Effectiveness of a Self-Help Device to Aid Hemiplegic Patients Open Oval-Shaped Canning Lids with a Single Hand: A Retrospective Observational Study

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Abstract: Purpose: Patients who can only use one of their upper limbs experience difficulties in opening the lids of full-open-end cans. Thus, we developed a self-help device consisting of a cord and J-shaped hook. This device allows the user to pull a tab fixed to the end of the can with the body, enabling the lid to be opened with one hand. This study aimed to demonstrate the effectiveness of the device by comparing it with a spoon for opening the lids of cans.
Methods: The study participants were 28 hemiplegic individuals. They were taught to use a device that involves leaning their body backward instead of pulling a tab with their fingers as well as using a spoon to open a lid. They were then asked to open the lid using only one hand. Next, we judged whether the participants could perform the movements, and measured the time taken to open the can using video recording.
Results: All the participants successfully opened the can with the device and its use greatly reduced the opening time.
Conclusions: Our results suggest that this device is effective in helping hemiplegic individuals open cans. They also demonstrate that this self-help device created from cheap, everyday components enables hemiplegic individuals to open can lids without difficulty.

Keywords: canning lids, hemiplegia, self-help device

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Introduction

Cans with “easy-open ends” that can be opened without a tin opener are common [1]. Easy-open lids that form the entire end of canned are known as “full open ends” (FOEs) [2]. FOEs are removed using a two-handed motion that involves holding the can still with one hand while pulling the FOE tab with the other hand [3]. This task is difficult for individuals who can only use one hand.

One method of opening such cans with one hand is to attach the can to a suction cup device (T.L.I. Suction Cup; Richell Corp.) [4]. This method enables round cans to be opened, but it cannot be used with rectangular or elliptical cans. Therefore, some people open round cans with one hand using a spoon or finger to press on the FOE [5, 6] and adopt this method for opening rectangular and elliptical cans. Both methods involve pushing the FOE down, causing both fingers and the can lid to become smeared with the can contents. Therefore, we developed a self-help device for opening the lids of rectangular or elliptical cans without the fingers or FOE touching its contents.

This study evaluated the effectiveness of this device in patients with hemiplegia by comparing it with a spoon (conventional method) for opening an elliptical can. We also investigated differences in the difficulty of using the device with the dominant and nondominant hands.

Methods

Participants

We recruited 28 patients with hemiplegic stroke

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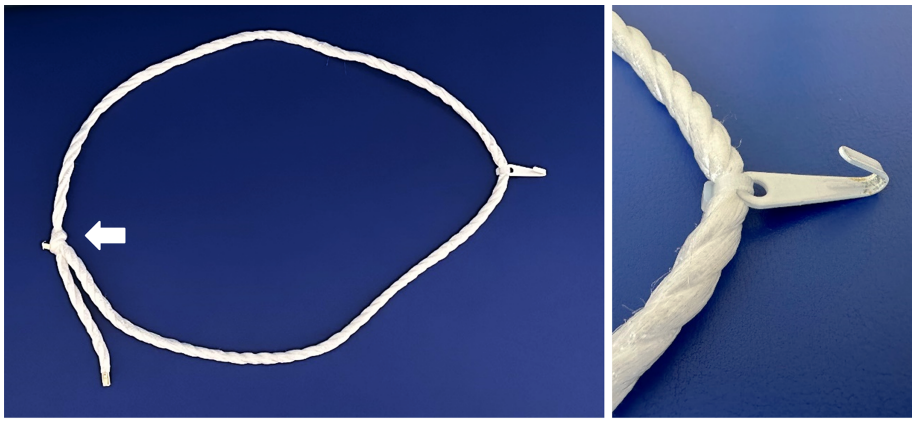

Fig. 1. Device structure

The string was made of polypropylene with a diameter of 8 mm. J-hook (Magical Pin Hooks; BEST Inc., Tokyo) were attached to the string with a cable tie. The part indicated by an arrow was made into an adjustable grip hitch to allow the total length to be adjusted in the range of 400–500 mm.

