Influences of Horticultural Therapy and Functional Recovery Training at a Day-Care Center for the Elderly and Text Mining of Care Records by AI

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Abstract

Background: In Japan, due to the COVID-19 pandemic, various behavioral restrictions were implemented from March 2020, resulting in an increased number of elderly people with reduced participation in care and rehabilitation. As a result, the decline in motor and cognitive functions became more pronounced. **Purpose:** The study examined how activities combining passive horticultural therapy, which is always introduced, with active functional recovery training, which is used in the functional recovery training of patients with hemiplegia, influence the behavior of elder people using the facility. **Methods:** 36 elder people with care need 1 or 2 who regularly used the day-care facilities after the pandemic ended and who agreed to participate in the study was included. The assessment data were every three months from December 2021 to December 2023 after the COVID-19 pandemic, the MMSE and Moca-J, TMIG-Index, and GDS15. AI-based text mining was used to compare changes in visit reports before and after the introduction of the Posture Chart and Red Code, and the relationship between the language used. **Results:** The results of MMSE and Moca-J were both significantly higher in Group B and C than in Group A. TMIG assessment, was significantly higher in Group B and C than in Group A, and Group C was significantly higher than Group B. The GDS, an assessment of depression in old age, tended to be significantly higher in Group A than in Groups B and C. In the "Co-Occurrence Network Analysis" shown after the introduction of the latest functional recovery training equipment such as the Red Cord, its results showed a high association between the words Bathing and CARE and words such as POSTURE, Red-Code,

and AI, App, which are used in functional training and rehabilitation, and their analysis. **Conclusion:** At day-care facilities specializing in functional recovery training and rehabilitation, a combination of horticultural therapy and the latest functional training equipment found to help maintain the physical and mental health of elderly people certified as requiring nursing care. Since this is a short-term study following behavioral restrictions, long-term research should continue to study the effects of adding functional training, handled by rehabilitation professionals, to horticultural therapy.

Keywords

1. Introduction

In Japan, senior day-care centers are places where seniors can engage with one another through various activities. The number of day-care facilities and community-based day-care facilities in Japan increased from 34,107 to 43,406 facilities in the three years from 2012 to 2015 [1] [2]. Since then, the number of those facilities has remained stable, and the total number of day-care facilities and community-based day-care facilities in 2020 will be 43,754 facilities, the largest number of welfare facilities for the elderly. On the other hand, the spread of infectious diseases in recent years has also led to a significant decline in the number of facilities used.

Behavioral restrictions caused by the onslaught of the new coronavirus (commonly known as COVID-19, virus name: SARS-CoV-2) and its mutant strains have resulted in an increasing number of elderly people suffering not only cognitive but also physical and mental damage [3] [4] [5]. The authors suggest that horticulture, which takes into account human-plant relationships, can be easily introduced as an occupational therapy technique if it is familiar to the elderly and has passive benefits such as placing oneself in that environment. On the other hand, active horticultural therapy, which is conducted outdoors, cannot be said to be a technique that can be provided consistently as training to restore physical function, as there are factors such as climate and location that cannot be dealt with by the therapists' ingenuity [6].

A Social Welfare Corporation and the authors are conducting a "study of functional training-type nursing care services from the perspective of horticultural therapy for nursing care [7]. This research is underway on the benefits of passive horticultural therapy, including visual stimulation of the gardening environment and horticultural works and the benefits of hand care treatment plus brain rejuvenation aroma [8]. Hand care treatment refers to hand massage utilizing vegetable carrier oils for aromatherapy. In terms of physical function, in addition to various exercises and active horticultural therapy, functional training

tools such as "red cord," "foot-pedal wheelchair," and "posture chart" applications (App Store) have been introduced one after another, which have been gaining attention in recent years.

These horticultural therapy activities were passive such as garden appreciation, "hand care treatment and brain rejuvenation aroma", which were less likely to be rejected and more share pleasant feelings [9]. In addition, active functional recovery training and rehabilitation were introduced, and physiotherapists or occupational therapists proposed various trainings suitable for individual subjects if desired. This study investigated how the combined activities of functional restoration training and horticultural therapy for hemiplegic patients affect the behavior of elderly people who require nursing care and who use day-care facilities. Using text mining using Artificial Intelligence (AI), it was sought to compare the relationship between changes in visit reports and the language used before and after the introduction of the "Posture Chart", "Red Code" and "foot-pedal wheelchair" [10].

