Complementary Therapies in Medicine 37 (2018) 29–36

Contents lists available at ScienceDirect

Complementary Therapies in Medicine

journal homepage: www.elsevier.com/locate/ctim

Developing evaluation scales for horticultural therapy

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ARTICLE INFO

Keywords:
Complementary and alternative medicine
Consumer horticulture
Gardening
Socio horticulture

ABSTRACT

Objectives: This study developed evaluation scales for measuring the effects of horticultural therapy in practical settings.
Design: Qualitative and quantitative research, including three preliminary studies and a main study, were conducted.
Setting: In the first study, a total of 779 horticultural therapists answered an open-end questionnaire based on 58 items about elements of occupational therapy and seven factors about singularity of horticultural therapy. In the second study, 20 horticultural therapists participated in in-depth interviews. In the third study, a Delphi method was conducted with 24 horticultural therapists to build a model of assessment indexes and ensure the validity. In the final study, the reserve scales were tested by 121 horticultural therapists in their practical settings for 1045 clients, to verify their reliability and validity.
Main outcome measures: Preliminary questions in the effects area of horticultural therapy were developed in the first study, and validity for the components in the second study. In the third study, an expert Delphi survey was conducted as part of content validity verification of the preliminary tool of horticultural therapy for physical, cognitive, psychological-emotional, and social areas. In the final study, the evaluation tool, which verified the construct, convergence, discriminant, and predictive validity and reliability test, was used to finalise the evaluation tool.
Results: The effects of horticultural therapy were classified as four different aspects, namely, physical, cognitive, psycho-emotional, and social, based on previous studies on the effects of horticultural therapy. 98 questions in the four aspects were selected as reserve scales. The reliability of each scale was calculated as 0.982 in physical, 0.980 in cognitive, 0.965 in psycho-emotional, and 0.972 in social aspects based on the Cronbach's test of intra-item internal consistency and half reliability of Spearman-Brown.
Conclusions: This study was the first to demonstrate validity and reliability by simultaneously developing four measures of horticultural therapy effectiveness, namely, physical, cognitive, psychological-emotional, and social, both locally and externally. It is especially worthwhile in that it can be applied in common to people.

1. Introduction

Horticultural therapy is a complementary and alternative medicine that is a professional treatment provided by trained professionals, by using horticultural activities with plants in an intervention pre-designed with therapeutic goals and objectives to improve or recover health conditions.[1–3] Toward this end, horticultural therapy, attempts a holistic approach that integrates physical, cognitive, psycho-emotional, and social factors; this is also its salient feature.[2–4] The status of horticultural therapy as a professional practice can be established by implementing a rational treatment program based on clinical diagnosis of the subject, by scientific means and methods, and having an evaluation system for its performance. Appropriate assessment systems not only help in validating the effectiveness of the treatment but also contribute to the systematisation of related disciplines.[5]

Assessing the effectiveness of horticultural therapy also means measuring its performance in achieving the specific goals set within the general purpose category, as mentioned above. The assessment of goal achievement is an assessment of the degree of direct impact on a person to be treated, to determine how much the subject has changed or to what extent he or she has achieved an outcome.[5,6] In the meantime, it can be considered that the horticultural therapy field has a tendency to evaluate the effect of the therapeutic activity in the form of such goal achievement evaluation.[6]

A review article on horticultural activity intervention and outcomes presented that 509 studies published before April 2014 have measured

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https://doi.org/10.1016/j.ctim.2018.01.008
Received 2 December 2017; Received in revised form 16 January 2018; Accepted 16 January 2018

specific health conditions in the physical, psychological, cognitive, social, and educational aspects using various surveys or measurement tools.[4] However, as these evaluations have computed the factors to be measured by the researchers as effective variables, the effectiveness of horticultural therapies has not been analysed comprehensively, but rather only by a few variables. Moreover, most of the 503 evaluation tools used so far in horticultural therapy studies were the self-esteem, depression, and geriatric depression scales that developed in an adjacent discipline.[5] Moreover, it is not easy to guarantee the effectiveness of treatment according to the goal realisation, because it has been calculated by a questionnaire survey answered by the clients with problems, such as mental disorder, development disorder, intellectual disorder, frail elderly, elderly with dementia, and stroke patients.[7]

Several evaluation tools have been designed to evaluate the performance of horticultural therapy. For example, a horticultural therapy evaluation form was developed by Oseas.[8] Horticultural therapy group activity treatment procedure was developed by the New York Medical Center; and a horticultural task skill inventory was developed by the Korean Horticultural Therapy and Well-being Association. However, these tools are limited in that the development process is not rigorous and the procedures for verifying the validity and reliability of evaluation tools basically required in tool development are not fulfilled.[7] Therefore, the available evaluation work, which has been the focus of previous evaluations on the effect of the fragmentary aspect for the effectiveness of the horticultural therapy, contains many limitations in that it cannot show the multi-faceted effect of horticultural therapy properly. Thus, the existing evaluation trends of the effectiveness of horticultural therapy and the problems with the tools suggest the need for alternative assessment tools. Alternative assessment tools must reflect appropriately the characteristics of horticultural therapy, and must be able to measure the effects of the therapists as experts as a whole. Above all, the evaluation tools have been developed through rigorous verification procedures for the requirements similar to test tools.

