ORIGINAL ARTICLE

Quantifying the effect of home visit occupational therapy on the quality of life of elderly individuals

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Abstract:
Purpose: Japan is now the world's first 'super-ageing' society. We analysed the effect of occupational therapy (OT) sessions in addressing issues related to the elderly population, in comparison with other services.
Methods: We studied 136 elderly patients receiving at-home care. Seventy-four patients received weekly OT and 62 did not. We assessed quality of life (QOL) and its trajectory over 1 year using the Philadelphia Geriatric Center Morale Scale (PGC) to quantify changes in QOL and the Function Independence Measure (FIM) to measure changes in activities of daily living.
Results: Patient progress fell within five different trajectories, which was influenced by psychosocial factors. OT correlated with significantly greater improvement in PGC and FIM scores than other home care services.
Conclusion: There is a significant benefit associated with OT and is expected to become increasingly more important in the growing elderly population. Tailoring of OT will be required to benefit those trajectory groups that showed unsatisfactory outcomes.

Keywords: home-visit occupational therapy, quality of life, elderly individuals

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1. Introduction

Japan is in the middle of a unique and unprecedented demographic change; the percentage of citizens 65 years and older has now risen to 23% of the total population [1] and will increase to 33% by 2030 [2]. This has been attributed to the tendency toward a lower total fertility rate as rural populations dwindle when younger generations move to cities, where large families are impractical due to limited space, high cost of living and inadequate childcare opportunities for working mothers. Another component is the increasing longevity of the elderly population and the growing tendency of their children to live away from them [3].

The relative isolation and potential vulnerabilities of the elderly age group were brought to the nation's attention by the Great East Japan earthquake, followed by a tsunami, on 11 March 2011. Elderly patients were over-represented in the number of citizens requiring emergency care and shelter [4].

To address problems facing ageing societies, the Japanese government has adopted measures to reduce medical expenses among the elderly, including the establishment of a long-term care insurance system and the revision of medical fees. This has been accompanied by an emphasis on in-home care, with a shift 'from care by family' to 'care by society' [5, 2, 6]

This shift has, in turn, focused attention on the issue of quality of life (QOL) among those receiving in-home care. Kawai [7] points out that the social norms of a super-ageing society tend to regard the elderly as a social problem that needs to be addressed, but it is questionable whether the elderly can live happily knowing that they are considered a social problem. Washida [8] asserts that humans cannot live without recognizing

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meaning in their lives. This in turn requires that we should strive to organize and administer occupational therapies that prevent elderly people from losing meaning in their lives and help them maintain or improve QOL.

Studies to date on the QOL of the elderly have been conducted from various viewpoints. Lawton [9] defined QOL in this population as 'subjective well-being' and created the Philadelphia Geriatric Center Morale Scale (PGC) (see Appendix) in 1972 to measure QOL among the elderly. The PGC is still used worldwide. In another study, Liang and Bollen [10] described factors affecting QOL in the elderly, including sex, race, marital status, health condition, employment situation, socioeconomic status and social activities. Koyano [11] asserted that being in good health and maintaining close relationships with others helps improve QOL. These studies primarily targeted healthy elderly people and did not specifically investigate elderly persons receiving occupational therapy (OT). Nevertheless, their findings serve as a benchmark for future consideration of geriatric QOL. Analyzing the differences in QOL between elderly persons receiving home care with or without OT may help therapists to tailor OT and improve patient QOL.

To assess these differences in home care, we conducted a prospective analysis of subjects who started to use home care services with and without OT over 1 year.

2. Materials and Methods

2.1. Design

The study was conducted under a prospective cohort design based on age-related physical function and QOL score in 200 patients aged 65 to 84 years who had begun to use home care services.

2.2. Study Participants and Activities

The study lasted from May 2013 to May 2014 and included patients from 12 visit care stations in three prefectures (Kyoto, Osaka and Nara Prefectures) in central Japan. Participants in the OT cohort were scheduled to commence receiving home care visits that consisted of weekly 1 h visits by an occupational therapist or nurse, who engaged the patient in exercise therapy [activities of daily living (ADL) practice], OT (cooking, gardening, crafts, music activities, going out-of-doors, practice in operating mobile, etc.), proposals of leisure activities or volunteer activities, counselling and home exercise guidance.

Participants in the non-OT cohort received 1−5 weekly home visits totalling 60−300 min by a nurse or healthcare professional who assisted the patient with cleaning, laundry, shopping, bathing, eating and medication management.

Setting

All 12 care stations provide home visit care service. In five locations, professional caregivers help with ADL, bathing, housework, shopping and conversation. The patients served by these five care stations were eligible for the study as part of the non-OT cohort. In the other seven locations, nurses or occupational therapists provide medical services including blood pressure measurement, physical therapy, family therapy, OT and prescription management. The patients served by these seven care stations were eligible for the study as part of the OT cohort.

2.3. Inclusion/exclusion criteria

Inclusion criteria included intact cognitive function and communication skills, and a stable general condition that allowed participation. Patients scoring less than 24 points on the Mini-Mental State Examination were excluded.

2.4. Data collection

Physical function and QOL scores were investigated in the patients' homes at intervals of 90 ± 10 days using the Functional Independence Measure (FIM) and the PGC Morale Scale. The PGC Morale Scale, used to measure QOL, comprises 17 questions (see Appendix). A normal score is 11.97 ± 3.57, derived from a population of healthy community-dwelling elderly people in Japan. The main outcome of this study was the PGC Morale Scale score.

Patient ADL was assessed using the FIM. The FIM evaluates movement and cognitive function in 18 items and 7 steps and is mainly used at rehabilitation clinic sites, both in Japan and abroad. The FIM score was the secondary outcome of this study. Both tests were administered by specialists, such as occupational therapists. The questionnaire for the PGC Morale Scale was completed by the participant with or without help from a family member or friend. Higher scores in the FIM and PGC imply higher QOL and ADL function. When the PGC or FIM could not be administered due to hospitalization or other interruption, or if all items in either evaluation were not completed, we judged that the data were missing and the patient was excluded from analysis.

2.5. Demographics

Clinical data and patient background information were collected by creating a personal questionnaire that included age, sex, illness name, course of treatment, level of care required, family structure, employment history, education history, hobbies and any participation in religious activities.

2.6. Statistical Analyses

The regularity of data distribution was validated using the Shapiro–Wilk test. Comparisons of factors of both the OT and non-OT cohorts were analysed using the Mann–Whitney U test. Correlation analysis between two variables in the PGC and FIM was analysed using the Spearman's ρ (rank correlation coefficient), with the significance of correlation coefficients also examined. Cross-group QOL trends were identified using hierarchical cluster analysis. The significance of probabilities was calculated using Fisher's exact probability test, with significance set at $p < 0.05$. Power analyses and statistical calculations were conducted using specialized software (G*Power ver. 3.1®, Heinrich Heine University; Düsseldorf, Germany). All other analyses were performed using social science software (SPSS ver. 22.0®, IBM; Armonk NY, USA).

2.7. Consent and Ethical Approval

All patients who participated in this study gave informed consent in writing. This study received formal ethical approval from Osaka Prefecture University Research Ethics Committee (2012-OT-17).

3. Results

3.1. Reasons for recruitment and exclusion

Therapy for 100 patients by occupational therapists as well as care for the 100 non-OT patients by nurses and caregivers was initiated out of the 12 home visit stations. Twenty-six patients receiving OT and 38 patients receiving non-OT care could not continue their home healthcare over the study year due to placement in a nursing home, moving to a distant family home, death or other reasons (53%, 17%, 14%, 9% and 7%, respectively). The remaining 136 patients (74 in the OT cohort and 62 in the non-OT cohort) were analysed as survey participants.

3.2 Participant Characteristics

Mean age (years), years of schooling, FIM score and PGC score of the 200 patients was 78.13 ± 5.1, 10.95 ± 2.3, 84.73 ± 20.4 and 9.09 ± 2.6, respectively, at the time of initiation of the survey. Other information we acquired included degree of nursing care needed, name of injuries and diseases, therapeutic course, occupational history, hobbies, religious observance participation and family configuration (Table 1). On comparison of baseline information between the OT and non-OT cohorts, significant differences between the two cohorts were seen in mean FIM score, with a score of 81 for the OT cohort and 92 for the non-OT cohort ($p = 0.024$) and the presence or absence of a hobby (64% for OT, 47% for non-OT; $p = 0.023$). No other significant differences between the cohorts were observed.

3.3. Mean FIM and PGC scores in the OT and non-OT cohorts after 1 year

Table 2 shows mean changes in FIM and PGC scores at the end of the year of the survey. PGC and FIM scores increased in the OT cohort. The change in mean PGC scores in the non-OT cohort was not significant, while FIM scores decreased significantly over the year.

3.4. Trajectories of QOL

Cluster analysis of data over the four visits revealed different trajectories of the subjects' QOL ratings. We labelled these QOL trajectories as follows: A. Improving, B. Worsening, C. Stable Satisfactory, D. Stable Unsatisfactory and E. Slightly Improving. These are illustrated in Fig. 1.

Members of the OT cohort were overrepresented in the favourable trajectories A, C and E ($p < 0.00$) and members of the non-OT cohort were overrepresented in the unfavourable trajectories B and D (Fig. 2).

3.5. Factors affecting QOL trajectory

The general characteristics of those following Trajectory A (Improving QOL) were that they started home healthcare immediately after discharge from hospital; they had worked in technical occupations and they tended to have hobbies and participated in religious activities. No specific trend was seen in family structure. A high percentage (93%) received OT.

The general characteristics of those following Trajectory B (Worsening QOL) were that home healthcare became necessary while they were receiving medical care. Their occupational histories were in sales, business, or transportation and communication. They tended to have no hobbies. No significant differences in religious activities or family configuration were seen. Most Trajectory B patients (63%) were in the non-OT cohort.

The general characteristics of those following trajectory C (Stable Satisfactory QOL) were that home healthcare became necessary while they were receiving routine outpatient care. Their work histories were in forestry and fishery occupations. They had hobbies and participated in religious activities. Their family configuration was mostly three-generation households, with 40% in the non-OT cohort.

The general characteristics of those who followed Trajectory D (Stable Unsatisfactory QOL) were that they had occupational histories in manufacturing and

Table 1. Patient characteristics.

		OT cohort	Non-OT cohort	*P*
	Number	100	100	
	Age	80.0 ± 7.0	80.0 ± 9.0	0.969
	Years of education	12.0 ± 3.0	12.0 ± 3.0	0.810
	FIM score	81.0 ± 35.0	92.0 ± 26.8	0.024
	PGCs core	8.0 ± 3.0	10.0 ± 4.0	0.206
Sex	Women	60	61	1.000
	Men	40	39	
Level of care required	1	19	21	0.857
	2	30	30	
	3	20	24	
	4	23	20	
	5	8	5	
Classification of disease	Musculoskeletal system	18	13	0.870
	Nervous system	32	32	
	Heart or lung disease	10	15	
	Trauma	17	16	
	Systemic disease	12	13	
	Immune disease	11	11	
Course of treatment	Discharge→Home care	52	44	0.322
	Visit→Home care	48	56	
Profession	Office work	7	7	0.588
	Selling	12	7	
	Professional or technical	18	16	
	Service	1	3	
	Agriculture, forestry or fisheries	26	22	
	Production or labour work	16	19	
	Transportation or communication	2	7	
	Others	18	19	
Hobby	Yes	64	47	0.023
	None	36	53	
Faith	Yes	64	55	0.249
	None	36	45	
Family structure	Alone	26	33	0.342
	Couple	36	41	
	Two-family	19	13	
	Three household	19	13	

- *t*-test was used for age, years of education, FIM and PGC
- Fisher's exact test was used for sex, level of care required, classification of disease, course of treatment, profession, hobby, faith, or family structure

Level of care required is according to the Japan's long-term care insurance system, in which 1 = minimal care requirement category and 5 = maximal care requirement category. Although the length of convalescence varied, these were categorised into groups by three-month periods, based on the time service provision began.

Table 2. Effect size of OT.

	Mean 1-year change in PGC	*p*	Mean 1-year change in FIM score	*p*
OT cohort	1.92	0.001	5.07	0.001
Non-OT cohort	−0.16	0.617	−6.07	0.001

OT = occupational therapy

labour services. They tended not to have hobbies and did not participate in religious activities. Their family configuration was mostly two-generation households, and 43% were in the non-OT cohort.

The general characteristics of those who followed Trajectory E (Slightly Improving) were that they started home healthcare immediately after discharge from the hospital. Their occupational history was in the service sector. They lived alone and showed no specific trends in hobbies or religious activities. A total of 38% were in the OT cohort.

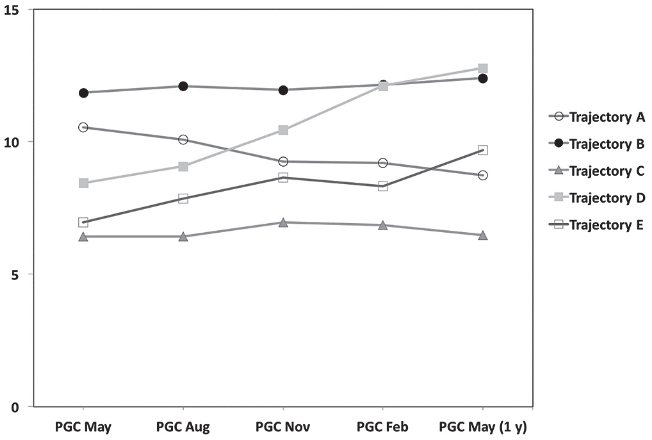

Fig. 1. The five trajectories.
A. Improving QOL (full square), B. Worsening QOL (empty circle), C. Stable Satisfactory QOL (full circle), D. Stable Unsatisfactory QOL (triangle), and E. Slightly Improving QOL (empty square).
PGC score = Philadelphia Geriatric Center Morale Scale score.

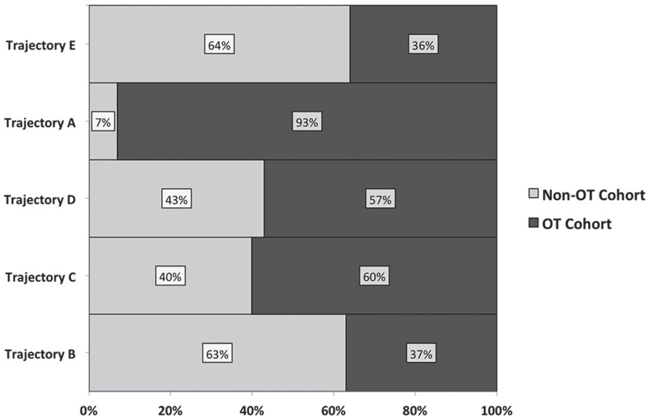

Fig. 2. Proportion of OT and non-OT cohorts in the five trajectories.

Kruskal–Wallis testing identified six factors that correlated with trajectory, namely therapeutic course, specifically the receipt of home care services immediately after discharge, and patient need for both home care service and medical care from their general practitioner; occupational history; hobbies; religious participation; family configuration and OT.

4. Discussion

Clients navigating the challenges of ageing face many difficulties, not all of which can be changed, such as family structure. In this study, of the several services offered to patients in their homes, including nursing, help with ADL and OT, we found that OT was the only service that significantly improved QOL. Patients receiving OT who were involved in religious participation and hobbies showed the most improvement. The importance of hobbies has been noted by others [12]; this is an easy feature to implement and may be combined with OT. Religious participation cannot be mandated, but an increased presence of clergy where the elderly congregate should certainly be encouraged. All three of these factors could be implemented wherever there is group participation, such as in community centres. Nevertheless, it is important to emphasize that the greatest need is found among those who live alone and are isolated. Another problem that needs to be addressed is the issue of help with ADL. Mandated bathing and meal times, arranged according to the health centre personnel's schedule, may promote passivity and lower the patient's feelings of independence. This will have to be addressed in creative ways. By becoming familiar with the different trajectories of the different groups, OT and also ADL personnel may be able to tailor their services to the patients' needs, working together to improve independence and QOL.

Several limitations of the study warrant mention. First, our study was confined to a part of the Kansai district, and the experiences and QOL of Japanese in other areas may differ. Second, the nature of our study's inclusion criteria almost guaranteed small subject numbers regardless of location. Finally, we did not investigate how OT should be tailored to meet the needs of patients who face different trajectories.

Conclusions

The fact that receivers of OT were under-represented in the lower QOL cohorts is encouraging; it implies that the kind of OT provided currently has a positive effect on elderly individuals. Further work on the implementation of hobby activity, possibly in the context of OT, may be fruitful. This was a small study, but with interesting findings. We hope it will encourage larger studies of OT in the rapidly expanding elderly population of Japan.

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APPENDIX

Contents of the PGC-MS instrument

Answers are given as yes or no and scored as one point for yes and zero points for no, for a maximum of 17 points.

1. Things keep getting worse as I get older.
2. I have as much pep as I had last year.
3. I feel lonely.
4. Little things bother me more this year.
5. I see enough of my friends and relatives.
6. As you get older, you are less useful.
7. I sometimes worry so much that I can`t sleep.
8. As I get older, things are (better/worse) than I thought they would be.
9. I sometimes feel that life isn't worth living.
10. I am as happy now as I was when I was younger.
11. I have a lot to be sad about.
12. I am afraid of a lot of things.
13. I get mad more than I used to.
14. Life is hard for me much of the time.
15. I am not satisfied with my daily life.
16. I take things hard.
17. I get upset easily.

ORIGINAL ARTICLE

Effectiveness of an Occupation-Based Home-Visit Program for Clients with Dementia and Caregivers: A Pilot Study

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Abstract: Several studies have been implemented on home-visit occupational therapy based on activities or occupations for clients with dementia and their caregivers, but all have been conducted abroad; none have taken place in Japan. Therefore, we performed a pilot study of the effectiveness of an occupation-based home-visit program for clients with dementia and their caregivers using single cohort design. The results of our analysis of participants' (n = 9) data indicated that the home-visit program could improve the behavioral and psychological symptoms of dementia, particularly apathy, among clients with dementia, as well as caregivers' needs or what caregivers expected of clients. Additionally, the program tended to decrease caregivers' care burden. The implications of the study are discussed in light of further research on this program.

Keywords: Dementia, occupational therapy, occupation-based, home-visit

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1. Introduction

In Japan, the prevalence of dementia in 2012 was estimated at 4.62 million people. Furthermore, while in 2012 nearly 15% of people aged 65 years or older had dementia, this rate is expected to increase to 20% by 2025 [1]. In response, the Japanese government [2] created a dementia policy in 2012 called the "Orange Plan." In line with this policy, the government has recently been promoting the creation of a society where people can live in pleasant and familiar surroundings for as long as possible, even when they are suffering from dementia. Within this background, occupational therapists are expected to play a part in implementing this government policy. However, we cannot yet assert based on empirical evidence that occupational therapists offer home-visit services for clients with dementia and their caregivers of sufficient quality in Japan. This is in contrast to the Netherlands and United States (US), where there are a number of studies on home-visit occupational therapy based on activities or occupations. Therefore, we believe that it is necessary to develop effective home-visit occupation-based therapy services for clients with dementia and their caregivers and disseminate them across Japan.

According to the Canadian Association of Occupational Therapists [3], an occupation is defined as "groups of activities and tasks of everyday life, named, organized and given value and meaning by individuals and a culture." Although the term "occupation-based" can be considered to refer to engaging in a given occupation [4], we consider it to include both focusing on an occupation (i.e., talking and sharing occupations with clients and their caregivers) and engaging in it.

The purpose of the present study was to develop a home-visit occupation-based program and determine its effectiveness. Our hypothesis was that a program that promotes clients' ability to engage with occupations and primary caregivers' ability to supervise clients can improve the behavioral and psychological symptoms of dementia (BPSD) among clients and decrease care

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burden and satisfy the needs of primary caregivers.

1.1 Literature Review

In the Netherlands, Graff and colleagues developed a home-visit occupational therapy program for clients with mild to moderate dementia and their primary caregivers and examined its effectiveness in a case study [5] and single cohort study [6]. Moreover, Graff and colleagues [7, 8] went on to examine the program's effectiveness via a randomized controlled trial (Dutch study). The program comprised 10 one-hour occupational therapy sessions over five weeks, and included the use of devices to compensate for clients' cognitive decline as well as cognitive behavioral interventions for caregivers that aimed at improving coping behavior and supervision of clients. At six weeks, clients in the intervention group exhibited significantly improved activities of daily living (ADLs), quality of life (QOL), health status, and depressive mood in comparison with clients in the control group. Furthermore, primary caregivers in the intervention group exhibited significantly improved QOL, health status, depressive mood, and confidence in control over their lives in comparison with those in the control group. This program was called the Community Occupational Therapy in Dementia Program (COTiD). Graff et al. [9] further assessed the cost-effectiveness of the COTiD alongside the single-blind randomized controlled trial, and found that the program was more successful and cost-effective in comparison to the usual care.

However, Voigt-Radloff et al. [10] reported that the COTiD did not work more effectively than a comprehensive one-session occupational therapy consultation within German routine healthcare (German study). Possible reasons for this were because Voigt-Radloff et al. could not arrange for a seminar on intervention repetition for interventionists, the interventionists had less treatment experience with their experimental intervention than did those in the Dutch study, and clients started off with higher ADLs in the German study than in the Dutch study.

Van't Leven et al. [11] reported that the COTiD was not sufficiently used by occupational therapists who had learned it in a COTiD guideline course at Radboud University. They ascribed this to difficulties in actually implementing the rather complicated treatment, and that therapists had less competence in treating clients at home according to the guidelines. They concluded that improvements in occupational therapists' knowledge and self-confidence would be needed in order to appropriately implement the COTiD guidelines.

In the USA, Gitlin et al. [12, 13] developed the Tailored Activity Program (TAP) and examined its effectiveness. Participants included clients with mild to severe dementia, whose score range on the Mini-Mental State Examination (MMSE) was 0 to 27. In the TAP, occupational therapists visited participants six times and telephoned twice in four months. Furthermore, they developed activities in accordance with clients' abilities, and offered interventions that attempted to reduce clients' environmental demands. The eight-session occupational therapy intervention also involved providing instructions to caregivers on the use of the developed activities. The results indicated that the BPSD for clients in the intervention group, especially shadowing and agitation, improved, as did mastery and self-efficacy for caregivers. Later, Gitlin et al. [14] examined the effectiveness of a program called Care of Persons with Dementia in their Environments (COPE), which aimed to decrease environmental stress and enhance caregivers' skills (engaging clients in activities, simplifying tasks, etc.). The COPE comprised all of the TAP sessions as well as two additional sessions—one home visit and one telephone call—administered by nursing staff that involved advising caregivers on identifying pain and helping clients drink water. Overall, the result indicated that clients showed improved independence in ADLs and engagement with meaningful activities. Moreover, caregivers showed improved well-being and enhanced confidence in using activities.

2. Method

2.1 Participants

The research sites were two cities in Hiroshima and Saga prefectures, Japan. From February 2012 to March 2014, we recruited 11 clients from two comprehensive community centers in these cities. Clients were eligible for participation if they were aged over 60; were exhibiting symptoms of dementia; could have a meal under observation by a caregiver, were living in the community; and had a family caregiver who cared for them at least three times per week, and who were motivated to care for the clients but had some concerns about it. In contrast, clients were ineligible if they had severe BPSD or a diagnosis of schizophrenia or bipolar disorder.

2.2 Intervention

The program comprised eight one-hour sessions held over eight weeks. In the first two sessions, an occupational therapist identified each client's meaningful activities (i.e., his/her occupations). To this end, the occupational therapist assessed clients' lifestyle, occupational history, and interests, as well as the caregivers' needs (i.e., what caregivers expected clients to do in order to promote the client's health), by interviewing both clients and caregivers. During that interview, we used the Canadian Occupational Performance Measure (COPM) to grasp clients' meaningful activities and caregivers' needs. The occupational therapist also evaluated the clients' BPSD and caregivers' care burden.

In the next five sessions, clients and primary caregivers implemented the previously identified meaningful activities via occupational therapists' support. Additionally, they explored other meaningful activities that promoted clients' health. Through demonstrations by the occupational therapists, caregivers learned how to utilize effective supervision, communication strategies, and skills to facilitate the clients' occupational performance. The facilitating skills included the use of reminder cards, verbal or visual cueing, simplifying activities, and simple one-step directions. The communication strategies included using short instructions, focusing clients' attention and encouraging them with praise, and expressing gratitude towards clients. In the last session, the occupational therapists reevaluated clients' BPSD and caregivers' care burden and needs (according to the COPM).

2.3 Interventionists

All interventions were implemented by several occupational therapists with some experience working in the field of dementia. Initially, the purpose and method of this study were explained to them, after which they were trained how to conduct narrative interviews, evaluations, and interventions by accompanying the first author over at least eight sessions of the program. Then, they began implementing the interventions by themselves. In the first two sessions, they had to report the results of all assessments and evaluations to the first author, who also provided advice regarding their intervention plans and methods. After the third session, interventionists had to continue reporting the contents of each session and plans for the next to the first author.

2.4 Outcome Measures

We assessed clients and caregivers in the first two sessions to provide baseline data, and then performed a reassessment in the last session (eight weeks after the start of the program). If the program was extended beyond eight weeks, we still performed the reassessment in the last session. Our primary outcome measure for clients was BPSD, which was assessed with the Neuropsychiatric Inventory (NPI). The score for this instrument ranges from 0 to 120 (with a lower score indicating less BPSD). One of the main outcomes for primary caregivers was care burden as assessed with the Zarit Burden Interview, which has a score range from 0 to 88 (with a lower score denoting less care burden). An additional outcome measure for primary caregivers was occupational needs, as assessed with the scale of performance and satisfaction in the COPM; the score for this scale ranges from 1 to 10, with a higher score indicating better performance and satisfaction.

We collected information on the age and sex of both client and caregiver at baseline. We also assessed the severity of clients' dementia using the Clinical Dementia Rating scale (CDR), which has a score range of 0 to 3 (0 = no cognitive impairment, 0.5 = very mild dementia, 1 = mild dementia, 2 = moderate dementia, 3 = severe dementia). Furthermore, we recorded the relationship between the client and caregiver.

2.5 Data Analysis

To determine the effect of the program, we used the Wilcoxon signed-rank test to assess changes in the primary outcome measures (NPI, Zarit Burden Interview, and COPM at eight weeks) over the intervention period. The statistical analysis was performed with IBM SPSS Statistics 22.0 (IBM Corp., Armonk, NY), with a significance level set at $p < .05$.

2.6 Ethical Considerations

All participants signed a consent form before data collection. Furthermore, all participation was voluntarily and participants were free to quit at any time.

3. Results

Of the 11 participants, two dropped out (one became ill, one withdrew) after baseline data were collected. As a result, a total of nine participants completed the program and had their outcome measures reassessed at eight weeks. The baseline characteristics of participants are shown in Table 1. Clients' mean age was 79.2 years old, the ratio of the sexes was 5/4 (male/female), and the mean CDR score was 1.3. Furthermore, clients'

Table 1. Baseline Characteristics of Clients and Caregivers

Characteristics	Participants (n = 9)
Age, *M* (*SD*)	
Client	79.2 (10.0)
Primary caregiver	62.5 (14.6)
Sex (M/F)	
Client	5/4
Primary caregiver	1/8
Relation of caregiver	
Spouse	4
Biological child	3
Others	2
CDR score, *M* (*SD*)	
Client	1.3 (0.5)

Note. CDR, Clinical Dementia Rating scale dementia severity ranged from mild to moderate (CDR range = 1−2). Regarding dementia type, Alzheimer's disease was the most common. Note that while participants with Alzheimer's disease took donepezil or memantine throughout the program, their drugs were not changed at all during the study period. Additionally, none of the participants had taken psychotropic drugs aside from these two during the program. Clients' most common relation to their caregiver was partner.

On average, the number of home visits was 8.9 (range = 8−13). Each client's occupational history, intervention contents, and caregivers' needs are shown in Table 2. The meaningful activities used in the intervention included reminiscence, singing, listening to music, organizing photos, making memory books, carving, golf, mah-jongg, cooking, cherry-blossom viewing, gardening, walking, and knitting. Almost all of these activities were related to clients' occupational histories. Furthermore, caregivers' needs included that the client be more active in daily life, find enjoyable activities, interact with other people outdoors, spend an enjoyable time with others, get dressed smoothly, consume a moderate amount of food at each meal, and excrete without failure.

The medians and interquartile ranges of the outcome measures at baseline and eight weeks are shown in Table 3. Notably, the total NPI score, which reflected

Table 3. Median and Interquartile Ranges of Outcomes Measures at Baseline and Eight Weeks

Items	Median (IQR) Baseline	Median (IQR) Eight weeks	*p*
NPI			
Total	14.0 (12.0, 25.0)	7.0 (2.0, 12.5)	0.01
Apathy	8.0 (6.0, 12.0)	4.0 (1.0, 5.0)	0.01
Zarit Burden Interview	39.0 (32.0, 62.0)	33.0 (15.5, 61.0)	0.09
COPM			
Performance score	2.6 (2.1, 3.7)	6.0 (5.6, 8.0)	0.01
Satisfaction score	2.5 (2.3, 3.0)	7.4 (5.5, 8.5)	0.01

Note. Wilcoxon signed-rank test; IQR, interquartile range, NPI, Neuropsychiatric Inventory; COPM, Canadian Occupational Performance Measure

Table 2. Clients' Occupational History, Intervention Contents, and Caregivers' Needs for Clients

Name	Sex	Age	Occupational history	Contents of intervention	[a] Caregivers' needs
A	M	71	Company executive, golf, karaoke, mah-jongg, calligraphy	Reminiscence with client's photo albums, organizing photos, mah-jongg, karaoke, advising on the client's care, and providing information on brain-activating rehabilitation to caregiver	Incorporating enjoyable activities into the client's daily life, obtaining information to prevent the progression of dementia
B	F	71	Schoolteacher, karaoke	Reminiscence, singing, advising caregiver on client care	Finding enjoyable activities, getting dressed smoothly, feeling well in daily life, going to the toilet independently at night
C	M	82	Office worker, experience of war, karaoke, movies, gardening	Reminiscence with client's photos, gardening, advising caregiver on how to cope with BPSD	More activity in daily life, obtaining knowledge of dementia
D	F	81	Office worker, housewife, knitting, listening to music	Reminiscence, singing, cooking, cherry-blossom viewing, discussing bathing methods	More activity in daily life, interacting with others, taking a bath more often
E	F	83	Factory worker, housewife	Reminiscence, cooking, gardening	More activity in daily life, to know dementia
F	M	90	Office worker, travel, taking photos, reading	Reminiscence with the client's photos, taking a walk and photos, putting a remind-card on the wall at the toilet	More activity in daily life, excreting without failure, taking a moderate amount of food
G	M	71	Office worker, sing, golf	Making a model of a ship, singing, participating in manufacturing classes in the community, practicing in the use of an easy-access remote control device	Interacting with others, finding more enjoyable activities, operating remote control device for the TV
H	F	97	Self-owned business, housewife, knitting	Reminiscence, knitting, handicraft, advising caregiver on how to care for and communicate with client	Interacting with others outdoors, finding activities client is able to do, excreting without failure
I	M	67	Electrician, golf, fishing	Reminiscence, making a memory book, patting-golf, carving, advising on the client's care, and giving caregiver information on brain-activating rehabilitation	Playing client's favorite sports, making opportunities to spend an enjoyable time with others, giving satisfactory care to client

Note. [a] Caregivers' needs refers to what caregivers expected the clients to do in order to promote the client's health.

severity of BPSD, significantly decreased at eight weeks ($z = -2.5$, $p < .05$); additionally, the apathy item of the NPI also significantly decreased ($z = -2.5$, $p < .05$). Caregivers' scores on the Zarit Burden Interview showed a decreasing trend, but did not exhibit a significant difference ($z = -1.7$, $p > .05$). However, caregivers' performance ($z = -2.5$, $p < .05$) and satisfaction scores ($z = -2.5$, $p < .05$) on the COPM significantly increased.

4. Discussion

We created an occupation-based home-visit program for clients with dementia and their caregivers and examined its effectiveness in a pilot study. The results indicated that the program, which promoted engaging clients with occupations and instructing primary caregivers to supervise clients, could improve clients' BPSD, particularly apathy, and satisfy caregivers' needs. One possible reason why this program improved clients' apathy was that the contents of the intervention included reminiscence. Because reminiscence reminds clients of past enjoyable events and stimulates their emotions, they are more likely to become lively and thereby reducing feelings of apathy. Another reason may be that clients could perform interesting or familiar activities without failure with caregivers' supervision. The program did not appear able to decrease the primary caregivers' care burden, although the change was in the right direction. In other words, our findings appear to support the hypothesis that a program promoting clients' engagement with occupations and instructing primary caregivers to supervise clients can improve clients' BPSD and satisfy caregivers' needs. However, it must be noted that the hypothesis may only be supported for clients with mild to moderate dementia and whose caregiver is motivated to provide care.

The results concerning clients' BPSD are consistent with those of previous studies. Graff et al. [8] reported that the COPE was effective for improving BPSD, especially depressive mood, among clients with dementia as well as the depressive mood among caregivers. Similarly, Gitlin et al. [12] reported that the TAP was effective in improving the BPSD of clients with dementia, especially agitation and argumentation. Taken together, we posit that an occupation-based program for clients with dementia and their caregivers in the community may be effective in improving depressive mood or apathy among clients with mild to moderate dementia, and in improving agitation or argumentation among clients with severe dementia.

Caregivers' needs in this study referred to having clients engage in meaningful activities that the caregiver expected the clients to do in order to promote clients' health. In the present study, clients engaged and performed meaningful activities in collaboration with their caregivers and occupational therapists, and caregivers learned how to supervise clients. According to a previous study [7], learning how to supervise clients could enhance caregivers' confidence in controlling clients' activities as well as clients' ability to perform meaningful activities or ADLs. Thus, we propose that a reason for the increased performance and satisfaction scores on the COPM in this study was that the caregivers obtained greater confidence in controlling clients' meaningful activities and daily life, and that clients' ability to perform meaningful activities improved with caregivers' ability to supervise clients.

As previously described, an occupation can be defined as "groups of activities and tasks of everyday life, named, organized and given value and meaning by individuals and a culture" [3]. Therefore, any meaningful activity can be regarded as an occupation. In the COPM, the therapist asks the client about the activities that he or she needs, wants, or is expected to perform in order to identify that client's occupations [15]. Thus, we regarded meaningful activities as not only interesting activities that the client needs or wants to perform, but also activities that he or she is expected to perform by the caregiver. Particularly, it is important to ask caregivers what they expect the client to do in order to promote the client's health because the client with dementia often has difficulty in expressing their own desires and concerns. Thus, one advantage of our program might be that clients with dementia can obtain greater confidence and liveliness by engaging in interesting, familiar, and expected activities.

On the other hand, our results did not support a portion of the hypothesis: that is, the program did not result in a significant decrease in care burden among primary caregivers. A possible reason for this is that two of the caregivers' situations influenced the result. Specifically, of the nine caregivers, one slightly abused and neglected his client, which made us unable to collaborate with him. Furthermore, one went into temporary retirement from her job in order to devote care to her spouse (i.e., the client) during the program, which led the caregiver to decrease her social contact. Looking at them individually, it is clear that their Zarit Burden Interview scores actually increased over the eight weeks.