2. Subjects and Methods

Of the 49 people who had been using the facility A before the COVID-19 pandemic, 36 elder people with care need 1 or 2 who regularly used it after the pandemic ended and who agreed to participate in the study were included. Comparisons with elderly persons who were not users of Facility A could not be made because of the different daily schedules and functional recovery training at each facility. The groups compared were Group A (8 participants), people who only used regular facility activities; Group B (12 participants), people who wanted passive horticultural therapy activities in addition regular facility activities; and Group C (16 participants), people who wanted rehabilitation with functional recovery training equipment in addition to horticultural therapy activities. Questionnaire assessments of the three groups every three months were conducted by occupational therapists at the facility or rehabilitation university teachers or trained laboratory students.

The assessment data were every three months from December 2021 to December 2023 after the COVID-19 pandemic, the MMSE (Mini-mental State Examination) [11] [12] [13] [14] and Moca-J (MCI Behavior Disturbance) [15] [16] [17] [18], TMIG-Index (Tokyo Metropolitan Institute of Gerontology index of competence) [19] [20], and GDS15 (Geriatric depression scale 15) [21] [22] [23].

Facility A: day-care senior citizen facility, "Day Service Center Cho-Yu-En".

2.1. Subjects

The flowchart for the selection of the subjects is shown in Figure 1. Subjects were community-dwelling elderly persons who had been attending A day-care center for elderly persons for at least 5 years. All subjects stopped using the facility during the COVID-19 pandemic and returned just prior to the start of the study,
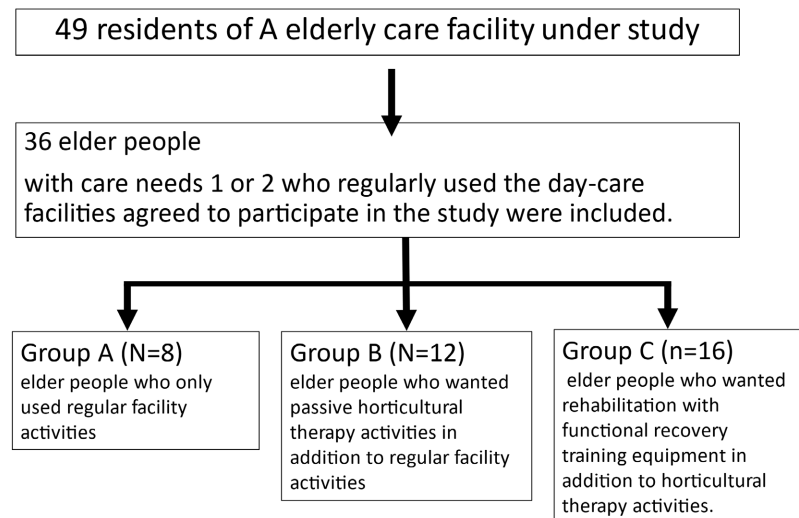
Figure 1. Flowchart of study participants. Group A (8 participants): elder people who only used regular facility activities. Group B (12 participants): elder people who wanted passive horticultural therapy activities in addition to regular facility activities. Group C (16 participants): elder people who wanted rehabilitation with functional recovery training equipment in addition to horticultural therapy activities.

December 2021. Table 1 showed a comparison of attributes between the three groups at the start of the clinical study, Table 2 showed an example of a daily schedule for this facility.

2.2. Equipment and Scales

The assessment data were taken over from the previous hospital personnel for December 2014 and January 2015 prior to admission. Immediately after admission and before the practice (February 2015), the facility's functional training instructor (Ns) or another nurse evaluated the patients monthly.

Specifically, the functional training instructors (Ns) at the facility conducted a preliminary assessment of the Mini mental State Examination (MMSE) and Dementia Behavior Disturbance (DBD) immediately after admission and before practical activities (February 2015), the Clinical Dementia Rating (CDR), and the Activities of Daily Living Assessment Chart (PSMS).