Accordingly, this study aims to develop a new evaluation tool that can measure the effectiveness of horticultural therapy to meet this need. The evaluation tool developed in this study may provide guidance to horticultural therapists in setting treatment plans for individual subjects.

2. Materials & methods

2.1. Study procedure

To develop evaluation scales for horticultural therapy, a qualitative and quantitative research, including three preliminary studies and a main study, were conducted.

Preliminary questions were developed in the first study, and validity for the components in the second study. In the third study, an expert Delphi survey was conducted as part of content validity verification of the preliminary tool. In the final study, the evaluation tool, which verified the construct, convergence, discriminant, and predictive validity and reliability test, was used to finalise the evaluation tool.

2.1.1. Study 1: developing the preliminary questions

Firstly, for the preparation of the preliminary questions, 55 items in the effects area of horticultural therapy were selected through the literature reviews of a meta-analysis study of horticultural therapy[9] and expert recognition of clinical sites.[10] In addition, 55 treatment items presented in occupational therapy and items of seven factors related to the unique characteristics of horticultural therapy[6,11] were based on the survey that was developed in this study.

The survey questionnaire for developing preliminary questions were mailed or e-mailed to 779 Korean horticultural therapists who obtained a horticultural therapy certification from the Korean Horticultural Therapy and Well-being Association in February 2009. Finally, 258 (33.1%) responses were obtained. The major reason for the missing responses was address change and indifference. Of the collected responses, 220 were used in the data analysis, except for those lacking answers.

The gender composition of the respondents reflects the fact that 85% of horticultural therapists in South Korea are women. Age was distributed evenly across the 20s – 50s. The collected data were analysed, and the therapeutic effect evaluation area was divided into physical, cognitive, psychological-emotional, and social domains. The physical domain contained 91 items; the cognitive domain, 55 items; the psychological-emotional domain, 86 items, and social domain, 78 items. A total of 310 items were selected as preliminary questions.

2.1.2. Study 2: validity for the components

As a follow-up procedure for the preliminary questions in the first study, in-depth interviews were conducted with 20 horticultural therapists in June 2009. Among the participants, 75% were female; 45% obtained a doctoral degree that is related to the field; and more than half had more than 10 years of experience. The validation process of evaluation tool components was completed by an open coding method of grounded theory proposed by Strauss and Corbin.[12] The grounded theory method was selected given that there are no standardised therapeutic tools in Korea and elsewhere, the therapists working in the clinical field must be aware of their interaction with the subject and understand the meanings that may occur in the future. The analysis revealed 89 concepts in four categories, namely, physical, cognitive, psycho-emotional, and social, with 17 subcategories.

2.1.3. Study 3: content validity verification of the preliminary tool by Delphi survey

In the third study, the validity of the content was verified using the expert group, horticultural therapists consensus Delphi method.[7] The subjects were 24 horticultural therapists (average 9 years of clinical career for horticultural therapy) who conducted a Delphi survey over three rounds, through e-mail, in August 2009. Detail information for the study 3 was in the published paper by Im et al.[7] The results of the third Delphi survey were used to finalise the content structure of the preliminary scales with 98 items.

2.1.4. Study 4: verification of the construct, convergence, discriminant, and predictive validity and reliability test of the evaluation tool

2.1.4.1. Study subject. This survey verified the validity and reliability of the model of the structured scale through the preliminary survey, and finalised the evaluation tool. A total of 1045 students were sampled randomly among the those who participated in clinical activities across South Korea.

2.1.4.2. Assessment tool. The evaluation tools of physical, cognitive, psychological-emotional, and social areas were applied in this study. They were validated by the expert Delphi survey,[7] which was the final stage of the preliminary survey. The response form of the test was composed of a five-point Likert-type scale, which has been used widely to reflect the individual differences in the respondents' response.[13] The instruments consisted of 'very bad (1 point), slightly worse (2 points), normal (3 points), slightly better (4 points), and very good (5 points)'. A higher total score in each evaluation tool indicates better condition of the subject. The negative emotions (e.g., depression, anger, shrinking, fear, etc.) of the psychological-emotional tools (Table 9) that contain negative contents, unlike the other items, showed that a low score suggested better condition of the subject, and the reaction of the subjects was based on this.

2.1.4.3. Data collection. The horticultural therapists, who conducted the program throughout the country and a mail survey, collected the data used in this study. The data collection period is from October 2009 to January 2010. Of the total 1200 questionnaires that were sent out, 1098 copies were collected, showing a recovery rate of 91.5%. Of the

Table 1
Demographic characteristics of the subjects (N = 1045).