The limitations of this study include the small number of participants and not setting up a control group. Additionally, participants were recruited from only two communities and we did not analyze the influence of type of dementia. Therefore, this study appears to offer relatively little evidence, and it may be difficult to generalize the results. However, it should be noted that some of the clients' BPSD showed a significant decrease and some of the caregivers' needs were significantly satisfied. Thus, the research implications include setting participant criteria such that caregivers can collaborate with occupational therapists to ensure that clients can engage in suitable meaningful activities, and to establish a control group.

5. Summary and Conclusions

Overall, the result of this study partially supported our hypothesis—namely, a program that aims to help clients engage with occupations and instruct primary caregivers in client supervision can improve clients' BPSD as well as satisfy the needs of caregivers. However, our results did not support the part of the hypothesis concerning caregivers' care burden. This program can possibly serve as one of the tools to promote the Orange Plan [2] and can contribute to building a society where people can live in pleasant and familiar surroundings for as long as possible, even when they are suffering from dementia.

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■ORIGINAL ARTICLE

Analysis of reaching movements in stroke patients using average variability of electromyogram value

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Abstract: The hypothesis in this study was tested by conducting EMG experiments comparing the variability in muscle activity during repetitive reaching movements in hemiplegic patients and healthy subjects. The present study investigated the characteristics of reaching movements in hemiplegic patients using the variability in average electromyogram (EMG) value. We studied 21 right-handed stroke patients with left-sided hemiparesis and 14 right-handed healthy control subjects. Post-stroke patients (hemiplegic group) and normal subjects (control group) repeated a reaching movement 10 times. The variability in average EMG value of each muscle was defined as the average standard deviation of the average rectified values (nARV-SDave). During the reaching movements, the nARV-SDave values was significantly higher in the hemiparesis group than in the control group for the biceps and triceps brachii ($P < 0.05$). In the hemiparesis group, significant negative correlations between the variability in nARV-SDave values and the Fugl-Meyer assessment scores were observed in all muscle types (rs = −0.46 to −0.76; $P < 0.05$, $P < 0.01$). This study identified a direct relationship between the variability in muscle activity and the severity of motor function deficit in post-stroke patients. The selective impact on the biceps and triceps were related to the nature of the reaching task.

Keywords: stroke, upper extremity, reaching movement, electromyography, hemiplagia

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Introduction

A stroke is a medical emergency because a severe reduction or interruption of blood flow to the brain causes the cell death within minutes. The most common complication following a stroke is a transient or permanent impairment of upper extremity functions, limiting the patients' autonomy [1]. As many daily activities involve reaching for an object, it is important for physical and occupational therapists to understand the kinematic and kinetic characteristics of reaching movements in post-stroke patients.

Several kinematic studies revealed that reaching movements in stroke patients are characterized by enhanced variability, prolonged movements, and a lower range of motion in the shoulder and elbow joints, compared with healthy subjects or the non-affected side [2−7]. The higher movement variability suggests that stroke patients are not able to stably perform reaching movements when asked to repeat them several times. In other words, stroke patients assume kinematically unstable reaching patterns, and the trajectory varies during repetitive reaching movements. Electromyography (EMG) studies identified muscle activation abnormalities in stroke patients, such as prolonged agonist bursts associated with reduced speed during elbow flexion and extension [8], simultaneous co-contraction of agonist and antagonist muscles [9−13], and abnormal muscle tone [14]. Muscle synergy and spasticity in stroke patients generate specific movement patterns [15, 16]. Most studies characterized the patients using

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integral EMG data and the ratio of agonist/antagonist muscle contraction, which provided useful information on muscle combination, synergy, and spasticity. These approaches identified the relation of the muscle groups affected by a stroke during typical synergy patterns (e.g., co-contraction) [15, 16], but the characteristics of specific muscles remain unclear. It is important to clarify this point to enable physical and occupational therapists to target specific muscles when treating post-stroke patients for unstable reaching movements.

The aim of this kinetic study was to analyze the characteristics of reaching movements in stroke patients. This hypothesis was tested by conducting EMG experiments comparing the variability in muscle activity during repetitive reaching movements in hemiplegic patients and healthy subjects. We hypothesized that specific muscles contribute to the variability in reaching movements, and that their activity correlates with the severity of motor dysfunction.

Methods

Subjects

The subjects were patients treated at Rehabilitation Hospital (Saitama, Japan) for a stroke. Those included in the study (hemiplegic group) met the following criteria: (1) no serious cognitive deficit; (2) a Mini-Mental State Examination (MMSE) score > 24; (3) no marked contracture affecting performance during a reaching task; (4) the absence of paralysis that would prevent the subjects from completing a reaching task; and (5) right arm dominance. The patients with a lesion located in the cerebellum or brainstem were excluded because the symptoms produced by such lesions are atypical in comparison with those in other areas. Subjects were recruited in a rehabilitation hospital.

We studied 21 right-handed stroke patients with left-sided hemiparesis (hemiparesis group, mean age: 57.0 ± 0.8 years, 19 men, two women) and 14 right-handed healthy control subjects (control group, mean age: 53.7 ± 10.7, seven men, seven women). All subjects gave their written informed consent. The protocol was in accordance with the Declaration of Helsinki and approved by the Ethics Committee. Table 1 presents demographic data for participants.

Experimental Procedure

The experimental design is described in Fig. 1. Each subject was seated on a chair in front of a table, with the trunk immobilized by a set of straps. On the side affected by the stroke, the hand and forearm were immobilized using a splint device. An acrylic board was placed on the table underneath the arm and was coated with silicon spray to decrease friction between the board and the splint. Each reaching task were initiated from a starting point (30° of abduction, 10° of shoulder extension, and 100° of elbow flexion) to a target point (30° of elbow flexion on the sagittal-horizontal axis). A circular tag was placed at the start and target points. The data were collected using laser sensors (LV21-A, Keyence Corp., Japan) located at the start and target points on the other side of the table.

Table 1. Demographic data of all subjects and clinical score of the hemiplegic subjects.

ID	Age	Sex	Duration of disease (Month)	MMSE	FM
H1	47	M	12	30	13
H2	57	M	13	30	25
H3	57	M	15	30	23
H4	48	M	5	30	34
H5	35	M	4	30	34
H6	64	M	10	25	25
H7	67	F	3	25	15
H8	63	M	5	30	29
H9	70	M	4	25	10
H10	63	M	4	27	5
H11	43	M	4	30	21
H12	59	M	3	30	12
H13	51	M	2	29	36
H14	62	M	7	30	22
H15	43	M	3	27	6
H16	67	M	5	30	30
H17	70	M	4	30	5
H18	56	M	6	30	19
H19	49	M	4	28	27
H20	61	M	4	25	10
H21	65	F	3	30	33
C1	42	F	–	–	–
C2	57	M	–	–	–
C3	56	F	–	–	–
C4	33	M	–	–	–
C5	34	M	–	–	–
C6	57	F	–	–	–
C7	63	F	–	–	–
C8	68	M	–	–	–
C9	61	M	–	–	–
C10	51	M	–	–	–
C11	52	F	–	–	–
C12	61	F	–	–	–
C13	64	M	–	–	–
C14	53	F	–	–	–
Mean ± SD	55.7 ± 10.2		5.7 ± 3.6	28.6 ± 2.0	20.7 ± 10.2

H: Hemiparesis group, C: Control group, M: Man, F: Female, MMSE: Mini-Mental-State Examination, FM: Fugl-Meyer Assessment of Sensorimotor Recovery After Stroke Score

Each task consisted of the subject attempting to move from the start point to the target point, and back to the start point. The length of each task was determined

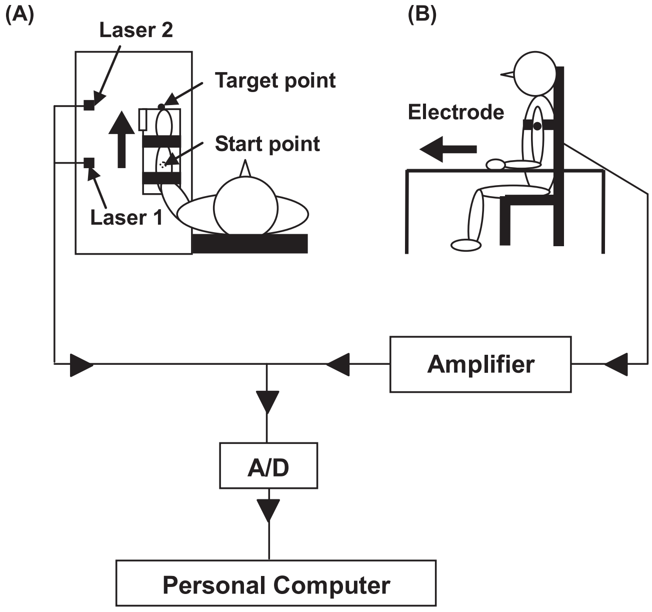

Fig. 1. Illustration of the experimental setup: (A) horizontal plane view, (B) sagittal plane view.

by the signal received by the laser sensor positioned at the start point (Laser 1). The subject was confirmed to reach the target point by a signal from the laser sensor at that point (Laser 2). During the reaching movement, the subjects began to move their forearm slightly before the starting point, pass over the target point, pull back their forearm and pass over the starting point. At the starting and target point, the subjects were instructed to make the pass-over distance less than a few centimeters.

Previous studies on healthy subjects analyzed reaching tasks using a ballistic movement [4, 5]. However, daily life seldom requires one to reach for something quickly. Therefore, our subjects were asked to perform the reaching task at a comfortable speed that they determined during preliminary trials. They repeated the reaching task 10 times with a few minutes of rest after each task. This task was not heavy, but we decided the length of the muscle recovery period was about 2 minutes by subject's subjectively opinions in our preliminary tests.

EMG Recordings and Analysis

Surface EMG recordings from the left upper extremity were obtained using active electrodes (DE-2.1, Delsys Inc., USA). The six muscles targeted were the pectoralis major, the anterior, middle, and posterior deltoid, as well as the brachii muscles of the biceps and triceps. The electrodes were placed at the center of the belly of each muscle. Before attaching the electrodes, the skin surface was abraded with Nuprep Skin Prep Gel (Weaver and Company, USA), and rubbed with alcohol. The position of the electrodes was verified by the examination of the EMG activity on a computer monitor during preliminary tasks [17].

The sampling frequency of the EMG signals was 1000 Hz. An EMG amplifier (Bagnoli2, Delsys Inc., USA) was used to record the EMG activity. The signals were digitized using a NR-2000 (Keyence Corp., Japan) and recorded on a computer. The signals from laser sensors were recorded to measure the analysis period.

The data were analyzed using the method described by Kaneko [18]. The EMG signals were filtered offline (bandwidth ranging from 10 to 500 Hz) using the Butterworth filter to calculate the average rectified value (ARV) using LabView version 7.1 (National Instruments Corp., USA; Fig. 2). For experiments comparing the stroke group to the control group, the ARV and analysis period needed to be normalized. We could not adapt the usual normalization method (e.g., Maximal Voluntary Contraction). Therefore, the ARV was normalized using the maximum ARV value of all 10 reaching tasks and the analysis periods. The EMG signals of each task were interpolated by spline transformation using MATLAB version 7.0.1 (MathWorks Inc., USA). Then, the number of representing data was fixed as 1000 points. Because all subjects took more than 1 second to complete the task, the method of interpolation for all trials was downsampling. The amplitude of the ARV and the time were normalized in this manner (normalized ARV; nARV). The standard deviation of the nARV was calculated at each point for a total of 10 tasks (nARV standard deviation; nARV-SD). The variability of the average EMG of each muscle was defined as the average nARV-SD (nARV-SDave) for the 10 normalized reaching periods recorded sequentially.

Clinical Evaluation

The motor function of the affected arm was evaluated using the Fugl-Meyer assessment method of sensorimotor recovery after the stroke test [19]. The scores ranged from 0 (severe deficit) to 66 (no detectable deficit). In this study, we used a variant of the Fugl-Meyer test (FM) designed for upper extremity functions.

Statistical Analysis

The unpaired t-test was used to compare the control group and hemiplegic group for the nARV-SDave values of each muscle. Spearman rank-order correlation was used to analyze the relationship between nARV-SDave values and FM score for each muscle. SPSS 22.0 was used for statistical analysis. The significance level of all statistical comparisons was set at $p < 0.05$.

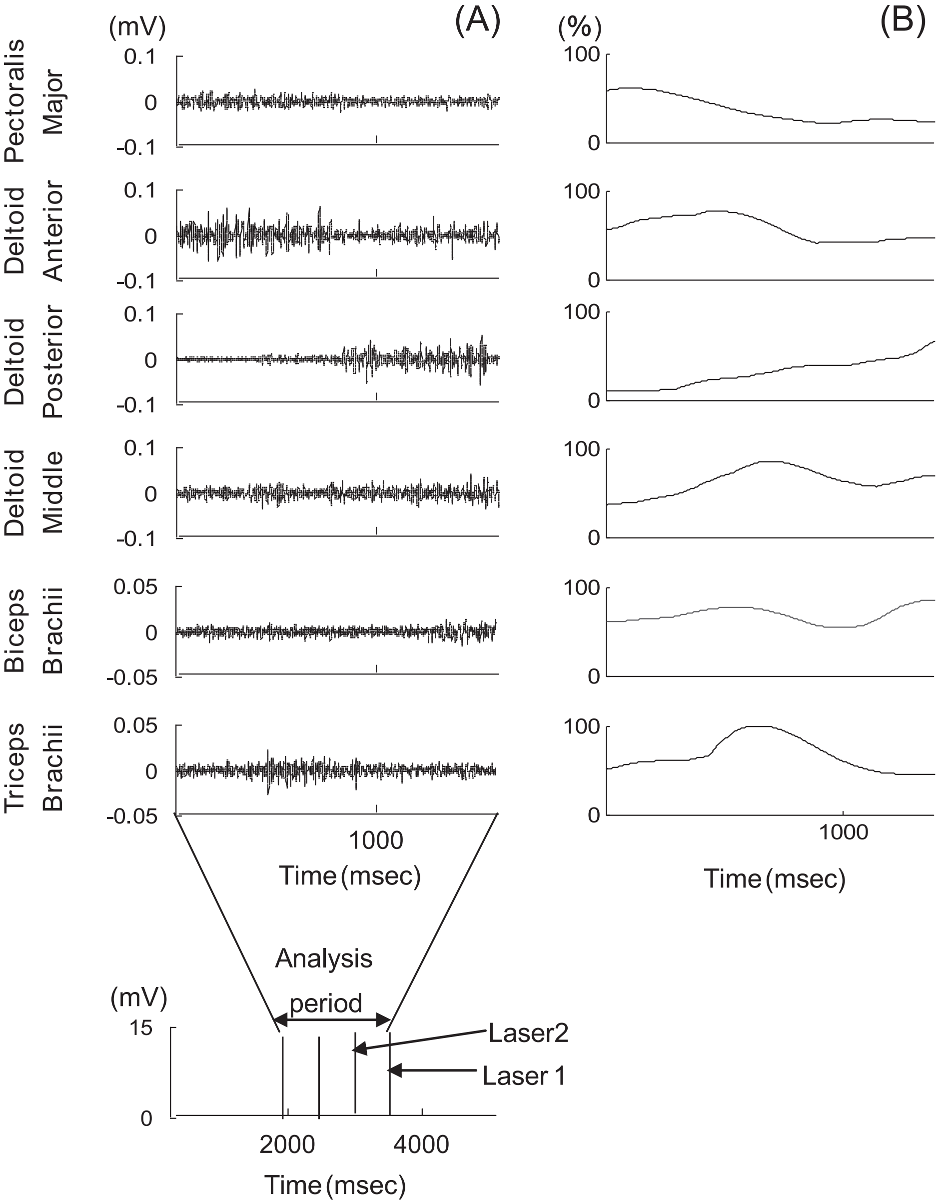

Fig. 2. Electromyogram (EMG) raw data recorded from the shoulder and elbow muscles of a normal subject (ID number C1) during each reaching task (A). Curved line indicates the normalized average rectified value (nARV) (B).

Results

Typical Subjects

Typical nARV curves are presented for one subject of the control group (Fig. 3) and the hemiplegic group (Fig. 4). The superimposed nARV curves were processed from the raw EMG data recorded during each of the 10 reaching tasks to show the variability in EMG values (Figs. 3A and 4A). The nARV-SD calculated from each nARV are presented in Fig. 3B and 4B. FM scores for each subject are presented in Table 1. The nARV curves of the typical control subject (Fig. 3) were less variable than those of the typical hemiplegic subject (Fig. 4).

Comparison of nARV-SDave between the hemiplegic and control groups

The two groups were compared for the mean nARV-SDave values of the six muscles. Significant differences in nARV-SDave between the two groups were identified by two-way ANOVA. The multiple range tests indicated that the nARV-SDave values of the biceps and triceps brachii were significantly higher in the hemiplegic group than in the control group (Fig. 5, $P < 0.05$). In contrast, no significant difference was observed between the groups for the other four muscles tested.

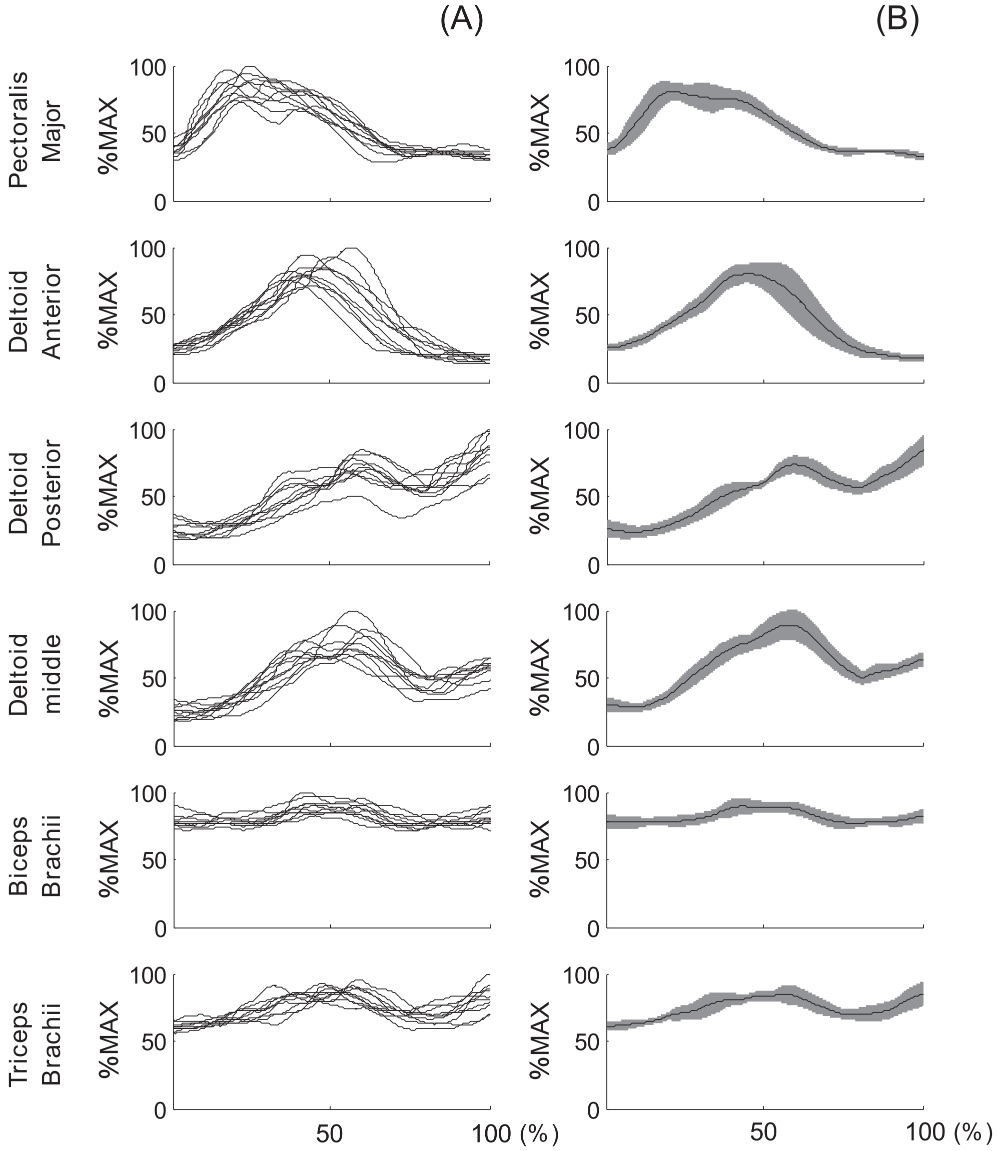

Fig. 3. Normalized average rectified value (nARV) for a typical subject of the normal group (ID number C2). (A) Superimposed nARV. (B) Averaged curve of the nARV (nARVave) with the standard deviation (nARV-SD) shown as the grey area.

Correlation between nARV-SDave and FM scores

The hemiparesis group was further evaluated for the relationship between nARV-SDave and FM scores for each muscle group (Fig. 6). Strong negative correlations were observed in all muscles.

Discussion

We used EMG recordings to distinguish the muscle activities during kinematically unstable repetitive reaching tasks. It has been emphasized that EMG is the most appropriate method to measure motor function, because it has high clinical significance [9−13, 15, 16, 20]. Integral EMG (IEMG) [14] and co-contraction ratio (CCR) [16] have been suggested to determine the co-contraction ratio between muscles. In recent years, partially linear decomposition methods, such principal component analysis (PCA), linear independent component analysis (ICA) [21, 22], and nonnegative matrix factorization (NMF) [23], are often used to investigate the relation between cortical activation (electroencephalography) and movement (EMG). They are useful to detect interactions between the central nervous system (CNS) and muscles. Whereas these new methods are useful to study muscle–muscle (e.g., co-contraction and synergy) or CNS–muscle interactions, these studies could not compare the variability in activities of each muscle type during repetitive reaching task. Therefore, the selective increase in variability in brachii muscle activity during repetitive reaching movements, identified in the present

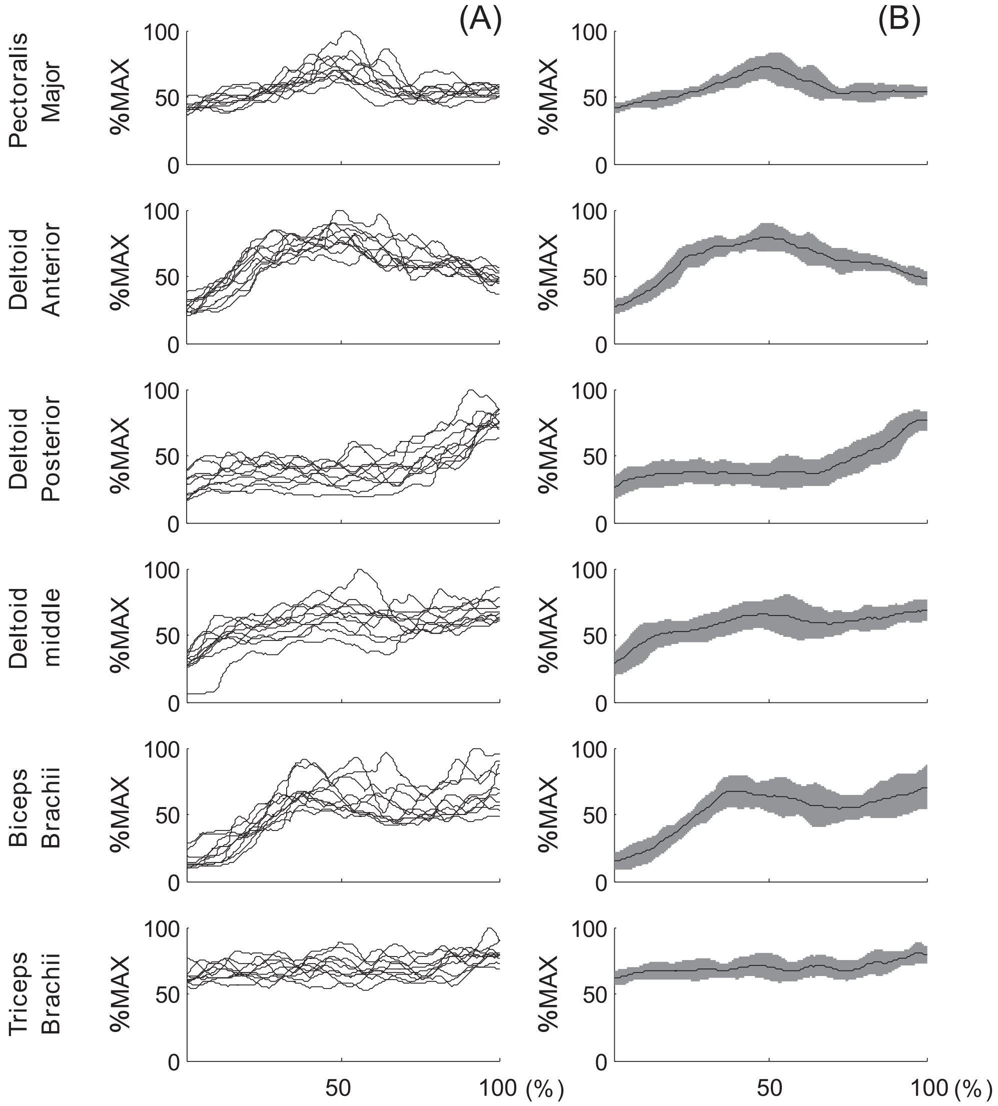

Fig. 4. Normalized average rectified value (nARV) for a typical subject of the stroke group (ID number H1). (A) Superimposed nARV values. (B) Averaged curve of the nARV (nARVave) with the standard deviation (nARV-SD) shown as the grey area.

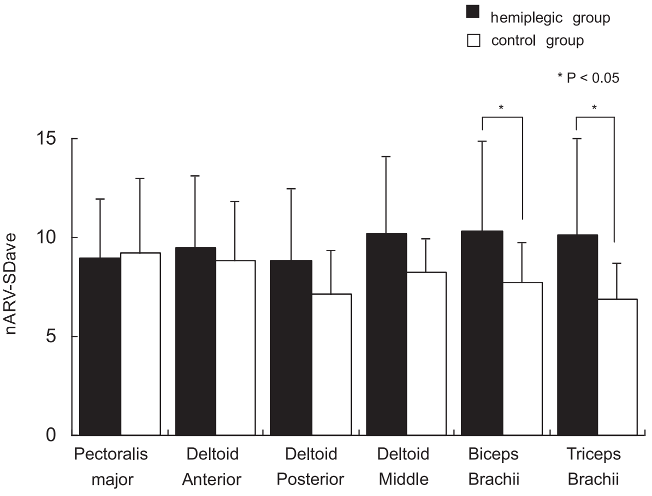

Fig. 5. Identification of the arm muscles responsible for reaching movement variability in post-stroke patients.

study, has high clinical significance.

The strong negative correlations between the nARV-SDave of all six muscle types and the FM score of the post-stroke patients clearly indicate that a severe deficit in motor function is associated with highly unstable muscle activities during repetitive reaching movements. Previous studies showed that the characteristics of reaching movements in stroke combine unstable trajectory and velocity [2–7]. These characteristics indicate that the continuous and smooth movement strategy used during reaching activities is lost in post-stroke patients [2]. The present study suggests that the variability in muscle activity may explain the unstable movement reported in previous kinematic studies [2]. Our results support the notion that the variability in muscle activity relates to unstable movement.

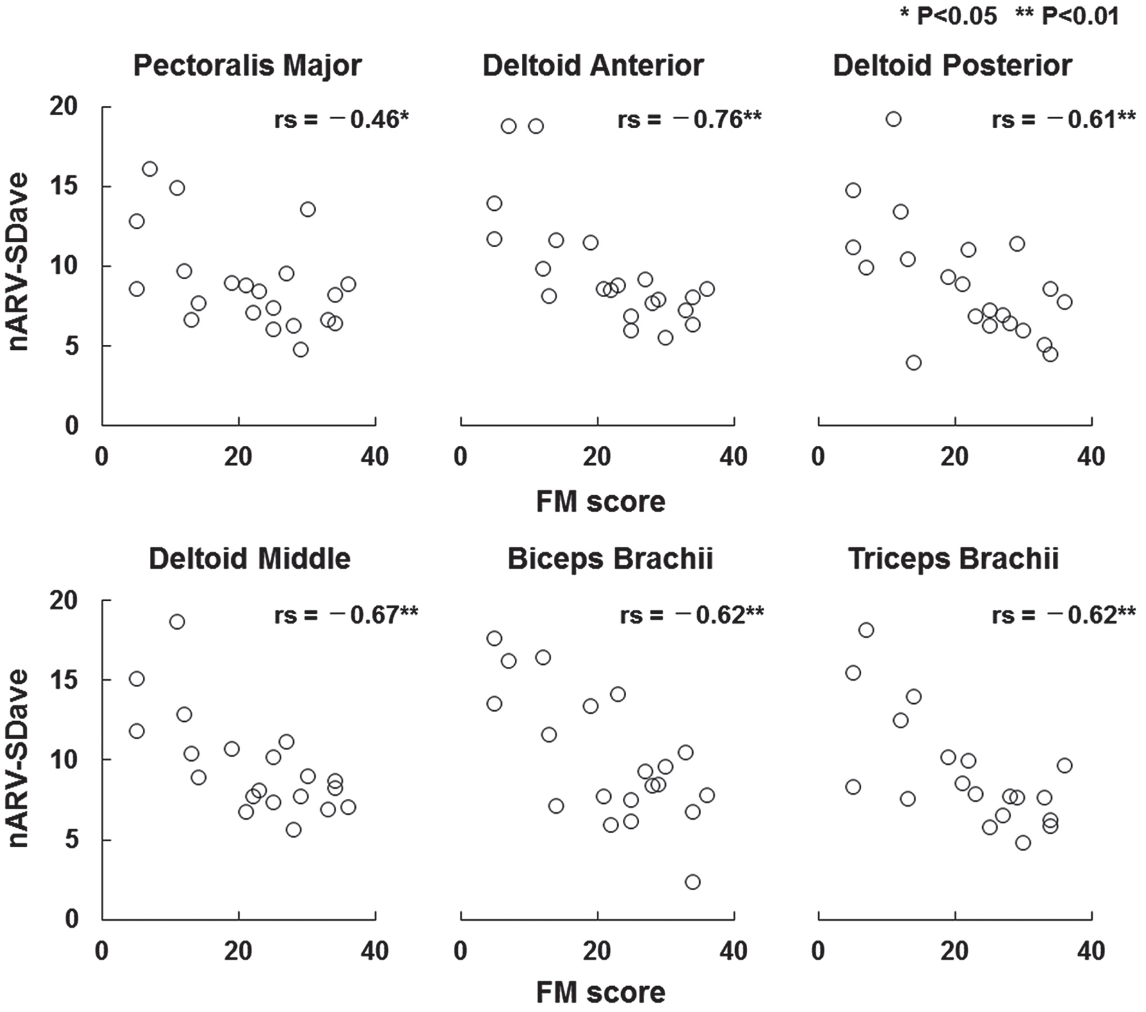

Fig. 6. Relationship between the nARV-SDave values and FM scores of each muscle in the hemiplegic subjects.

It should be emphasized that measurements of muscle activity using EMG have a high clinical significance from the viewpoint of variability. Because motor impairment in the upper extremity is the most frequent stroke complication, therapists make considerable efforts to target abnormal muscle activities. Furthermore, the present study proposes a promising method to objectively assess hemiplegic upper extremities to avoid unreliable assessments, such as the FM score, as pointed out by [16] Despite these facts, such subjective assessment methods are the most widely used in clinical settings [19, 25]. Although these clinical assessments are very useful to roughly estimate motor disorders, they cannot clarify multiple muscle activities in detail. Consequently, the reliable EMG measurements presented herein clarify the characteristics of variability in muscle activity in post-stroke patients.

The selective impact of a stroke on the activities of biceps and triceps brachii is intriguing. Previous studies used reaching tasks that involved pointing a forward spatial target [4, 5]. Because these tasks required lifting the upper extremity, the deltoid played a major role to hold the arm up against gravity. However, our study adopted a reaching task requiring the subjects to slide their forearm on a table with reduced friction. Therefore, the subjects could complete the task even if they had serious upper extremity paresis limiting their ability to raise their arm against gravity. During our task, the prime mover muscles were likely the biceps and triceps brachii, rather than the deltoid. A previous study compared muscle activation patterns during reaching and retrieval movements with and without gravity compensation, and the data showed that the level of muscle activity was lower with gravity compensation [26]. These results are consistent with our reasoning that the sliding task would predominantly engage the bicep and tricep muscles.

The comparable deltoid and pectoralis major activities of the hemiplegic and control groups suggest that unstable muscle activity might exist in control subjects during repetitive reaching movements. These findings may be related to Bernstein's problem, whereby more than one motor signal can lead to the same trajectory of a given motor system and identical motor signals can lead to different movements under non-identical initial conditions or in the presence of variations in the eternal force field [27, 28]. The hypothesis supporting the concept of degrees of freedom to motor control is that the principal problem faced by the central nervous system is the large number of joints and muscles in the human body and the infinite combinations of muscle action [27, 29]. In stroke subjects, kinematic variability may be due to unstable muscle activity during a single reaching movement. In the post-stroke subjects, the trajectory was fluctuating during repetitive reaching movements owing to variability in muscle activity. In control subjects, kinematic variability may be due to difficulties in reproducing exactly repeated muscle activities. Although muscle activity remains stable during each reaching movement, the combination of muscle activity is not constant between repetitions. Normally, coordination between muscle types (synergy) decreases the kinematic variability even if the variability in muscle activity increases, a mechanism lost in hemiplegic subjects.

Conclusion

We report the existence of variability in muscle activity during repetitive reaching movements in hemiparesis subjects. A significant negative correlation was established between the variability in muscle activity and the clinical score. The use of EMG analysis may be useful to clinically assess the variability in muscle activity.

Conflicts of Interest
The author declares no conflict of interest.

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REVIEW

Influence of interaction among the elderly through amusement on their physiological function: One-month introduction at a day care service center for the elderly

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Abstract: Objective: Amusement was introduced for one month and interaction among the elderly and its influence on their physiological function and sleep were investigated. **Methods:** The subjects were 9 elderly females (age: 89.0 ± 4.7 years old) who periodically visited a day care service center for the elderly. The survey was performed between October 2015 and December 2015. For the amusement, Blackjack was introduced. The survey period was comprised of 3 amusement introduction periods: pre-amusement, and one week and one month after amusement introduction. In each period, the heart rate (HR), sympathetic nerve activity (CSI), and parasympathetic nerve activity (CVI) were measured during amusement, and the difference in the salivary amylase level between before and after amusement was determined. The sleep efficiency and sleeping hours were measured at night of the days with amusement. Repeated measures one-way ANOVA was performed regarding the survey period as a factor and HR, CSI, CVI, sleep efficiency, sleeping hours, and difference in the amylase level as dependent variables. **Results:** Significant amusement-induced changes were noted in the CVI and salivary amylase level. These were significantly lower at one month after amusement introduction than those in pre-amusement. **Conclusion:** Amusement-induced laughing and regret or interaction through the amusement influenced their autonomic nerve system and they may have felt comfortable.