2.2.1. MMSE Screening Tool

MMSE was the most used instrument for the assessment of cognitive function in both clinical and research settings. It was usually used as a screening test for dementia and cognitive impairment or as a brief cognitive assessment that takes about 10 min to complete. MMSE were orientation (10 points), registration (3 points), at tension and calculation (5 points), recall (3 points), language and praxis (9 points).

2.2.2. Moca-J Screening Tool

The MoCA Test was validated in the setting of mild cognitive impairment (MCI) and has been subsequently adopted in numerous clinical settings. The sensitivity

Table 1. Comparison of attributes between the three groups at the start of the clinical study.

	Status of each group as at June 2022		
	Age	Level of care required	Frequency of facility use/week
Group A	80.87 ± 5.79	1.63 ± 0.51	1.25 ± 0.46
Group B	80.91 ± 4.61	1.67 ± 0.49	1.25 ± 0.45
Group C	78.75 ± 3.49	1.63 ± 0.50	1.50 ± 0.52

Table 2. Example of a daily schedule for this day facility.

Basic activities, support service hours	Basic activities only N = 8	Basic activities + active or passive horticultural therapy N = 12	Basic activities + passive horticultural therapy + use of functional recovery training equipment N = 16
-9:00	Welcome to the facility	Welcome to the facility	Welcome to the facility
9:00-9:30	Morning greeting (checking the date), exercises, vital measurements, serving tea	Morning greeting (checking the date), exercises, vital measurements, serving tea	Morning greeting (checking the date), exercises, vital measurements, serving tea
9:30-10:00	Massage, manual training including range of motion training or bathing	Massage, manual training including range of motion training or bathing	Massage, manual training including range of motion training, foot pedal wheelchair training, posture chart suggestion exercise or bathing
10:00-12:00	Manual training or free activities such as range of motion training	Red cord training, passive horticultural therapy (e.g. hand care treatments, garden observation)	Red cord training, passive horticultural therapy (e.g. hand care treatments, garden observation) or gait training
12:00-12:30	Lunch	Lunch	Lunch
12:30-15:00	Small group exercises, standing training, leisure time or naptime. The third week of every month was physical fitness week.	Small group exercises, active horticultural therapy, manual training, standing training or leisure time or naptime. The third week of every month was physical fitness week.	Small group exercises, manual training including range of motion training, foot-pedal wheelchair training, posture chart suggestion exercise, standing training or leisure time or naptime. The third week of every month was physical fitness week.
15:00-	Gymnastics at 15:00, free activities, transport	Gymnastics at 15:00, free activities, transport	Gymnastics at 15:00, free activities, transport

of the MoCA for detecting MCI is 90%, compared to 18% for other leading cognitive screening tools such as the MMSE. The MoCA assesses were short-term memory, visuospatial abilities, executive functions, attention, concentration and working memory, language, and orientation to time and place. Read list of words, subject must repeat them. Do 2 trials. Do a recall after 5 minutes.

2.2.3. TMIG-Index of Competence

Elderly populations are evaluated on their ability to perform instrumental activities of daily living (IADL) using one of three subscales in the TMIG Index of Competence, while the Basic Checklist tool developed to screen for frailty is de-

signed to measure actual task performance.

2.2.4. GDS15

Diagnosing depression in the elderly poses a serious problem because of the ageing process and various diseases that influence and mask symptoms of depressed mood. For instance, depression is often confused with dementia. It is therefore crucial to use a diagnostic tool that takes these problems into account. Symptoms of depression were assessed using the 15-item Geriatric Depression Scale (GDS-15) and demonstrated validity among ambulatory elderly.

2.3. Text Mining

In Japan, rehabilitation professionals visit elderly people in their homes to encourage independence in bathing. Therefore, AI-based text mining was used to compare changes in visit reports before and after the introduction of the Posture Chart and Red Code, and the relationship between the language used. The written data recorded from time to time in the daily notes and support memos of the physiotherapist or occupational therapist at the facility were analyzed by AI software using text mining "Co-Occurrence Network Analysis" techniques. In this study, we attempted text mining, focusing on medical records, service plans, and caregiver records related to home bathing. In Japan's nursing care fee regulations, an "additional fee for bathing assistance" has been set from 2021. Therefore, we conducted text mining of medical records, service plans, and caregiver records, concentrating on home bathing-related by OTR or RPT.