Item	Classification	N	%
Gender	Male	419	40.1
	Female	626	59.9
Age range (year)	Under 8	46	4.4
	8–19	261	27.9
	20's	54	5.4
	30's	86	8.4
	40's	87	8.5
	50's	76	7.4
	60's	76	7.4
	70's	157	14.8
	80's	135	12.8
	90's	36	3.6
Physical disability	Stroke	61	5.9
	Cerebral palsy	35	3.4
	Limb disability	26	2.5
	Visual disability	16	1.5
	Speech/hearing disability	3	0.3
	Terminal cancer patient	35	3.4
	Long-term care recipient	14	1.4
Mental disability	Intellectual disorder	187	17.9
	Schizophrenia	82	7.8
	Developmental disorder	53	5.1
	Depression disorder	16	1.5
	Manic disorder	5	0.5
	Other disorders	27	2.6
Emotional/other disability	Dementia	10	3.8
	Attention deficit hyperactivity disorder	15	3.6
	Emotional disorder	8	4.3

total questionnaires collected, 1045 were used, and 53 were exempted as they contained many ambiguous or missing items.

2.1.4.4. Data analysis. The data were analysed using SPSS, SAS and AMOS statistical programs. Using SPSS, the basic technical statistics for each question, and the cause and kurtosis were calculated. To verify the convergence and discriminant validity, the correlation between four scales and sub-factors were analysed. To verify the construct validity, AMOS was used to calculate the fitness index of the model. SAS was used to validate the predictive validity by performing discriminant analysis. The reliability of each scale was verified by calculating Spearman-Brown's half reliability and Cronbach's value, indicating an internal consistency between items using SPSS. Statistical significance of all statistics was obtained at $p < 0.05$ level.

3. Results and discussion

3.1. Demographic characteristics

As shown in Table 1, 40.1% and 59.9% of the participants were males and females, respectively, with an age range from 8 to 90 years. A number of the subjects had physical disabilities (18.4%), mental disorders (35.4%), specifically schizophrenia (22.2%), and other disabilities (25.6%). Others had no disability (20.6%) and had intellectual disabilities (50.5%). Table 2 presents the distribution of the 121 horticultural therapists and subjects who applied the horticultural therapy program to these subjects.

3.2. Validity verification

3.2.1. Item goodness degree

To confirm whether the measure of the individual items of each scale, which were confirmed by the content validity test, supports the goodness and the discrimination of the item, technical statistics, such as mean, standard deviation, skewness, and kurtosis were derived. Items that required revision and re-evaluation were the following: those with a kurtosis and a degree of variable of 2.0 or less and −2.0 or less; those with an average of 2.0 or less and 4.5 or more; and those with a standard deviation of 1.0 or less. The items with the item response rate of more than 50% and the item-sub-scale correlation of less than 0.3 were considered as low-discrimination items, and thus, were removed.[14–16]

The results of the analysis confirmed that all items in the four evaluation tools were less than 2.0, the standard deviation was less than 1, and none of the items in which the observed distribution was concentrated in the degree of kurtosis. In addition, the four sub-scales ranged from 0.834 to 0.958 in the item-sub-scale correlation, item-total scale correlation, and inter-scale correlation analysis.

3.2.2. Construct validity

A confirmatory factor analysis (CFA) was performed on the models of each scale to determine the goodness of fit. To verify the fit of the model, the $\chi 2$ test, which is commonly used, could be rejected easily even if the model were too small, because the content of the hypothesis is too strict, and the same model could be rejected or adopted according to the sample size. Instead, the root mean square residual (minimum value of discrepancy function C; CMIN/df) and the absolute fit index, which represent the overall fit of the model, root mean square residual (RMR), root mean square error of approximation (RMSEA), and goodness-of-fit index (GFI) were employed. Moreover, the Tucker-Lewis index (TLI), the comparative fit index (CFI), the normed fit index (NFI), and the adjusted goodness-of-fit index (AGFI) were used to determine the fit of the model.[17] The CMIN/df values are regarded as appropriate up to about 5.0; however, in this study, it was more strictly less than 3.0. The absolute fitness index, RMSEA, was developed to correct the limits of the $\chi 2$ statistic,[18] indicating a perfect fit when close to zero, a 'good' fit when less than 0.05, a 'normal' fit when between 0.08 and 0.1, and the undesirability of the model to be adopted when greater than 0.1. In this study, RMSEA was based on 0.05 or less with 90% confidence interval, and RMR, on 0.05 or less. Although the values of TLI, CFI, and NFI were distributed between 0 and 1,[19,20] the criterion of 0.9 or more, which is a strict criterion, was applied in this study. The CFA revealed that the fitness index showed good overall fitness (Table 3).

3.2.3. Convergence and discriminant validity

To clarify the convergence and discrimination with other scales, by analysing the relationship with other scales or variables measuring similar concepts, a correlation test between four scales and their subscales was conducted. The functional areas to be evaluated could be regarded as interrelated or separated in the process of treatment.[5]

Because the physical function area is highly correlated with the cortex of the cerebrum, it will be highly correlated with the cognitive function area that enables work activity, and the cognitive function area can be used to solve problems and communicate with others. This may be expected to highly correlate with emotional or social functional areas.[21] However, it can be expected that the physical domains, which intensify or maintain the undamaged remaining regions, are less correlated with the psycho-emotional and social ones, and thus the two have a somewhat lower correlation.