(12 males, 16 females) who regularly attended daytime nursing care facilities. All participants were right-handed and in the chronic phase (> 1 year after stroke onset). The mean age of the participants was 70.2 ± 9.5 years (range, 48–86 years). The participation criteria for this study were (1) unilateral motor paralysis; (2) a lack of functional impairment that would interfere with daily life, manifesting in the upper limbs, fingers, or lower limbs on the nonparalyzed side; (3) an absence of higher brain dysfunction; (4) a revised Hasegawa Simplified Intelligence Scale score within the normal range of ≥ 21 [7]; and (5) the ability to stably maintain a sitting position.

Ethics

This study was approved by the Ethics Committee of Tohoku Medical School (approval number 39; approval date: August 23, 2023) and was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Equipment

Figure 1 shows the device. The experiment was conducted with the participants seated with the shoulder joint in the intermediate position, elbow joint bent at 90°, and wrist positioned such that it touched the proximal edge of the can. While in this position, the length of the device was adjusted so that the tip of the J hook touched the tab on the can. Elliptical cans were used in the experiment.

The opening motion was videoed from the paralyzed side and from the front simultaneously with two webcams (c920r, Logicool Co Ltd., Lausanne) at 30 frames per second with myoVIDEO (NORAXON USA Inc., Scottsdale), which was used for recording and analysis.

Opening motion procedure

Figure 2 shows the procedures for opening the can with the device and with a spoon using the right hand.

The top row shows opening with the device. The can should be placed on the non-slip mat and the tab lifted with a finger (Step 1). The tab should then be rotated to the opposite side, and the device hung around the neck. The device should be hooked onto the tab, the middle of the FOE should be held down with the finger, and the body should be tilted backwards until the FOE is half open (Step 2). The fingers should be shifted to grasp the front and back of the can, and the body should be tilted backwards again until the FOE is fully open (Step 3). The can should then be rotated so that the tab is on the nonparalyzed side, and the tab should be held and the FOE slightly tilted toward the contents of the can (Step 4). The FOE should be tilted slightly toward the outside (Step 5). Steps 4 and 5 should be repeated until the FOE comes off (Step 6).

The bottom row shows opening with a spoon. The can should be placed on the non-slip mat and the tab lifted with a finger (Step 1). The spoon should be held with the thumb against the outside of the bowl and pressed down on the edge in front of the tab that is starting to open. While rotating the can clockwise, the can should be opened by pressing down the edge of the spoon in the counter-clockwise direction (Steps 2–5). The procedure is completed by fishing out the FOE that has fallen into the contents of the can (Step 6).