AI analysis tool was KH-corer 3. [24] [25] [26]

2.4. Statistical Analysis

Comparison results of MMSE, CDR, DBD, and PSMS by 3 Group are presented as mean ± SD (min-max), interquartile range, and median, and statistical significance was confirmed by the Streel-Dwass method. The statistical analysis software used was SPSS ver. 29.

2.5. Ethical Considerations

We strictly observed the Helsinki Declaration of 2015 (revised in 2013), explained the purpose and outline of this study to them and obtained informed consent from them beforehand. We explained in writing to the subjects and her family the purpose and content of the study, that the data obtained would not be used for any purpose other than the study, and that we would be careful not to leak any personal information and sought their cooperation after obtaining their understanding. We also explained in writing and orally that participation in the study was voluntary and that they would not be disadvantaged even if they did not become subjects. All procedures were approved by the Kyushu University of Health and Welfare (Miyazaki, Japan) Ethics Committee (13-001) and Nishi-Kyushu University (Saga, Japan) Ethics Committee (H29-5, H30-14, R5). The authors have no conflicts of interest directly relevant to the content of this

article.

All subjects gave their informed consent and agreed to the purpose of this study and agreed to proceed with the research in accordance with the Declaration of Helsinki and with the contents approved by the Ethics Committee.

3. Results

Figures 2-5 show the results of the comparison of MMSE, CDR, DBD and PSMS
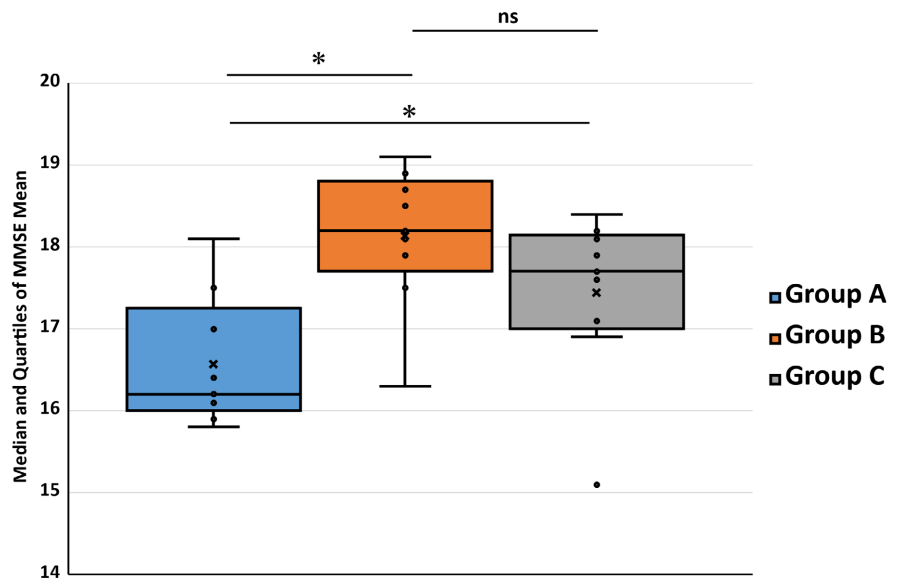