The four scales and each sub-scale were found to have a significant positive correlation with each other ($p = 0.00$). Among these, the physical scales showed a high correlation with the cognitive scale (0.65), whereas the psycho-emotional and social scales showed a relatively low static correlation of 0.44 and 0.42, respectively. Meanwhile, the cognitive and the psycho-emotional scales were 0.65; the cognitive and the social scales were 0.71; and the psycho-emotional and the social scales were 0.79; the correlation was relatively high (Table 4). In summing up the above analysis results, it can be judged that the four scales of this study proved to be convergent and distinguishable.

3.2.4. Predictability

The validity of the predictive validity was determined by discriminant analysis, which classifies each group as a reference variable. The group was divided into three groups, namely, with physical

Table 2
Distribution of therapists, agency type, and client's disability by region.

Distribution by region	Therapist		Agency type[a]						Client's disability[b]				
	1st grade	2nd grade	A	B	C	D	E	Total	F	G	H	I	Total
Gyeonggido	21	24	112	109	119	51	23	414	70	117	98	129	414
Seoul	24	7	85	106	44	4	3	242	33	81	88	40	242
Jeollado	1	4		9	13	16		38	9	18	7	4	38
Gyeongsangdo	4	14		86	5	80		171	54	83	17	17	171
Chungcheongdo		7		32		38		70	10	33	16	11	70
Gangwondo	2	7	5	28	11		8	52	15	14	9	14	52
Jejudo		6		12	35	11		58	2	24	32		58
Total	52	69	202	382	227	200	34	1045	194	372	270	219	1045

[a] A, Education institute; B, Approved welfare centres; C, Residential care institution; D, Health care centres; E, Others.
[b] F, Physical disability; G, Mental disability; H, Emotional and other disability; I, Non-disability.

disability, with mental disorder, and without disability, based on the type of subjects who were mainly applied to horticultural therapy clinical trials for about 20 years, from 1990 to 2009, and classified the persons with disabilities as mild and severe. In addition, among the people with disabilities, horticultural therapy classifies the most frequent stroke, intellectual disability, schizophrenia, and dementia according to the type of disability, and classifies the subjects without disability into groups by age group, such as infant/child, adolescent, adults, and elderly. In the classification A of Table 5, the probability of discriminating the subjects with physical disability as one was 64.77%; the mental disorder was 51.65%; and the non-mental disorder was 58.14%, when the whole subjects were classified into three groups, such as disability, mental disorder, and non-disorder (Table 5). Thus, when the total subjects were divided into three groups, the predictive probability was 58%, indicating that the predictive validity was high (Table 5).

3.2.5. *Reliability verification*

For the four rating scales, the reliability test was based on the Cronbach's test of intra-item internal consistency and the half reliability of Spearman-Brown (Table 6). Although half reliability can be divided into several ways when dividing the test in half, the criterion is that it is divided into only one, and that the reliability coefficient is higher the longer the test length is. However, Spearman-Brown's half reliability is presented along with Cronbach's because it uses a calibrated function to compensate for this.[22] Although there is no established recommended criterion for reliability coefficient, a confidence coefficient of 0.5 or more is considered satisfactory as a credibility grant for developing a scale, but 0.7 is used generally.[23,24] Cronbach's coefficient of internal consistency between finalised items was 0.982 on the physical scale, 0.980 on the cognitive scale, 0.965 on the psycho-emotional scale, and 0.972 on the social scale. According to Spearman-Brown formula, the half reliability was 0.939 in physical, 0.935 in cognitive, 0.764 in psycho-emotional, and 0.934 in social. The reliability coefficient of all scales is high at 0.07 or more (Table 6).

Finally, the physical scale is a measure for evaluating the degree of smoothness of various physical activities performed once or repeatedly, including strength, flexibility, hand function, mobility-balance sense, and sensory-perception function. It was composed of five scales and 27 items (Table 7). The cognitive scale is a measure of cognitive ability, such as discriminating, judging, and inferring things or situations. It consists of 25 questions and five sub-scales, namely, orientation, memory, concentration, creativity, and coping ability (Table 8). The psycho-emotional scale divides the psycho-emotional aspects of a given situation into positive and negative emotions. The positive emotional scale consists of 13 items, and the negative emotional scale, 11 items (Table 9). The social scale measures the characteristics of behaviours that occur while interacting with others, consisting of 22 questions and four sub-scales of communication, interpersonal relationships, participation, and care (Table 10). The scope of the evaluation is evaluated as very poor (1), slightly poor (2), moderate (3), slightly good (4), and very good (5) on a five-point scale for each question. For the four scales, 1045 respondents were asked to rate the quadrants as 'high' (4.0 or higher) and 'low' (2.0 or lower) on a five-point scale.