Keywords: amusement, sympathetic nerve activity, parasympathetic nerve activity, salivary amylase

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Introduction

The 65-year-old or older population exceeded 30 million with rapid aging in Japan. It is predicted to peak with about 39 million in 2042 and the 75-year-old or older population will continuously increase thereafter. The Ministry of Health, Labour and Welfare promotes construction of the Integrated Community Care System targeting 2025 [1], and how to prevent a need-for-nursing care state in the elderly is an urgent issue. Regarding the prevention of nursing care, improvement of sociality of the elderly, such as an increase in conversation with emotional changes by interaction through conversation employing the life review/reminiscence therapy, and subsequent improvement of nighttime sleeping hours have been reported [2−4]. In addition, prevention of nursing through amusement devices has recently been attracting attention, and improvement of the motor function by using amusement devices has been reported [5]. Matsuguma et al. performed research and development of a game machine for standing up-

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sitting down training, and investigated the influence of the entertainment value of the game on the positiveness of patients/users and improvement of persistence. Specifically, fatigue strength was significantly decreased by voluntary training with the game on subjective evaluation, and the subjects tended to consider that 'I want to do it again' and 'it was fun', showing a positive attitude [6]. It was suggested that 'pleasant stimulations', such as 'enjoying' and 'having fun', which are entertainment values of amusement, increase motivation, positiveness, and activeness, influencing improvement of the motor function. Regarding communication through the game, they reported that new communication between patients and rehabilitation staff and among patients were constructed [6, 7]. It was suggested as described above that amusement increases motivation and positiveness, promotes activeness, and produces new communication [6, 7]. However, no study on the physiological function demonstrating 'pleasant stimulation' by interaction through amusement has been performed, or the effect of this 'pleasant stimulation' on sleep.

In preceding studies on mental stress, analysis of the endocrine system or heart rate variability was used as a physiological index of stress analysis [8, 9]. Yamaguchi et al. focused on salivary amylase as a new index of sympathetic nerve activity. They clarified that salivary amylase may serve as a stress index responding more rapidly than cortisol, and unpleasant stimulation elevates salivary amylase activity and inversely, pleasant stimulation decreases it, showing a possibility to distinguish comfort and discomfort based on salivary amylase [10, 11].

Shimizu et al. investigated 'laughing stimulus'-induced changes in physiological indices, and suggested that stress was reduced by laughing based on the salivary amylase level, and sympathetic nerve activity was enhanced while being stimulated with laughing, followed by enhancement of parasympathetic nerve activity, and returning to the resting state [12]. Takada et al. performed intervention of the elderly with 'pleasant conversation', and observed that it was appropriate for intervention of the elderly because its physical and mental burdens were small, and fulfillment of the mind and the effect of relaxation were observed after the conversation [13]. However, all these were transient effects of short-time intervention, and the effect of long-term intervention was not investigated. A long-term effect is necessary from the viewpoint of preventing needs for nursing. In addition, these studies used the low frequency (LF) component of spectral analysis of heartbeat R-R interval, which is an index of parasympathetic nerve enhancement, and LF/high frequency (HF) component, which is an index of sympathetic nerve enhancement, as indices of autonomic nerve activity [12, 13]. However, to estimate autonomic nerve activity by spectral analysis, it is essential to have uniform respiration to a specific depth during measurement of cardiac cycle data [14], and Sawada pointed out that spectral analysis of the R-R interval of heartbeats is not appropriate to trace reflections of sympathetic nerve activity of the heart [15]. In such a background, Toichi et al. found a method to evaluate cardiac autonomic nerve activity based on heartbeat R-R interval data using the Lorentz plot. They stated that this method is capable of evaluating sympathetic and parasympathetic nerve activities individually, which has been difficult using spectral analysis, and its usefulness has been reported [16].

Thus, we intervene in interactions among the elderly through one-month amusement, and investigated time-course changes in the autonomic nerve activity calculated using the Lorenz plot and salivary amylase level and the influence on sleep.

Materials and Methods

Subjects

The subjects were elderly females (age: 89.0 ± 4.7 years old) who periodically visited a day care service center for the elderly in Japan. The level of care needed was between Support Need 2 and Long-Term Care 2. Regarding ADL, the Barthel Index (BI) [17] was 87.2 ± 11.2, requiring support/assistance to some extent, but the grade of independence was high (Table 1). The cognitive function was evaluated using the Mini-Mental State Examination (MMSE) [18]. The score was 26.8 ± 2.6, and it was lower than 23 in 2 subjects, but their scores correspond to mild on the severity judgment [19].

Table 1. Basic attributes of the subjects

		n	mean	SD
Gender	Female	9		
Age (years)			89	(4.7)
Level of care needed	Support Need 2	3		
	Long-Term Care 1	4		
	Long-Term Care 2	2		
BI (point)			87.2	(11.2)
	90–100	5		
	70–85	4		
MMSE (point)			26.8	(2.6)
	≤ 23	2		
	27–24	2		
	28–29	5		
K6 Scales (point)			4.3	(3.8)
	≤ 4	6		
	5–10	3		

For evaluation of mental stress, the Japanese version of the Kessler Psychological Distress Scale (K6) [20] was used. Reliability and validity of social survey using K6 have been evaluated in Japan. The score range of K6 is 0−24, and mental stress increases as the score increases. A recent study proposed a cut-off value of 10 or higher for mood/anxiety disorder in the Japanese version [21], in which the score of the subjects was 4.3 ± 3.8 including 2 subjects with a score of 10, but no marked change in the cognitive function, words, or behavior suggesting serious depression was noted throughout the survey period (Tables 1 and 2). Of 15 subjects to whom the study content was explained beforehand and consent was obtained, 9 subjects in whom saliva could be collected and the sleep condition could be measured were included in analysis. This study was conducted with the approval of the Research Ethics of Hiroshima University (approval number: E-318), conforming to the Declaration of Helsinki.

Survey items

The survey was performed from October 2015 to December 2015. The survey period was comprised of 3 amusement introduction periods: before amusement introduction (pre-amusement), and one week and one month after amusement introduction. In each period, the heart rate (HR) and autonomic nerve activity were measured, saliva was collected, and the sleep condition was measured.

Amusement

Blackjack was introduced. Staff of the day care service center for the elderly served as a dealer, and the subjects were players. In Blackjack, the dealer and players match games. The basic rule is that players collect cards so as to make the total score close to but smaller than 21 and greater than that of the dealer. Regarding the card score, ‘A’ was scored 1 or 11 (whichever convenient), and ‘2−10’ cards were scored as their numbers, respectively. Since numbers printed in the designs of trump cards are small, reading and calculating the numbers are difficult. Thus, the card designs were removed and only numbers were printed (Fig. 1). To increase activeness, cards were spread and the players picked up cards for the game (Fig. 2b), the dealer did not distribute cards (Fig. 2a).

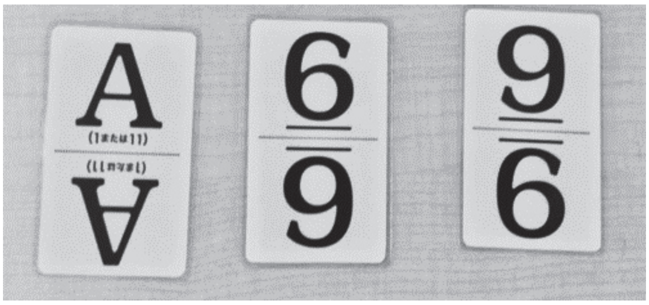

Fig. 1. Cards labeled with an only a letter or number.

Measurement of heart rate and autonomic nerve activity

HR and changes in the autonomic nervous system on heart rate variability analysis were measured from before amusement to after amusement using a wearable heartbeat sensor, WHS-1 (UNION TOOL Co.) directly applied to the chest with a Blue Sensor (METS Inc.) electrode pad. The amusement time was 13:30−14:30, and data were collected during this period in all amusement introduction periods. Based on the R-R interval data measured in 60-minute electrocardiography, HR (number of beats/min) and the indices of sympathetic (CSI: cardiac sympathetic index) and parasympathetic (CVI: cardiac vagal index) nerve activities were calculated using the Lorenz plot analysis program [22]. In this Lorentz plot, the measured values of continuous heartbeat R-R intervals were presented as I_1, I_2, …, I_n.

Table 2. Association between the amusement introduction period and heart rate, autonomic nervous system, sleep condition, Kessler Psychological Distress Scale (K6 Scales) (n=9)

	Pre-amusement		One week after amusement introduction		One month after amusement introduction		p-value
	Mean	SD	Mean	SD	Mean	SD	
HR (/min)	75.3	(6.1)	73	(3.3)	79	(7.9)	0.052
CSI	1.3	(0.2)	1.3	(0.4)	1	(0.1)	0.208
CVI	6.0^{*a}	(0.5)	5.9	(1.0)	5.4^{*a}	(0.5)	0.059
Sleep efficiency (%)	90	(6.1)	92.7	(3.4)	91.4	(4.9)	0.262
Sleeping hours (min)	420.2	(80.4)	421.4	(118.6)	470.6	(70.7)	0.134
MMSE (point)	26.8	(2.6)	25.4	(1.9)	27.0	(2.3)	0.148
K6 Scales (point)	4.3	(3.8)	3.6	(3.9)	4.1	(4.8)	0.712

p value: repeated measures one-way ANOVA
*a: pre vs 1month, $p = 0.004$ by Bonferroni

a: Distribution of cards by the dealer

b: Withdrawal of cards by players

Fig. 2. Card distribution method in the amusement.

Heartbeat R-R intervals of I_k were plotted on the horizontal axis and those of $I_k + 1$ were plotted on the vertical axis, and the plots are distributed in an oval pattern with straight line $I_k = I_k + 1$ as a longitudinal axis. The major axis component L (horizontal to the line $I_k = I_k + 1$) and minor axis component (vertical to the line $I_k = I_k + 1$) were calculated, and the L/T ratio was regarded as the CSI value and the area value of L and T, $\log(L \times T)$, was regarded as the CVI value [16]. An increase and decrease in the CSI value indicate promotion and suppression of sympathetic nerve activity, respectively. An increase and decrease in the CVI value indicate promotion and suppression of parasympathetic nerve activity, respectively.

Measurement of change in the salivary amylase level

Saliva was collected between 11:30 and 12:00 before lunch and between 14:45 and 15:00 after amusement. To collect saliva samples for measurement, the subjects held a swab in their mouth for 3 minutes (a maximum of 5 minutes) using Salimetrics Oral Swab (Salimetrics LLC). Saliva was separated from the swabs by centrifugation at 3,500 rpm for 15 minutes and frozen. For the measurement, the BG5 PNP method (corresponding to JCCLS) was used. The salivary amylase level before amusement was subtracted from that after amusement in all periods, and changes were determined. There are several amylase measurement methods, such as enzyme and blue starch methods. The standard value is different among the measurement methods and individual variation is large [23]. Since changes in individuals were investigated in this study, the change was determined by subtracting the amylase level after the amusement from that before the amusement.

Measurement of sleep condition

The sleep condition was measured at night on the day the subject performed amusement. They wore Actiwatch Spectrum Plus (Philips Respironics GK) on their wrist from 15:00 to pick-up time on the following morning. Body movement and ambient light were subjected to quantitative analysis using Actiware, and the sleep efficiency (%) and sleeping hours (min) were calculated.

DATA ANALYSIS

The means and standard deviations of HR, CSI, CVI, sleep efficiency, sleeping hours, and change in the amylase level in the amusement introduction period (pre-amusement and one week and one month after amusement introduction) were determined. Repeated measures one-way ANOVA was performed regarding the period as one factor and HR, CSI, CVI, sleep efficiency, sleeping hours, and difference in the amylase level as dependent variables. For multiple comparison, the Bonferroni method was used. The normality of HR, CSI, CVI, sleep efficiency, sleeping hours, and the change in the amylase level were confirmed using histograms and the Kolmogolov-Smirnov test ($p = 0.200$). Statistical analysis was performed using EZR Ver 1.32 [24] setting the significance level at $p < 0.05$.

Results

Significant differences among the amusement introduction periods were observed in CVI (Table 2, repeated measures one-way ANOVA): The value at pre-amusement was 6.0 and that at one month after amusement introduction was 5.4, showing a significant decrease. The heart rate, CSI, sleep efficiency, and sleeping hours were not significantly different. The change in the salivary amylase level was significantly different among the amusement introduction periods (Fig. 3, repeated mea-

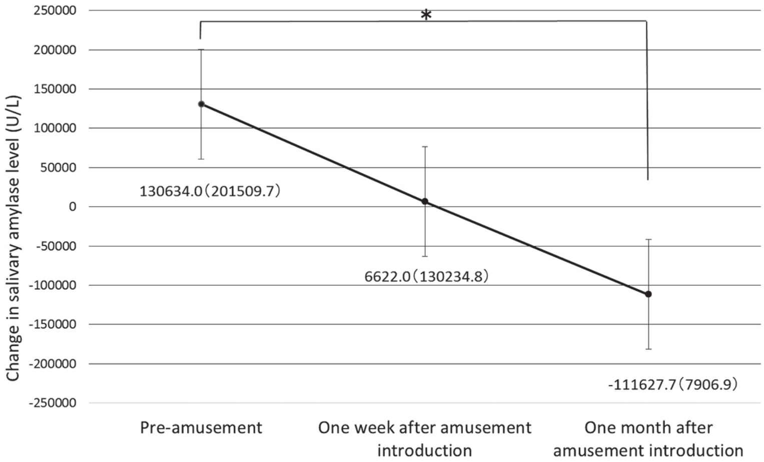

Fig. 3. Association between the amusement introduction period and change in the salivary amylase level.
Change in salivary amylase level = after amusement salivary amylase level - before amusement salivary amylase level Mean (SD)
Repeated measures one-way ANOVA: $p = 0.010$
*: pre vs 1month, $p = 0.035$ by Bonferroni

sures one-way ANOVA). The values at pre-amusement and one month after amusement introduction were 130,634 and −111,627 U/L, respectively, showing a significant decrease at one month.

Discussion

The amusement introduction period and CVI showed a significant association, and CVI was significantly lower at one month after amusement introduction than that at pre-amusement (Table 2). The results of this study were consistent with those of previous reports [12, 13, 25], but these studies investigated the effect of short-time intervention, whereas our study introduced amusement and followed the subjects for a long period, which initially clarified the association between amusement and parasympathetic nerve activity. Regarding sympathetic nerve activity, no association with the amusement introduction period was noted. In the amusement, Blackjack, the cards were shuffled by the subjects before the game, the cards were distributed, and the number of chips was determined from the distributed card. The subjects calculated the sum of the 1st and 2nd cards in their head to decide on pulling the 3rd card. These processes may include many stress stimulations required for active processing. Cardiovascular response to stress stimulation includes active and passive copings [26]. Positive coping means actively confronting stimulation, such as competition in mental arithmetic and reaction time, i.e., active challenge and competition in response to stimulation that one can deal with. In passive coping, one cannot move, remaining in a passive attitude against stress stimulation and continue to pay attention and surveillance [15]. Sympathetic nerve activity is promoted and parasympathetic nerve activity is suppressed in a situation requiring active coping whereas sympathetic nerve activity is suppressed and parasympathetic nerve activity is promoted in a situation requiring passive coping [26]. Therefore, active coping during the amusement may have suppressed parasympathetic nerve activity, resulting in a low CVI value. On the other hand, it has been reported that ‘laughing stimuli’ of comic dialogues stimulate and enhance both sympathetic and parasympathetic nerve activities, and the mean parasympathetic nerve activity level was inhibited while being stimulated [25], in which the subjects did not constantly receive ‘laughing stimuli’ and changes also appeared in movements, such as instantaneous ‘laughing’, ‘laughing aloud’, ‘laughing with body movement back and forth’, and ‘laughing holding one’s sides’ [25]. It was also reported that sympathetic nerve activity was significantly enhanced and parasympathetic nerve activity was significantly suppressed in subjects who felt a funny video as ‘funny’, compared with those in subjects who did not perceive the video as funny [27]. In addition, it has been suggested that ‘laughing stimulus’-induced enhancement of sympathetic nerve activity occurred while being stimulated with laughing, followed by enhancement of parasympathetic nerve activity and returning to a resting state [12]. In our study, instantaneous stimuli, such as laughing and regret, and resting, such as waiting for one’s turn and conversation, were repeated in the interactions during the amusement, suggesting that enhancement and suppression of sympathetic and parasympathetic nerve activities repeated. No significant association was observed between the amusement introduction period and sympathetic nerve activity. Averaging the total time performing the amusement may have influenced this. Considering that analysis averaging the entire range with stimulation investigates only a part of the characteristics in studies on 'laughter stimulation', Kobayashi tried to investigate time-series data to qualitatively analyze the characteristics of response to 'laughter stimulation' in individual data [25]. We may also have been able to closely analyze changes in sympathetic and parasympathetic nerve activities during the amusement by time-series analysis, such as 'immediately after initiation of the amusement' and '10 minutes after initiation of the amusement'.

Our study did not aim at evaluation of the amusement-induced autonomous nervous activity during a short period, but one-month intervention with the amusement may have suppressed parasympathetic nerve activity by promoting active coping behavior, and interaction through the amusement may have suppressed excess sympathetic nerve activity.

Significant differences were noted in the change in the salivary amylase level among the amusement introduction periods, and it was significantly lower at one month after amusement introduction than that at pre-amusement (Fig. 3). The interaction during the amusement may have given comfortable stimuli [10, 11, 28], and reduced the salivary amylase level. There are 2 control mechanisms reducing the salivary amylase level: The sympathetic nervous-adrenal medullary system (SAM system) inhibits norepinephrine release from the adrenal medulla through suppressing sympathetic nerve activity, and another system suppresses sympathetic nerve activity and directly acts on the nerve to inhibit enzyme secretion from the salivary glands, suggesting that one of these mechanisms induced the low amylase level [28]. Shimizu et al. reported that the salivary amylase level was significantly decreased by intervention with 'laughing stimuli', showing stress reduction by laughing: Laughing induced mental changes, such as reduction of negative emotion and feeling better, and these psychological changes were involved in the reduction of the salivary amylase activity level [12]. Based on these reports, the significant decrease in the change in the salivary amylase level during the amusement introduction period suggests that the subjects felt amusement-induced laughing and regret and interaction through the amusement comfortable.

Regarding the sleep efficiency and sleeping hours, no significant association with the amusement introduction period was noted, but the mean sleeping hours increased by about 50 minutes at one month after amusement introduction compared with that at pre-amusement (Table 2). The awake time in the bed becomes longer in the elderly [29, 30], and the sleep efficiency decreases [30]. Regarding treatment of insomnia in the elderly, it has been reported that dozing of elderly subjects at a nursing home can be prevented by setting a specific social activity [31], and an individual social activity program for residents with dementia at a nursing home improved the sleep efficiency and reduced nocturnal awakening [32]. Since the subjects of our study were users of day care services for the elderly, their sleep efficiency was originally high and the sleeping hours were long based on the sleep data, which may have resulted in the absence of significant association of sleep efficiency and sleeping hours with the amusement introduction (Table 2). However, the sleeping hours extended while maintaining sleep efficiency, suggesting that the interactions through the amusement positively influenced their sleep conditions at night.

Generalization of these study results may be problematic because the frequency of using a day care service center for the elderly varied among the elderly female subjects, but the internal validity of the results may have been high because they mostly stayed at home when they did not use the services. This study followed the subjects for one month and clarified the associations between the amusement introduction and parasympathetic nerve activity and salivary amylase.

Conclusion

Based on the physiological indices: heart rate, heart rate variability analysis, and salivary amylase, it was suggested that amusement-induced laughing and regret or interaction through the amusement influenced the autonomic nerve system and they felt comfortable.

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ORIGINAL ARTICLE

Gaze Analysis During Toilet Activity in Elderly People

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Abstract: Background: Toilet activity is performed every day with a physiological phenomenon so called "excretion", which is highly necessary. In this study, we used Eye Mark Recorder, a gaze analyzer, to analyze eye movement of elderly people during toilet activities. In addition, we compared the results with those obtained from a preceding study regarding toilet activities in young people.

Result: The toilet activity was divided into three phases: until they sit down, while they are sitting on the bowl, and until they leave the room. Until they sat down and until they left the room, they were looking at the entire environment in the toilet. While they were sitting on the bowl, however, they were mostly looking forward. A similar tendency was observed in young people as well. Furthermore, retention time, degree of dependence on the lower gaze, rate of recognition, as well as an association between the time required for movement and the degree of dependence on the lower gaze were investigated. The elderly people were far more likely to gaze toward the floor compared to the young people.

Conclusions: The results showed which areas the subjects had to look at during 3 toilet-activity phases in order to understand the spatial relation. In toilet activities of the elderly, the rate of gaze toward the floor increased probably due to aging, posture and decreased balancing ability. We will need to further investigate associations between the subjects' age, posture, balancing ability and the gaze during the toilet activities.

Keywords: gaze analysis, toilet activity, eye mark recorder

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Introduction

When someone makes decisions somehow in daily activities, there is an eye movement in advance [1]. It has also been reported that eye movement occurs 0.6 seconds before the activity [2], suggesting that there is a close relationship between activities of daily living and visual functions. Wilmut [3] stated that visual information is essential for controlling the limbs, and Crowdy et al. [4] reported on effects of visual control in patients with cerebellar symptoms or unilateral spatial neglect. Hence, we consider that the ability of activity of daily living would be increased or improved by analyzing and understanding the gaze observed before various movements.

The preceding studies regarding visual functions and daily activities include a study by Ehara et al. [5] on gaze behaviors in cooking activities, a study by Nito et al. [6] on association between visual and upper limb movements while eating with spoons and chopsticks, and a study by Suzuki et al. [7] on visual input during dressing activity in hemiplegia patients. In addition, Land et al. [2, 8, 9] reported studies regarding eye movement when making tea or measurement of eye movement when swinging a baseball bat to hit a ball. However, there is no report available on measurement of gaze in toilet activities.

Toilet activity is performed every day with a physiological phenomenon so called "excretion", which is highly necessary [10]. Suehiro et al. [10] reported that in addition to somatic, vestibular and auditory sensations, visual sensation also plays a significant role in toilet activity. Furthermore, Kimura et al. [11] stated that it is crucial to visually confirm toilet activity throughout the course from the time of taking them to the toilet until the end. In the preceding study [12], we analyzed gaze of young people during toilet activities. The results revealed that, their gaze was mainly in forward direction in both men and women although there was a slight dif-

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ference between them in terms of duration of gaze. We will need to further compare the data obtained from the elderly with those from young people.

For the gaze of the elderly while walking, Itoh et al. [13] reported that they had been mostly looking at the floor or around the feet and frequently gazing toward the floor. In addition, their duration of gaze to watch their steps was longer than that of young people. Itoh et al. [14] also reported that the elderly had relied on the central vision while walking and that their eye-movement range had been broader and stayed lower. These suggest that eye movement of the elderly during toilet activities would be toward the lower direction compared to that of the young people.

The objectives of this study were to reveal the gaze of the elderly during toilet activities and to investigate if there would be any differences between men and women or any features according to sex. The data obtained were further compared with those of young people measured in the preceding study and investigated to find out if there were any differences between the elderly and young people or features according to their age.

Method

Subjects

The subjects included 35 healthy elderly adults (hereinafter, the elderly; 17 men and 18 women, the mean age 68.8 ± 5.7 years old, using a nearby day-care nursing service center) who had no problem with eye moving in activities of daily living and had submitted oral and written informed consent. We excluded subjects who have problems with visual field or visual eyesight, subjects who could not understand instructions for motions, or subjects whose eye marks could not be detected.

Measuring device

In this study, we used a hat-shaped gaze analyzer, Eye Mark Recorder (Pupil Centre Corneal Reflection; EMR-8B, nac Image Technology), to measure gaze of elderly people. The device consists of a head unit, controller, Calibration cable, etc. (Fig. 1) and is able to output visual field images with eye mark signals on them. The visual field images were recorded using a digital cassette recorder (GV-HD700, SONY). In addition, the gaze measurements were performed on both eyes. The horizontal angle of the visual field camera lens was 115°. The sampling frequency was 60 Hz.

Method of measurement

The measurements were performed in a toilet room of about 1.62 m^2 in a nearby day-care nursing service center (Fig. 2). The subjects became familiar with the toilet environment and activities before wearing the Eye Mark Recorder in order to avoid the effects of experiences as much as possible. Then they wore the Eye Mark Recorder, and calibration was performed at the point 1m away from the toilet door. We observed their various gazes when they are at the toilet door and when they are sitting on the toilet bowl, and examined if there is any shift of eye marks. After calibration, subjects stood up from a chair and waited in front of the door. We recorded their gaze throughout the whole process of opening the door with a starting signal, simulating the movement of putting down the trousers, sitting down on the toilet bowl, sitting still for 5 seconds, and leaving the room. After recording, we analyzed the gaze with EMR-dFactory Ver.1.2 (nac Image Technology).

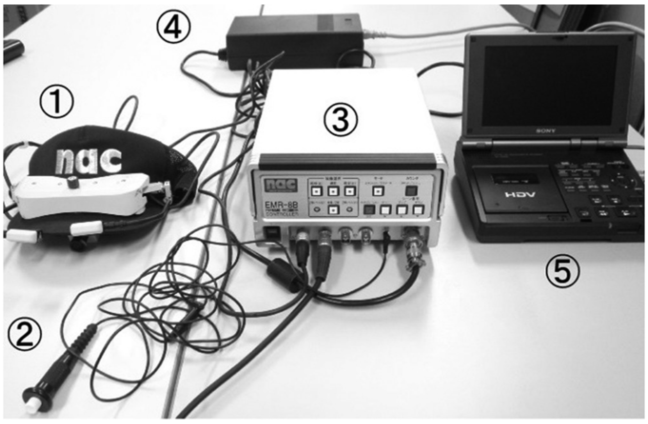

Fig. 1. Eye Mark Recorder System.
① Head Unit ④ AC adapter
② Calibration cable ⑤ Digital cassette recorder
③ Controller

Analysis method

The gaze was defined as a line connecting a gaze point and the central fovea of retina, and retention time was defined as the duration of time they are looking at the gaze point. We also defined the condition “one gazed at the point” as a situation where an eye mark stayed within the range of 9 degrees from a point for more than 200 msec. Upon analysis, toilet activity was divided into three phases: until they sit down, while they were sitting on the bowl, and until they leave the room, according to the excretion activity model proposed by Yada et al. [15] In each phase, (1) we extracted the gaze points in order to reveal where they were looking at, (2) calculated the rate of retention time in order to find where they were looking at the most (gaze duration/time required for activity × 100), and (3) calculated the sum of retention time for the gaze on the floor in each phase, using the

Fig. 2. Appearance of toilet room.

rate of retention time obtained in (2), as the degree of dependence on the lower gaze, (4) calculated the rate of recognition (number of subjects gazed/the total number of subjects × 100), on the basis of the study conducted by Katsura et al. [16], in order to find out what were the gaze points looked at by many people as they were crucial for activities, and (5) revealed the association between the time required for activities and the degree of dependence on the lower gaze.

In statistical analysis, Mann-Whitney U test was used in comparisons between elderly men and women for the rate of retention time and the degree of dependence on the lower gaze, as there had been non-normality included in the data. Meanwhile, χ^2 test was used in comparison for the rate of recognition. The association between the time required for activities in each phase or for a series of those in all 3 phases and the degree of dependence on the lower gaze was analyzed using the Spearman's rank correlation coefficient. The significance level was set to be < 0.05. After the tests, we investigated the difference between the elderly and young people from results obtained from the elderly men and women and those of young people.

This study was conducted with approval from the bioethics committee of Himeji Dokkyo University (No.12-04) and the ethical review board of Osaka Prefecture University (2012-OT01).

Results

Table 1 shows the time required subject's motion in each phase. The results of gaze points of the elderly subjects in each phase and the rate of retention time are shown in Fig. 3 and Table 2. Together, the data of young people [12] is shown in Table 2.

(1) Gaze points

For men, 17 points until they sat down, 7 points while they were sitting on the bowl, and 18 points until they left the room were extracted. For women, 17 points until they sat down, 8 points while they were sitting on the bowl, and 16 points until they left room were extracted. In men, light switch was not extracted from the phase while they were sitting on the bowl, and in women, the left wall next to the door and the left front wall were not extracted from the phase until they left the room.

The gaze points were very similar to those of young people [12] in each phase, although there were some minor differences. The subjects were likely to look around the entire toilet environment until they sat down or until they left the room. While they were sitting on the bowel, they tended to look forward most of the time.

(2) Rate of retention time

Until they sat down, the rate of retention time was significantly higher in women than in men for the right wall next to the door (U = 91.0, $p = 0.04$). While until they left the room, the rate of retention time was significantly higher in men than in women for outside the door.

In elderly people, the rate of retention time on the floor was higher compared to that of young people until they sit down and until they left the room. In young people, however, the rate was higher for the wall and toilet bowl, etc. compared to the elderly.

(3) Degree of dependence on the lower gaze in each phase

The degrees of dependence on the lower gaze in each phase for both elderly and young people [12] are shown in Table 2. In the elderly people, no significant difference was observed between men and women for

Table 1. The time required subject's motion in each phase.

	Until they sit down	While sitting on the bowl	Until they leave the room
Elderly men	21.8	5	33.2
Elderly women	17.2	5	27.6
all subjects	19.5	5	30.3

Unit: second

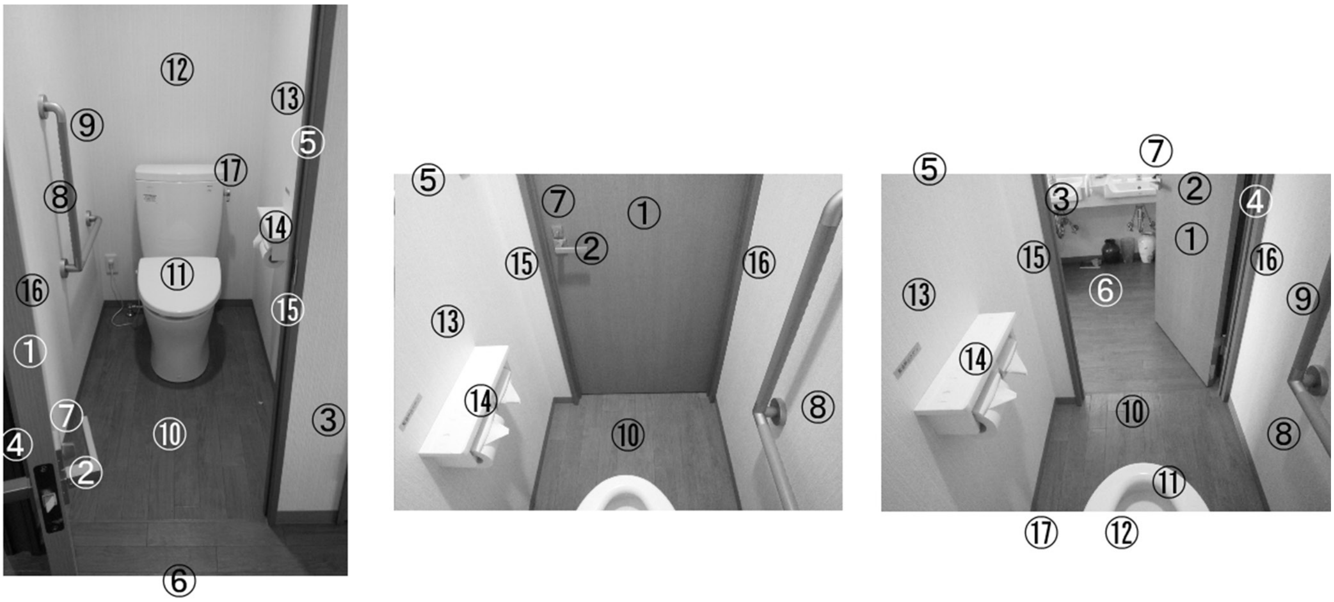

Fig. 3. Extracted gaze points.
① Door
② Door handle
③ Right wall next to the door
④ Left wall next to the door
⑤ Light switch
⑥ Outside the door
⑦ Lock
⑧ Left wall
⑨ Handrail
⑩ Floor
⑪ Toilet bowl
⑫ Front wall
⑬ Right wall
⑭ Toilet roll
⑮ Right front wall
⑯ Left front wall
⑰ Flush lever
⑱ Other

the 3 phases and for the series of activities.

The degree of dependence on the lower gaze was higher in the elderly compared to the young people for the series of activities until they sat down and until they left the room.

(4) Rate of recognition in each phase

The rates of recognition in each phase for both elderly and young people [12] are shown in Table 3. For the elderly, no significant difference was observed in all 3 phases. For the young people, significant difference was observed in the flush lever ($\chi^2 = 0.02$, $p = 0.02$).

When compared between the elderly and young people, the rate of recognition for the floor was lower in the young people than in the elderly. However, it was higher for the handrail, wall, and the flush lever in the young people compared to the elderly. It was also revealed that the young people were more likely to obtain information from various gaze points. While sitting on the bowl, there were some minor differences for the lock, left wall, floor and the toilet roll; the rates varied among individuals. As in the phase until they sat down, the rate of recognition was high for the floor in the elderly in the phase until they left the room.

(5) Association between the time required in each phase and the degree of dependence on the lower gaze

The association between the time required in each phase and the degree of dependence on the lower gaze for both elderly and young people [12] are shown in Table 4. There was no association between the time required in each phase and the degree of dependence on the lower gaze in the entire elderly people or only in men or in women.

For the phase until they sat down, the association between the time and the degree of dependence on the lower gaze varied among men in young people. However, for the other phases, there was no difference between the young people and the elderly.

Discussion

(1) Gaze points

It was revealed that the extracted gaze points were almost the same between the elderly men/women and young people. According to the report made by Miyahira et al. [17] there seemed to be a possibility that gaze points were different between men and women during toilet activities. However, the results of this study suggested that in toilet activities there was hardly any or no difference in gaze points according to sex or age. Further investigation will be required with increased number of subjects.

For phases until they sat down and until they left the room, activities included physical movement of excretion activity model proposed by Yada et al. [15],

Table 2. Gaze points and rates of retention time.