Figure 2. Median and quartile comparison of mean MMSE scores by care requirements (0 - 30). Average score at start: Group A 15.8, B 16.3, C 15.1; ns: no significant, *: $p < 0.05$.
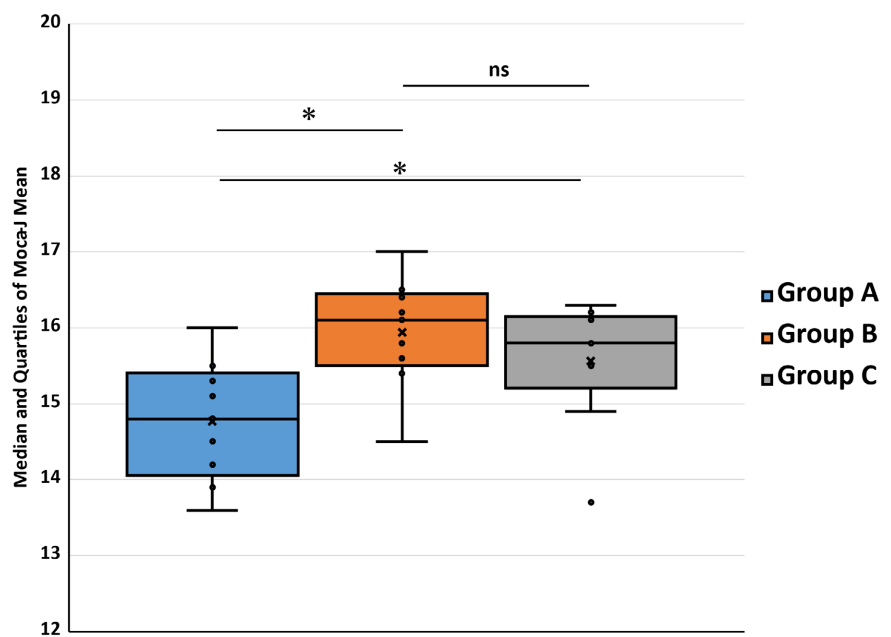

Figure 3. Median and quartile comparison of mean Moca-J scores by care requirements (0 - 30). Average score at start: Group A 13.6, B 14.5, C 13.7; ns: no significant, *: $p < 0.05$.
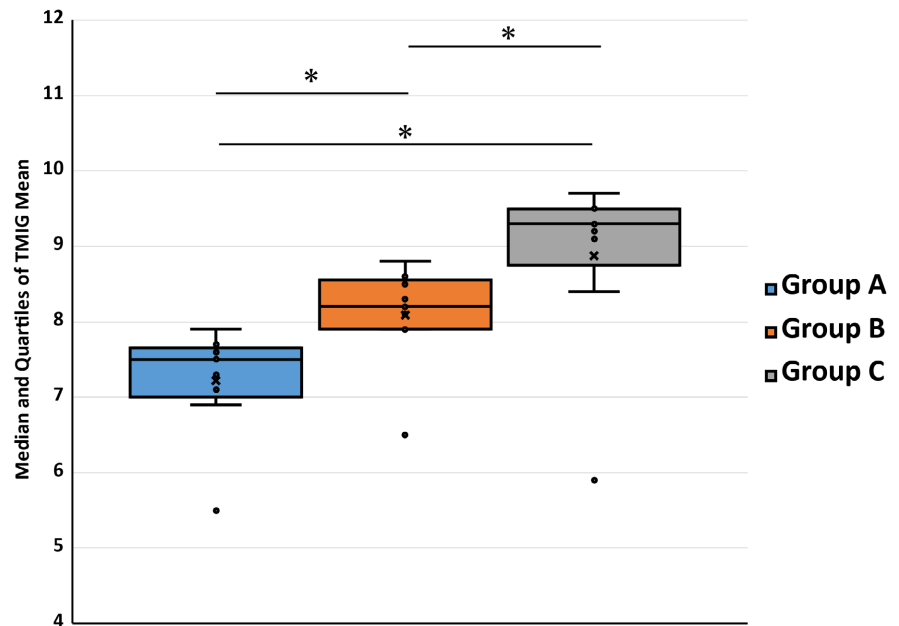
Figure 4. Median and quartile comparison of mean TMIG scores by care requirements (0 - 13). Average score at start: Group A 5.5, B 6.5, C 5.9; ns: no significant, *: $p < 0.05$.
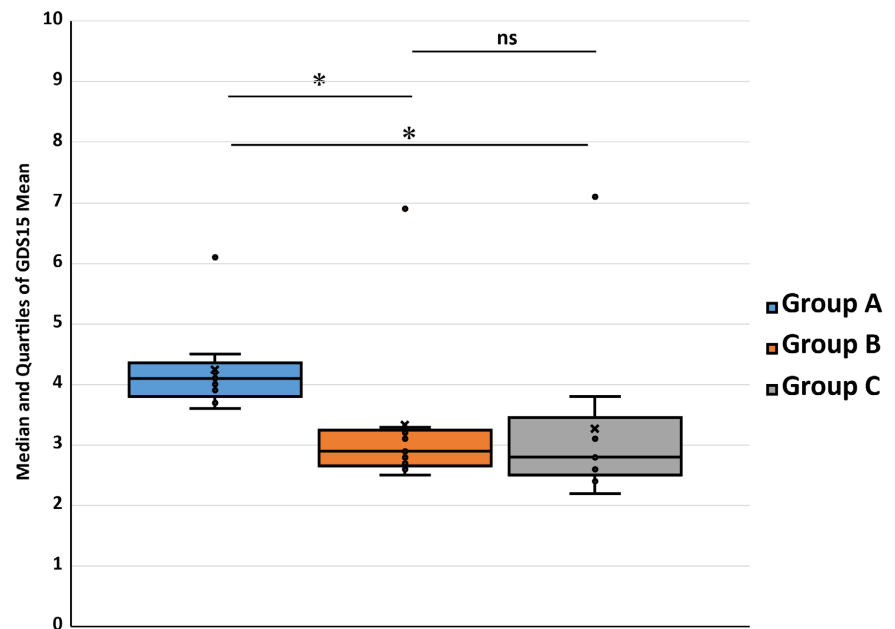