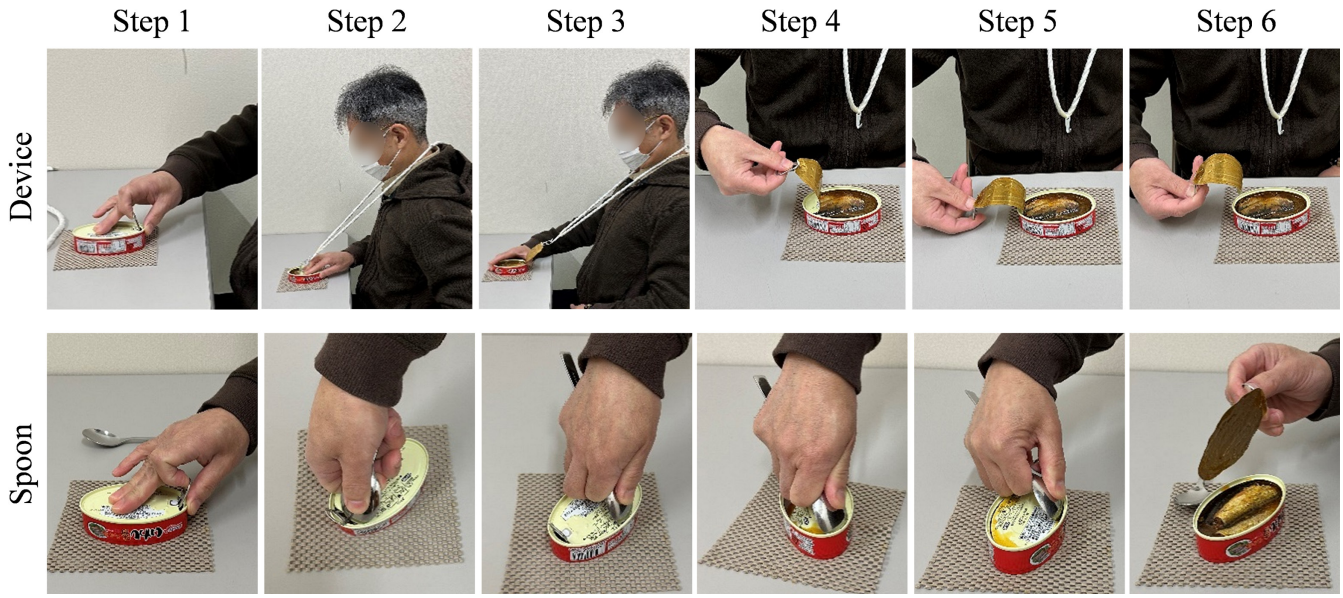

Fig. 2. Procedures for opening.
The top row shows opening with the device. Steps 1–3 are photographed from the paralyzed side, and Steps 4–6 are photographed from the front. The procedure is similar for the left and right hands, but in Step 4, the FOE must always be tilted toward the contents of the can. The FOE should be tilted toward the contents of the can only until it is vertical, as shown in the picture of Step 4. Care must be taken not to tilt it too far toward the contents of the can, as in this case it will be impossible to bring it back up. The bottom row shows opening with the spoon. All steps are photographed from the paralyzed side. The procedure is similar for the left and right hands, but the can is rotated and the FOE is pressed down in the opposite directions.

Procedure

The procedures for opening the can with the device and with a spoon were explained, and after they had practiced both, the participants were asked to open the can with the nonparalyzed hand. After the experiment, we judged whether each participant could perform the opening the can. Next, the time required to open the FOE (opening time) was measured from the video recording.

Analysis

Success or failure of opening operation

We compared the success and failure of opening the can with the device or with a spoon. Success and failure were defined as complete and incomplete removal of the lid, respectively.

Opening time

The time from the point at which the participant first touched the device or spoon until the opened FOE was lifted off the can was measured in the video, and the opening times for the device and spoon were compared. A Wilcoxon signed-rank test was used for statistical analysis, with $p < 0.05$ regarded as significant. Participants who failed to open the can with the device, spoon, or both were excluded from this comparison.

The opening time with the device was compared between individuals with right and left hemiplegia. A Mann-Whitney U test was used for statistical analysis, with $p < 0.05$ regarded as significant. IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY) was used for statistical analyses.

Results

Success or failure of opening (Table 1)

All the participants successfully opened the can with the device, and 25 successfully opened it with a spoon.

Opening time

As shown in Table 1, it took significantly longer to open the can with a spoon than to open it with the device ($p < 0.01$). As shown in Table 2, there was no difference in the opening time with the device between patients with right and left hemiplegia.

Discussion

In this study, we compared a self-help device that we developed with a spoon for can opening to verify the effectiveness of this device. All participants successfully opened the can with the device, and its use significantly reduced the opening time. These results suggest that

Table 1 Comparison of success or failure of opening and opening time.

	Self-help device	Spoon	*p* value
Success or failure of opening ($n = 28$)			
Success	28	25	
Failure	0	3	
Opening time (seconds) ($n = 25$)	78.1 (60.0–92.8)	110.7 (82.3–125.3)	0.001

Opening times are shown with median values (interquartile ranges).

Table 2 Comparison of opening times of patients with left and right hemiplegia in device motion.

	Patient with left hemiplegia $n = 14$	Patient with right hemiplegia $n = 14$	*p* value
Opening time (seconds)	72.8 (56.2–92.6)	78.2 (67.6–90.2)	0.593

Opening times are shown with median values (interquartile ranges).

using our device to open cans is more practical for hemiplegic individuals than the conventional spoon method.

As shown in Steps 2–5 in the bottom row of Fig. 2, opening the can with a spoon requires pressing it down repeatedly at short intervals around the edge of the FOE to open it completely. However, the device allows the can to be held down with the hand, and it may be opened in one go by following Steps 2 and 3 in the top row of Fig. 2. The repeated movements required to open the can with a spoon are not needed when the device is used, and this may significantly shorten the opening time. A longer time required to perform a task indicates that the operation is more difficult [8]. In other words, the fact that it took less time to open the can with the device indicates that the task was less difficult than opening it with a spoon. Furthermore, since opening a can with our device engages the stronger muscles of the body rather than the muscles of the fingers as when using a spoon [9], it may have made the opening process easier, leading to the reduced opening time.