	Elderly men (Young men)	Elderly women (Young women)	Mann-Whitney U test		Quartile deviation
Until they sit down					
Door	33.9 (25.9)	31.9 (30.6)	129.5, $p = 0.44$	n.s	6.3
Door handle	1.8 (1.4)	0.7 (1.7)	120.5, $p = 0.26$	n.s	0.8
Right wall next to the door	3.7 (4.0)	5.7 (4.4)	91.0, $p = 0.04$	*	3.5
Left wall next to the door	0.04 (0)	0.1 (0)	153.0, $p = 1.00$	n.s	0.0
Light switch	4.3 (4.3)	5.6 (4.1)	113.5, $p = 0.19$	n.s	2.2
Outside the door	3.3 (5.9)	3.7 (4.6)	132.5, $p = 0.50$	n.s	3.4
Lock	0.6 (1.0)	0.7 (1.1)	132.0, $p = 0.40$	n.s	0.9
Left wall	7.5 (6.6)	6.2 (8.0)	130.5, $p = 0.46$	n.s	3.0
Handrail	0.3 (0.6)	0.4 (0.6)	146.5, $p = 0.81$	n.s	0.6
Floor	10.1 (6.3※)	8.1 (2.5※)	106.0, $p = 0.12$	n.s	4.1
Toilet bowl	12.0 (14.4)	10.0 (13.9)	120.0, $p = 0.28$	n.s	2.6
Front wall	3.8 (2.5)	3.9 (4.0)	128.0, $p = 0.41$	n.s	2.2
Right wall	13.1 (18.2)	16.2 (17.0)	115.0, $p = 0.21$	n.s	5.0
Toilet roll	1.5 (1.2)	1.6 (1.4)	145.0, $p = 0.79$	n.s	1.4
Right front wall	3.9 (7.1)	5.1 (5.6)	148.5, $p = 0.88$	n.s	3.0
Left front wall	0 (0.1)	0 (0.3)	153.0, $p = 1.00$	n.s	0.1
Flush lever	0 (0)	0.1 (0.2)	144.0, $p = 0.54$	n.s	0.0
Other	0.3 (0.5)	0.01 (0)	142.5, $p = 0.48$	n.s	0.0
While sitting on the bowl					
Door	89.0 (88.4)	70.7 (85.8)	112.0, $p = 0.17$	n.s	10.0
Door handle	1.7 (3.6)	1.1 (3.8)	128.0, $p = 0.24$	n.s	2.2
Light switch	0 (0)	0.1 (0)	144.5, $p = 0.33$	n.s	0.0
Lock	1.6 (1.6)	0.1 (1.3)	143.5, $p = 0.61$	n.s	0.0
Left wall	0.8 (2.1)	3.2 (0.6)	129.0, $p = 0.19$	n.s	0.0
Floor	0 (0.7)	0 (3.3)	153.0, $p = 1.00$	n.s	0.0
Right wall	2.4 (1.6)	10.4 (2.3)	153.0, $p = 1.00$	n.s	0.6
Toilet roll	0.8 (0.3)	5.7 (0)	153.0, $p = 1.00$	n.s	0.0
Right front wall	3.6 (1.8)	7.8 (2.7)	153.0, $p = 1.00$	n.s	0.6
Left front wall	0 (0)	0 (0.1)	153.0, $p = 1.00$	n.s	0.0
Until they leave the room					
Door	33.0 (29.8)	35.8 (32.5)	130.0, $p = 0.46$	n.s	6.5
Door handle	0.4 (0.8)	0.7 (1.5)	101.5, $p = 0.09$	n.s	0.9
Right wall next to the door	0.3 (2.0)	1.6 (2.8)	94.5, $p = 0.053$	n.s	2.1
Left wall next to the door	0.1 (0)	0 (0)	144.0, $p = 0.78$	n.s	0.0
Light switch	2.8 (2.7)	3.5 (2.9)	118.0, $p = 0.26$	n.s	1.9
Outside the door	12.7 (13.7)	8.1 (11.3)	85.5, $p = 0.03$	*	3.9
Lock	0.7 (0.6)	0.5 (0.7)	137.0, $p = 0.61$	n.s	0.3
Left wall	6.0 (2.8)	5.5 (3.1)	145.5, $p = 0.81$	n.s	2.9
Handrail	0.1 (0.2)	0.1 (0.1)	143.5, $p = 0.76$	n.s	0.0
Floor	7.6 (2.3)	4.4 (1.6)	103.0, $p = 0.10$	n.s	1.2
Toilet bowl	8.6 (10.0)	9.2 (11.3)	147.0, $p = 0.86$	n.s	3.7
Front wall	3.1 (5.4)	4.8 (5.3)	103.5, $p = 0.10$	n.s	2.8
Right wall	11.9 (14.7)	14.0 (13.8)	126.5, $p = 0.39$	n.s	3.9
Toilet roll	8.1 (8.3)	7.0 (6.9)	139.0, $p = 0.66$	n.s	2.8
Right front wall	2.7 (3.4)	3.4 (4.3)	130.0, $p = 0.46$	n.s	1.6
Left front wall	0.1 (0.8)	0 (0.1)	144.0, $p = 0.78$	n.s	0.0
Flush lever	2.1 (2.5※)	1.6 (1.7※)	117.0, $p = 0.25$	n.s	1.3
Other	0.01 (0)	0.01 (0)	152.5, $p = 0.99$	n.s	0.0

Unit: %, *: $p < 0.05$, n.s: not significant
Number in ( ) are data of young people. Excerpt from reference 12.
※ Significant difference was observed between young men and young women.

Table 3. Rates of recognition in each phase.

	Elderly men (Young men)	Elderly women (Young women)	χ^2 test	
Until they sit down				
Door	100 (100)	100 (100)	1.0, $p = 1.0$	n.s
Door hadle	41.2 (20.0)	27.8 (19.4)	0.70, $p = 0.40$	n.s
Right wall next to the door	58.8 (65.0)	83.3 (67.7)	0.15, $p = 0.15$	n.s
Left wall next to the door	0 (0)	5.6 (0)	1.0, $p = 1.0$	n.s
Light switch	94.1 (85.0)	88.9 (83.9)	1.0, $p = 1.0$	n.s
Outside the door	76.5 (75.0)	72.2 (71.0)	0.01, $p = 0.92$	n.s
Lock	11.8 (20.0)	16.7 (22.6)	1.0, $p = 1.0$	n.s
Left wall	88.2 (85.0)	77.8 (96.8)	0.66, $p = 0.66$	n.s
Handrail	0 (10.0)	5.6 (9.7)	1.0, $p = 1.0$	n.s
Floor	88.2 (65.0)	83.3 (38.7)	1.0, $p = 1.0$	n.s
Toilet bowl	100 (100)	100 (100)	1.0, $p = 1.0$	n.s
Front wall	64.7 (40.0)	66.7 (64.5)	0.05, $p = 0.81$	n.s
Right wall	100 (90.0)	94.4 (100)	1.0, $p = 1.0$	n.s
Toilet roll	41.2 (15.0)	33.3 (32.3)	0.73, $p = 0.73$	n.s
Right front wall	82.4 (85.0)	72.2 (71.0)	0.69, $p = 0.69$	n.s
Left front wall	0 (0)	0 (6.5)	1.0, $p = 1.0$	n.s
Flush lever	5.9 (0)	5.6 (3.2)	1.0, $p = 1.0$	n.s
Other	5.9 (0)	0 (3.2)	0.49, $p = 0.49$	n.s
While sitting on the bowl				
Door	100 (100)	94.4 (96.8)	1.0, $p = 1.0$	n.s
Door hadle	5.9 (15.0)	16.7 (16.1)	0.60, $p = 0.60$	n.s
Lock	11.8 (10.0)	11.1 (3.2)	1.0, $p = 1.0$	n.s
Left wall	5.9 (10.0)	5.6 (3.2)	1.0, $p = 1.0$	n.s
Floor	0 (10.0)	0 (3.2)	1.0, $p = 1.0$	n.s
Right wall	5.9 (10.0)	27.8 (6.5)	0.18, $p = 0.18$	n.s
Toilet roll	5.9 (0)	11.1 (0)	1.0, $p = 1.0$	n.s
Right front wall	23.5 (13.7)	22.2 (16.1)	0.10, $p = 0.76$	n.s
Until they leave the room				
Door	100 (100)	100 (100)	1.0, $p = 1.0$	n.s
Door hadle	17.6 (30.0)	33.3 (41.9)	0.44, $p = 0.44$	n.s
Right wall next to the door	23.5 (50.0)	50 (45.2)	1.61, $p = 0.20$	n.s
Left wall next to the door	5.9 (0)	0 (0)	0.49, $p = 0.49$	n.s
Light switch	94.1 (80.0)	100 (71.0)	0.49, $p = 0.49$	n.s
Outside the door	100 (100)	88.9 (93.5)	0.49, $p = 0.49$	n.s
Lock	23.5 (20.0)	22.2 (16.1)	0.10, $p = 0.76$	n.s
Left wall	94.1 (55.0)	88.9 (51.6)	1.0, $p = 1.0$	n.s
Handrail	0 (5.0)	0 (0)	1.0, $p = 1.0$	n.s
Floor	88.2 (40.0)	77.8 (38.7)	0.66, $p = 0.66$	n.s
Toilet bowl	100 (95.0)	100 (100)	1.0, $p = 1.0$	n.s
Front wall	70.6 (90.0)	83.3 (83.9)	0.44, $p = 0.44$	n.s
Right wall	100 (100)	94.4 (96.8)	1.0, $p = 1.0$	n.s
Toilet roll	94.1 (95.0)	88.9 (90.3)	1.0, $p = 1.0$	n.s
Right front wall	88.2 (75.0)	66.7 (80.6)	0.23, $p = 0.23$	n.s
Left front wall	5.9 (20.0)	0 (3.2)	0.49, $p = 0.49$	n.s
Flush lever	88.2 (85.0※)	72.2 (51.6※)	0.40, $p = 0.40$	n.s

unit: %, *: $p < 0.05$, n.s: not significant
Number in ( ) are data of young people. Excerpt from reference 12.
※ Significant difference was observed between young men and young women.

Table 4. Association between the time required in each phase and degree of dependence on lower gaze.

	Elderly men (Young men)	Elderly women (Young women)	All elderly people (All young people)
Until they sit down	−0.21, $p = 0.15$ n.s (−0.45, $p = 0.05$※)	0.24, $p = 0.35$ n.s (−0.07, $p = 0.71$ n.s)	0.20, $p = 0.25$ n.s (−0.20, $p = 0.15$ n.s)
Until they leave the room	−0.33, $p = 0.20$ n.s (0.19, $p = 0.42$ n.s)	0.17, $p = 0.51$ n.s (0.19, $p = 0.32$ n.s)	0.01, $p = 0.96$ n.s (0.16, $p = 0.26$ n.s)
A series of activities	−0.23, $p = 0.39$ n.s (−0.42, $p = 0.06$ n.s)	0.43, $p = 0.08$ n.s (−0.02, $p = 0.92$ n.s)	0.24, $p = 0.17$ n.s (−0.16, $p = 0.27$ n.s)

Values represent Spearman correlation coefficients (rs)
*: $p < 0.05$, n.s: not significant
Number in ( ) are data of young people. Excerpt from reference 12.
※ Significant difference was observed between young men and young women.

suggesting that they had to look at a variety of gaze points in order to understand the spatial relation. On the contrary, while they were sitting on the bowl, there was hardly any physical movement, suggesting that they were able to understand the spatial relation with a few gaze points. It was also revealed that this method of understanding the spatial relation was an essential strategy regardless of age. We considered that we may need to practice toilet activities and toilet induction, taking the gaze points in each phase into consideration.

Further investigations will be necessary in the future for each phase in order to assess whether or not postures or activity efficiency would differ between activities looking at the gaze points and those not looking at the gaze points. In addition, we will also need to investigate the differences for gaze points between the simulated activities performed in this study and actual activities.

(2) Rate of retention time

Significant differences were observed between men's and women's gaze points. Women tended to gaze toward the right wall next to the door until they sat down and for the gaze toward outside the door until they left the room. Generally, women are said to have lower visual cognitive function than men. We think that the men's gaze was directed to something else instead of staying long at the right wall near the entrance. Because, before they sat down, the men perceived the toilet environment faster than the women. Likewise, we think that the proportion of retention time outside the door increased because, before they left the room, the men finished the cognition inside the toilet early and their attention was directed to the outside. These rates of retention time were considered to be a feature of sex difference in toilet activities. We expect the cognitive process for grasping the toilet environment to be revealed by considering the rates of retention time and the gaze movement in future researchers.

As a feature until they sat down, both the elderly people and the young people had higher rates of retention time in the order of the door, the right wall, the toilet bowl, and the floor. As a feature while sitting on the bowl, the rates of retention time at the front was high. As a feature until they left the door, the rates of retention time at the sink levers and the toilet roll were higher than those until they sat down. Moreover, in the elderly, the rate of retention time was high for the gaze toward the floor in both phases until they sat down and until they left room compared to the young people. The rate of retention time for the gaze toward the wall, however, decreased as that for the floor increased. These results appeared characteristic to the gaze during toilet activity in the elderly. It was also suggested that the methods of collecting information to understand the spatial relation might be different between the elderly and young people. We need to reveal how they obtain information by analyzing the details of eye movement during activities.

It is also necessary to assess the elderly with diseases, as the subjects included in this study were healthy elderly adults, and investigate whether or not the rate of retention time for the gaze toward the floor would be different. The association between the retention time and the conduct of activities should be revealed as well.

(3) Degree of dependence on the lower gaze in each phase

For the degree of dependence on the lower gaze, there was no significant difference observed in each phase between elderly men and women. In the phases until they sat down and until they left the room, it was higher in the elderly than in the young people. It was considered necessary to investigate changes in the degree of dependence on the lower gaze according to each age group.

Itoh et al. [13] and Kuroiwa et al. [18] stated that the gaze of young people when they were walking tended to be forward while that of elderly people tended to be lower. It was also revealed in this study that the gaze of the elderly was lower than that of young people. Moreover, it has been reported that balancing ability of the elderly was associated with visual sensation, contrast sensitivity, and stereoscopic vision [19, 20] and that their ability of maintaining the posture decreased remarkably under the condition where their visual field had been reduced [21]. The more they become dependent on the lower gaze, the more their visual field would be reduced and their ability of maintaining the posture during toilet activity might be affected as well, resulting in onset of falls. We may be able to prevent these falls, leading them to the safe toilet activities, by investigating whether or not if there is a difference in the degree of dependence on the lower gaze between the subjects with the history of falls and those without.

(4) Rate of recognition in each phase

Until they sat down, the recognition rate was high for the gaze toward the floor in the elderly compared to the young people. However, in young people, it was high for the handrail, wall and flush lever compared to the elderly. These indicate that young people were attempting to obtain information from more various gaze points compared to the elderly. Meanwhile, Itoh et al. [13] reported that, for the elderly people, gaze while walking included eye movement to collect information using visual data as feedforward and activities to observe their own feet movements; the recognition rate for the gaze toward the floor was high in the elderly probably as they attempted to collect information and observe their own feet movements. We need to investigate how the toilet activity of the elderly will be affected if their gaze toward the floor is restricted.

The recognition rates for the toilet bowl, right and left walls, and the light switch were high in both elderly and young people. These points may be important for them to gaze at in order to understand the spatial relation. The recognition rate for the light switch was high probably because it required them to do operation.

The recognition rate for the handrail was low in both elderly and young people. It may depend on frequency of use in their daily lives; it is necessary to further investigate the association between subjects with diseases or subjects whose balancing ability have decreased and the recognition rate for the handrail.

While sitting on the bowl, there was no difference in the recognition rate between the elderly and young people. The higher rates were reported for gaze points around the door located in front of them. However, gaze points with high recognition rates had varied according to subjects; we need to consider that their gaze while sitting on the bowl could be different among individuals. Further investigations will be necessary to find out how the recognition rate is affected by making the duration longer for sitting on the toilet bowl.

In the phase until they left the room, higher tendencies were observed for elderly people to gaze at the light switch, the left wall, the floor, and the flush lever compared to young people. The recognition rate was high for the left wall in elderly men and women; information from the left wall might have been more important in the elderly compared to the young people. We need to investigate whether or not a similar tendency would be observed in a different toilet environment. For the floor, the cognition rate was higher in the elderly than in the young people, probably for the same reason as in the phase until they sat down. The cognition rate for the flush lever was significantly higher in men than in women. This may be associated with how often the flush lever is being used by men and women. Women use the flush lever more often than men; they might have been able to obtain information not with the direct gaze but with the indirect vision. We should further investigate how experiences would affect gaze.

(5) Association between the time required in each phase and the degree of dependence on the lower gaze

Itoh et al. [13] evaluated correlation between the walking speed and the gaze direction toward the floor and around the feet, and reported that significant correlation was observed in the young people but not in the elderly. Furthermore, they also reported that rates of gaze direction toward the floor and around the feet in the elderly might be associated with factors of aging effects such as visual functions which young people do not have or aging effects of physical functions other than walking speed or feet movements. In the preceding study [12], a negative correlation ($r = -0.45$) was observed between time and the degree of dependence on the lower gaze in young men, while in the elderly, no significant correlation was observed. These results correspond to those reported by Ito et al. It was therefore suggested that the degree of dependence on the lower gaze had been affected not by duration of activities but by other factors such as age, posture and balancing ability. We should further investigate how the differences in posture or balancing ability would affect gaze in the future.

Conclusions

In this study, we analyzed gaze of elderly people during toilet activities and investigated characteristics according to their age or sex. The results were further compared with data obtained from young people in the preceding study. The gaze points were almost the same for the elderly and young people. It was considered that they might need to look at the entire toilet environment until they sit down or until they leave the room, and while they are sitting on the bowl, they may need to look forward in order to understand the spatial relation. Furthermore, comparisons were made between the elderly and young people for rates of retention time, degrees of dependence on the lower gaze, recognition rates, as well as associations between time required in each phase and the degree of dependence on the lower gaze. According to the results, the rate of retention time was high for the gaze toward the floor. This was probably due to their age, posture and decreased balancing ability rather than duration of the movement. In the future, we should investigate a method of intervention for subjects to safely perform toilet activities by revealing how activities would change if gaze points were limited during the toilet activity, how toilet environment change would affect gaze, and relationship between balancing ability and gaze.

Limitation

The Eye Mark Recorder used in the gaze analysis had a wire cable. This might have affected the toilet activity. Some activities such as putting up and down the trousers, wiping the buttocks, and flushing the toilet were simulations. The results need to be compared with those obtained for gaze in actual activities. Duration of sitting on the toilet bowl had been assessed in advance and determined. However, it may vary according to the subjects; we should also investigate how gaze would be affected if the duration was longer.

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ORIGINAL ARTICLE

Relationship between Fear of Falling, Physical Activity, and Health-Related Quality of Life in Elderly Daycare Service Users

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Abstract: Background: Physical activity (PA) has been found to affect the fear of falling (FOF). Although objective measures can improve the accuracy of measurement compared with subjective measures, previous studies have primarily used self-report measures to assess PA. The relationship between FOF, PA, and health-related quality of life (HRQOL) in elderly people who need long-term care has therefore not been sufficiently clarified.
Purpose: The purpose of this study was to investigate the relationship between FOF, PA, and HRQOL in elderly daycare service users.
Methods: The participants were 39 frail elderly people living at home who regularly used daycare facilities (13 men, 26 women; mean age, 75.1±6.7 years). A cross-sectional study design was used. FOF was assessed using the Japanese version of the Falls Efficacy Scale (FES), PA was measured using a triaxial accelerometer, and HRQOL was assessed using the Japanese version of the Short Form-8 Health Survey. Based on median FES scores, participants were divided into two groups, High FES and Low FES, and then the PA and HRQOL values were compared.
Results: Patients in the Low FES group had significantly less PA ($p = 0.019$) and lower physical component scores in regard to HRQOL ($p = 0.006$).
Conclusions: The results of this study suggest the presence of a relationship between low FES scores in elderly daycare service users and less PA and low physical component scores in regard to HRQOL.

Keywords: elderly, fear of falling, physical activity, health-related QOL, accelerometers

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Introduction

Bone fractures and trauma due to falling are some of the factors that reduce independence in activities of daily living (ADL) in the elderly. One issue is the fear of falling (FOF). Research on fall prevention has progressed, and FOF is reported to be related to physical functioning [1−2], social relationships [3], and health-related quality of life (HRQOL) [4]. Therefore, FOF is considered a more significant issue than falling itself [5−6]. FOF can lead to activity avoidance [7], which has been reported to occur in 35% to 55% of elderly people worldwide [8−11]; in Japan, this is reported in 50% to 60% of elderly people [12−13]. FOF is also reported to lead to restricted activity in 13% to 50% of elderly people [14−16].

Previous studies on factors related to FOF have reported a relationship between walking speed [17], scores on the timed up-and-go test [18−19], muscle strength [20], and balance in the standing position [21]. In addition to physical function, physical activity (PA) has also been found to influence FOF [22]. However, most of these studies used self-report measures to assess PA. The accuracy of subjective assessment of the elderly may be affected by a decline in cognitive function due to aging. Therefore, in research on PA in the elderly, the use of objective rather than subjective measures can improve the accuracy of the measurements. PA research on elderly people using accelerometers found that FOF was related to total daily activity [23]. We previously reported a relationship between low-intensity activity and FOF in elderly daycare service users [24]. These results may be related to low PA and FOF. However, the relationship

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between FOF, PA, and HRQOL in elderly people who need long-term care has not been sufficiently clarified.

The purpose of this study was to investigate the relationship between FOF, PA, and HRQOL in elderly daycare service users. Accelerometers were used to measure PA in an attempt to base the findings on objective data. While elderly daycare service users generally demonstrate low PA, most studies have used self-report measures to assess PA. Therefore, the use of objective rather than subjective measures, incorporating physical function and ADL, may enhance the potential of elderly daycare service users to meet the recommended daily PA level. The findings of this study are expected to contribute to the development of effective intervention programs designed to decrease FOF and improve HRQOL in the elderly.

Methods

1. Participants

The study participants were 39 frail elderly people (13 men, 26 women; mean age, 75.0 ± 6.7 years; age range, 60−85 years) living at home who regularly used daycare facilities no more than twice a week. All participants were able to walk independently. Participants who had dementia were excluded. A mental status questionnaire [25] indicated whether cognitive function was in the normal range (Table 1). The research plans and procedures for obtaining consent from the participants were approved by the ethics committee of Niigata University of Health and Welfare. Written informed consent was obtained from all participants.

2. Tasks and Procedures

The study design was cross-sectional, and interviews and physical measurements were performed. Interviews were held to investigate the use of an assistive device, history of falling in the previous year, and score on the Japanese edition of the Falls Efficacy Scale (FES). The FES is a well-known FOF scale in Japan [13]. The FES is composed of 10 items, with responses chosen from the following, as specified in the Japanese edition: ‘1: not confident’, ‘2: lacking some confidence’, ‘3: confident’, or ‘4: very confident’ (Table 2). Regarding physical measurements, the timed up-and-go (TUG) test was used to assess mobility [26]. In the TUG test, participants are timed on how long it takes to stand up from

Table 1. Participants’ demographics.

	n = 39
Age (year)	75.0 ± 6.7
Body Mass Index (kg/m^2)	24.2 ± 4.2
Mental Status Questionnaire (point; 0−10)	10 [8−10]
Main diagnoses	
Cerebrovascular disease	15 (38.5%)
Fracture	8 (20.5%)
Osteoarthritis of the knee	6 (15.4%)
Low back pain	8 (20.5%)
Others	2 (5.1%)
Use of an assistive device	26 (66.6%)
Fall history within 1 year	11 (28.2%)

Mean± SD, Median [range]

Table 2. Falls Efficacy Scale score distribution.

Items	
1 Take a tub bath	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
2 Reach into cabinets or closets	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
3 Prepare a simple meal	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
4 Walk around house	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
5 Get in/out of bed	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
6 Answer telephone	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
7 Stand/sit	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
8 Get dressed and undressed	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
9 Simple cleaning	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident
10 Simple shopping	1: Not confident 2: Lacking some confidence 3: Confident 4: Very confident

an armchair, walk 3 m, return, and sit back down on the chair. To evaluate ADL and instrumental ADL, scores on the Barthel Index [27] and the Frenchay Activities Index were used [28−29]. HRQOL assessment was performed using the Japanese version of the Short Form-8 (SF-8) Health Survey. The SF-8 is composed of multiple question items that measure eight health concepts [30]. Two summary scores of the SF-8, the Physical Component Summary (PCS) and the Mental Component Summary (MCS), were used.

An individual's PA was measured using a small (74.5 × 13.4 × 34.0 mm) and lightweight (36.0 g) triaxial accelerometer (Actimarker; Panasonic, Osaka, Japan) with epoch length set at 12 s [31]. This device collects data on triaxial acceleration at 20 Hz; a standard deviation of 12 s is defined as the mean value of acceleration. All participants were requested to wear the device for 7 to 10 consecutive days, from the time of getting out of bed in the morning until going to bed at night, except during bathing activities. The device was fastened to the pants above the iliac spine. After wearing the device, the participants returned it to the researchers, who then downloaded the data using the device software. Data from the day of using the daycare facility were excluded, and were only used if there were more than 5 days in total for which the device had been worn for more than 10 h throughout the day [32]. From the PA data gathered by the accelerometers, metabolic equivalents (METs) were used to represent PA levels. METs are calculated using a linear regression formula produced by the relationship between the mean value of acceleration and the METs measured with a respiratory gas metabolic system. The mean daily METs value was used.

3. Data analysis

The participants were divided into two groups based on median FES scores: a High FES and a Low FES group. The outcome measures between the two groups were then compared using the chi-square test, t-test and Mann–Whitney U test. The significance level was set at 5%. Statistical analyses of the data were performed using SPSS (version 15.0; IBM Japan, Tokyo, Japan).

Results

The participants' demographic characteristics are shown in Table 1. Overall, 26 (66.6%) participants reported use of an assistive device, and 11 (28.2%) reported a fall within the previous year. The data analyzed in this study are shown in Table 3. The median ADL and physical function scores were as follows: Barthel Index score, 95 points (range, 80−100 points); median Frenchay Activities Index, 18 points (range, 3−26 points); and the TUG test, 16.3 s (range, 7−64.5 s). FOF, which was assessed based on FES scores, had a median value of 31 points (range, 20−39 points). Regarding HRQOL measured using the SF-8, the median PCS score was 45 (range, 32.6−53.5), and the median MCS score was 46.1 (range, 34.1−60.6).

Table 3. The main outcome measures of the study subjects (n = 39).

The main outcome measures	Median [range]
Barthel Index (point; 0−100)	95 [80−100]
Frenchay Activities Index (point; 0−45)	18 [3−26]
Timed Up and Go (sec.)	16.3 [7−64.5]
Fall Efficacy Scale (point; 0−40)	31 [20−39]
SF-8 PCS	45 [32.6−53.5]
SF-8 MCS	46.1 [34.1−60.6]

PCS: Physical component summary, MCS: Mental component summary

The relationship between the High and Low FES groups' scores and outcome measures are shown in Table 4. The participants were divided into two groups based on median FES scores: 20 participants in the High FES group and 19 participants in the Low FES group. According to the results of comparing the High and Low FES groups, a significant difference was observed in PA ($p = 0.019$) and PCS on the SF-8 ($p = 0.006$). No significant difference was observed in other factors.

Discussion

This study was to investigate the relationship between FOF, PA, and HRQOL in elderly daycare service users. The results of the present study suggest that low FES scores are associated with low levels of PA and poor HRQOL in elderly daycare service users. In this study, the FES was used for assessing FOF, but the cutoff value of this scale is not clear. Therefore, the participants were classified into two groups based on the median of FES scores, there was no significant difference in sex, age, cognitive function, and ADL in the two groups. Therefore, there was little significant difference between the participants in the two groups.

Murphy et al. [33] reported that a "sedentary lifestyle" affects FOF in the elderly. Too much sitting might also be considered a behavioral health hazard [34]. Reid et al. [35] examined patterns of television watching among the elderly over a survey period of 12 years and their associations with performance-based measures of physical function, and found that patterns of sedentary behavior were associated with weak lower-extremity muscle strength. For the frail elderly, it is necessary to improve PA in order to prevent a decline in physical

Table4. Relationships between Fall Efficacy Scale and outcome measures.

	Low FES Group (n = 19)	High FES Group (n = 20)	p value
Gender (women)	12 (63.2%)	13 (65.0%)	0.584
Age (year)	75.7 ± 6.6	74.6 ± 6.9	0.615
Body Mass Index (kg/m^2)	23.8 ± 5.3	24.5 ± 3.5	0.494
Mental status questionnaire (point; 0−10)	10 [8−10]	10 [8−10]	0.229
Use of an assistive device	13 (68.4%)	13 (65.0%)	0.545
Fall history within 1 year	7 (36.8%)	4 (20.0%)	0.209
Barthel Index (point; 0−100)	95 [80−100]	97.5 [80−100]	0.615
Frenchay Activities Index (point; 0−45)	19 [3−26]	17.5 [4−22]	0.460
Timed Up and Go (time)	19.5 [7−32.4]	15.1 [8−64.5]	0.116
Physical activity (METs)	1.37 [1.27−1.62]	1.54 [1.30−1.77]	0.019
SF-8 PCS	40.0 [32.6−49.2]	45.0 [36.2−53.5]	0.006
SF-8 MCS	44.0 [34.1−60.6]	51.9 [35−59.7]	0.056

FES: Fall Efficacy Scale
PCS: Physical component summary, MCS: Mental component summary
Low FES Group: 20−31 point, High FES Group: 32−39 point
n (%), Mean ± SD, Median [range]
Chi-squared test, t-test, Mann–Whitney U test

function. The Sedentary Behavior Research Network [36] suggests that sedentary behavior should be formally defined as “any waking behavior characterized by an energy expenditure ≤ 1.5 METs while in a sitting or reclining posture”. In the present study, accelerometers were used to measure PA in an attempt to base the findings on objective data. The median PA level in the Low FES group was 1.37 METs, which indicated sedentary behavior. Daily repetition of this low-level PA is thought to have led to a reduction of self-efficacy in ADL. In addition, a meta-analytic review by Schepens et al. [22] reported that prospective studies found a strong relationship between FOF and PA. Participants in the present study, many of whom were frail elderly people with low PA, used daycare services. Their main going out activity was to attend their daycare facilities; they seldom participate in outdoor activities independently. It is therefore possible that their low-intensity lifestyle could reduce their self-efficacy for various activities. Ensuring meaningful activities for such persons and increasing their PA may contribute to improving their self-efficacy in ADL.

The participants of the present study were able to walk independently, although 66.6% used an assistive device. Kondo et al. [37] reported that the use of an assistive device was related to a low FOF. In the present study, no such relationship was found. The use of assistive devices is affected by a decline in physical function, and thus this sample included many participants with low mobility. Friedman et al. [5] reported that falls were an independent predictor of developing FOF. However, no relationship with fall history was found. FOF is associated with a decline in physical performance and a gradual decline in HRQOL [3]. Numerous studies have reported that elderly people with low dynamic balance or mobility have a high FOF [17−18, 38]. However, the results of the present study showed no relationship between FOF and physical performance. In contrast to the present study, the participants in previous studies tended to be healthy elderly people, not frail elderly people using daycare services. Higuchi et al. [39] reported that the TUG test is not related to FOF in elderly people with low functioning in need of long-term care. However, few studies on this issue have been conducted, and it is therefore necessary to examine the relationship between physical performance and FOF in the low-functioning frail elderly. In the present study, physical HRQOL was found to be declining. It is therefore necessary to break away from this vicious lifestyle cycle and encourage the elderly to rebuild their lifestyle to improve their PA.

The primary limitation of this research is that it was a cross-sectional study, and thus the causal relationships remain unclear. For future research, a longitudinal study is needed.

Summary and conclusions

The aim of this study was to investigate the relationship between FOF, PA, and HRQOL in elderly daycare service users. The findings showed that participants in the Low FES group had lower PA and physical component scores in regard to HRQOL. These results suggest a relationship between lower FES scores in elderly daycare service users and lower PA and physical component scores in regard to HRQOL.

Conflicts of interest

The author has no conflicts of interest to declare.

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ORIGINAL ARTICLE

Development of a Video-Based Hazard Detection Task: Preliminary Study in Younger Drivers

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Abstract: We are developing tasks on a laptop computer to enable cheaper and easier driving assessments at medical institutions. The aim of this preliminary study is to characterize the performance of young drivers in the developed tasks. The participants were 42 young licensed drivers who performed a video-based hazard detection task and a visual searching task (Trail Making Test). In the hazard detection task, they were instructed to touch the hazardous events on the computer screen that was likely to become involved in a traffic conflict during a driving video. Results showed that the video included 11 hazards and young drivers detected hazardous events during a particular period of time. For the visual searching tasks, our computer-based TMT had proper cognitive load, which was not found in existing paper-based TMT. Further investigations recruiting subjects from other age groups should be necessary to validate our driving assessment programs.

Keywords: driving, assessment, hazard detection, young drivers

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Introduction

Automobiles are an essential means of transportation for modern daily living [1]. Difficulty with driving automobiles due to a disability is known to significantly reduce quality of life [2−4]. In Japan, the Road Traffic Law was revised in 2002 to stipulate that many medical conditions constituted relative grounds for disqualification. In light of this change, occupational therapists now have more opportunity, and greater responsibility, to perform driving assessments for patients with stroke and brain injury. Typically, the determination of fitness to drive after a brain damage is made by a public safety commission based on an off-road evaluation performed at a medical institution and an on-road evaluation carried out at a driving school. As public safety commissions defer to the judgments of medical institutions, specifically doctors' diagnoses, these medical institutions must provide appropriate evaluations and assistance. In particular, although adaptive driving devices can be used to compensate for a decline in driving ability due to motor disability, it is not easy to compensate similarly for cognitive disability, and an appropriate assessment of this type of disability is therefore required [5].

The off-road evaluations currently carried out in medical institutions mainly consist of neuropsychological tests performed by occupational therapists. The tests most often used for driving assessments include visual searching tasks [6−8], reaction time tasks [9−11], visuospatial recognition tasks [12−14], the useful field of view test [15−16], and the Stroke Drivers Screening Assessment (SDSA) [17−20]; however, as these are static tests, they are all far removed from the actual experience of driving. We believe that dynamic tasks using moving

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images are more appropriate for driving assessments. In fact, assessments using driving simulators have been shown to be highly valid as driving assessments [21–23], but these are too expensive and require too large an installation site to be of practical use.

We have, therefore, used actual driving footage to develop a hazard detection task on a laptop computer. We also developed a visual searching task capable of assessing visual searching ability, which is regarded as the most important element in driving [24]. The objective of the present study was to evaluate the characteristics of young holders of driver's licenses in the performance of these two tasks.

Methods

Participants

The participants were 42 young driver's license holders (15 male and 27 female; mean age 21.7 ± 2.4 years, range 19–33 years). None had any history of neurological disease, ophthalmic problems, or other issues that might affect their participation in the study. Nine participants had obtained their driver's license within the previous year, 14 within the previous 1–2 years, 9 within the previous 2–3 years, 6 within the previous 3–4 years, and 4 at least 4 years previously. In terms of driving frequency, 2 participants drove every day, 3 drove once every 2–3 days, 5 drove once a week, 21 drove several times a year, and 11 reported driving almost never. One participant each had either experienced accidents involving skidding on a snowy road, or reversing into an object while parking, or colliding with an object due to not paying attention to what was in front of them. Both verbal and written informed consent were obtained from all the participants. This study was approved by the Ethics Committee of Shinshu University's Faculty of Medicine (approval no. 2081).

Hazard detection task

We used a dashboard camera (Venture Craft, Paparazzi) to record actual video footage of driving and extracted and edited segments from this recorded footage in which hazard prediction was used to produce a driving scenario. The maximum speed during the recording of this driving footage was approximately 40 km/h. MovieWriter2010 Pro (CORE) was used to edit the videos. The completed driving scenario comprised an eight-scene (four in the city center and four in residential areas) video lasting approximately two minutes. Each of the scenes was between 15 s and 40 s long. The four city-center segments included scenes that required drivers to watch carefully for oncoming vehicles, buses stopping to allow passengers to alight and board, pedestrians walking along the sidewalk and crossing the road, and oncoming traffic when either entering or turning right at an intersection, turning right at the intersection. The four residential area video segments included scenes requiring drivers to watch out for pedestrians and cyclists unexpectedly entering their path as they drove along narrow streets, and entered the main road. Both the city-center and residential scenes required drivers to drive forward, negotiate curves, stop, and to proceed slowly.

The participants had to identify scenes of predicted risk during the two-minute driving scenario. They were instructed to touch the touch panel on a laptop computer (Let's Note CF-C1B, Panasonic, 12.1-inch) every time they identified such a scene (Fig. 1). Every time they touched the panel, the video stopped, and the onscreen still image was captured. At this point, the authors asked the participants about the identified elements and recorded them on an assessment monitor (Plus One, LCD-10000U, Century, 10-inch). Touching the panel again restarted the driving scenario. The participant-identified elements, still images marked with the exact locations, and the times they touched the screen were saved on the computer. The hazard detection task program was developed by Nishizawa Electric Meters Manufacturing Co., Ltd. The results were used to evaluate the characteristics of the locations and touch on the screen, the elements the participants identified, the frequencies with which they were identified, and the times at which they were detected.