Figure 5. Median and quartile comparison of mean GDS15 scores by care requirements (0 - 15). Average score at start: Group A 6.1, B 6.9, C 7.1; ns: no significant, *: $p < 0.05$.

by three groups. The results of MMSE and Moca-J, tests of cognitive function, were both significantly higher in Group B and C than in Group A. iADL assessment, TIMG assessment, was significantly higher in Group B and C than in Group A, and Group C were significantly higher than Group B. The GDS, an assessment of depression in old age, tended to be significantly higher in Group A than in Group B and C.

Text Mining of Medical Records, Service Plans and Caregiver Records Related to Home Bathing by OTR or RPT

In the "Co-Occurrence Network Analysis" shown in **Figure 6**, before the introduction of the latest functional recovery training equipment such as the Red Cord, the association between Bathing and Rehabilitation was small, with many terms related to Bathing itself. **Figure 7** shows the "Co-Occurrence Network Analysis" after the introduction of the functional recovery training equipment, including the words Bathing and CARE and the words POSTURE, Red-Code, and its use in functional training and rehabilitation. The results showed a high association between the words Bathing and CARE and words such as POSTURE, Red-Code, and AI, App, which are used in functional training and rehabilitation, and their analysis.

To summarize the study results, Cognitive function and iADL ratings of all the elderly were estimated to be decreased than before the COVID-19 pandemic. Depression among the elderly was presumed to be increased than before the COVID-19 pandemic. The results of MMSE and Moca-J were both significantly higher
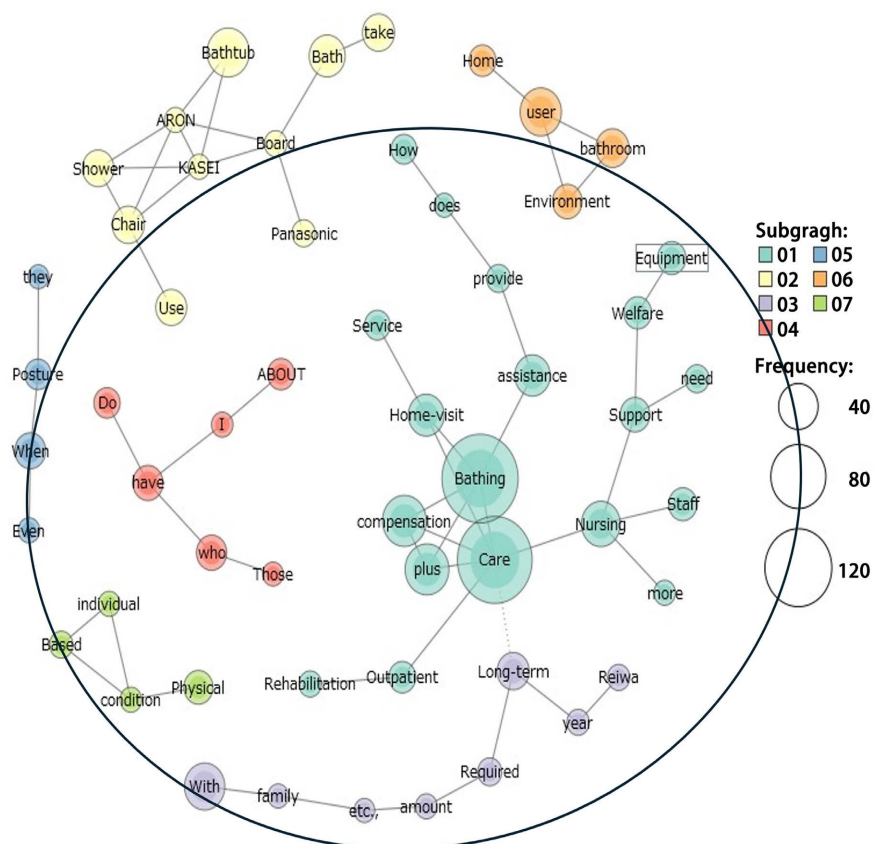