In conclusion, the physical, cognitive, psycho-emotional, and social evaluation tools, which are reliably based on the theoretical concept of horticultural therapy, were developed in this study. This attempt provides an opportunity for an in-depth approach in terms of establishing the basic framework of horticultural therapy, to clarify the problems of measuring the effectiveness of horticultural therapy and overcome the limitations. The four evaluation tools developed in this study were formulated through strict research and analysis methods and procedures, and have proven validity and reliability. These tools were developed as integrated surveys that can be applied to all age groups, from childhood to old age, and to all types of subjects, both with and without disability. These tools can serve as instruments to produce objective data, for clinical judgement, and to pave the way for the evaluation of the effectiveness of horticultural therapy in the medical field. In addition, these scales provide a system of accumulating data on the effectiveness of horticultural therapy. As the effects of horticultural

Table 3
Statistics of model fit indices and the results of confirmatory factor analysis of each scale for verification of construct validity.

Scale[a]	X^2	*df*	CMIN/*df*[b]	*P*	RMSEA[c]		RMR[d]	GFI	AGFI	CFI	TLI	NFI
					LO90	HI90						
PS	648.15	223	2.90	0.000	0.03	0.04	0.03	0.95	0.92	0.98	0.98	0.98
CS	609.94	209	2.91	0.000	0.03	0.04	0.03	0.95	0.93	0.98	0.98	0.98
PES	501.84	188	2.66	0.000	0.03	0.04	0.03	0.96	0.93	0.98	0.98	0.98
SS	392.11	140	2.80	0.000	0.03	0.04	0.03	0.96	0.94	0.99	0.98	0.98

[a] PS: Physical scale, CS: Cognitive scale, PES: Psycho-emotional scale, SS: Social scale.
[b] Minimum value of discrepancy function Chi-squre test statistic/*df*.
[c] Root-mean square error of approximation.
[d] RMR: Root mean square residual, GFI: Goodness-of-fit-index, AGFI: Adjusted goodness-of-fit index, CFI: Comparative fit index, TLI: Tucker-Lewis index, NFI: Normed fit index.

Table 4
Correlation coefficient of each combination between physical, cognitive, psycho-emotional, and social scales, and their respective sub-scales for verification of convergent and discriminant validities.

Scales		HTEI[a]				PS					CS					PES		SS			
		PS[b]	CS	PES	SS	MS	FL	HF	MSB	SPF	OR	ME	AS	CR	PHC	PE	NE	CO	PR	PA	CGA
		1.00																			
	CS	0.65[c,**]	1.00																		
	PES	0.44**	0.65**	1.00																	
	SS	0.42**	0.71**	0.79**	1.00																
PS	MS	0.93**	0.61**	0.43**	0.39**	1.00															
	FL	0.96**	0.57**	0.39**	0.37**	0.90**	1.00														
	HF	0.95**	0.63**	0.42**	0.37**	0.86**	0.89**	1.00													
	MSB	0.84**	0.42**	0.24**	0.24**	0.72**	0.81**	0.73**	1.00												
	SPF	0.84**	0.67**	0.45**	0.46**	0.68**	0.71**	0.73**	0.65**	1.00											
CS	OR	0.65**	0.84**	0.51**	0.56**	0.58**	0.58**	0.59**	0.49**	0.69**	1.00										
	ME	0.56**	0.89**	0.54**	0.60**	0.52**	0.47**	0.54**	0.35**	0.60**	0.81**	1.00									
	AS	0.64**	0.93**	0.60**	0.66**	0.61**	0.57**	0.62**	0.44**	0.63**	0.73**	0.78**	1.00								
	CR	0.59**	0.93**	0.58**	0.64**	0.55**	0.51**	0.59**	0.36**	0.62**	0.71**	0.77**	0.86**	1.00							
	PHC	0.57**	0.95**	0.67**	0.73**	0.55**	0.50**	0.55**	0.35**	0.59**	0.69**	0.77**	0.87**	0.86**	1.00						
PES	PE	0.48**	0.66**	0.91**	0.81**	0.46**	0.42**	0.43**	0.27**	0.43**	0.49**	0.55**	0.62**	0.59**	0.69**	1.00					
	NE	0.32**	0.48**	0.87**	0.58**	0.30**	0.28**	0.30**	0.15**	0.36**	0.40**	0.39**	0.44**	0.43**	0.49**	0.58**	1.00				
SS	CO	0.36**	0.59**	0.68**	0.83**	0.34**	0.31**	0.33**	0.18**	0.39**	0.46**	0.52**	0.54**	0.54**	0.59**	0.71**	0.48**	1.00			
	PR	0.40**	0.67**	0.74**	0.96**	0.38**	0.36**	0.34**	0.24**	0.43**	0.52**	0.56**	0.62**	0.61**	0.68**	0.75**	0.54**	0.74**	1.00		
	PA	0.40**	0.68**	0.72**	0.90**	0.38**	0.36**	0.37**	0.25**	0.43**	0.55**	0.57**	0.64**	0.58**	0.70**	0.72**	0.55**	0.66**	0.81**	1.00	
	CGA	0.35**	0.64**	0.72**	0.92**	0.33**	0.32**	0.31**	0.20**	0.39**	0.49**	0.54**	0.60**	0.58**	0.66**	0.74**	0.53**	0.65**	0.87**	0.81**	1.00

[a] HTEI: Horticultural therapy evaluation indices: physical, cognitive, psycho-emotional, and social realms. PS: Physical scale, CS: Cognitive scale, PES: Psycho-emotional scale, SS: Social scale.
[b] MS: Muscle strength, FL: Flexibility, HF: Hands function, MSB: Mobility/sense of balance, SPF: Sense/perception function, OR: Orientation, ME: Memory, AS: Attention span, CR: Creativity, PHC: Problem handling capacity, PE: Positive emotions, NE: Negative emotions, CO: Communication, PR: Personal relations, PA: Participation, CGA: Care giving attitude.
[c] Correlation coefficient.
** Significant at $p = 0.01$ by Pearson correlation.