Visual searching task

The trail-making test (TMT) was used for the visual searching task illustrations. The TMT is a test designed to evaluate visual searching ability, and it consists of two parts—Part A (TMT-A) and Part B (TMT-B) [25]. In TMT-A, the participants saw the numerals 1 through 25 on a computer screen, and they were asked to touch them in ascending order. In TMT-B, they were shown the numerals 1 through 13 and the Japanese *hiragana* characters あ (a) through し (shi) on the screen, and they were asked to touch the numbers and *hiragana* alternately in the order 1 → あ → 2 → い, and so on to the end. The participants started the tasks themselves by touching the "Start" button, and the characters 終了 (*shuūryō*, "end") appeared immediately after the final target was touched. For both tasks, sounds indicating either a correct or incorrect target were played when each target was touched. Even after a target had been touched correctly, it remained on the screen. The time required, time to touch for each target, and the numbers of correct and incorrect answers were saved on the computer. The results were used to calculate the time re-

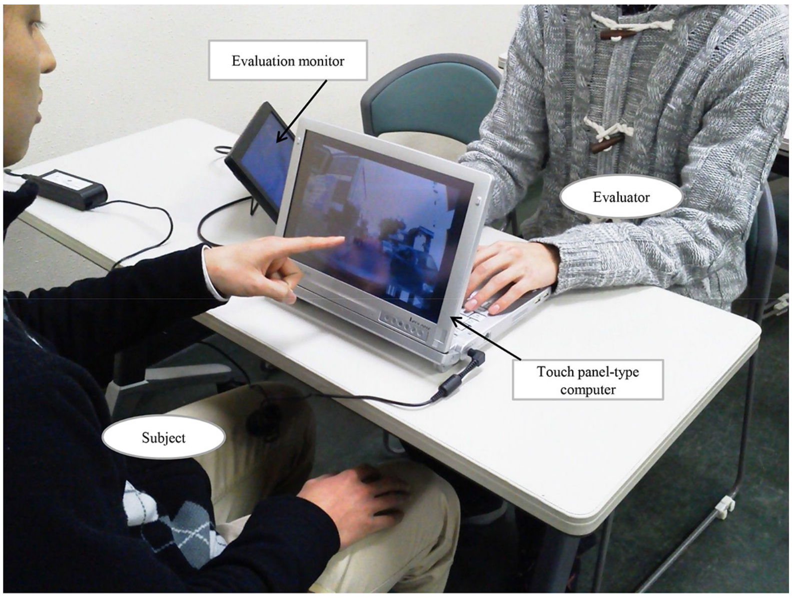

Fig. 1. Experimental setup.

quired, the number of incorrect answers, and the cognitive load value (the time required for the TMT-B divided by the time required for the TMT-A). The cognitive load is an index of the difference in difficulty between the TMT-A and TMT-B, and as the TMT-B is more difficult than the TMT-A (Lehrner et al., 2008), the cognitive load is > 1 if the TMT is valid. In addition to the computer-based TMT, we also administered the paper-based TMT to examine the validity of the computer-based TMT as a task to evaluate visual searching ability. The order of the task conditions (computer-based TMT and paper-based TMT) was counter balanced between subjects. The visual searching task program was developed by Nishizawa Electric Meters Manufacturing Co., Ltd.

Results

Hazard detection task

The mean number of participant-identified hazards during the eight-segment, two-minute-long driving scenario was 5.5 ± 2.3 (range 2−11) per person. After scenes identified by < 10% of the participants ($\leq 4/42$) were excluded from all the hazards identified, 11 scenes were left. These comprised watching out for oncoming vehicles and traffic lights when entering an intersection (17%), watching out for incoming vehicles from the left (62%), watching out for a stopped bus preparing to start up again (43%), watching out for an incoming vehicle making a wide turn (93%), complying with the requirement to stop when entering a main road (38%), watching out for oncoming traffic when turning right at an intersection (38%), being careful not to run over pedestrians when turning right at an intersection (19%), watching speed when driving down a narrow road (71%), watching out for pedestrians on the left stepping out unexpectedly (24%), watching out for an oncoming vehicle stopped across the center line (50%), and watching out for a bicycle crossing against the lights (64%). The hazard “watching out for oncoming vehicles and traffic lights when entering an intersection” (17%) was identified during a 5-s interval 18−23 s after the video began, and “watching out for a vehicle making a wide turn” (93%) was identified during a 14-s interval 38−52 s after the video began, indicating that the time range during which hazards were identified varied depending on the specific hazard (Table 1).

Visual searching task

One participant was excluded due to missing values, and the results from 41 participants were therefore analyzed. Non-repeated measure two-way ANOVA showed the interaction between condition (computer versus paper) and type (TMT-A versus TMT-B) (F(1,80) = 26.6, $p < 0.0001$). A simple main effect analysis revealed that the time taken in computer-based TMT-A was significantly shorter than in computer-base TMT-B (F(1,80) = 50.6, $p < 0.0001$), and in paper-based TMT-A (F(1,80) = 53.0, $p < 0.0001$) (Fig. 2). The number of incorrect answers was found only in computer-based TMT-B, and a significant interaction was found between condition and type (F(1,80) = 33.1, $p < 0.0001$). A simple main effect analysis revealed that the number of incorrect answers in computer-based TMT-B was significantly greater (F(1,80) = 16.6, $p < 0.0001$). As for

Table 1. Results of hazard detection task.

Hazard	Hazard location	Detection frequency	Detection time (s) (range)	Type of hazard
1		17%	20.1 ± 1.6 (18−23)	Watching out for oncoming vehicles and traffic lights when entering an intersection
2		62%	27.6 ± 1.0 (26−29)	Watching out for incoming vehicles from the left
3		43%	28.9 ± 2.1 (26−35)	Watching out for a stopped bus preparing to start up again
4		93%	40.7 ± 3.2 (38−52)	Watching out for an incoming vehicle making a wide turn
5		38%	47.8 ± 6.5 (39−58)	Complying with the requirement to stop when entering a main road
6		38%	64.9 ± 1.8 (62−69)	Watching out for oncoming traffic when turning right at an intersection
7		19%	66.3 ± 1.7 (64−69)	Being careful not to run over pedestrians when turning right at an intersection
8		71%	82.5 ± 6.0 (72−89)	Watching speed when driving down a narrow road

Table 1. Results of hazard detection task (continued).

Hazard	Hazard location	Detection frequency	Detection time (s) (range)	Type of hazard
9		24%	108.5 ± 1.0 (107−110)	Watching out for pedestrians on the left stepping out unexpectedly
10		50%	116.9 ± 0.7 (116−118)	Watching for an oncoming vehicle stopped across the center line
11		64%	128.0 ± 1.2 (124−130)	Watching out for a bicycle crossing against the lights

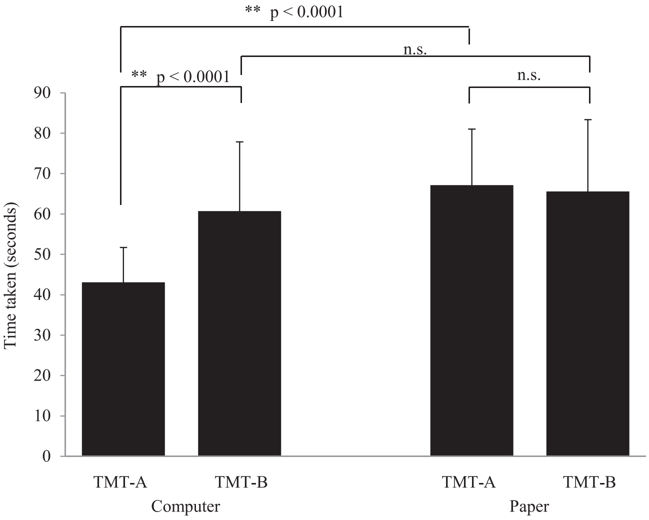

Fig. 2. Comparisons of time taken in visual searching task. Non-repeated measure two-way ANOVA revealed significant interaction between task conditions (Computer vs. Paper) and task types (TMT-A vs. TMT-B). Analysis of simple main effect showed that time taken in the computer-based TMT-A significantly shorter than the computer-based TMT-B, and the paperbased TMT-A.

the cognitive lead, the computer-based TMT showed a significant higher cognitive load than the paper-based TMT (t(40) = 6.4, $p < 0.00001$) (Fig. 3).

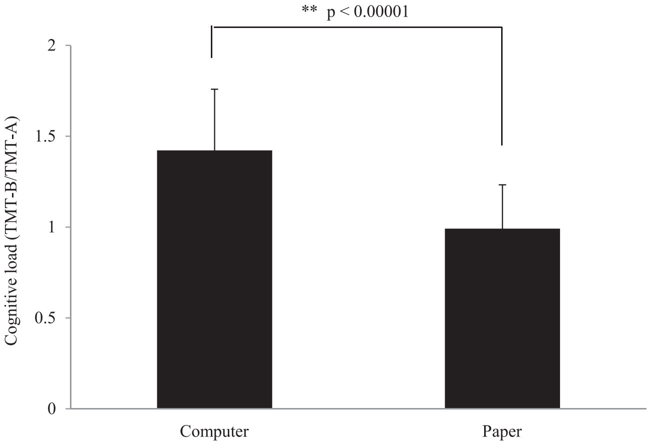

Fig. 3. Comparisons of cognitive load in the visual searching task.
Cognitive load of the computer-based TMT is significantly higher than the paper-based TMT.

Correlation between hazard detection task and visual searching task

To examine the relationship between the hazard detection task and the visual searching task, we calculated Pearson correlation coefficient (r) as a function of the number of detection in the hazard detection task and the time taken in the visual searching task. Results showed that no significant correlation was found for the number of detection versus the computer-based TMT-A ($r = 0.10$, $p > 0.1$), the TMT-B ($r = 0.02$, $p > 1.0$), the paper-based TMT-A ($r = -0.06$, $p > 0.1$), and the TMT-B ($r = -0.07$, $p > 1.0$) (Fig. 4).

Discussion

In this study, we reported that the characteristics of young licensed drivers in newly developed hazard detection task, and examined the validity of the computer-based visual searching task as a measure of cognitive lead.

Recently, the road sign recognition task has shown correlations with on-road driving evaluations, enabling assessments of an individual's ability to read driving-related situations [19, 26–27]. In this task, driving situations are displayed as photographs or illustrations, and the participant is asked to choose the road sign most appropriate to each situation. This task, however, only evaluates the participant's understanding of the situation and his or her knowledge of road signs without assessing their ability to predict hazards. Actual driving also requires the ability to deduce the situation after having seen the road sign, the opposite process from what is assessed in this test. In addition, as this test uses photographs or illustrations, rather than video footage, it is far removed from actual driving situations in which visual information changes moment by moment. Nouri and Lincoln (1992) [28] have described a task in which participants are shown a 3-min driving video and are asked to predict hazards. That test, however, requires participants to recall of hazards at the end of the driving video, meaning that it does not evaluate the immediate ability to predict risk. The hazard detection task we have developed, however, assesses the ability to predict risk in real time during a driving video, meaning that it is capable of evaluating the ability to judge situations in an environment similar to that of actual driving. Although hazard detection ability assessment using driving videos has previously been reported [29], these assessments were not designed to be conducted in medical institutions. To our knowledge, in Japan, there are no previous reports on hazard detection ability assessment using video. Furthermore, video-based assessment procedures reflective of Japanese traffic conditions, scenery, and

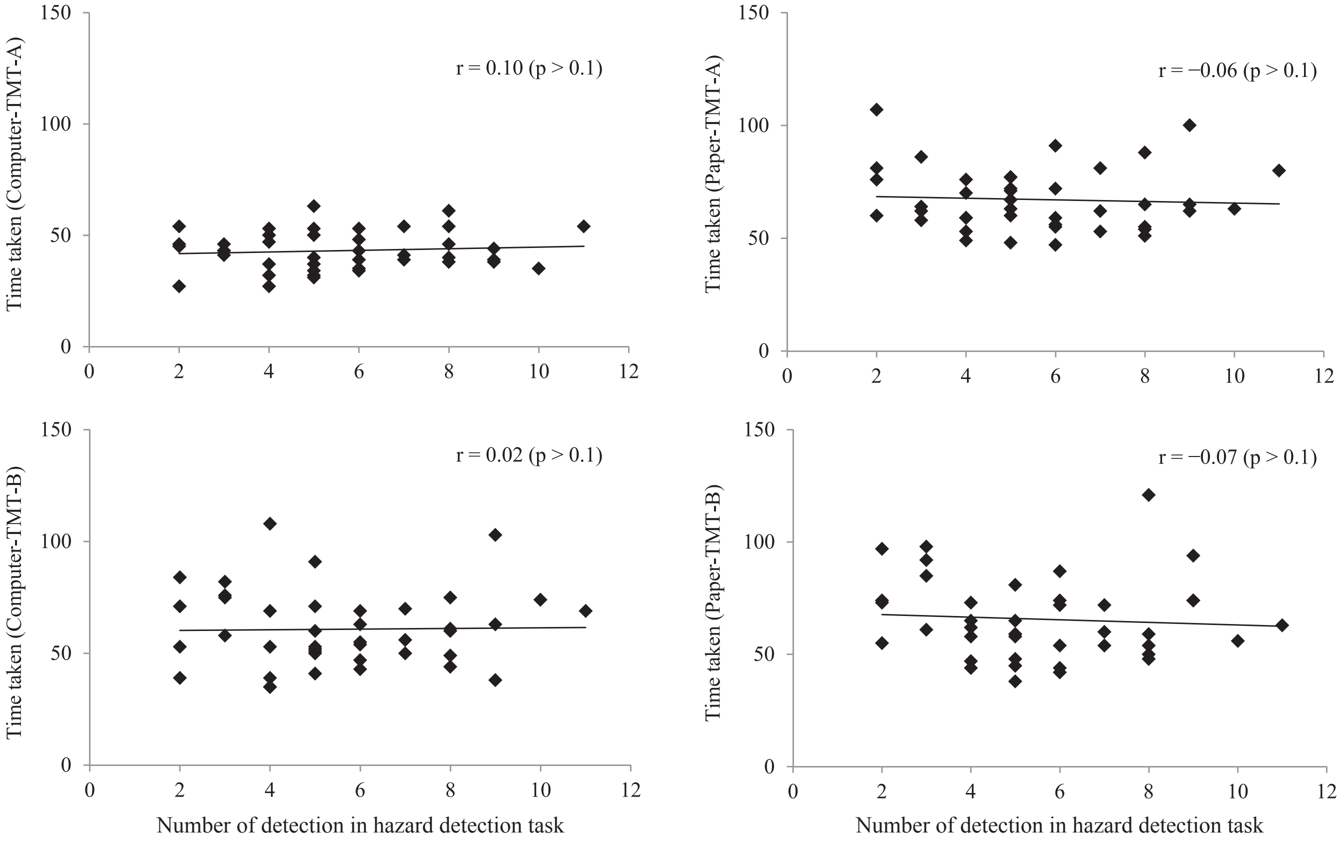

Fig. 4. Correlation between hazard detection task and visual searching task.
No significant correlation is found between number of detection in hazard detection task and time taken in visual searching task.

traffic rules are necessary.

We found that when young licensed drivers completed our hazard detection task, their responses were characterized by variations in the frequency with which different hazards were detected, but there was a consistent time range during which they were detected. The fact that the detection frequency varied indicates that there is a priority order for those hazards that should be detected in the driving scenario. This suggests that hazard detection failure of frequently identified objects may indicate low ability in predicting hazards. A clear delay in hazard identification beyond the normal time range, as found in this study, may also indicate low hazard prediction ability. However, it should be noted that the hazard detection task has limitations. One of the most important limitations is that this task is not capable of evaluating the ability of actual behavioral response to avoid accidents. Therefore, the relation to the performance in on-road assessments such as road test [30] should be examined.

As for the visual searching task, the TMT is a well-known neuropsychological test for assessing visual searching ability, and its results are known to be correlated with on-road driving evaluations [25, 31–32]. Reports vary concerning the time required to perform the TMT tasks [12, 33–34], and no standardized data are available, but the TMT's most important characteristic is that the TMT-B must have a higher cognitive load than the TMT-A [35]. Accordingly, the TMT-B should require more time to complete than does the TMT-A, and its performance should result in more errors. In our study, this was definitely the case. Unlike existing paper-based TMT, the computer-based TMT-B required more time than did the TMT-A, and the number of errors was greater. The cognitive load of the TMT-B was, therefore, greater than that of the TMT-A, demonstrating that the tasks in our TMT are valid. This task is also performed solely by touching the screen, making it more useful for assessing pure visual searching ability than existing TMTs, which also involve motor function by requiring participants to join targets with a pencil.

Another important result of our study was that the number of detections in the hazard detection task did not correlate to the time required in the visual searching task. This would suggest that the hazard detection task measures different ability from the visual searching task. Successful TMT performance requires rapid visual processing, on the other hand, the hazard detection task requires not only visual processing but also the ability to predict hazardous events. As safety driving involves a wide variety of cognitive abilities [36–38], the development of tasks in addition to those used in the present study might enable the development of a low-cost driving assessment program that does not require the installation of any equipment.

Conclusions

This pilot study showed that the video-based hazard detection task included 11 hazardous events to be detected at various times, and that young drivers detected hazardous events during a particular period of time, and also that the computer-based TMT was valid to evaluate visual searching ability. The results of this study, however, only illustrate the characteristics of young driver's licenses holders. Future research is needed to ascertain the relevant characteristics of other age groups. Young people and the elderly cause more traffic accidents than do other age groups [39], and a study of elderly licensed drivers' hazard detection task performance, in particular, will be important for developing a more thorough picture of drivers and their cognitive capabilities.

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RAPID COMMUNICATIONS

Computed Tomography Investigation of the Effects of a Dynamic Orthosis on the Metacarpophalangeal Joint

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Abstract: Background: Continuous stretching is an effective treatment for contractures, and its efficacy can be improved with a dynamic orthosis. Dynamic orthotic positioning is expected to achieve greater clinical results in joints with less pretreatment stiffness and in those with a short window between injury and treatment. Here we studied the effect of dynamic orthotic positioning on the metacarpophalangeal (MCP) joint using computed tomography (CT).
Methods: The MCP joints of 10 human index fingers were examined using CT in healthy subjects who wore flexion- or traction-type orthoses versus those who wore no orthoses.
Results: The palmar joint distance between the traction-type and no orthosis group was not significantly different; however, the distance was shorter with the flexion-type than the traction-type orthosis ($p < 0.05$). Compared to healthy subjects without orthoses, the palmar joint space decreased in patients with flexion-type orthoses ($p < 0.05$) and increased in healthy subjects with traction-type orthoses ($p < 0.05$).
Conclusions: The traction-type dynamic orthosis was designed to correct flexion while achieving joint traction to enhance MCP joint area spacing and minimize damage caused by articular surface collision. Our findings show that the traction-type dynamic orthosis causes joint space widening and may reduce the risk of articular surface collision compared with the flexion-type orthosis.

Keywords: tomography, orthotic devices, metacarpophalangeal joint, pilot projects, traction

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Introduction

Joint contracture, which can result from various complications that occur after a hand injury, remains a common orthopedic problem. After fracture, a hand therapist should avoid placing the hand in an incorrect position and having the joints fixated for longer than medically necessary, and they should be cautious about inappropriate rehabilitation such as the excessive use of strong force. Contractures in the metacarpophalangeal (MCP) joint can occur after a joint trauma or burn [1].

Continuous stretching is an effective treatment for contractures, and its efficacy can be improved with a dynamic orthosis [2], a well-accepted modality used to regain joint motion in an injured hand [3]. Dynamic orthotic positioning is expected to achieve greater clinical results in joints with less stiffness before treatment as well as those with a short window between injury and treatment [4]. The dynamic flexion orthosis (hereafter referred to as the flexion-type orthosis) [5] has been widely used for the treatment of extension contractures of the MCP joint. The conventional flexion-type orthosis can affect the articular surface of the joint, which can lead to pain when the finger is held in flexion for an extended period [6]. As a result, it is difficult to

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achieve range of motion improvements [5]. Decreased finger motion reduces one's ability to perform activities using the hand and activities of daily living (ADLs) [7]. In contrast, traction reduces fracture fragments via ligamentotaxis and helps prevent periarticular joint ligament contracture. Conventional traction orthoses are often used in the treatment of joint fractures that require surgical invasion [8]. However, few reports state that a dynamic orthosis can increase flexion while achieving joint traction without increasing the risk of subsequent surgical intervention.

If a dynamic orthosis that provided traction while bending the MCP joint existed, patients' conditions could improve smoothly without pain and patients may experience an early improvement in ADLs. However, since such a device does not exist, a flexion-type dynamic traction orthosis was developed [9] (hereafter, traction-type orthosis). The precedent study stated that activity difficulty was reduced by improving the range of motion of the MCP joint [1]. Therefore, we used a traction-type orthosis to extend the ligament. Computed tomography (CT) is useful in the anatomical evaluation of the MCP joint [10]. One study showed the usefulness of the orthosis-wearing effect using CT [11]. Therefore, the aim of this study was to evaluate the distance and area of the joint space using CT in healthy subjects fitted with a flexion-type, a traction-type, or no orthosis.

Methods

Study design and ethics

The study design was approved by the hospital's ethics committee on human research, and written informed consent was obtained from each subject.

Subjects

The MCP joints in 10 healthy human index fingers from six men and four women (mean age, 29.4 years; range, 24−34 years) were evaluated. The average body mass index was 21.89 kg/m^2; average height was 166.6 cm; and average weight was 66.8 kg. All of the subjects were right-handed.

Measurements

This pilot study investigated the joint space distance and area in the MCP joint as a function of three alternative orthotic positioning methods. CT images of the subjects who wore a flexion-type, a traction-type, or no orthosis were obtained, and the sagittal sections of the MCP joint were measured. The images were obtained with patients in the prone position with the shoulder joint at 180° flexion, elbow joint extended, wrist joint at 30° of extension, and MCP joint at 40° of flexion. For those not wearing an orthosis device, the hand was passively positioned by the radiologist. The distance between the central, most dorsal, and most palmar parts of the joints and the area of the joint space in the palmar and dorsal parts of the joint were measured using digital photography analysis as described below. The wearing time for the orthosis was approximately 10 min, and the images were captured thrice.

Orthotic devices

The flexion-type orthosis was manufactured of thermoplastic Orfit (1835-7, 3 mm, no hole; OG Giken Ltd., Okayama, Japan), and a Velcro strap and elastic band were used. The traction-type orthosis was also manufactured from thermoplastic Orfit (3 mm, no hole; OG Giken Ltd.), aquaplast (1.6 mm, hole; OG Giken Ltd.), and a Velcro strap and elastic band were used (Fig. 1). These orthoses applied a 200-g force [12] on the proximal phalanx bone of the index finger. No subject experienced pain while wearing either orthosis.

CT equipment

The scan conditions for CT were as follows: number of rearrangement functions, Fc30; lines, 0.5 mm × 64; helical pace, 53; tube voltage, 120 kV; tube electric current, 100 mA; and turnover rate, 0.5 s. The CT equipment used was Aquilion One (Toshiba Inc., Tokyo, Japan). Regarding the CT device, 160 lines of volume helical scanning are possible. In addition, the CT device allows three-dimensional image construction. The images were taken in the sagittal plane at a 0.1-mm slice interval and analyzed using Vitrea software (Toshiba Inc.). The images were evaluated in a blinded fashion by a radiologist.

Measurement of joint space distance in the MCP joint

The level of the sagittal plane was measured at the middle point between the medial and lateral joint aspects. The most palmar points were identified on the proximal phalanx base and the metacarpal head (Fig. 2(i)a). The most dorsal points were also obtained for the proximal phalanx base and metacarpal head (Fig. 2(i)b). The central points were defined as the points halfway between the most palmar and the most dorsal points for the proximal phalanx base and the metacarpal head (Fig. 2(i)c). The mean joint space distance was the average distance among three points on the proximal phalanx and the metacarpal head, namely the most proximal points, most distal points, and central point (Fig. 2(i)d–f).

Measurement of joint space area in the MCP joint

The level of the sagittal plane was measured at the middle point between the medial and lateral joint

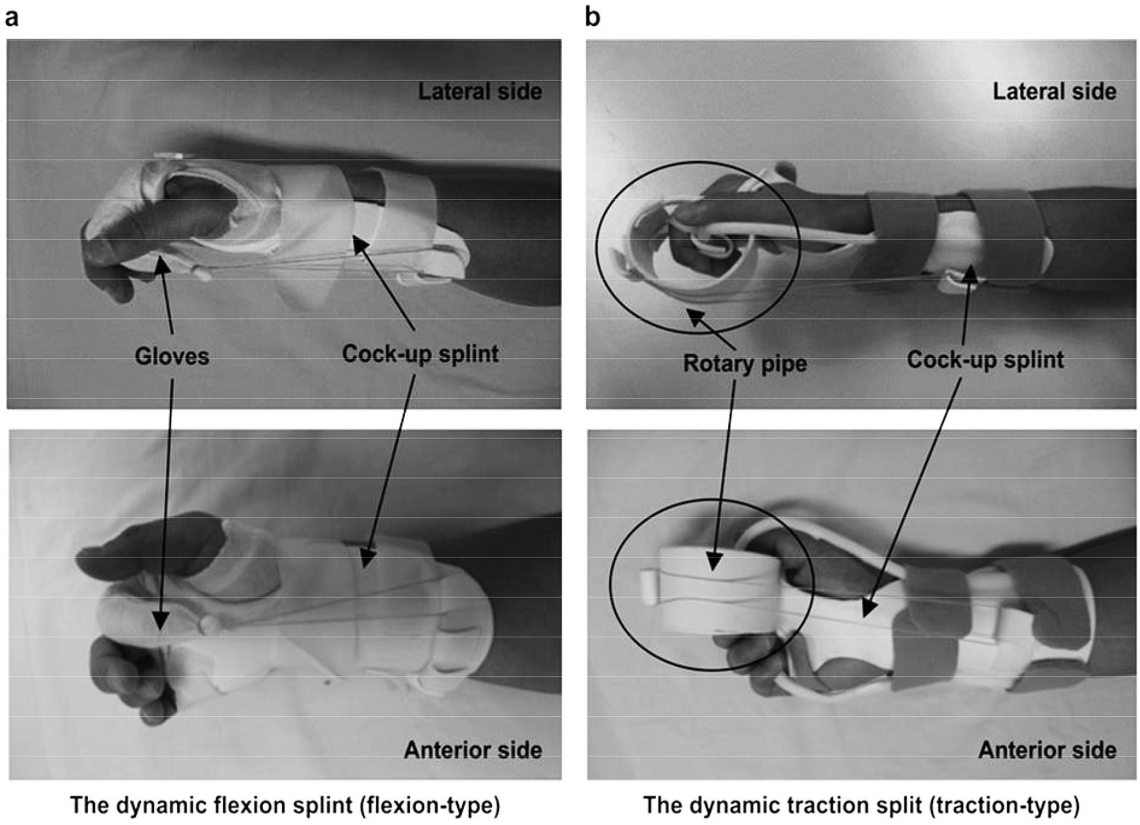


Fig. 1. The dynamic orthoses used in this study
a Flexion-type orthosis. The cock-up orthosis fixes the wrist joint and metacarpal bones. The subject's fingers are placed in a glove, and the tip of the finger is directly pulled by the glove into flexion at the metacarpophalangeal joint.
b Traction-type orthosis. The cock-up orthosis fixes the wrist joint and metacarpal bones. The subject's fingers are placed in a rotary pipe, while the proximal phalanges are fixed by a dorsal and palmar cuff while traction is applied to enhance the joint space and provide flexion.

aspects. The palmar area of the joint space was defined as the area between the central and most palmar parts of the joint. The dorsal area of the joint was defined as the area between the central and most dorsal parts of the joint (Fig. 2(ii)). A total of 20 points were marked on the proximal phalanx base and metacarpal head. These points were 0.1 mm apart based on the bone curvature. The ratio of cancellous bone and the articular cavity was maintained at 1:1.

Statistical methods

We used Friedman's test to confirm whether there was a difference among the flexion-type, traction-type, and no orthosis groups. A significant difference was observed, so we performed the Steel-Dwass test for multiple comparisons to confirm whether there was a significant difference among groups. We then calculated the P value. Statistical analyses were performed using the SPSS Base 11.0J software package (SPSS Japan Inc., Tokyo, Japan). P values < 0.05 were considered statistically significant.

Results

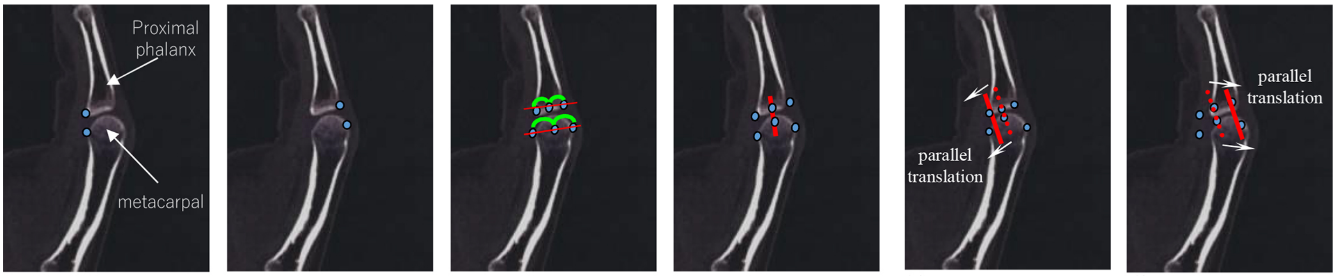
Joint space distance of the MCP joint

There was no significant difference in the most dorsal joint space distance between the flexion-type and traction-type orthoses (Fig. 3). When no orthosis was used, significant narrowing occurred compared to that of the flexion-type and traction-type orthoses ($p = 0.03$).

The central joint space increased significantly by the traction-type orthosis compared to that with the flexion-type orthosis ($p = 0.04$) or no orthosis ($p = 0.03$). In contrast, the palmar joint space decreased significantly with the flexion-type orthosis compared to the traction-type orthosis ($p = 0.02$) or no orthosis ($p = 0.04$).

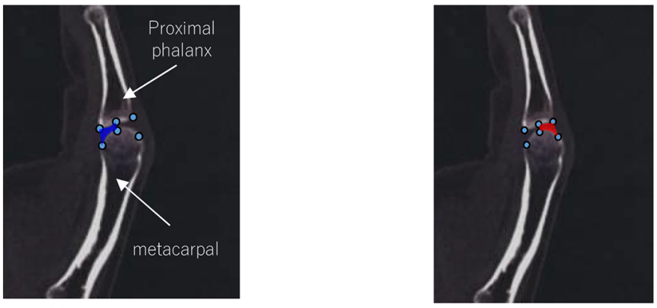
Joint space area of the MCP joint

The dorsal joint space area significantly increased by the traction-type orthosis compared to that when no orthosis was used ($p = 0.02$). In contrast, the dorsal joint space area was not significantly different between the



(a) The most palmar point (b) The most dorsal point (C) Central point (d) The central part (e) The most palmar part (f) The most dorsal part

(i) Method for measurement of the joint space distance in the metacarpophalangeal joint



(a) The palmar part (b) The dorsal part

(ii) Method for measurement of the joint space area in the metacarpophalangeal joint

Fig. 2. Method for measuring the joint space distance and area in the metacarpophalangeal joint

(i) Method for measuring the joint space distance in the metacarpophalangeal joint. (a) The most palmar point is the most palmar point of the proximal phalanx and the metacarpal head. (b) The most dorsal point is the most dorsal point of the proximal phalanx and the metacarpal head. (c) The central point is the point halfway between points a and b. (d) The central part is the line between the two central points. (e) The most palmar part makes a parallel translation from c to the most palmar point of the proximal phalanx; the distance to the metacarpal head was obtained. (f) The most dorsal point makes a parallel translation from c to the most dorsal point of the proximal phalanx.

(ii) Method for measuring the joint space area in the metacarpophalangeal joint. (a) The palmar part is the area of the joint located between the central part and the most palmar part. (b) The dorsal part is the area of the joint located between the most dorsal part and the most central part.

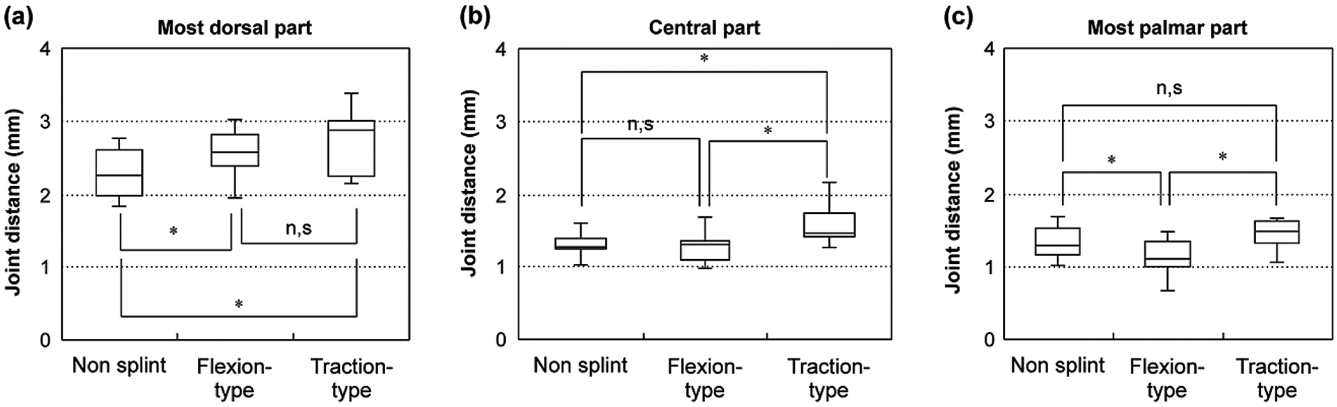


Fig. 3. Comparison of the joint space distance in the metacarpophalangeal joint

We examined 10 index fingers of healthy volunteers. (a) is the most dorsal part; and (b) and (c) are the central and the most palmar part. n.s; not significance, *; $p < 0.05$.

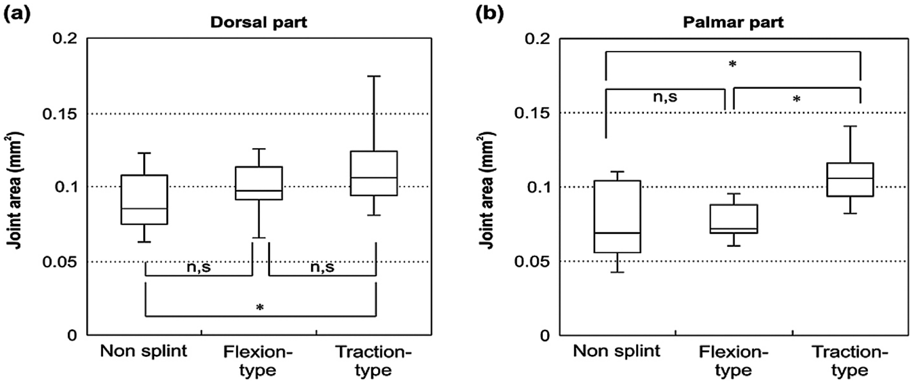


Fig. 4. Comparison of the joint space area in the metacarpophalangeal joint
We dissected 10 fingers of healthy volunteers. (a) the most dorsal part; and (b) the most palmar part. n,s; not significance, *; $p < 0.05$.

flexion-type orthosis and no orthosis (Fig. 4).