Figure 6. "Co-Occurrence Network Analysis" before introduction of functional recovery training equipment. Number of occurrences: 5 or more; Jaccard coefficient: 0.2 or more; *The frequency of language used in the various documents is represented by the size of the circle, and clusters (hierarchical clusters, number of cluster settings: 8) are represented by colors. Solid lines connecting circles indicate strong co-occurrence, and dashed lines indicate weak co-occurrence.

Figure 7. "Co-Occurrence Network Analysis" after introduction of functional recovery training equipment. Number of occurrences: 5 or more; Jaccard coefficient: 0.2 or more; *The frequency of language used in the various documents is represented by the size of the circle, and clusters (hierarchical clusters, number of cluster settings: 8) are represented by colors. Solid lines connecting circles indicate strong co-occurrence, dashed lines indicate weak co-occurrence.
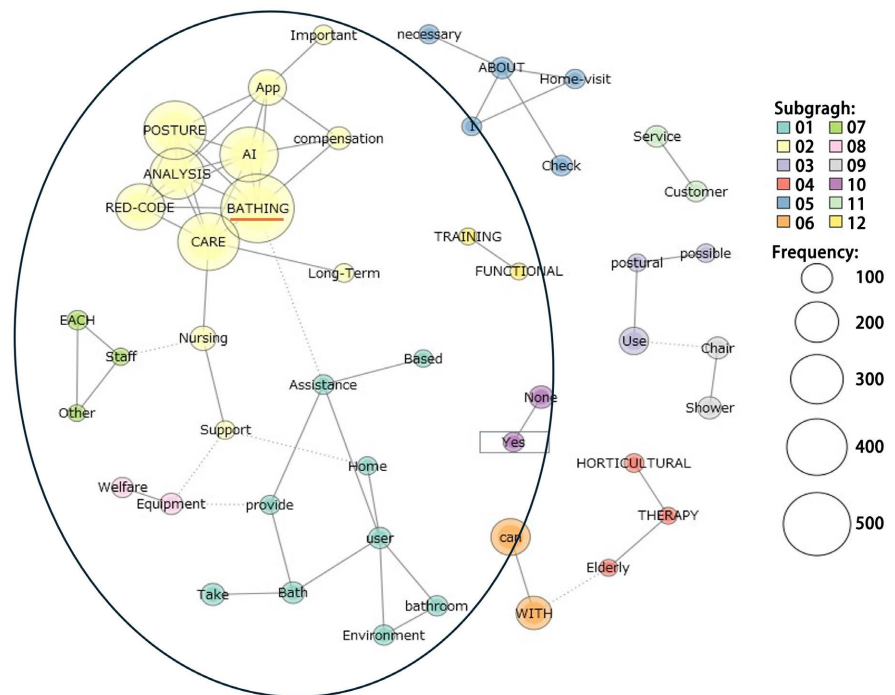
in Group B and C than in Group A. TIMG assessment, was significantly higher in Group B and C than in Group A, and Group C were significantly higher than Group B. The GDS, an assessment of depression in old age, tended to be significantly higher in Group A than in Group B and C. In the "Co-Occurrence Network Analysis" shown after the introduction of the latest functional recovery training equipment such as the Red Cord, its results showed a high association between the words Bathing and CARE and words such as POSTURE, Red-Code, and AI, App, which are used in functional training and rehabilitation, and their analysis.