Table 5
Levels of prediction calculated by four categories and their respective subgroups.

Category and group[a]		N[b]	Predicted group			
A			Physical disability	Mental disability		Non-disability
	Physical disability	193	125(64.77%)[c]	20(10.36%)		48(24.87%)
	Mental disability	637	120(18.84%)	329(51.65%)		188(29.51%)
	Non-disability	215	49(22.79%)	41(19.07%)		125(58.14%)
	Error count estimates		41.82%			
B			Stroke	Intellectual disability	Schizophrenia	Dementia
	Stroke	96	73(76.04%)	3(3.13%)	9(9.38%)	11(11.46%)
	Intellectual disability	204	14(6.86%)	117(57.35%)	35(17.16%)	38(18.63%)
	Schizophrenia	114	16(14.04%)	30(26.32%)	60(52.63%)	8(7.02%)
	Dementia	233	49(21.03%)	52(22.32%)	34(14.59%)	98(42.06%)
	Error count estimates		42.98%			
C			Infant/child	Teenager	Adult	Elderly
	Infant/child	93	34(36.56%)	12(12.90%)	32(34.41%)	15(16.13%)
	Teenager	40	5(12.50%)	25(62.50%)	5(12.50%)	5(12.50%)
	Adult	37	1(2.70%)	4(10.81%)	30(81.08%)	2(5.41%)
	Elderly	45	5(11.11%)	5(11.11%)	7(15.56%)	28(62.22%)
	Error count estimates		39.41%			
D			Mild disability		Severe disability	
	Mild disability	316	208(65.82%)		108(34.18%)	
	Severe disability	403	171(42.43%)		232(57.57%)	
	Error count estimates		38.3%			

[a] Category A is composed of the whole subjects that are divided into three groups: those with physical disability; those with psychological disability; and those without disability; Category B is composed of those subjects who have stroke, and with intellectual disability, schizophrenia, and dementia; Category C is composed of four age groups of subjects without disability: infants and children, teenagers, adults, and the elderly; Category D is composed of two groups of subjects with disability who are distinguished by their severity, i.e., mild and severe ones.
[b] The numbers in column 'N' means number of corresponding cases.
[c] The percentage in parentheses means the probability of prediction of each combination.

therapy on various types of subjects can be measured widely and precisely, a systematic management of the records of measurement results can be used in academic and clinical fields as valuable data for evaluating the effectiveness of horticultural therapy.

The limitations of this study must be considered. First, it focused on common issues applicable to all subjects, revealing the basic concepts, characteristics, and principles of horticultural therapy, thereby not treating them individually. Therefore, it is inconvenient to use a separate evaluation tool corresponding to the clinical characteristics of a subject or a horticultural therapy program having a specific purpose in parallel. Second, it emphasised on broadly covering all the factors that can be considered in the treatment process; there was a problem that the contents of the detailed components of the scale were somewhat inclusive or abstract. Therefore, it is expected that therapists must use

Table 6
Reliability levels of physical, cognitive, psycho-emotional, and social scales, and their sub-scales.

Scale[a]	Sub-scale	Inter-item consistency		Split-half reliability			
		N of items	Cronbach's alpha	Correlation between split half	Spearman brown	part 1	part 2
PS	Muscle strength	5[b]	0.96[c]	0.90[d]	0.95[e]	0.94[f]	0.93[g]
	Flexibility	6	0.96	0.93	0.96	0.95	0.92
	Hand function	7	0.96	0.88	0.94	0.95	0.93
	Mobility/sense of balance	3	0.87	0.83	0.91	0.74	1.00
	Sense/perception function	7	0.95	0.88	0.94	0.90	0.95
Total		27	0.98	0.88	0.94	0.98	0.96
CS	Orientation	4	0.96	0.93	0.96	0.90	0.91
	Memory	4	0.95	0.88	0.94	0.89	0.94
	Attention span	4	0.93	0.83	0.91	0.89	0.89
	Creativity	4	0.93	0.83	0.91	0.87	0.91
	Problem handling capacity	9	0.96	0.85	0.92	0.95	0.90
Total		25	0.98	0.88	0.94	0.97	0.97
PES	Positive emotions	13	0.96	0.88	0.93	0.94	0.93
	Negative emotions	11	0.96	0.88	0.94	0.93	0.93
Total		24	0.97	0.62	0.76	0.96	0.96
SS	Communication	5	0.90	0.71	0.83	0.85	0.90
	Personal relations	7	0.94	0.90	0.94	0.89	0.89
	Participation	5	0.93	0.78	0.88	0.92	0.85
	Care giving attitude	5	0.95	0.88	0.94	0.93	0.89
Total		22	0.97	0.88	0.93	0.94	0.96