The palmar joint space area was significantly increased by the traction-type orthosis compared to the flexion-type orthosis ($p = 0.04$). In contrast, the palmar joint space area decreased insignificantly by the flexion-type orthosis compared with no orthosis ($p = 0.12$). Finally, the palmar joint space area of the traction-type orthosis was significantly greater than that of the flexion-type orthosis.

Discussion

CT is useful in the anatomical evaluation of the MCP joint; [10] hence, we used it to measure the effect of the dynamic (traction-type) orthosis on the MCP joint distance and area spacing. The traction-type orthosis can add traction to the MCP joint in a variety of flexed positions because it uses a rotary pipe. Compared to the flexion-type orthosis, the traction-type orthosis induced joint space widening and, therefore, can reduce the risk of articular surface collision, which can cause injury. However, compared to wearing no orthosis, wearing the traction-type orthosis did not significantly increase the joint space area in the most palmar part of the MCP. According to previous studies, the bony origin of the index collateral ligament of the MCP joint lies along the dorsolateral tubercle of the metacarpal, while its insertion is along the proximal phalanx near the volar plate [13]. Generally, the collateral ligaments of the MCP joint relax in the extended position and are tense in the coiled position. Furthermore, when the MCP joint is flexed to 40°, the radial collateral ligament and the ulnar collateral ligament are extended by 2−3 mm [13]. Therefore, in the 40° coiled position, approximately 70% of the collateral ligament is in a rigid state. The traction-type orthosis creates traction from the stiff angle, which suggests why it was ineffective at increasing the joint distance in the most palmar part.

MCP joint contracture is a common clinical condition [8]. The most common cause of extension contracture of the MCP joint is shortening of the collateral ligament [8]. It is important to maintain the maximum possible range of joint motion during the early treatment of contractures. Treatment is difficult and requires more time once the contracture is fully formed. Here, a traction-type dynamic orthosis was designed to correct flexion while achieving joint traction to enhance the MCP joint area spacing and minimize damage caused by articular surface collision [5, 9].

Based on the results of our study and previous studies, a therapist considers the power of traction and manufactures orthoses according to patients’ symptoms. Therefore, sharp pain caused by traction-type orthosis does not differ significantly from that caused by flexion-type orthosis [14]. However, our results show that the articular surface was pulled using a traction-type orthosis rather than a flexion-type orthosis. This shows that both ligament and joint capsules were pulled using the traction-type orthosis. Furthermore, another study reported that a significant improvement in ROM occurred with the traction-type orthosis compared with the flexion-type orthosis after 6 weeks [9]. In addition, the traction-type orthosis is effective for treating contractures of the MCP joint [15].

This study has a few limitations. First only healthy subjects, not those with MCP joint contractures, were evaluated; therefore, the data may not be extrapolated to other patients. Second, in clinical practice, an orthosis is often worn for long periods, but this study evaluated only the immediate effects of its application. The traction-type orthosis will most likely require several improvements. In addition, because of the risk of irradiation to the patient when using CT, it may be necessary in future studies to devise an alternative means of evaluating the usefulness of the dynamic orthosis. To validate the results of the current study, further long-term studies are needed in a larger patient population. In this study, we made our evaluations using surrogate scales without a functional standard. Furthermore, in the future, we wish to evaluate the dynamic orthosis using functional standards such as range of motion or sharp pain.

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ORIGINAL ARTICLE

Tasks and Prospects of Psychiatric Occupational Therapy in South Korea

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Abstract: Background: Occupational therapy (OT) in South Korea suffers from ambiguous legislation and lack of institutional support.
Aim: To identify the current state and prospects of psychiatric OT in South Korea.
Methods: We introduced the concept of Japanese psychiatric OT to Korean occupational therapists (OTRs). In-depth semi-structured interviews were conducted with participating OTRs. All interview data were analyzed using thematic analysis and NVivo10.
Results: Interview data were divided into two themes: (1) [Current state of Psychiatric OT in South Korea] and (2) [Impressions on Psychiatric OT in Japan]. Furthermore, [Current state of Psychiatric OT in South Korea] was divided into three nodes: (a) [clinical psychiatry], (b) [legal system], and (c) [psychiatric OT]. In addition, we identified that psychiatric OT in Korea had four major problems related to clinical psychiatry, the legal system, psychiatric OT, and education. Although the treatment structure of OT for acute phase, referred to as "parallel place," is difficult to apply in South Korea, opinions on OT in Japan by practitioners were generally positive.
Conclusion: We suggest three approaches that could be used in the future in South Korea. Considering the differences in culture and therapeutic systems between South Korea and Japan, this study proposes solutions to improve the quality and status of psychiatric OTRs in South Korea.

Keywords: psychiatric occupational therapy, South Korea, Japan, mental health, legislation

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1. Introduction

Occupational therapy (OT) in Korea began with psychiatric OT conducted by the Japanese Governor General of Korea in 1928 [1]. It was formally introduced after the Korean War to treat the injured and focused on treating physical disability rather than mental illness [2]. Thereafter, the Mental Health Act was amended, and a clause regarding OT [3, 4] was created in 2008. In the following year, regulations were enforced regarding the involvement of occupational therapists (OTR) [3, 4]. However, the Mental Health Act states that psychiatric OT is to be carried out by mental health specialists (i.e., social workers, nurses, and clinical psychologists) [3, 5], which contradicts with regulations [6].

In Japan, where OT is also conducted under the national health insurance system, similar to South Korea, the total number of OTR in 2010 was 53,080 and the number of psychiatric OTR was 5,565 [7], which is relatively large compared to South Korea. Japan has also more consistent regulations regarding psychiatric OT.

With regard to psychiatric OT in South Korea, a previous study described the issues in South Korea's legal system with reference to foreign countries [6]. Another study examined the current state of psychiatric OT and its problems (shortage of personnel, limited use of assessment tools, and lack of awareness about OT) [8]. However, the state of psychiatric OT remained relatively unchanged even after the studies were conducted.

In order to establish psychiatric OT in South Korea, researchers in the previous study investigated the issues

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surrounding psychiatric OT in South Korea. We focused particularly on the changes that were made to the laws regarding mental health in South Korea, details of OT education, working environment of OTRs in the mental health field, and problems in fieldwork education [9, 10].

In the present study, OTRs in South Korea were directly interviewed and the data were analyzed. This method allowed us to objectively identify the challenges of psychiatric OT in South Korea compared to previous studies. Through our clinical and research experience in Japan, we examined plans for establishing psychiatric OT that is most appropriate to South Korean culture and institution.

2. Methods

Based on the first author's six and a half years of experience in Japanese psychiatric OT, we used qualitative research methods [11], including an in-depth semi-structured interview that examined the opinions of Korean psychiatric OTRs on the characteristic elements and benefits of the psychiatric OT system in Japan (Table 1), as well as problems in the current state of OT and its future challenges. The names of participants were replaced with pseudonyms to ensure anonymity. The study was approved by the Ethics Committee of Kyoto University Graduate School and Faculty of Medicine.

Table 1. Characteristics of Japanese Psychiatric Occupational Therapy

<Session 2>
Interview 1. Japanese mental health system and laws related to psychiatric OT Interview 2. The basics of psychiatric OT (focusing on evaluation, planning, effectiveness of occupation, etc.)
<Session 3>
Interview 3. OT and psychiatric healthcare systems according to recovery status (i.e., acute phase, convalescence, and chronic phase) Interview 4. Treatment program (Introduction to the general program and OT-specific treatment such as parallel place)

Note. OT: Occupational therapy

2.1. Participants

As of 2014, there were 10,071 licensed OTRs in South Korea [12], but only 25 worked in the field of psychiatry [13]. Among them, recruitment emails were sent to 15 OTRs who were assumed to have been working in adult psychiatry for more than a year. A researcher visited six participants who had agreed to participate, explained the research objectives, both in writing and verbally, and received written informed consent prior to initiation. The other nine OTRs refused to participate because they were either on maternity leave or for other private reasons. Participant characteristics are shown in Table 2.

2.2. Data Collection

This study was carried out over three sessions (one session per day) in order to give participants time to fully understand the contents and make appropriate decisions. The first session was a demographic interview consisting of open-ended questions (duration: 22–58 min). In the second and third sessions, we introduced characteristic elements of psychiatric OT in Japan (Table 1), on which the participants were asked to comment and reflect. Further, they were asked questions regarding the problems with South Korean psychiatric OT and their possible solutions (4–5 h per session). The interview was conducted while allowing the participants to rest and relax, according to their state and needs. The contents of the semi-structured interview are shown in Table 3.

All interviews were conducted by the first author and were recorded with the consent of the participant. Observations made during the interview were noted in the field notes, along with the time and date of the interview, description of the environment/facility, and nonverbal behaviors.

2.3. Data Analysis

We used thematic analysis [14, 15], which was conducted over six phases: familiarization with data, generating initial codes, searching for themes among

Table 2. Participant Characteristics

Subject	Employment Status	Employment Period	Education	Facility	Age	Gender
1	Permanent	Over 10 Years	Master	Hospital	50s	Female
2	Contract	Over 10 Years	Doctoral	Hospital	40s	Female
3	Contract	5–10 Years	Bachelor	Community Facility	30s	Female
4	Permanent	5–10 Years	Master	Hospital	30s	Male
5	Contract	1–5 Years	Bachelor	Community Facility	20s	Female
6	Contract	5–10 Years	Master	Community Facility	30s	Male

codes, reviewing themes, defining and naming themes, and producing the final report.

Furthermore, in order to improve the reliability of data analysis, we used NVivo10 [16], which helps formulate theories by individually coding textual data by word, phrase, sentences, and eventually creates categories [17].

All transcripts were transcribed verbatim and translated into Japanese; nuances of the language and cultural expressions were explained in detail to all researchers. The researchers reviewed the transcripts and field notes multiple times, and consensus coding was performed until all researchers agreed on the main themes and subthemes. A total of 433 pages of transcripts and coding categories, which required no further revision, were documented and converted into NVivo data by the first author. The data were categorized into final coding categories, and during this process, the relationship between the nodes were structured in stages. A total of 422 subnodes were divided into two nodes: (1) [Current state of Psychiatric OT in South Korea] and (2) [Impressions on Psychiatric OT in Japan]. In addition, [Current state of Psychiatric OT in South Korea] node was divided into three nodes: (a) [clinical psychiatry], (b) [legal system], and (c) [psychiatric OT]. The entire process of NVivo analysis was carried out according to the guidelines of NVivo10 data analysis [18, 19].

3. Results

The data obtained through NVivo10 were converted into 737 data (images, excel, and word files), which were discussed by the researchers. Nodes that were commonly mentioned by more than half of the participants were determined as significant. Based on the number of times the participants mentioned the node (References) and the number of participants who mentioned the node (Sources), we considered meaningful data as 1) references that occurred more than ten times and 2) sources that were more than four participants; these were more

Table 3. Questions in the Semi-Structured Interview

<Session 2>
Interview 1 1. Impressions and questions regarding the provided book (on psychiatric OT in Japan) if the participant read it 2. Impressions and questions regarding the researcher's explanation for Interview 1 3. Impressions and opinions related to the psychiatric heath care system and psychiatric OT laws in Japan 4. Differences and similarities in the psychiatric heath care systems and psychiatric OT laws between South Korea and Japan 5. What would be the most beneficial if applied to South Korea, and why? 6. Opinions on the best ways to apply this beneficial factor
Interview 2 1. Impressions and questions regarding the researcher's explanation for interview 2 2. Impressions and opinions regarding Japan's psychiatric OT system 3. Impressions and opinions regarding the evaluation method of Japan 4. Opinions on the psychiatric OT planning method in Japan 5. Impressions and questions on the YouTube video (on art and craft) created by the researcher if the participant watched it 6. Impressions and opinions on a method of treatment such as handicraft in Japan 7. On OT in South Korea (trends, evaluation, plans, and treatment methods) 8. What would be the most beneficial if applied to South Korea, and why? 9. Opinions on the best ways to apply this beneficial factor
<Session 3>
Interview 3 1. Impressions and questions regarding the researcher's explanation for interview 3 2. Impressions on the psychiatric heath care system and OT according to recovery status in Japan 3. Differences and similarities in the psychiatric heath care systems between South Korea and Japan 4. Thoughts on application in South Korea and its possibility 5. Opinions on the best ways to apply these beneficial factors
Interview 4 1. Impressions and questions regarding the researcher's explanation for interview 4 2. Impressions and opinions on Japan's treatment structure and treatment program 3. Impressions and opinions on Japan's parallel place 4. Thoughts on the most beneficial factor if applied in South Korea, and why? 5. Opinions on the best ways to apply this method

Note. OT: Occupational therapy

than 5% of total transcripts (Coverage) (Table 4). Table 5 presents some noteworthy statements made by the participants.

Due to limited number of psychiatric OTR in South Korea, there is a risk of exposing the identity of participants despite ensuring anonymity. Therefore, the participants will be referred to as numbers randomly assigned by researchers in this paper (Table 5). For example, P1 denotes Participant 1.

3.1. Clinical psychiatry

In the [clinical psychiatry] node (Table 4), the lack of an understanding of OT in South Korea and the skepticism about the professionalism of OTRs was most commonly mentioned (Table 5A).

Furthermore, there were conflicts among healthcare professionals due to overlapping treatment, and OTRs were at a disadvantage because of to their small organization size (Table 5B). Moreover, health system in South Korea lacks a systematic patient management program after discharge, which prolongs hospitalization and inhibits rehabilitation.

3.2. Legal system

Article 46, paragraph 2 of the legislation, which is an OT-related law, does not require an OTR to perform the treatment [3, 20]; thus, the need to employ an OTR was low. Moreover, due to limited medical insurance fees, it was difficult to receive support from hospitals for arranging a suitable environment for performing OT

Table 4. NVivo 10 Results

Categories	Node				References	Sources	Coverage
Current state of Psychiatric OT in Korea	Clinical Psychiatry	Clinical problems	Problems with other occupations	Lack of understanding regarding OT	17	5	3.48%
				Overlapping treatment	12	3	5.07%
			Problems after discharge	Non-systematic patient management system	10	4	3.96%
		Treatment/clinical status			15	5	12.89%
	Legal System	Problems related to psychiatric OT laws	Problems with medical fees		18	5	3.37%
			Exclusion/discrimination from mental health specialist occupations		21	6	2.67%
		Mental health laws problems		Laws related to working pattern	21	4	5.01%
	Psychiatric OT	Problems in clinical practice	The shortage of OTRs		16	5	1.55%
			Unclear identity of psychiatric OT		11	4	2.21%
			Lack of psychiatric OT evaluation		11	6	4.88%
		Problems in education	Lack of psychiatric OT lectures		11	5	3.15%
		Solutions	Need for evidence		10	6	2.72%
			Need for listing OTRs as essential legal personnel		15	4	3.68%
			Need for publicizing OT		11	5	3.89%
			Need for a larger number of psychiatric OTRs		14	5	4.36%
			Need for establishing the practice of psychiatric OT		12	3	6%
			Need for development/proposal of practical programs		11	3	9.76%
Impressions on Psychiatric OT in Japan	Reflections regarding parallel place	Problems with application in South Korea	Problems with medical fees		10	5	4.16%
	Reflections on the explanation of the researcher				11	3	5.8%

Note 1. OT: Occupational therapy; OTR: Occupational therapist

Note 2. Gray background: nodes that were mentioned more than ten times or nodes that were mentioned by more than four subjects or coverage that were more than 5%.

(Table 5C).

Another reported major problem in the legal system was [exclusion /discrimination from mental health specialists] (Table 5D). This node was most frequently mentioned and was mentioned by all participants. Legally, mental health specialists hold many rights and can perform OT according to article 46, paragraph 2 of the legislation [3]; therefore, OTRs in clinical settings frequently encounter discrimination and have many complaints regarding this matter.

In terms of local facilities, problems in working patterns, such as legally requiring OTRs as well as other professionals to renew their contracts annually, were discussed.

3.3. Psychiatric OT

The [psychiatric OT] node can be divided into three categories: [problems in clinical practice], [problems in

Table 5. Participants Quotes

A	(Questions from other occupations) What can occupational therapists boast as their expertise within psychiatry; What are you(OTR) good at… (P1)
B	Since there are other professions that perform overlapping duties... it's kind of like a fight with professions (from different occupations)… there is a subtle… competition... that exists... (P4)
C	There was no support, and of course, there were financial issues, and legal issues, and the fact that we can't hire another person (OTR). There isn't any funding, so there won't be a reason to hire (an OTR). (P4)
	[Occupational and recreational therapy] They're bundled together like this. You don't receive additional payment... you can do occupational therapy or recreational therapy… (P5)
D	There are limits placed in work. In fact, since it is not included as a mental health specialist, (omitted) (OTRs) actually get excluded from all lectures and education on counsel or treatment programs (P1).
	Occupational therapists are part of miscellaneous personnel; the people who are in miscellaneous personnel are, you know, people who do accounting? (Omitted) It's under that category, the occupational therapists. (P6)
E	There is a lack of support in discussing the matter in institutes right now. It's because there are only a few people (OTRs) working in psychiatry… (P3)
	Since there are only a small number of OTRs, OT must focus on one thing, even though there are various things that the OT wants to do... it's kind of unfortunate... (P4)
F	In nursing, for example, there is medical knowledge—medication management and such—which are representative of an occupation. (omitted) (However,) when you're asked what does an occupational therapist do well in the psychiatry field, there isn't a single proper response yet… that you can say... (P1)
G	Regarding the therapeutic value of occupation, I think it's largely missing from our education process. Also, it seems that graduating from school (majoring in occupational therapy) doesn't imply that everybody can perform psychiatric occupational therapy (P3)
	The most difficult part of working in psychiatry is that we learned very little from school (omitted) and we don't practice (what we learned related to arts and craft) ~(P6)
H	Nurses are also involved with training for activities of daily living; there are no clear distinction for an occupational therapist (as an occupation for performing training for activities of daily living in the law) (P4)
	Occupational therapist must be placed under a personnel structure by law.(P5)
I	I think more publicity for psychiatric occupational therapy is needed (omitted) for it to be invigorated—anywhere—it requires people to be interested in that area (P2)
	Lobbying activities must be made by creating data on the need for OT (P3)
J	If there are more OTRs, people will say (omitted) oh, there are so many occupational therapists in psychiatry—it's an obvious occupation (in psychiatry) that people are in—this way, people become naturally aware of OT, right? (P1)
	There are this many occupational therapists working in developed countries; but, even if you submit this evidence to the secretary general for healthcare policy, it won't be recognized, so I think there needs to be more OTRs working in the psychiatric field (P6)
K	Either way, one part (practice) needs to be selected quickly. If not, it appears that we might lose it all (to another occupation). (omitted) The daily routine in hospital wards is already fully planned out with activity programs. (P3)
L	It would be great if parallel place was possible… but because of the very small budget of the Ministry of Health and Welfare, and because the health insurance is always in deficit, the current tone is decrease and reduction. So, I don't think it will be easy. Even implementation itself (P6)

education], and [solutions]. Among them, three nodes, [the shortage of OTRs], [unclear identity of psychiatric OT], and [lack of psychiatric OT evaluation], were commonly mentioned under the [problems in clinical practice] node. The most frequently mentioned node was [shortage of OTRs] (Table 4), which was also mentioned as a factor that weakened the organizing ability and as impeding treatment variety (Table 5E).

Regarding the [unclear identity of psychiatric OT] node, there were four OTRs who had concerns similar to those listed in Table 5F, which was the second most frequently mentioned node among [problems in clinical practice] (see Table 4).

All the participants evaluated the psychiatric OT (Table 4) and pointed out the lack of an evaluation system appropriate to Korean culture and clinical practice, including the lack of a common evaluation tool that can be used by psychiatric OTRs.

Moreover, in the [problems in education] node, participants mentioned lack of psychiatric education during undergraduate studies that lead to difficulties in applying for psychiatric OT in clinical practice (Table 5G).

Lastly, the [solutions] nodes included [need for evidence], [need for listing OTRs as essential legal personnel], [need for publicizing OT], [need for a larger number of psychiatric OTR], [need for establishing the practice of psychiatric OT], and [need for development/proposal of practical programs]. Among these, [need for evidence] was proposed by all participants as a solution to problems in clinical practice, and as a necessary step to list OTR as an essential legal personnel. The node [need for listing OTRs as essential legal personnel] was the most frequently mentioned node among [solutions], and other nodes were mostly mentioned in support of this node (Table 5H). Furthermore, [need for publicizing OT] was mentioned as a challenge in Table 5I due to the lack of awareness of OT and problems in the legal system, which seem to be due to a shortage of psychiatric OTRs in South Korea (Table 5J).

In addition, in the node [need for establishing the practice of psychiatric OT], participants believed that the Korean psychiatric OTRs should not overlap in practice with other professionals and should develop treatment and therapy that are not practiced by other specialists (Table 5K).

Lastly, the [need for development/proposal of practical programs] node was present in more than 9% of total transcripts, and many OTRs asked for specialized practices and practice methods due to lack of established psychiatric OT practices.

The relationship between the current state of psychiatric OT in South Korea and its solutions according to analyses of interviews are shown in Fig. 1.

3.4. Impressions on Psychiatric OT in Japan

In the [psychiatric OT in Japan], [reflections regarding parallel place] and [reflections on the explanation of the researcher] nodes were considered meaningful.

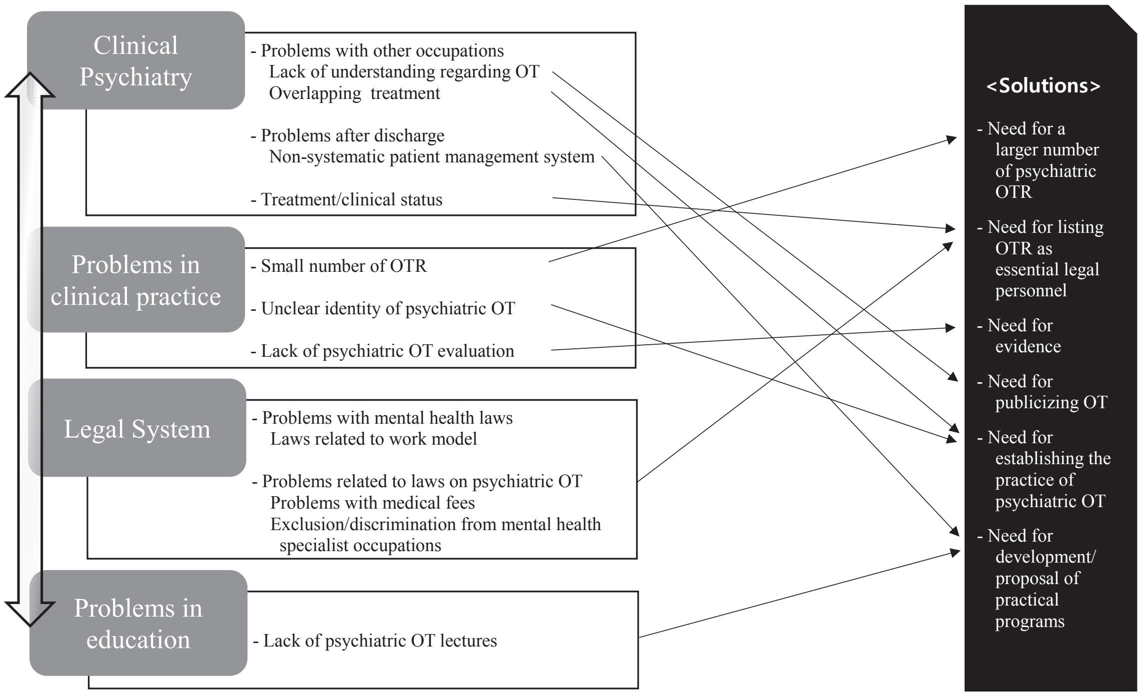

Fig. 1. The relationship between the current state of psychiatric OT in South Korea and its solutions

Among these, the [reflections on the explanation of the researcher] node included opinions, reflections, and satisfactory ratings of the explanation by the first author (Table 2), and, based on this, any problems with the explanation method were identified.

Although these were not selected as nodes for analyses because they were neither mentioned more than 10 times nor accounted for 5% of what was mentioned, the participants' response to the evaluation of legislation, recovery status, and healthcare system in Japan was mostly positive. At least four participants expressed positive comments saying that they were specific and systematic.

More than 4 participants showed positive responses to [parallel place], that is, patients could choose their desired occupation and were able to proceed with the treatment according to their current state. Parallel place is a unique treatment structure in Japan, similar to Parten's parallel play or Mosey's parallel group [21, 22], but this treatment structure targets mainly patients in the acute phase, without increasing the level of cohesion in the organization [23]. However, [problems with medical fees] were pointed out as challenges in terms of application in South Korea (Table 5L). It was indicated that application in South Korea would be difficult due to lack of legal standards regarding clinics and facilities, and the materials and tools required for OT [24], compared to those that are present in Japan. Furthermore, it was mentioned that with the current medical insurance fees, it is not possible to receive funding from the hospital to equip OTRs with the materials and tools required for OT; there were also many opinions on the need for application of elements other than parallel place in clinical practice.

4. Discussion

Previous research clearly indicated problems in psychiatric OT in South Korea such as lack of education, evaluation tools, and workforce, problems in OTR organization and the legal system, and lack of awareness regarding OT [6, 8, 10].

By conducting an in-depth semi-structured interviews and using NVivo10, the present study objectively identified/organized the problems and their solutions regarding psychiatric OT in South Korea. Specifically, we identified that psychiatric OT in Korea had four major problems (Fig. 1) related to clinical psychiatry, the legal system, psychiatric OT, and education. In addition, we learned that psychiatric OTRs in South Korea considered the following solutions to address these problems: the need for evidence, need for listing OTRs as essential legal personnel, need for publicizing OT, need for a larger number of psychiatric OTRs, need for establishing the practice of psychiatric OT, and need for development/proposal of practical programs.

Furthermore, South Korean psychiatric OTRs expressed positive responses towards legislation, evaluation methods, and the recovery status/health care system in Japan, as they described them as detailed, specific, systematic, and clear. However, we also found that factors, such as medical fees and differences in treatment systems, led to hesitation about parallel place.

4.1. Pandora's box

After analyzing the data repeatedly to identify the cause of the problems, we narrowed the possible reasons down to two: low professionalism of psychiatric OT and social and institutional problems in South Korea.

Contrary to what was expected, most of the factors mentioned above as problems and their respective solutions started with one single factor, that is, low professionalism of psychiatric OT. The problems caused by social and institutional problems in South Korea only included problems after discharge in the [clinical psychiatry] node and problems with mental health laws in the [legal system] node.

Problems caused by social and institutional problems in South Korea were the same as problems faced by people in other occupations, such as psychiatric practice. However, at the surface level, OT seemed to struggle with problems due to factors such as legislation, institution, society, clinical practices, and other occupations; yet a deeper evaluation revealed that they were caused by one single factor, that is, low professionalism of psychiatric OT.

When we used the NVivo10 to categorize and analyze data, we used the language or words used by OTRs. While such an analysis revealed many problems in psychiatric OT in South Korea, the suggested solutions were superficial. This was because the participants unconsciously used projection and rationalization as defense mechanisms. Unfortunately, some defense mechanisms used by the participants made it more complicated to identify this problem as they knew, albeit vaguely, that the cause of the problems with psychiatric OT was related to low professionalism.

Admitting this play of defense mechanisms in the interview process will perhaps contribute to a reflective inquiry and serve to improve the results of the research.

4.2. Solutions for Psychiatric OT in South Korea

There are few OTRs working in psychiatry in South Korea, and we attempted to represent their current position and circumstances and identify the solution to improve professionalism in a small organization. There could be three approaches that could be used in the future.

First, psychiatric OT could include the task of coordinating therapy programs. OTRs could hire music therapists, horticultural therapists, and art therapists, and manage the therapeutic plan and schedule. This would be an efficient way to organize group programs. However, for this, psychiatric OTRs should be legally defined as mental health specialists so that they have the authority to coordinate therapeutic plans. In addition, to gain recognition as coordinators and, OTRs need to demonstrate outstanding abilities in occupation analysis and provide evidence to justify the occupation provided to patients. Therefore, the OT association and school teachers should work together to research and develop the OT education program.

Second, psychiatric OTRs could perform all the tasks and operate the programs on their own, as in Japan. However, this approach might face many obstacles. For starters, the entire curriculum needs to be reformed, such as extension of practice hours, for OTRs to be able to perform all the tasks. In addition, there would be many difficulties due to coordination in terms of the scope of work with other professions, and such a change will take time. For this reason, psychiatric OTRs in South Korea need to explain the distinct effects of the tasks performed by them as compared to other occupations by presenting definite evidence. Further, it would require a communication between OTRs in Japan and the OT association in Korea to adopt this approach.

Finally, there is an approach wherein psychiatric OT in South Korea could develop and evaluate their specialized programs. Since this should be a program that is not currently performed by other occupations, it will require detailed research and a considerable amount of funding. Further, it would require guidance and approval from the Korean Association of Occupational Therapists. As such, it is expected that psychiatric OTRs working in clinical practices, the OT association, and school teachers work together to facilitate research.

4.3. Applicability of Japan's Psychiatric OT for the Development of South Korea's Psychiatric OT

This study was conducted as a trial with one of the study purposes being to examine the applicability of Japan's psychiatric OT, which is equipped with a better therapy structure and system in terms of clinical practices, in the context of South Korea, as both countries share a similar health care system. However, we encountered several problems in the course of the study.

First, there was a difference in history and culture of South Korea and Japan. Even though both countries are located in Asia and have a similar national health care system, there was a wide gap in the contexts. After Japan's colonial rule in South Korea ended, the financial and health insurance system was in a bad shape. In addition, many people were physically injured during the Korean War, and there was an increase in acute disease treatment and physical treatment directly related to death. Therefore, the progress of mental treatment and rehabilitation for improving quality of life received low priority. This historical background created imbalances in payments covered by health care insurance in South Korea, so the problems that the country's heath care system faces are fundamentally different from those of Japan's, which was well-established.

Second, there was a gap in OT treatment structure between the two countries. In South Korea, one program is used to perform therapy using the same occupations. On the contrary, Japan uses the parallel place, which is different from group therapy, and provides occupations personalized according to the needs and current status of patients. In this regard, the anxiety of OTRs in South Korea about parallel place was higher than expected. To begin with, since they had never seen or experienced this therapy structure designed for multiple patients, it might have been difficult for them to imagine and the anxiety could have been a result of their doubts about the structure. The operations of parallel place, which provides various tasks tailored to the needs of a certain person, are in fact difficult to apply to South Korea in practical terms. In South Korea, a therapy program gathers patients with the same needs and groups them by providing them the same tasks. For this purpose, music therapists, horticultural therapists, art therapists, and other professionals work together in this process. Therefore, it is difficult to imagine a therapy structure like parallel place. While it is true that problems with legislation and institutions have a large impact, in order to upgrade these, a therapeutic method to maximize the professionalism of OTRs and ensuring cost-effectiveness while hiring them is required. Therefore, instead of debating whether or not to apply parallel place, priority should be on researching and developing unique group operational and therapeutic methods and increase professionalism of OTRs in South Korea.

5. Conclusion

The present study analyzed the status and problems in psychiatric OT in South Korea. From the perspective of Korean OTRs who have experience with psychiatric OT in Japan, we examined the tasks and solutions of psychiatric OT in South Korea. Although issues such as the historical background between the two countries cannot be disregarded, we hope that this study can contribute to an interdisciplinary research aiming to establish an international standard of psychiatric OT appropriate to South Korea. This would allow us to improve treatments for those suffering from mental illness.

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ORIGINAL ARTICLE

Relationship between Recovery and Cognitive Insight, Neurocognition, Social Functioning, and Symptoms in Patients with Schizophrenia: A Cross-Sectional Study

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Abstract: This cross-sectional study investigated the factors associated with recovery in patients with schizophrenia. One-hundred and three patients with schizophrenia participated in this study. Measures included the Japanese version of the Recovery Assessment Scale (RAS-J), Japanese version of the Beck Cognitive Insight Scale (BCIS-J), Wechsler Adult Intelligence Scale-III (WAIS-III) similarities and symbol search subtests, Life Assessment Scale for the Mentally Ill (LASMI), and Brief Psychiatric Rating Scale (BPRS). Stepwise multiple regression analyses were performed to investigate relationship between recovery and other clinical variables, including cognitive insight, neurocognition, social functioning, and symptoms. Goal/success orientation and hope in the RAS-J was significantly associated with self-reflectiveness ($\beta = 0.42$) in the BCIS-J and self-recognition ($\beta = 0.59$) in the LASMI. Reliance on others in the RAS-J was significantly associated with self-certainty ($\beta = 0.49$) and self-reflectiveness ($\beta = 0.49$) in the BCIS-J. Personal confidence in the RAS-J was significantly associated with self-certainty ($\beta = 0.22$) in the BCIS-J and endurance and stability ($\beta = 0.78$) in the LASMI. No domination by symptoms in the RAS-J was significantly associated with self-certainty ($\beta = 0.69$) and self-reflectiveness ($\beta = 0.28$) in the BCIS-J. Willingness to ask for help in the RAS-J was significantly associated with self-certainty ($\beta = 0.41$) in the BCIS-J and belligerence ($\beta = 0.59$) in the BPRS. RAS-J total score was significantly associated with self-certainty ($\beta = 0.20$) and self-reflectiveness ($\beta = 0.12$) in the BCIS-J and endurance and stability ($\beta = 0.69$) in the LASMI. Our findings provide encouraging evidence for the relationship between recovery and cognitive insight and contribute to developing tailored interventions to improve cognitive insight with the aim of achieving recovery in patients with schizophrenia.

Keywords: recovery, cognitive insight, schizophrenia, self-reflectiveness, self-certainty

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Introduction

Schizophrenia treatment has moved beyond management of psychotic symptoms to the more ambitious, and to the patient more personally meaningful, goal of “recovery”. Recovery is a widely discussed concept that emerged in the 1980s in published accounts detailing the struggles of people with severe and chronic mental illness. These accounts described patients’ journeys to rebuild their lives, defining recovery as a deeply personal, unique process of changing one’s attitudes, values, feelings, goals, skills, and/or roles [1, 2]. Recovery reflects a way of living a satisfying, hopeful, and contributing life, even with limitations caused by the illness, and involves the development of new meaning and purpose in one’s life as one grows beyond the catastrophic effects of mental illness [3]. Because of the importance of recovery in severe mental illnesses, including schizophrenia, interventions to support recovery have been widely implemented [4, 5]. Furthermore, there have been attempts to develop methods of evaluating recov-

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ery in the treatment and rehabilitation of schizophrenia [6]. In a review of previous studies, Liberman et al. [7] suggested the following definition of recovery from any serious mental illness using objectively measurable indicators: at least two consecutive years of maintenance at or above the threshold levels, including symptom remission, functioning in vocational or educational activities, satisfying social interpersonal relationships, and independent self-care functioning. In addition, previous studies have reported several factors that are associated with recovery, including experience of peer support [8], social support from family and friends [9, 10], and meaningful social participation such as work [7, 11, 12].