4. Discussion

Cognitive function and iADL ratings of all the elderly were estimated to be decreased than before the COVID-19 pandemic. Depression among the elderly was presumed to be increased than before the COVID-19 pandemic. The results of the MMSE and Moca-J cognitive function tests were significantly higher for the elderly in Groups B and C than for those in Group A, who did not participate in horticultural therapy activities or new functional training activities.

Tabira *et al.* stated, "Three months of rehabilitation based on active process analysis enabled us to identify the impaired and residual parts of the patient's body, and the intervention was effective in achieving the targeted improvement

goals" [27]. TIMG evaluation in these studies, an iADL evaluation, was significantly higher in Groups B and C than in Group A, and significantly higher in Group C than in Group B. Thus, the results indicate that participation in active and passive horticultural therapy alone significantly improved activities of daily living. In addition, active use of functional recovery training equipment, which enables recovery training of motor functions according to physical symptoms, was even more effective.

Yamada *et al.* showed that a rehabilitation approach is effective for depression in elderly patients after a stroke by using positive vision feedback for a case of apathy with depression after stroke [28]. The GDS in these studies, an assessment of depression in old age, was assumed to have a higher tendency toward depression at the start of the assessment due to the COVID-19 pandemic. We believe that the results of the subsequent evaluation showed that the depressive tendency decreased significantly due to the mental effects of activities that the participants looked forward to, such as gardening, and the excitement of being able to move their bodies and use a few physical functions that they give up on.

"A text-mining analysis" has become widely used in recent years and has been shown to be effective in analyzing patients' social networking services (SNS) [29] [30] [31] [32]. "Co-occurrence network analysis" showed that before the introduction of the latest functional recovery training equipment such as RED-CODE, there was little relationship between bathing and rehabilitation, and there were many terms related to bathing itself, but during this period. It was thought that this approach, like that of many other facilities, led to the improvement of bathing conditions. On the other hand, "co-occurrence network analysis" after the introduction of functional recovery training equipment revealed that the words "bath" and "care" and words used in functional training and rehabilitation such as "POSTURE", "RED-CODE", and "AI/app." It was found that there was a high correlation between the results and the analysis. This indicates that the focus is on functional recovery training aimed at improving the bathing action itself and was a feature of this facility.

Since this is a short-term study following behavioral restrictions, long-term research should continue to study the effects of adding functional training, handled by rehabilitation professionals, to horticultural therapy.

5. Limitations

This study was limited to elderly persons in need of care from 1 to 2 who attend day-care facilities for the elderly in the city of A. Since even Group A provides functional recovery training activities in welfare facilities for the elderly, comparisons with elderly persons who do not use these facilities were not possible. In addition, this study was conducted in Japan, where the population is the most aged, and may serve as a reference for geriatric rehabilitation in countries around the world where the population will continue to age. However, the unique situation of geriatric care in Japan, where there are more than 4,000

day-care facilities alone, is very different from that in other countries, and the understanding of the data and views should be adapted to the actual situation in each country.

6. Conclusion

This research has shown that the introduction of horticultural therapy is particularly useful for the mental aspect of Japanese day-care facilities for the elderly, which specialize in functional recovery training and rehabilitation. On the other hand, when aiming for functional recovery for each patient, such as after-effects of hemiplegia after cerebral infarction, we believe that it is more effective to introduce not only active horticultural therapy but also the latest functional recovery training equipment. It was also indicated that it would be desirable for rehabilitation specialists such as physical therapists and occupational therapists to be in charge of such cases.

Acknowledgements

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this article.

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