[a] PS: Physical scale, CS: Cognitive scale, PES: Psycho-emotional scale, SS: Social scale.
[b] Number of items of each scale and sub-scale.
[c] Cronbach's alpha value based on standardized values of items.
[d] Correlation coefficient between the first and second split halves of items.
[e] Spearman-Brown coefficient (equal-length).
[f] Cronbach's alpha value of the first half items.
[g] Cronbach's alpha value of the second half items.

Table 7
27 items on physical scale and its five sub-scales: muscular strength, flexibility, hands function, mobility-sense of balance, and sensory perception function.

Items	Guideline
Muscle strength	
(1) Lifting	Being able to vertically lift object
(2) Cutting	Being able to cut even thick branches by using tools
(3) Pressing	Being able to fix or support something by pressing the object (ie. planting)
(4) Watering	Using tool [hose (large), water strainer (middle), sprinkling water (small)] to water
(5) Moving	Being able to moving object to the required place by using material or tool
Flexibility	
(6) Stretching arms	Being able to stretch arms to place or grab an object in any direction
(7) Holding & pulling	Folding arms to bring material and tools back to one's seat
(8) Bending upper body	Bending body by bending neck or back
(9) Turning body	Being able to work by turning body right and left while bending back (i.e. handing over material or tools)
(10) Putting in	Putting in/placing in: Being able to easily use tools (spoons, chopsticks, or cups) or with hands to put or place something in
(11) Local muscle Coordination	Using both hands easily for tasks (Rolling/Bending/Weaving/Winding)
Hands function	
(12) Grasping	Grabbing material and tools with fingers without making mistake
(13) Holding	Being able to use wrist when gripping materials and tools
(14) Sticking in	Capacity to stick or attach flowers in materials such as floral foams (or others)
(15) Hand dexterity (use of both hands)	Moving hands swiftly for a set activity
(16) Hand dexterity (use of one hand)	
(17) Eyes-hands correspondence (use of both hands)	Using eyes and hands in coordination to operate object
(18) Eyes-hands correspondence (use of one hand)	
Mobility/Sense of balance	
(19) Walking	Being able to walk alone without aids on level ground (or climb stairs)
(20) Sitting	Being able to sit for 30 min during the program
(21) Balancing	Being able to maintain balance when walking, standing, or squatting down
Sensory/perception function	
(22) Sense of sight	Capacity to discern color, size, shape and etc with eyes
(23) Sense of hearing	Listening, perceiving and reacting to various sounds produced when working such as sounds of water, cutting, bristling, hitting, winding, etc.
(24) Sense of smell	Sensing and reacting to the fragrance exposed to the client such as the smell of flowers and plants
(25) Sense of touch	Discerning feeling of objects, recognizing the characteristics of the material such as size, temperature, shape and material through fingertips or part of body touching the object
(26) Sense of pain	Capacity to feel pain when being wounded or shocked by object
(27) Sense of weight	Capacity to discern light and heavy weight

Table 8
25 items on cognitive scale and its five sub-scales: orientation, memory, attention span, creativity, and handing capacity.

Items	Guideline
Orientation	
(1) Space recognition	Capacity to recognize where the activity is taking place
(2) Time recognition	Capacity to recognize current date and time
(3) Person recognition	Capacity to discern people around oneself
(4) Sense of season	Capacity to feel the sense of season through flowers and plants (fruits & vegetable)
Memory	
(5) Instant memory (15–20 s.)	Capacity to remember and execute the instructions of the therapist (15 ~ 20 s)
(6) Short term memory (6 months)	Capacity to remember activities of the last therapy session (up to 6 months)
(7) Anecdote memory	Personal history or experience of life (memories of flowers or past memories)
(8) Meaning memory	General knowledge shared by people (language or social norm)
Attention span	
(9) Ability for continuing	Ability to continue once started until completed
(10) Ability for choose	Ability to continue find objects with the same color or the needed objects
(11) Ability for specialization	Ability to do more than two tasks at once (cutting by holding scissors with one hand and the material with the other)
(12) Ability for distinction	Ability to discern size and characteristics of object and adjust it according to the circumstance
Creativity	
(13) Imitative expression	Ability to follow example or demonstration for a work
(14) Creative expression	Capacity to express work in a unique way
(15) Calculation capacity	Capacity to count objects as needed and making adjustments (i.e. adjusting number of pumping water or seeds to be planted)
(16) Knowledge cumulation	Accumulation of knowledge learned through horticultural activity (i.e. plant name, use of tool, cultivation method, application to daily life, etc.
Problem handling capacity	
(17) Task performance	Capacity to conduct complicated activities
(18) Comprehension	Understanding of the order of work and instructions
(19) Object arrangement	Distinguishing the foreground and background, and knowing the spatial relations, perceiving depth and having spatial location sense when arranging various materials such as plants and flowers
(20) Judgement	Capacity to modify, rearrange, and restore working circumstances
(21) Attention	Being attentive to task activity and focusing on work
(22) Observation	Being able to listen to and follow the instruction of the therapist given to another person or copy what someone else is doing
(23) Self-control	Being able to listen to and follow the instruction of the therapist Being able to proper reaction to emotions and appropriate coping behavior
(24) Cautiousness	Being able to deal with plants or use tools precisely without mistakes
(25) Hygiene	Maintaining good hygiene by washing hands and etc after completing activitying able to deal with plants or use tools precisely without mistakes