Delusion is a characteristic psychotic symptom of schizophrenia, and was once considered to be psychologically beyond comprehension [13]. In recent years, the cognitive behavioral approach to psychotic symptoms has empirically clarified cognitive psychological mechanisms related to the psychotic symptoms of schizophrenia [14]. Within this approach, a lack of clinical insight has been accepted as a hallmark feature of schizophrenia, where insight is defined as awareness of having a mental illness, of specific symptoms and their attribution to the disorder, of social consequences, and of need for treatment [15−18]. An important extension of the concept of clinical insight was proposed by Beck et al. [19]. They suggested that although clinical insight focuses on awareness of illness factors, the concept of “cognitive insight” focuses on the cognitive processes involved in correcting erroneous judgments and certainty about mistaken judgments. Beck et al. [19] distinguishes the traditional approach to clinical insight from cognitive insight, suggesting that the latter is a form of cognitive flexibility that encompasses the evaluation and correction of distorted beliefs and misinterpretations. It has been proposed that patients with schizophrenia, particularly those with delusions, have a limited capacity to evaluate erroneous inferences, to distance themselves from and reflect on their psychotic experiences, and to respond to corrective feedback [20, 21]. In addition, it has been found that cognitive insight is associated not only with delusions, but also with cognitive functioning [22, 23] and has an impact on real world functioning, such as daily functioning, interpersonal relations, and work [24, 25]. For these reasons, psychological interventions aimed to improve cognitive insight in schizophrenia have been developed [26, 27].

Promoting the recovery of patients with schizophrenia is a very important theme within mental health care provided within occupational therapy [28−32]. However, whether the cognitive insight is associated with recovery in patients with schizophrenia has not yet been demonstrated. In this study, we investigated the relationship between recovery and several variables, including cognitive insight, neurocognition, social functioning, and symptoms in Japanese patients with schizophrenia at a psychiatric hospital. We hypothesized that cognitive insight would be associated with recovery in these patients. Moreover, hypotheses included that neurocognition and social functioning would be associated with recovery. Clarifying these relationships may have important clinical implications for the development of interventions that promote recovery in patients with schizophrenia.

Methods

We conducted a cross-sectional study investigating the factors associated with recovery in patients with schizophrenia at a Japanese psychiatric hospital between October 2016 and January 2017. Ethical approval for the study protocol was granted by the ethics board of the Mental Support Soyokaze Hospital, Nagano, Japan. Study participants provided written informed consent for all study procedures.

Participants

Inclusion criteria for this study were aged 20−65 years, and a diagnosis of schizophrenia or schizoaffective disorder based on the criteria of the Structured Clinical Interview for DSM-5 [33]. Exclusion criteria were a diagnosis of mental retardation, alcohol or drug disorders (abuse or dependence), or any current or past history of neurological disorders, including head injury, cerebral vascular disorders, epilepsy or dementia.

Measures

Recovery was assessed with the Japanese version of the Recovery Assessment Scale (RAS) [34−36]. The RAS was developed by Corrigan et al. [34, 35], and a Japanese version (RAS-J) was subsequently developed by Chiba et al. [36]. Outcomes on the RAS-J were analyzed using the five domains previously described, which includes goal/success orientation and hope, reliance on others, personal confidence, no domination by symptoms, and willingness to ask for help [36]. Each item was scored on a 5-point Likert scale (1, strongly disagree; 5, strongly agree), with higher scores indicating a better attitude to recovery.

Cognitive insight was assessed with the Japanese version of the Beck Cognitive Insight Scale (BCIS-J). This comprises 15 items and two subscales: nine self-reflectiveness items assessing objectivity, reflection, and openness to feedback, and six self-certainty items assessing certainty about being right and resistance to correction [19, 37]. Each item was scored using a 4-point scale (0, do not agree at all; to 3, agree completely), with a higher score of self-reflectiveness indicating greater objectivity, and recognition of self and situation and with a higher score of self-certainty indicating greater certitude and confidence in one's belief. A composite index was calculated by subtracting the self-certainty score from the self-reflectiveness score. Low composite index scores indicate lower cognitive insight, reflecting low self-reflectiveness and high self-certainty.

Neurocognition was assessed with the similarities and symbol search subtests from the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III) [38]. Sumiyoshi et al. [39, 40] suggested that the combination of these WAIS-III subtests is the optimal and most concise assessment of neurocognition in terms of administration time, providing an assessment that is sensitive to overall cognitive functioning and functional outcomes for schizophrenia.

Social functioning was assessed with the Life Assessment Scale for the Mentally Ill (LASMI) [41]. The LASMI was developed to assess an individual's disabilities in daily life. It contains 40 items in five categories, including daily living, interpersonal relations, work, endurance and stability, and self-recognition, with higher scores indicating more severe disability. In this study, we used four categories: daily living, interpersonal relations, endurance and stability, and self-recognition.

Symptoms were assessed with the 18-item Brief Psychiatric Rating Scale (BPRS) [42]. Outcomes on the BPRS were analyzed using the 5-factor solution described by Harvey et al. [43], which includes the following subscales: positive, negative, disorganization, belligerence, and affect. Each item was rated from 1 (not present) to 7 (extremely severe), with higher scores indicating more severe symptoms.

Statistical analyses

Descriptive statistics were used to summarize the demographic and clinical variables. Pearson correlation coefficients were calculated to examine the association between RAS-J and each variable (BCIS-J, WAIS-III similarities and symbol search, LASMI, and BPRS). To investigate the extent of the impact of clinical variables on recovery, stepwise multiple regression analysis was performed to determine the factors associated with recovery. Scores on each of the RAS-J subscales and the RAS-J total score were dependent variables, and clinical variables that were significantly correlated with RAS-J (with $p < .05$ and with $r > 0.3$) were independent variables. A test result was considered significant where $p < .05$ for a two-sided test. Statistical analyses were performed with JMP13.0.0 for Microsoft Windows (SAS Institute, Cary, NC, USA).

Results

One-hundred and three patients with schizophrenia participated in this study. Demographic and clinical variables are summarized in Table 1 and 2. The mean age of participants was 50.93 years (*SD* = 10.93), and the mean antipsychotic dose (chlorpromazine equivalents) was 750.89 mg (*SD* = 253.28). Of the 103 participants, 59 (57.28%) were male and 81 (78.64%) were inpatients. Mean scores for RAS-J subtests were as follows: goal/success orientation and hope, 32.34 (*SD* = 5.83); reliance on others, 14.24 (*SD* = 2.47); personal confidence and hope, 15.97 (*SD* = 3.71); no domination by symptoms, 6.87 (*SD* = 1.88); willingness to ask for help, 14.07 (*SD* = 2.32); and the mean RAS-J total score was 83.50 (*SD* = 12.04). Mean scores for the BCIS-J were as follows: self-reflectiveness, 11.09 (*SD* = 4.92); self-certainty, 7.36 (*SD* = 2.88); and composite index score, 3.69 (*SD* = 3.96). Results of the Pearson correlation of the scores for RAS-J with other variables are shown in Table 3. There were several significant correlations ($r >$ 0.3). Goal/success orientation and hope was correlated with self-reflectiveness (r = 0.35) in the BCIS-J and self-recognition (r = 0.37) in the LASMI. Reliance on others was correlated with self-reflectiveness (r = 0.65), self-certainty (r = 0.45), and the composite index (r = 0.46) in the BCIS-J. Personal confidence was correlated with self-certainty (r = 0.38) in the BCIS-J, endurance and stability (r = 0.53), and self-recognition (r = 0.31) in the LASMI, and disorganization (r = 0.40) and belligerence (r = 0.45) in the BPRS. Not dominated by symptoms was correlated with self-reflectiveness (r = 0.47)

Table 1. Patient demographics

Age (years), mean (SD)	50.93 (10.93)
Gender, n (%)	
Male	59 (57.28)
Female	44 (42.72)
Age of onset (years), mean (SD)	23.76 (3.47)
Number of hospital stays, mean (SD)	2.80 (1.22)
Total length of hospital stays (months)[a], mean (SD)	21.92 (16.46)
Education (years), mean (SD)	11.30 (2.38)
Experience of employment, n (%)	
Yes	31 (30.10)
No	72 (69.90)
Treatment setting, n (%)	
Inpatient	81 (78.64)
Outpatient	22 (21.36)
Antipsychotic dose (mg/day)[b], mean (SD)	750.89 (253.28)

[a] The total length of hospital stay represented the total length of all previous hospital stays.

[b] Chlorpromazine equivalent dose.

Table 2. Descriptive statistics of clinical variables

	Mean (*SD*)	Range
RAS-J		
Goal/success orientation and hope	32.34 (5.83)	21–43
Reliance on others	14.24 (2.47)	10–20
Personal confidence	15.97 (3.71)	9–25
No domination by symptoms	6.87 (1.88)	4–15
Willingness to ask for help	14.07 (2.32)	10–20
RAS-J total	83.50 (12.04)	65–114
BCIS-J		
Self-reflectiveness	11.09 (4.92)	3–27
Self-certainty	7.36 (2.88)	3–16
Composite index	3.69 (3.96)	−4–16
WAIS-III		
Similarities raw score	15.39 (5.98)	0–27
Symbol search raw score	21.97 (9.05)	8–39
LASMI		
Daily living	22.37 (6.87)	8–32
Interpersonal relations	22.50 (7.75)	8–34
Endurance and stability	7.55 (1.34)	4–9
Self-recognition	7.85 (2.89)	1–12
BPRS		
Positive	24.16 (4.63)	11–32
Negative	12.30 (2.68)	6–19
Disorganization	13.89 (3.24)	6–19
Belligerence	12.19 (3.17)	6–18
Affect	17.84 (3.82)	9–24
BPRS total	80.49 (14.01)	38–107

RAS-J, Japanese version of the Recovery Assessment Scale; BCIS-J, Japanese version of the Beck Cognitive Insight Scale; WAIS-III, Wechsler Adult Intelligence Scale-Third Edition; LASMI, Life Assessment Scale for the Mentally Ill; BPRS, Brief Psychiatric Rating Scale.

and self-certainty (r = 0.61) in the BCIS-J. Willingness to ask for help was correlated with self-reflectiveness (r = 0.32) and self-certainty (r = 0.61) in the BCIS-J, and belligerence (r = 0.31) in the BPRS. RAS total was correlated with self-reflectiveness (r = 0.48) and self-certainty (r = 0.54) in the BCIS-J, endurance and stability (r = 0.30) in the LASMI, and belligerence (r = 0.38) in the BPRS.

The stepwise multiple regression analysis was performed to investigate factors associated with recovery measured by the RAS-J. However, there was evidence of multicollinearity because the variance inflation factor for dependent variables in a stepwise multiple regression analysis including BCIS-J self-reflectiveness, self-certainty, and composite index scores, with RAS-J reliance on others as the dependent variable were 356.72, 126.36, and 223.47, respectively. Therefore, we conducted the analysis of factors associated with RAS-J reliance on others excluding the BCIS-J composite index. The final models from the stepwise multiple regression analyses are shown in Table 4. The models fit were good (goal/success orientation and hope, F = 765.30, p = .000; reliance on others, F = 597.26, p = .000; personal confidence, F = 1529.56, p = .000; no domination by symptoms, F = 621.95, p = .000; willingness to ask for help, F = 1150.42, p = .000; RAS-J total, F = 1499.79, p = .000).

Goal/success orientation and hope in the RAS-J

Table 3. Correlations among RAS-J, BCIS-J, WAIS-III, LASMI, and BPRS

RAS-J	GO	RE	PE	NO	WI	Total
BCIS-J						
SR	0.35**	0.65**	0.14	0.47**	0.32**	0.48**
SC	0.24*	0.45**	0.38**	0.61**	0.61**	0.54**
CI	0.27**	0.46**	−0.12	0.10	−0.07	0.19
WAIS-III						
Similarities	−0.11	0.05	−0.11	0.17	0.15	−0.03
Symbol search	0.04	0.03	−0.15	0.10	−0.18	−0.04
LASMI						
DL	0.03	−0.01	0.21*	0.09	0.19	0.13
IR	−0.05	−0.26**	0.20*	−0.10	0.01	−0.03
ES	0.28**	−0.04	0.53**	−0.00	0.08	0.30**
SR	0.37**	−0.01	0.31**	−0.09	0.07	0.27**
BPRS						
Positive	0.27**	−0.06	0.29**	0.10	0.17	0.26**
Negative	−0.18	−0.25*	0.16	−0.20*	0.17	−0.09
Disorganization	0.11	−0.24*	0.40**	−0.08	0.27**	0.17
Belligerence	0.26**	0.13	0.45**	0.19	0.31**	0.38**
Affect	−0.15	−0.25*	−0.24*	−0.21*	−0.15	−0.26**
Total	0.09	−0.16	0.25*	−0.04	0.18	0.12

RAS-J, Japanese version of the Recovery Assessment Scale; GO, goal/success orientation and hope; RE, reliance on others; PE, personal confidence; NO, no domination by symptoms; WI, willingness to ask for help; BCIS-J, Japanese version of the Beck Cognitive Insight Scale; SR, self-reflectiveness; SC, self-certainty; CI, composite index; WAIS-III, Wechsler Adult Intelligence Scale-Third Edition; LASMI, Life Assessment Scale for the Mentally Ill; LASMI-DL, daily living; LASMI-IR, interpersonal relations; LASMI-ES, endurance and stability; LASMI-SR, self-recognition; BPRS, Brief Psychiatric Rating Scale.

$^*p < .05$, $^{**}p < .01$

Table 4. Stepwise multiple regression analyses for relationships between recovery measured by RAS-J and clinical variables

		B	*SE*	*β*	*t*	95% CI	*p*	*Adjusted* R^2
GO	SR (BCIS-J)	1.13	0.14	0.42	8.22	0.85−1.40	.000**	0.94
	SR (LASMI)	2.30	0.20	0.59	11.60	1.91−2.69	.000**	
RE	SC (BCIS-J)	0.90	0.15	0.49	5.89	0.60−1.20	.000**	0.92
	SR (BCIS-J)	0.58	0.10	0.49	5.96	0.38−0.77	.000**	
PE	SC (BCIS-J)	0.46	0.10	0.22	4.73	0.27−0.65	.000**	0.97
	ES (LASMI)	1.66	0.10	0.78	16.51	1.46−1.86	.000**	
NO	SC (BCIS-J)	0.62	0.07	0.69	8.58	0.48−0.77	.000**	0.93
	SR (BCIS-J)	0.17	0.05	0.28	3.49	0.07−0.26	.000**	
WI	SC (BCIS-J)	0.74	0.10	0.41	7.19	0.53−0.94	.000**	0.96
	Belligerence (BPRS)	0.67	0.06	0.59	10.38	0.54−0.79	.000**	
RAS-J total	SC (BCIS-J)	2.12	0.54	0.20	3.95	1.05−3.19	.000**	0.98
	SR (BCIS-J)	0.86	0.32	0.12	2.73	0.24−1.49	.007**	
	ES (LASMI)	7.55	0.45	0.69	16.94	6.66−8.43	.000**	

RAS-J, Japanese version of the Recovery Assessment Scale; GO, goal/success orientation and hope; RE, reliance on others; PE, personal confidence; NO, no domination by symptoms; WI, willingness to ask for help; BCIS-J, Japanese version of the Beck Cognitive Insight Scale; SR, self-reflectiveness; SC, self-certainty; LASMI, Life Assessment Scale for the Mentally Ill; LASMI-IR, interpersonal relations; LASMI-ES, endurance and stability; LASMI-SR, self-recognition; BPRS, Brief Psychiatric Rating Scale; *B*, Partial regression coefficient; *β*, standardized partial regression coefficient; 95% CI, 95% confidence interval
**$p < .01$

(*adjusted* R^2 = 0.94) was significantly associated with self-reflectiveness (β = 0.42, *p* = .000) in the BCIS-J and self-recognition (β = 0.59, *p* = .000) in the LASMI. Reliance on others in the RAS-J (*adjusted* R^2 = 0.92) was significantly associated with self-certainty (β = 0.49, *p* = .000) and self-reflectiveness (β = 0.49, *p* = .000) in the BCIS-J. Personal confidence in the RAS-J (*adjusted* R^2 = 0.97) was significantly associated with self-certainty (β = 0.22, *p* = .000) in the BCIS-J and endurance and stability (β = 0.78, *p* = .000) in the LASMI. No domination by symptoms in the RAS-J (*adjusted* R^2 = 0.92) was significantly associated with self-certainty (β = 0.69, *p* = .000) and self-reflectiveness (β = 0.28, *p* = .000) in the BCIS-J. Willingness to ask for help in the RAS-J (*adjusted* R^2 = 0.96) was significantly associated with self-certainty (β = 0.41, *p* = .000) in the BCIS-J and belligerence (β = 0.59, *p* = .000) in the BPRS. RAS-J total score (*adjusted* R^2 = 0.98) was significantly associated with self-certainty (β = 0.20, *p* = .000) and self-reflectiveness (β = 0.12, *p* = .007) in the BCIS-J and endurance and stability (β = 0.69, *p* = .000) in the LASMI.

Discussion

Participant characteristics

Participants in this study included 81 inpatients (78.64%) and 22 outpatients (21.36%), with a mean RAS-J total of 83.50 (*SD* = 12.04). Although standardized scores for the RAS-J have not been elucidated, our results are consistent with the Japanese sample with schizophrenia reported by Chiba et al. (*mean* = 82.11, *SD* = 15.76) [36], which included 115 inpatients (55%) and 94 outpatients (45%). Therefore, the degree of recovery for participants in our study may be generalizable to Japanese patients with schizophrenia. Although the BCIS-J standardized score has also not been identified, the mean self-reflectiveness score in our study (11.09, *SD* = 4.92) was similar to that in a Japanese sample with schizophrenia reported by Uchida et al. (11.85, *SD* = 3.30), while mean self-certainty scores in our study (7.36, *SD* = 2.88) were higher than those reported in the previous study (4.27, *SD* = 2.13) [37]. It has been reported that low self-reflectiveness and high self-certainty reflect low cognitive insight, and are associated with the occurrence of delusions [44, 45]. Therefore, it is possible that participants in our study had more severe delusions than those among general Japanese patients with schizophrenia.

Factors associated with recovery in patients with schizophrenia

Results of stepwise multiple regression analysis indicated that goal/success orientation and hope in the RAS-J was significantly associated with self-reflectiveness in the BCIS-J and self-recognition in the LASMI. Reliance on others in the RAS-J was significantly associated with self-certainty and self-reflectiveness in the BCIS-J. Personal confidence in the RAS-J was significantly associated with self-certainty in the BCIS-J and endurance and stability in the LASMI. No domination by symptoms in the RAS-J was significantly associated with self-certainty and self-reflectiveness in the BCIS-J. Willingness to ask for help in the RAS-J was significantly associated with self-certainty in the BCIS-J and belligerence in the BPRS. Finally, RAS-J total score was significantly associated with self-certainty and self-reflectiveness in the BCIS-J and endurance and stability in the LASMI.

This is the first study to demonstrate that cognitive insight measured with the BCIS-J is significantly associated with recovery measured with the RAS-J in patients with schizophrenia in a Japanese psychiatric hospital setting. In our model, cognitive insight was the most important predictive variable explaining the degree of recovery. These results provide encouraging evidence for a relationship between recovery and cognitive insight, supporting the assertion that interventions aimed to improve cognitive insight are needed for the achievement of recovery in patients with schizophrenia.

Moritz et al. [26, 27] developed metacognitive training (MCT) as a psychological intervention for improving cognitive insight related to delusions in schizophrenia. Ishigaki [46] developed the Japanese version of the MCT (MCT-J), and introduced it into the mental health field in Japan. Further study is needed to examine the impact of MCT-J in improving cognitive insight and the effects this has on recovery of patients with schizophrenia.

Endurance and stability in the LASMI, which assesses social adaptation, and its sustainability and stability, was associated with goal/success orientation and hope, personal confidence, and total RAS-J scores. Goals and hopes are important components of recovery [11, 47]. This suggests that interventions aimed at improveing sustainability and stability of social adaptation would help patients achieve these recovery domains. Belligerence in the BPRS was associated with willingness to ask for help in the RAS-J. In fact, our findings show that comprehensive support is important for the achievement of recovery. Therefore, not only should interventions aim to improve cognitive insight but they should also target social adaptation.

We did not find a significant correlation between RAS-J and the WAIS-III similarities and symbol search subtests that reflect neurocognition. This result is not consistent with some previous studies, which have found associations between neurocognition and recovery in schizophrenia [22, 23, 48, 49]. This difference may be due to differences in the measures used to assess neurocognition, as we only used two WAIS-III subtests reflecting overall cognitive functioning in schizophrenia [39, 40]. Therefore, it could not examine the relationship between multiple aspects of cognitive functioning and recovery measured using RAS-J in this study. To verify the relationship between neurocognition and recovery, it may be necessary to include a comprehensive measure of cognitive functioning, such as the MATRICS Consensus Cognitive Battery (MCCB) or Brief Assessment of Cognition in Schizophrenia (BACS) which could assess multiple aspects of cognitive functioning in schizophrenia.

Limitations

A number of study limitations should be noted. First, study participants might not be representative of all patients with schizophrenia, as this study was conducted at a single site and the sample size was small. Therefore, caution should be exercised in generalizing the findings to patients with schizophrenia as a whole. A multicenter research approach with a large sample is required to avoid this limitation and provide greater clarity regarding the relationship between recovery and cognitive insight. Second, participants included both inpatients and outpatients with schizophrenia. It may be necessary to investigate factors associated with recovery in each of these groups separately, because hospitalization may act to impede recovery [50]. Third, the longitudinal studies are required to explore the cause-and-effect association between recovery and cognitive insight, because cross-sectional studies are limited in the inferences that can be made about cause-and-effect associations between recovery and the factors including cognitive insight examined. Fourth, the RAS-J is a self-reported questionnaire and useful to assess subjective personal recovery, but not for assessing objective recovery. Therefore, future research is needed to investigate the relationship between objective recovery and cognitive insight in schizophrenia.

Conclusions

This study provides encouraging evidence for the relationship between recovery and cognitive insight in schizophrenia and may contribute to developing tailored interventions to improve cognitive insight with the aim of achieving recovery of patients with schizophrenia. Interventions to improve cognitive insight are rarely implemented in Japan. Therefore, future research is needed to evaluate the effects of adding such interventions to rehabilitation programs, including occupational therapy, and the impact on recovery within the context of such programs.

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ORIGINAL ARTICLE

Possible Effectiveness of Collaboration between Occupational Therapists and Care Managers using the Management Tool for Daily Life Performance for Stroke Patients in Transitional Care

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Abstract: Collaboration between medical care and long-term care professionals is very important in cases of stroke rehabilitation in Japan. This study aimed to explore whether collaboration between occupational therapists and care managers using the Management Tool for Daily Life Performance (MTDLP) supports the daily life performance at 1 month after discharge in stroke patients. Participants were 15 patients [77.3 ± 7.9 years (mean ± SD)] in the acute care ward and 22 patients (71.7 ± 9.6 years) in the convalescent rehabilitation ward. Patients were assessed using the Barthel Index, Lawton and Brody Instrumental Activities of Daily Living Scale, and a measure of self-rated health at discharge and 1-month follow-up to investigate the effects of collaboration between occupational therapists and care managers using MTDLP. Collaboration tasks performed by occupational therapists using MTDLP prior to discharge included creating and delivering the daily life performance transfer sheet, conducting patient home visits with care manager, and attending the care service conference. In acute care ward patients, the Barthel Index was significantly increased at 1 month after discharge compared with that at discharge ($p = 0.044$). Furthermore, self-rated health was significantly improved in both the acute care and convalescent rehabilitation ward patients at 1 month after discharge compared with that at discharge ($p = 0.035$ and $p = 0.019$, respectively). These results suggest that the collaboration between occupational therapists and care managers using MTDLP contributed to a positive effect in promoting independent daily living after discharge in stroke patients.

Keywords: occupational therapy, activities of daily living, instrumental activities of daily living, self-rated health, collaboration

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Introduction

Japan is experiencing a rate of population aging that is unprecedented worldwide [1]. The Ministry of Health, Labour and Welfare is promoting the community-based integrated care system, which aims in enriching long-term care, healthcare, support, and preventive services so that elderly individuals can maintain the lifestyle to which they are accustomed [2]. The community-based integrated care system that comprehensively ensures the provision of healthcare, nursing care, prevention, housing, and livelihood support will be established by 2025 [2]. This system would allow elderly individuals to follow their own habits and live in familiar environments, even when they require long-term care [2]. The collaboration between medical care and long-term care is important in the community-based integrated care system.

Stroke is a leading cause of long-term disability in Japan and worldwide [3,4]. Considering the aging Japanese population, an increased incidence of stroke is

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expected [5]. Many stroke patients require rehabilitation to reduce their degree of disability and enhance their likelihood of returning to functional independence at home [6]. In general, stroke rehabilitation in Japan in consistent throughout the acute, convalescent, and maintenance phases [7]. Stroke rehabilitation during the acute phase aims to encourage the compensatory functions of the cerebrum and facilitate the restoration of impairment functions while preventing disuse syndromes at the acute care ward [7]. In the convalescent phase, patients who are past the acute phase and who can be expected to further improve functions with rehabilitation undergo intensive rehabilitation in the convalescent rehabilitation ward until discharge from the hospital [7]. The main purpose of rehabilitation in the maintenance phase is to maintain the acquired functions, activities, and social participation for as long as possible. Throughout these consistent stroke rehabilitation processes, collaboration between medical care and long-term care professionals is crucial to ensure continuous daily living support for patients and their family caregivers, as well as for efficient use of social resources.

The Japanese Association of Occupational Therapists developed the Management Tool for Daily Life Performance (MTDLP), which has been found to contribute to comprehensive community care based on a 2008 geriatric health promotion project by the Ministry of Health, Labour and Welfare [8]. Daily life performance includes all aspects of life, including activities of daily living (ADL), instrumental activities of daily living (IADL), work, hobbies, and leisure. Daily life performance can be inhibited by decreased mental and physical function due to illness or aging, unhealthy lifestyle, poor interpersonal relationships, and changes in living environment [8]. MTDLP is an intervention tool used in occupational therapy and a support method that focuses on finding meaningful occupation for subjects to increase recovery and improve disabilities that inhibit daily life performance. MTDLP consists of a series of processes that include intake, assessment, planning, intervention, and transference of tasks.

In stroke rehabilitation, transitional care is required for the support of daily life performance for patients and their family caregivers after leaving the hospital. Consequently, collaboration between occupational therapists in medical care and care managers in long-term care is very important in the early stages after discharge. However, to our knowledge, no studies have reported the effects of collaboration between occupational therapists in medical practice and care managers in communities regarding the care of stroke patients in the early stages after discharge. This study aimed to explore whether collaboration between occupational therapists and care managers using MTDLP supports the daily life performance at 1 month after discharge in stroke patients.

Methods

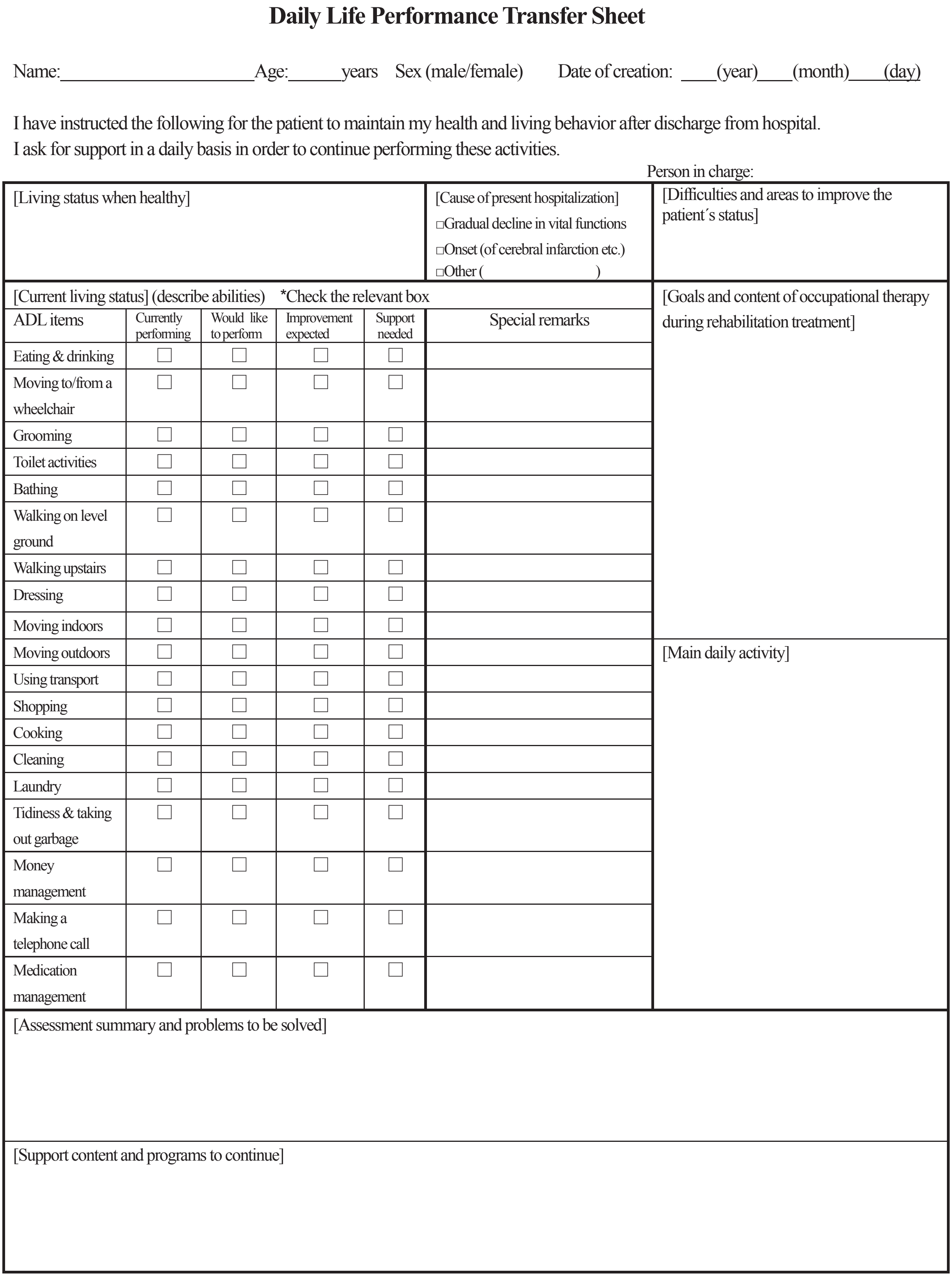
Subjects

Patients were admitted with stroke to seven acute care wards and eight convalescent rehabilitation wards and were prescribed rehabilitation for home discharge. We prospectively enrolled 15 patients [77.3 ± 7.9 years (mean ± SD)] in the acute care ward and 22 patients (71.7 ± 9.6 years) in the convalescent rehabilitation ward between September 2012 and January 2013. This study was conducted based on the Ethical Standards of the Japanese Association of Occupational Therapists. All subjects gave written informed consent to participate. Each subject had the opportunity to refuse participating in the study.

Study design

All participants received occupational therapy based on MTDLP. Occupational therapists conducted collaborative tasks using MTDLP for care managers before discharge of all subjects. Collaborative tasks conducted by occupational therapists using MTDLP included creating and delivering the daily life performance transfer sheet (Fig. 1), conducting home visits with care managers, and attending a care service conference before discharge. These collaborative tasks were carried out in order to enable continued support and to maintain and improve the daily activities of subjects after discharge.

All subjects were assessed via the Barthel Index [9], which measured ADL; the Lawton and Brody IADL scale [10]; and a measure of self-rated health [11], which was used as a quality of life (QOL) index for daily life performance. Participants were assessed both at discharge and 1 month after discharge. Furthermore, transmission items (i.e., information transmitted from occupational therapists to care managers) relating to instructions for patients' daily living support after discharge were collected using the daily life performance transfer sheet at discharge. The Barthel Index has been widely used to assess ADL in stroke patients. It consists of the following ten items relating to basic ADL: feeding, transfer, grooming, toilet use, bathing, mobility, stairs, dressing, and control of bowels and bladder. Scores on the Barthel Index range from 0 to 100, with lower scores indicating greater dependency [12]. The Lawton and Brody IADL scale has been widely used to assess IADL. Scores range from 8 to 24, with lower scores indicating greater dependency. The scale assesses the following functional abilities: using the telephone, shopping, preparing meals, doing housework, doing laundry, using transpor-



Daily Life Performance Transfer Sheet

Name:____________ Age:______years Sex (male/female) Date of creation: ____(year)____(month)____(day)

I have instructed the following for the patient to maintain my health and living behavior after discharge from hospital.
I ask for support in a daily basis in order to continue performing these activities.

Person in charge:

[Living status when healthy]	[Cause of present hospitalization] □Gradual decline in vital functions □Onset (of cerebral infarction etc.) □Other ( )	[Difficulties and areas to improve the patient´s status]

[Current living status] (describe abilities) *Check the relevant box

ADL items	Currently performing	Would like to perform	Improvement expected	Support needed	Special remarks
Eating & drinking	☐	☐	☐	☐	
Moving to/from a wheelchair	☐	☐	☐	☐	
Grooming	☐	☐	☐	☐	
Toilet activities	☐	☐	☐	☐	
Bathing	☐	☐	☐	☐	
Walking on level ground	☐	☐	☐	☐	
Walking upstairs	☐	☐	☐	☐	
Dressing	☐	☐	☐	☐	
Moving indoors	☐	☐	☐	☐	
Moving outdoors	☐	☐	☐	☐	
Using transport	☐	☐	☐	☐	
Shopping	☐	☐	☐	☐	
Cooking	☐	☐	☐	☐	
Cleaning	☐	☐	☐	☐	
Laundry	☐	☐	☐	☐	
Tidiness & taking out garbage	☐	☐	☐	☐	
Money management	☐	☐	☐	☐	
Making a telephone call	☐	☐	☐	☐	
Medication management	☐	☐	☐	☐	

[Goals and content of occupational therapy during rehabilitation treatment]

[Main daily activity]

[Assessment summary and problems to be solved]

[Support content and programs to continue]

Fig. 1. Daily life performance transfer sheet.
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tation, taking medications, and managing money [10]. Self-rated health is an important indicator of QOL [13] and was thus used as a proxy for QOL. Self-rated health was assessed by asking respondents, "In general, how would you rate your health today?" possible response options were "very good" (1), "good" (2), "moderate" (3), "bad" (4), or "very bad" (5) [11].

The MTDLP process

The following section summarizes the standard MTDLP process [8].

Intake

Subjects and their families are interviewed regarding their desired daily life performance using a daily life performance interview sheet. A "wish and interests checklist" is used when subjects cannot verbally express their desires.

Daily life performance assessment

Subjects' desired daily life performance and factors that inhibit daily activities are assessed using the International Classification of Functioning, Disability, and Health (ICF) and the MTDLP sheet.

Daily life performance improvement plan

A support plan to enable subjects to implement daily life performance is drafted based on the MTDLP sheet. The intervention program is divided into a basic program (approach for mental and physical function), an application program (approach for activities and participation), and a social adjustment program (adaptive approach for environmental adjustments to the subject's living environment).

Intervention, re-evaluation, and revision

Provide the training, support, adjustment, and reassessment required to improve daily life performance based on planning.

Completion; transference of tasks

The outcomes and course of MTDLP are summarized in the daily life performance transfer sheet (Fig. 1). The support measures necessary to improve future daily life performance are transferred to professionals involved in the patient's life support, including care managers and care staff. In this study, occupational therapists conducted collaborative tasks using the MTDLP for care managers.

Data analysis

Paired t-tests and the Wilcoxon Signed-Rank Test were used to compare scores on the Barthel Index, the Lawton and Brody IADL scale, and assessments of self-rated health at discharge versus 1 month after hospital discharge. *P*-values < 0.05 indicated statistical significance. All statistical analyses were performed using SPSS version 19 (SPSS, Tokyo, Japan).

