclusion of critical care and introverted patients in the data collection process raises concerns about representation. Future studies should aim for a more comprehensive representation of patient groups.

Form Factor Applicability: Certain selected horticultural therapy factors may have limited applicability in comprehensive hospital settings due to site-specific requirements. Future research should explore a broader array of therapy forms with greater applicability.

**New knowledge from research**

This study significantly contributes to the knowledge of horticultural therapy within comprehensive hospital settings by unraveling novel insights into patient preferences and willingness across various therapy forms. It delves into the intricate interplay of physical condition, pain, fatigue, sensory stimulation, achievement, and personal interest, elucidating their impact on therapeutic engagement. The research underscores the importance of these nuanced preferences. It proposes a holistic design approach for outdoor rehabilitation landscapes that can cater to the unique environmental needs of sensory, interactive, and creative horticultural therapy.

The study advocates for key considerations in shaping outdoor rehabilitation landscapes in comprehensive hospitals, each tailored to the specific characteristics of horticultural therapy types:

Prioritizing Sensory Horticultural Therapy: Planners and designers are urged to prioritize the environmental needs of sensory horticultural therapy, emphasizing expansive open spaces and diverse sensory elements. This recommendation stems from the therapy's strongest positive correlation with patient participation willingness, suggesting that a thoughtfully designed environment enhances the therapeutic benefits derived from sensory experiences.

Focusing on Interactive Horticultural Therapy: The environmental space requirements of interactive horticultural therapy should be a focal point, emphasizing achieving an optimal balance and design quality. Given its second-highest positive correlation with patient participation willingness and its potential to exercise patients' muscle strength and limb flexibility while eliciting positive emotions, designers are encouraged to plan spaces intricately catering to interactive horticultural activities.

Addressing Creative Horticultural Therapy as an Auxiliary Factor: Despite having a generally low positive correlation with patient participation willingness, Creative horticultural therapy appeals to individuals with a stronger association with art. Designers are advised to consider spatial needs as an auxiliary factor, tailoring the environment to the specific requirements of patients inclined towards creative horticultural activities in terms of space form and distance.

In essence, this research deepens our understanding of patient preferences. It offers actionable insights for planners, designers, and healthcare professionals, fostering a more tailored and effective integration of horticultural therapy into comprehensive hospital settings.

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