Table 9
24 items on psycho-emotional scale and its two sub-scales: positive and negative emotions.

Items	Guideline
Positive Emotions	
(1) Pride	Trusting oneself and expressing the feeling of being proud
(2) Sense of stability	Overall stable and comfortable
(3) Sense of satisfaction	Being satisfied of the given situation
(4) Sense of achievement	Showing positive reaction regarding one's own activity (work)
(5) Relaxation	Not being sensitive and enjoying the given situation
(6) Interest	Expressing expectation and curiosity regarding activity (the next session/today)
(7) Pleasure	Enjoying horticultural activity itself and cheerfully being involved (smiling and laughing)
(8) Easiness	Making others laugh or have fun through works, movements, expressions, etc.
(9) Patience	Enduring and making efforts even if the work is hard or unsatisfactory
(10) Absorption	Actively being involved in all activities
(11) Hope	Expressing positive expectations regarding the outcome of the horticultural activity
(12) Impression	Being satisfied of the work made through the horticultural activity
(13) Coping with stress	Suppressing aggressive reaction or anger (i.e.; cutting, pressing, winding, sticking, horticultural activity)
Negative Emotions	
(14) Depression	Showing reactions of depression such as silence, smiling and loss of motivation, etc.
(15) Anger	Showing reactions of showing dissatisfaction, animosity to others, or intentionally damaging objects
(16) Anxiety	Showing unstable behavior such as becoming distracted, anxious, fidgety, psychomotor agitation or leaving the designated place
(17) Shrinking	Showing lack of self-confidence and guilt over one's mistake
(18) Isolation	Tend not to associate with others and stay apart
(19) Fear	Showing anxiety and fear regarding an object or situation
(20) Frustration	Not able to engage in activity and losing oneself and resorting to self-resignation
(21) Despair	Expressing negative expectations regarding the future (Negative regarding the next session and taking care of plants)
(22) Worry	Not being able to do anything alone without help from the therapist or others
(23) Rejection	Rejecting to do task activity or the approach of others
(24) Resignation	Thinking that the objective is unattainable because of loss of self-confidence

Table 10
22 items on social scale and its four sub-scales: communication, personal relations, participation, and care giving attitude.

Items	Guideline
Communication	
(1) Intimacy	Using means such as physical contact to express intimacy
(2) Eye-contact	Eye contact to communicate with others
(3) Attentive hearing	Actively listening to the instruction, emphasis, repetition, regulation, caution of the therapist and being interested in the words and behaviors of other people
(4) Question/answer	Asking questions during activity or giving appropriate answer to the therapist's question
(5) Self-expression	Expressing verbally and non-verbally one's opinion, feeling, emotion, experiences and etc appropriately for each situation
Personal relations	
(6) Sharing	Using common tools with other people
(7) Mutual help	Helping others in difficult tasks during activity
(8) Concession	Lending or yielding left over material or tools that one is not using to another person
(9) Self-assertion	Capacity to express one' opinion (hope, rejection, demand) when necessary while working
(10) Responsibility	Being responsible of a given activity to the end
(11) Understanding	Respecting other people's reaction and demand and accomodating the other person
(12) Sociability	Being able to strike a conversation with others, make friends and have good interpersonal relationship
Participation	
(13) Role performance	Executing the role endowed in a given situation faithfully
(14) Observance of the rules	Not becoming distracted and following the set rules during an activity
(15) Cooperation	Agreeing to the objective of the activity and cooperating with others for this end
(16) Punctuality	Keeping time well
(17) Readiness and arrangement	Agreeing to the object cooperating in preparation before the activity and cleaning after the activity
Care giving attitude	
(18) Consideration	Understanding the differences of oneself with others, and being able to consider the position of the other person
(19) Respect for life	Expressing preciousness of life
(20) Sharing	Making efforts to share possession with others
(21) Adaptation	Getting along in the circumstance and showing appropriate reaction
(22) Accepting	Understanding the difference between oneself and others, being able to accept the other person's situation as is (i.e. plant and human, person with disabilities, man and woman, children and adult)

the guidelines that explain the meaning of each item and the intention of the setting to secure the validity of each item. In future studies, it is expected that the therapeutic effect will be maximised by developing practical tools more appropriate for individual subjects based on this tool.

Acknowledgement

This article was supported by the KU Research Professor Program of Konkuk University.

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