Results

Subjects' demographic characteristics and clinical data are shown in Table 1. Mean ages of patients in the acute care and convalescent rehabilitation wards were 77.3 ± 7.9 years and 71.7 ± 9.6 years, respectively. Patients (n = 37) included 15 (seven men and eight women) from the acute care ward, and 22 (10 men and 12 women) from the convalescent rehabilitation ward. Approximately 87% of acute care ward patients and 68% of convalescent rehabilitation ward patients had experienced ischemic stroke. Eight patients from each of the acute care and convalescent rehabilitation wards had right-sided hemiparesis; whereas, five from the acute care ward and nine from the convalescent rehabilitation ward had left-sided hemiparesis. The percentages of patients from the acute care ward receiving different care levels were as follows: support level 1, 7%; support level 2, 13%; care level 1, 20%; care level 2, 7%; care level 3, 7%; care level 4, none; care level 5, 7%; and unapplied, 40%. The percentages of patients from the convalescent rehabilitation ward receiving different care levels were as follows: support level 1, 5%; support

Table 1. Characteristics of the study subjects

Variables	Acute care ward (n = 15)	Convalescent rehabilitation ward (n = 22)
Age, years, mean ± SD	77.3 ± 7.9	71.7 ± 9.6
Female, n (%)	8 (53.3)	12 (54.5)
Type of stroke, n (%)		
ischemic	13 (86.7)	15 (68.2)
hemorrhage	1 (6.7)	2 (9.0)
other	1 (6.7)	5 (22.7)
Hemiparetic side, n (%)		
right	8 (53.3)	8 (36.4)
left	5 (33.3)	9 (40.9)
other	2 (13.3)	5 (22.7)
Care levels in long-term care insurance, n (%)		
support level 1	1 (6.7)	1 (4.5)
support level 2	2 (13.3)	2 (9.1)
care level 1	3 (20.0)	2 (9.1)
care level 2	1 (6.7)	0
care level 3	1 (6.7)	10 (45.4)
care level 4	0	3 (13.6)
care level 5	1 (6.7)	2 (9.1)
unapplied	6 (40.0)	2 (9.1)

SD: standard deviation

level 2, 9%; care level 1, 9%; care level 2, none; care level 3, 45%; care level 4, 14%; care level 5, 9%; and unapplied, 9%.

Table 2 shows ADL, IADL, and self-rated health scores at discharge and 1-month follow-up. Scores on the Barthel Index increased significantly from discharge to 1 month after discharge among acute care ward patients ($p = 0.04$). In contrast, assessment of self-rated health decreased significantly from discharge to 1 month after discharge in both acute care and convalescent rehabilitation ward patients ($p = 0.04$ and $p = 0.02$, respectively). There were no significant differences in other scales of daily life performance at discharge versus 1 month after discharge. Figure 2 shows the items transmitted from occupational therapists to care managers relating to patient support after discharge. Among patients from the acute care ward, transmission items primarily related to outdoor and indoor movement, bathing, toilet use, shopping, and use of public transportation. Among patients from the convalescent rehabilitation ward, transmission items primarily related to indoor and outdoor movement, transfers, toilet use, stair use, bathing, dressing, and shopping. In general, a wider variety of items were transmitted for patients from the convalescent rehabilitation ward compared to the acute care ward.

Discussion

Findings of the present study indicated that ADL scores among acute care patients improved significantly from discharge to 1-month follow-up, indicating less

Table 2. Comparisons the daily life performances between at discharge and 1 month after discharge in the acute care and convalescent rehabilitation ward patients

	discharge	1 month after discharge	*p*
Acute care ward (n = 15)			
Barthel index, mean ± SD	69.3 ± 30.1	76.3 ± 30.3	0.04
Lawton and Brody IADL scale, mean ± SD	3.1 ± 2.6	3.1 ± 2.9	0.83
Self-rated health, mean ± SD	3.3 ± 0.8	2.9 ± 0.9	0.04
Convalescent rehabilitation ward (n = 22)			
Barthel index, mean ± SD	71.6 ± 26.3	74.8 ± 26.0	0.15
Lawton and Brody IADL scale, mean ± SD	2.3 ± 1.8	2.7 ± 1.9	0.16
Self-rated health, mean ± SD	3.2 ± 0.7	2.7 ± 0.9	0.02

SD: standard deviation; IADL: instrumental activities of daily living

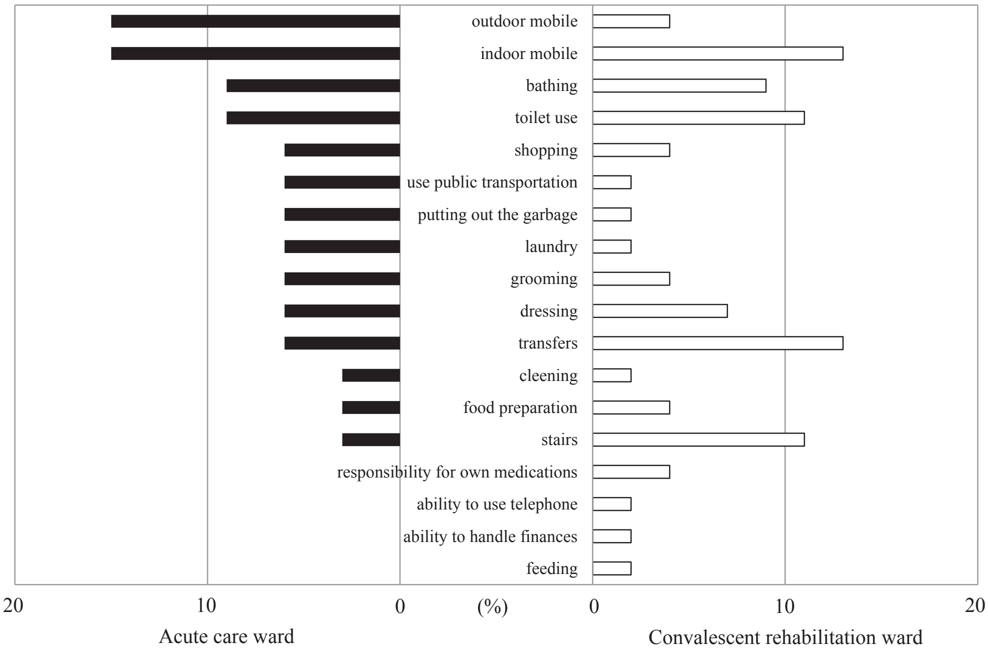

Fig. 2. The items transmitted from occupational therapists to care managers.

dependence a month after discharge. Furthermore, IADL scores were maintained from discharge to 1-month follow-up in both acute care and convalescent rehabilitation patients. These results suggest that the patients' plan of ADL and IADL may have been included in the care plan after discharge, and the intervention support may have worked effectively. Therefore, collaboration between occupational therapists and care managers using MTDLP may have worked effectively on the care plan after discharge and may have promoted independent daily living in stroke patients.

Some studies have reported that ADL among stroke patients were maintained for 1 year after discharge [14, 15]. On the other hand, Yoshino, et al. reported that ADL among stroke patients were significantly decreased 1 month after discharge [16]. Research findings have attributed this decreased activity following discharge to poor health services, effects of climate, negative family attitudes, indoor movement, and low motivation [17]. These previous reports indicate that ADL tend to decline immediately after discharge in stroke patients. Therefore, collaboration between medical care and long-term care professionals is crucial to ensure continuous living support for patients and their family caregivers, as well as efficient use of social resources.

Costs associated with the collaboration between medical care and long-term care professionals (e.g., patient home visits during hospitalization) is covered by medical insurance in Japan. Likewise, it covers the costs associated with transfer of information from medical professionals to care managers during hospitalization of patients regarding their care plans following discharge. However, due to medical fees, daily occupational and physical therapy tend to be regarded as more important than patients' home visits or providing information to care managers. Moreover, patients who independently perform ADL often do not receive the certification of long-term care and the care plan for preventive by long-term care or community support system. As a result, the ability of more independent patients to perform ADL and IADL may be reduced, making daily living care necessary. Furthermore, the method of collaboration between occupational therapists and care managers for discharge of stroke patients was not established. This problem in the collaboration method was also considered to be caused by the fact that occupational therapists often neglect collaboration with care managers. In this study, occupational therapists conducted collaborative tasks using MTDLP for care managers before patient discharge. Specifically, occupational therapists contacted care managers using the daily life performance transfer sheet before discharge to ensure continuous daily living support and maintain and improve patient' abilities after discharge. Furthermore, occupational therapists conducted home visits together with care managers and attended the care service conference before patient discharge. By systemizing the collaboration method using MTDLP, occupational therapists will be able to further promote cooperation with care managers and reliably transfer information of daily living support after discharge for stroke patients.

In the present study, the items transmitted from occupational therapists to care managers in regarding patients from the acute care ward related primarily to outdoor and indoor movements, bathing, toilet use, shopping, and use of public transportation. In patients from the convalescent rehabilitation ward, transmission items related primarily to mostly indoor and outdoor movement, transfers, toilet use, stair use, bathing, dressing, and shopping. The daily life performance transfer sheet makes it possible to clearly transmit information necessary for the support of ADL and IADL after discharge. To maintain and improve ADL and IADL after discharge, it is important that these transmission items are reflected in the patient's care plan in the long-term care system.

In this study, improved self-rated health in acute care and convalescent rehabilitation ward patients was observed 1 month after discharge following an MTDLP intervention involving collaborative tasks between occupational therapists and care managers. Self-rated health is well known to be an important indicator of QOL; it has also been reported to predict mortality [18−20] and the prognosis of stroke patients [21]. Stroke has been shown to lead to depressive and anxiety disorders and other emotional effects [22]. One-third of all stroke patients experience significant depressive symptoms after the onset of stroke [23]. Accordingly, one study reported that reducing the number of depressive symptoms among disabled older adults would be beneficial in improving self-rated health as well as maintaining and promoting QOL [24]. Subjective ratings of overall health remain strongly and independently associated with depressive symptoms, even when controlling for physical illness and functional disability [25]. Greater attention should therefore be given to the self-rated health of older adults with stroke, particularly in relation to the significant impact of depression on their self-rated health [26]. Addressing elements of daily life that affect subjective well-being are also being increasingly recognized as beneficial to recovery from and adaptation to stroke [27]. In a randomized controlled multi-center trial, Noto et al. showed that occupational therapy using MTDLP improved QOL for dependent community-dwelling elderly individuals [28]. MTDLP is a support method focusing on providing meaningful occupation to patients to aid in their recovery and to improve disability in daily life performance. Collaboration between occupational therapists and care managers using MTDLP may improve QOL for stroke patients through sharing the information on patients' meaningful occupation.

Study limitations

The present study had several limitations. First, the sample size was small due to an insufficient number of stroke patients who required daily living support after discharge. Second, as a control group was not established, we cannot verify the effect of collaboration between occupational therapists and care managers on patient outcomes after discharge. Future studies could utilize a control group to assess the effects of an intervention involving collaborative tasks using MTDLP. Third, collaboration skills of occupational therapists and care managers were not sufficiently controlled in this study. The meeting we held regarding collaborative tasks using MTDLP was attended by occupational therapists; care managers received individual explanations only. Finally, it was unclear whether the items transmitted from occupational therapists to care managers were reflected in the care plan after discharge. Going forward, it will be necessary to further promote patient home visits and the care service conference to care managers in order to ensure transmission items are reflected in the care plan.

Conclusion

The findings of this study suggest that collaboration between occupational therapists and care managers using the MTDLP might be effective in promoting independent daily living after discharge in stroke patients. Based on these findings, collaboration between occupational therapists and care managers using the MTDLP should be encouraged to support the daily life performance of stroke patients.

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■ORIGINAL ARTICLE

Current Situation and Challenges Regarding the Social Participation of Syrian Refugees with Disabilities in Urban Areas of Jordan

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Abstract: Introduction: The conflict in the Syrian Arab Republic has been ongoing since 2011. Since the war broke out, many Syrians have evacuated Jordan as refugees. 28% of refugees have some kind of functional disorder. We conducted the present study to identify the health conditions of Syrian refugee with disabilities (Person With Disabilities: PWDs) in urban area of Jordan and the situations of their and their families' social participation. **Methods:** The subjects of the study were twelve participants of PWDs and their families in Jordan. We conducted semi-structured interview between August 2014 and December 2016. Qualitative Content Analysis Method was performed to assess the social participation of them. **Results:** The social participation of PWDs were categorized under five main themes: 【Lack of health care for PWDs in urban areas】, 【Insufficient health literacy of PWDs and their family members】, 【Restriction of social participation of PWDs and their family members】, 【Spreading of disuse syndrome】 and 【Care burden on family members】. **Conclusion:** The study identified that the social participation of PWDs and their families in urban area could be often restricted, and that insufficient health care services, health literacy, disuse syndrome, and burdens of nursing care be correlated to the level of social participation of PWDs and their families. Therefore, It is essential that health professionals including occupational therapists provide knowledge and health services concerning the prevention of disuse syndrome and support for the empowerment of PWDs.

Keywords: Syrian refugee with disabilities, community based rehabilitation, social participation, disuse syndrome

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Introduction

The conflict in the Syrian Arab Republic has been ongoing since 2011. Since the war broke out, many Syrians have evacuated abroad as refugees. As of January 2015, more than 4.9 million Syrians were registered as refugees in Syria's neighboring countries—Jordan, Lebanon, Iraq, and Egypt [1, 2]—with the number in Jordan totaling 635,324. Approximately 78% of Syrian refugees in Jordan live in urban areas, including the governorates of Amman [3], Irbid and Mafraq. In recent years, the number of refugees in urban areas has been increasing [2]. It is reported that many Syrian refugees in urban areas have difficulty accessing health care services due to the rapid increase in the population and insufficient social resources [4]. According to an investigation by Handicap International, 22% of refugees registered with the United Nations High Commissioner for Refugees (UNHCR) have some kind of functional disorder, while 6% have severe functional disorders [5]. These Syrian refugees with disabilities (person with disabilities, or PWDs) are in a vulnerable social position [6]. They need not only basic support, such as housing, livelihoods, food and human rights, but also specific support such as rehabilitation services and the provision of orthoses [5].

Community-based organizations (CBOs) in urban areas carry out support programs for Syrian refugees with disabilities in cooperation with the Jordanian government and international agencies [7]. In those organizations and agencies, occupational therapists work in support program for Syrian refugees with disabilities in urban area. However, there are no studies demonstrating whether these programs comply with the needs of PWDs and their families, and promote their health and

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social participation. Therefore, we conducted the present study to identify the health conditions of PWDs and the situations of their and their families' social participation through semi-structured interviews. Furthermore, we analyzed the results using a community-based rehabilitation (CBR) matrix on the themes of the PWDs' health conditions and social participation [8]. The purpose of the present study was to clarify challenges of provision of support by health professional including occupational therapist for Syrian refugee with disabilities and their families.

Methods

1. Participants

The subjects of the study were Syrian refugees with disabilities (PWDs) and their families in the governorates of Amman and Irbid in Jordan. Twenty-five participants were chosen randomly for this study from a list of Syrian refugee with disabilities, which was provided by the nongovernmental organization Mobility Solution. We explained that the study would comprise recorded interviews, followed by analysis of the interview data. We received letters of consent and acceptance from 12 participants, and conducted the study interviews with them.

2. Questionnaire and Interview

This study involved the use of a questionnaire and a recorded semi-structured interview in Arabic. The interview was conducted with each participant individually between August 2014 and December 2016. The questionnaire inquired about the name, sex, age, diagnosis, transfer status, duration of stay in Jordan, refugee status, and income of the PWDs and his/her family members. The semi-structured interview was conducted with an interview guide. The interview covered the health condition of the PWD ("Has your health condition changed between living in Syria and Jordan?"); his/her relationships with members of the community ("Do you have any relationships or support from members of the community?"); recognition of the disability by the PWDs and his/her family members ("What do you need regarding your disability?"); current difficulties faced by the PWDs and his/her family members ("Do you face any difficulties in your daily life?"); knowledge and recognition of the type of support available from the host community by the PWDs and his/her family members ("Do you know of any assistance programs provided by the Jordanian government or NGOs?"); and the needs of the PWDs and his/her family members ("What kind of support do you expect from the Jordanian government and NGOs?") (Table 1). The interviews were recorded by IC recorder.

3. Data Analysis

The interview data were then analyzed. The analysis was conducted by three researchers familiar with the international health field, and comprised the following two phases. First, the researchers listened to the interview data and transcribed the contents. For the language bias, we conducted back-translation. The transcriptions were then coded to identify elements of each participant's comments about health and social participation. The codes were sorted into sub-categories and categories, and the relevance of each category was analyzed. The codes were then classified into components of the CBR matrix (Fig. 1) [8]. Then, we analyzed the tendencies and challenges of the social participation of the Syrian refugees with disabilities and their families.

4. Ethical Considerations

The study carried out the research with the approval (Number 309) of the Kobe University Ethical Committee.

Table 1. Interview guide to Syrian refugee with disabilities (Person With Disabilities: PWDs) and their family.

Topics	Question
Health condition of the PWDs	"Has your health condition changed between living in Syria and Jordan?"
His/her relationship with the community	"Do you have any relationships or support of the community?"
Recognition of the disability by the PWDs and his/her family members	"What do you need regarding your disability?"
Current difficulties faced by the PWDs and his/her family member	"Do you face any difficulties in your daily life?"
Knowledge and recognition of the type of support available from the host community by the PWDs and his/her family members	"Do you know of any assistance programs provided by the Jordanian government or NGOs?"
the needs of the PWD and his/her family members	"What kind of support do you expect from the Jordanian government and NGOs?"

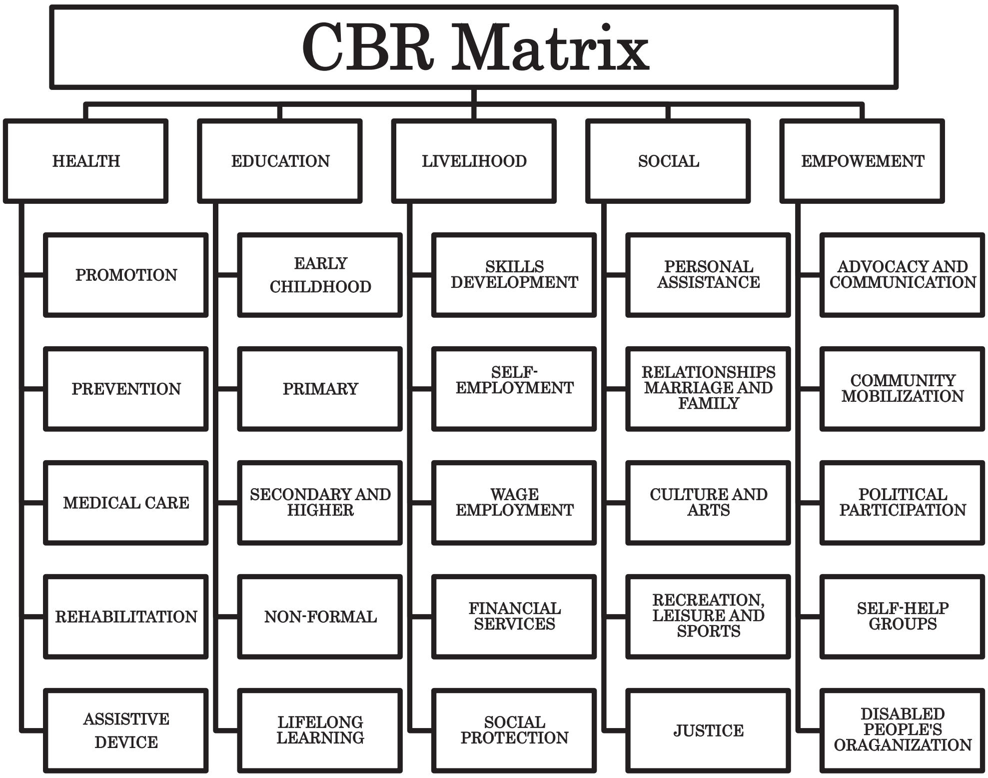

Fig. 1. Community-Based Rehabilitation Matrix (WHO 2010)

Results

1. Characteristics of Participants

There were 12 participants, all male. Amount of interview time was 301 minutes. Median of interview time and SD were 24 ± 5.9 minutes. Their mean age was 20.5 ± 12.9 years (range: 15−56 years), and their mean duration of stay was 1.7 ± 0.4 years. All of the participating PWDs had physical disorders. Five of the participants had dependence in transferring motion and seven of the participants had independence in transferring motion. All the participants were registered as refugees by the UNHCR. Two of the PWDs' families had incomes, while 10 families did not have incomes (Table 2).

2. Health conditions and social participation

A total of 621 codes relating to the health conditions and social participation of the subjects were extracted from the transcriptions. From the codes, 10 sub-categories and 5 categories were classified along with the "current situation of social participation of the Syrian refugees with disabilities and their families in urban areas" (Table 3). Then, the categories, subcategories, codes, and personal narratives were described as 【category】, ［subcategory］, and 『personal narrative』, respectively.

The category 【Lack of health care for PWDs in urban areas】 comprised two sub-categories: ［Difficulty in receiving medical treatment in Syria］ and ［Difficulty in receiving health care services in Jordan］. One family member of a PWDs talked about ［Difficulty in receiving medical treatment in Syria］ as follows: 『*Our hospital in Syria was destroyed by bombing, so nobody can get treatment even if they're injured. There are no doctors, so it's impossible to have an operation*』. One family member of a PWDs talked about ［Difficulty in receiving health care services in Jordan］ as follows: 『*My son was able to have an operation in Jordan, but he couldn't receive rehabilitation treatment at the hospital. He could have rehabilitation at a private hospital, but we can't afford the medical fees*』.

The category 【Insufficient health literacy of PWDs and their family members】 comprised two sub-categories: ［Lack of recognition of disorders among PWDs and their family members］ and ［Lack of information about health care services among PWDs and their family members］. One family member of a PWDs talked about ［Lack of recognition about disorders among PWDs and their family members］ as follows: 『*The doctor said that rehabilitation would be necessary after discharge from the hospital. But we don't know what we should do*』. One family member of a PWDs talked about ［Lack of

Table 2. Profile characteristics of participants (21.Aug.2014~28.Dec.2016)

No	Gender	Age	Diagnosis	Status of transfer	Duration of stay (year)	Registration	Interviewees	Income	Interview time
1	M	20	Spinal Cord Injury	Dependence	1.4	UNHCR	Brother	Employment (Father)	27min
2	M	21	Spinal Cord Injury	Independence (W/C)	1.5	UNHCR	PWDs	None	20min
3	M	56	Head Injuary	Dependence	1.9	UHNCR	Brother	None	21min
4	M	37	Cerebrovascular Disease	Dependence	2.1	UNHCR	Brother	None	33min
5	M	13	Spinal Cord Injury	Dependence	2	UNHCR	Father	Employment (Father)	19min
6	M	39	Spinal Cord Injury	Independence (W/C)	2.4	UNHCR	PWDs	None	29min
7	M	18	Peripheral Nerve Disorder	Independence	1.4	UNHCR	PWDs	None	37min
8	M	20	Peripheral Nerve Disorder	Independence	1.3	UNHCR	PWDs	None	22min
9	M	33	Cerebrovascular Disease	Independence	2.3	UNHCR	PWDs	None	30min
10	M	19	Spinal Cord Injury	Dependence	2.2	UNHCR	PWDs	None	19min
11	M	15	Peripheral Nerve Disorder	Independence	1.2	UNHCR	PWDs	None	18min
12	M	43	Peripheral Nerve Disorder	Independence	0.7	UNHCR	PWDs	None	26min

Table 3. Current situation about social participation of Syrian refugee with disabilities and their family member in urban area

Sub-category【10】	Category【5】
Difficulty in receiving medical treatment in Syria Difficulty in receiving health care services in Jordan	Lack of health care for PWDs in urban areas
Lack of recognition of disorders among PWDs and their family members Lack of information about health care services among PWDs and their family members	Insufficient health literacy of PWDs and their family members
Vulnerable position of Syrian refugees Limitation of PWDs' activities due to their physical disabilities	Restriction of social participation of PWDs and their family members
Deterioration of health condition High risk of disuse syndrome	Spreading of disuse syndrome
Long time required for nursing care Variety of nursing care	Care burden on family members

information about health care services among PWDs and their family members］as follows:『*Actually there is little information available. Especially I'm in a country that I don't know anything about. I can't go anywhere*』.

The category【Restriction of social participation of PWDs and their family members】comprised two sub-categories:［Vulnerable position of Syrian refugees］,［Limitation of PWDs' activities due to their physical disabilities］. One family member of a PWDs talked about the［Vulnerable position of Syrian refugees］as follows:『*We have limitations in many areas including work and education, because I can't work and I can't pay my house rent.*』. One PWDs talked about［Limitation of PWDs' activities due to their physical disabilities］as follows:『*I can't even go outside, because I have a disabled foot*』.

The category【Spreading of disuse syndrome】comprised two sub-categories:［Deterioration of health condition］and［High risk of disuse syndrome］. One family member of a PWDs talked about［Deterioration of health condition］as follows:『*The wounds (bed sores) on my son's body are hard to cure*』and『*He has stiff joints (contracture)*』.

One PWDs talked about the［High risk of disuse syndrome］as follows:『*I spend most of my time in bed. I can't look after myself, so I need support from my family*』.

The category【Care burden on family members】comprised two sub-categories:［Long time required for nursing care］and［Variety of nursing care］. One family member of a PWDs talked about the［Long time required for nursing care］as follows:『*We have to attend to his nursing care 24 hours a day. It's very hard...*』. One family member of a PWDs talked about the［Variety of nursing care］as follows:『*Because my son can't look after himself, I need to help him go to the toilet, change his clothes, and so on. Of course, if he goes outside, we have to support him*』.

3. Evaluation of health conditions and social participation using the CBR matrix

We classified the codes in this study into components of the CBR matrix (Health, Education, Livelihood, Social and Empowerment). Some 444 codes were thus classified. Of these, 160 codes were classified into the component "Health" (seven codes under "Promotion," two codes under "Prevention," 56 codes under "Medical care," 60 codes under "Rehabilitation," and 35 codes under "Assistive devices"); 25 codes were classified into the component "Education" (14 codes under "Early childhood," 11 codes under "Primary education," zero codes under "Secondary and higher education," zero codes under "Non-formal education," and zero codes under "Lifelong learning"); 119 codes were classified into the component "Livelihood" (zero codes under "Skills development," nine codes under "Self-employment," 36 codes under "Wage employment," 39 codes under "Financial services," and 35 codes under "Social protection"); 105 codes were classified into the component "Social" (66 codes under "Personal assistance"; 35 codes under "Relationships, marriage and family"; zero codes under "Culture, arts and recreation"; zero codes under "Leisure and support"; and four codes under "Justice"); and 35 codes were classified into the component "Empowerment" (29 codes under "Advocacy and communication," zero codes under "Community mobilization," six codes under "Political participation," zero codes under "Self-help groups," and zero codes under "Disabled people's organization") (Table 4). Then, the components of the CBR matrix and the personal narratives were described as "components of the CBR matrix" and『personal narratives』.

Within the component of "Health," one PWDs talked about "Promotion" as follows:『*I started to suffer bad health after I came to Jordan*』. One PWDs talked about "Prevention" as follows:『*I don't know how I can prevent health impairment*』. One PWDs talked about "Medical care" as follows:『*We can't get check-ups at the hospital, because we have no money*』. One PWDs talked about "Rehabilitation" as follows:『*We don't have any opportunity to receive rehabilitation*』. One PWDs talked about "Assistive device" as follows:『*There are no wheelchairs for going outside*』.

Within the component of "Education," one family member of a PWDs talked about "Early childhood" as follows:『*I haven't let my child go to school since we came to Jordan*』. One PWDs talked about "Primary education" as follows:『*I can't go to school because I can't walk*』.

Within the component of "Livelihood," one PWDs talked about "Self-employment" as follows:『*Refugees can't work in Jordan*』. One PWDs talked about "Wage employment" as follows:『*We need to get permission in order to work*』. One family member of a PWDs talked about "Financial services" as follows:『*There are no organizations that lend money*』. One PWDs talked about

Table 4. Cord classification of CBR Matrix component

compornents	elements	code	original data
health (160)	promotion	7	I started to suffer bad health after I came to Jordan
	prevention	2	I don't know how I can prevent health impairment
	medical care	56	We can't get check-ups at the hospital, because we have no money
	rehabilitation	60	We don't have any opportunity to receive rehabilitation
	assistive devices	35	There are no wheelchairs for going outside
education (25)	early childhood	14	I haven't let my child go to school since we came to Jordan
	primary	11	I can't go to school because I can't walk
	secondary and higher	0	
	non-formal	0	
	lifelong learning	0	
livelihood (119)	skils development	0	
	self-employment	9	Refugee can't work in Jordan
	wage employment	36	We need to get permission in order to work
	financial services	39	There are no organizations that lend money
	social protection	35	The social situation of refugees is vulnerable
social (105)	personal assistance	66	There aren't many caregivers in our family
	relationships marriage and family	35	We don't have much interaction with members of the community
	culture and arts	0	
	recreation, leisure and sports	0	
	justice	4	There is little information about the rights of persons with disabilities
empowerment (35)	advocacy and communication	29	I don't know who I should tell about my difficulties
	community mobilization	0	
	political participation	6	There are no opportunities to take part in politics
	self-help groups	0	
	disabled people's organization	0	
total		444	

“Social protection” as follows: 『*The social situation of refugees is vulnerable*』.

Within the component of “Social,” one PWDs talked about “Personal assistance” as follows: 『*There aren’t many caregivers in our family*』. One PWDs talked about “Relationships, marriage and family” as follows: 『*We don’t have much interaction with members of the community*』. One PWDs talked about “Justice” as follows: 『*There is little information about the rights of persons with disabilities*』.

Within the component of “Empowerment,” one PWDs talked about “Advocacy and communication” as follows: 『*I don’t know who I should tell about my difficulties*』. One PWDs talked about “political participation” as follows: 『*There are no opportunities to take part in politics*』.

Discussion

The study identified that the social participation of Syrian refugees with disabilities (PWDs: persons with disabilities) and their families in urban area is often restricted. The findings suggested that insufficient health care services and health literacy, disuse syndrome, and burdens of nursing care might be correlated to the level of social participation of PWDs and their families.

In general, governments normally guarantee the basic human rights and physical security of citizens. However, in the case of refugees, this safety net often disappears [9]. Almost all Syrian refugees are in a vulnerable position in terms of social participation, for example, with regard to health care access, education, and livelihood. In particular, persons with disabilities face disproportionate risks in disaster situations such as the Syrian conflict and are often excluded from relief and rehabilitation processes [10]. Furthermore, PWDs face limitations to their activities due to their physical disabilities.

Nearly six years of conflict in Syria have resulted in the destruction of countless livelihoods and health care services [11]. Therefore, there are more than 4.9 million Syrians who have migrated to Syria’s neighbors as refugees, as of January 2017. In Jordan, host communities and humanitarian organizations are grappling with the challenge of accommodating significant numbers of Syrian refugees over the long term [12]. Furthermore, many of the participants had difficulties accessing health care services due to the lack of medical care providers, the need for transportation to medical institutions, and the medical expenses required. It was considered that these factors might lead to a lack of health care for PWDs in urban areas.

Some of the participants had incorrect understandings of their disorders, and lacked information on health care services. These situations may be based on a lack of information on social resources in residential areas, such as how to access health care services and how to apply for them. Insufficient orientation by medical providers about rehabilitation, nursing care and prevention relating to their disorders may be contributing factors to the insufficiency of health literacy among PWDs and their families.

Lack of health care and insufficient health literacy are connected with the spread of disuse syndrome. Some of the participants presented disuse syndrome in the form of joint contracture, muscular atrophy, or bedsores. Almost none of the participants had information on disuse syndrome and approaches to its treatment and prevention. Furthermore, as almost all the PWDs had physical disabilities and needed support for transportation, they tended to spend their daily lives at home. These factors may have contributed to the deterioration of their health conditions and the high risk of disuse syndrome. Almost all the participating PWDs needed support from their families in basic daily activities such as eating, washing, going to the toilet, grooming, and transportation. Therefore, family members of PWDs must be able to provide a variety of nursing care for a long period of time. Subsequently, some family members had difficulties accessing social resources or employment due to their engagement in nursing care.

This study indicated that each category had some degree of relevance. PWDs and their family members may face restrictions in social participation due to their vulnerable positions as refugees and also limitations to their activities due to their physical disabilities. Such restrictions might result in difficulties in gathering information on health care or accessing health care services. The insufficient health literacy and lack of health care of PWDs might result in the spread of disuse syndrome. The deterioration of PWDs’ health conditions and the onset of disuse syndrome might in turn increase the care burden on their family members. Disuse syndrome among PWDs and the increasing care burden they require from their family members are thus linked to the restrictions on the social participation of PWDs and their family members (Fig. 2).

We elucidated our study on the social participation of PWDs using a community based rehabilitation (CBR) matrix [8]. PWDs and their family members had difficulties in terms of education and livelihood, just like refugees in normal health. Furthermore, they had little recognition of the prevention of disuse syndrome and health promotion, difficulties in receiving personal assistance, and lack of empowerment. From the results of the evaluation using the CBR matrix, it can be sug-

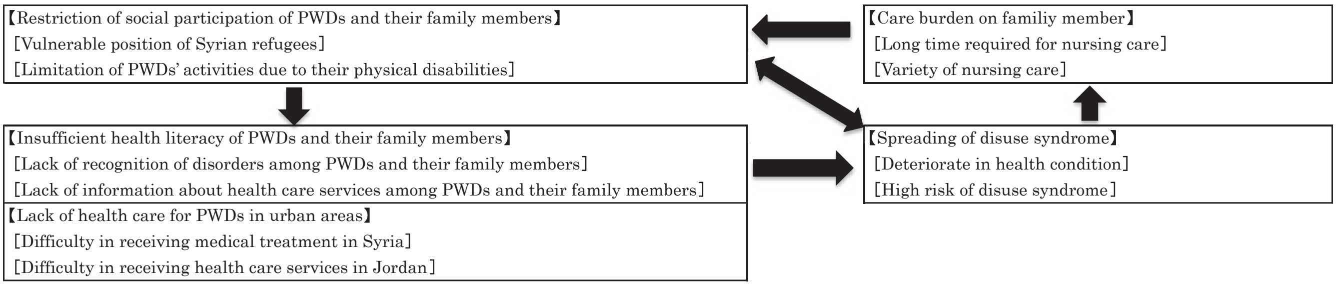

Fig. 2. Relationship about difficulties of Syrian refugee with disabilities and their family members

gested that health professionals need to guide preventive measures and the promotion of health among PWDs, and cooperate with them in their empowerment.

Our study was limited by the small size of the sample. The recruitment of subjects for the study was difficult, because the participants were afraid to have their social status revealed. However, this was the first time for a study to be conducted on the current situations of the health and social participation of Syrian refugees with disabilities and their family members in urban areas.

Conclusions

Our current study concluded that Syrian refugees with disabilities presented disuse syndrome related to their health conditions, and that they and their family members faced restrictions in terms of social participation. Furthermore, it was indicated that the PWDs' insufficient health literacy, lack of health care services, disuse syndrome, vulnerable positions as refugees, limitations on activities due to physical disabilities, and care burden on their families might be related to the restrictions in social participation that they experienced. It is essential that health professionals including occupational therapists provide knowledge knowledge and health services concerning the prevention of disuse syndrome and support for the empowerment of Syrian refugees with disabilities.

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