There was no significant difference in the opening time when the device was used by individuals with left or right hemiplegia. As all the study participants were right-handed, those with left hemiplegia used their dominant hand, and those with right hemiplegia used their nondominant hand. This suggests that there was no difference in the degree of difficulty in using the device, and that it was equally effective irrespective of the use of the dominant or nondominant hand.

Limitations and future directions

The study participants were all individuals with chronic hemiplegia who were capable of attending a daycare facility. Patients with acute hemiplegia and severe brain dysfunction were excluded. Thus, it is unclear whether this method will be effective in patients with acute hemiplegia and/or severe higher brain dysfunction. All the study participants were right-handed, and it was not demonstrated whether a similar effect can be obtained for left-handed individuals. Further studies are required to verify this method in patients with acute hemiplegia, higher brain dysfunction, and other diseases, as well as in left-handed individuals.

Summary and Conclusions

Our findings suggest that the self-help device is effective in patients who can use only one hand for can opening. This device, made from inexpensive everyday items, may enable individuals who can use only one hand to open cans easily.

Conflict of Interest

There are no conflicts of interest to declare.

Acknowledgements

I would like to sincerely thank all the participants in this study.

References

[1] The Canmaker [online]. Frequently Asked Questions [cited 2022 August 22]. Available from: https://web.archive.org/web/20131203010423/http://www.canmaker.com/news/index.php/home/faqs.

[2] Kasai T, Miura H, Ishikawa M, Yokoyama M, Hasegawa K, editors. Dictionary of Packaging (in Japanese). Tokyo: Asakura Publishing Co., Ltd; 2011; 106.

[3] Crown Prince Inc [online]. How To Open A Ring-Pull Can [cited 2022 August 22]. Available from: https://www.crownprince.com/open-ring-pull-can.htm.

[4] Hatena Blog [online]. Opening cans one-handed (in Japanese) [cited 2022 August 19]. Available from: https://longl.hatenablog.com/entry/2022/06/09/185748.

[5] 2kaku-me [online]. Opening the canned with one hand (in Japanese) [cited 2022 August 19]. Available from: https://www.nikakume.com/2021/06/05/opening_canned/.

[6] Cooking one-handed: The trick of opening cans with one hand [online]. YouTube (in Japanese) [cited 2022 August 19]. Available from: https://www.youtube.com/watch?v=c1xxfYisOW4.

[7] Imai Y, Hasegawa K. The Revised Hasegawa's Dementia

Scale (HDS-R) – evaluation of its usefulness as a screening test for dementia. J Hong Kong Coll Psychiatry. 1994; 4: 20–4.
[8] Sakamoto Y, Taniguchi T, Nagao T, Higashi T. Operation time by handedness and non-handedness in works with degree of difficulty differences. Ability of non-handedness and handedness (in Japanese). Bulletin of the School of Allied Medical Science, Nagasaki University. 1994; 8: 93–5.
[9] Nakamura R, Saito H, Nagasaki H. Fundamental Kinesiology, 6th ed (in Japanese). Tokyo: Ishiyaku Publishers Inc; 2003.

■CASE REPORTS

Effectiveness of Visiting Occupational Therapy for a Junior High School Student Refusing to Attend School Due to Internet Game Addiction

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Abstract: Introduction: The number of Japanese children who refuse to attend school is increasing every year. However, it is uncommon for occupational therapists (OTs) to visit to the homes and rooms of these students. We examined the effects of visiting occupational therapy on a junior high school student with an addiction to Internet games.
Methods: The case (Case) involved a home visit by an OT to a 13-year-old boy with attention deficit/hyperactivity disorder. Case told the OT that he was addicted to competitive Internet games and went to bed around 5 a.m.
Result: OT spoke with Case concerning his daily rhythm, and he promised to be in bed by midnight. However, this promise was frequently broken, and no improvement was seen in his life rhythm or his relationship with his family. Therefore, the OT increased the frequency of visits from once to twice a week. Six months into the visit, the OT took advantage of plastic model making, which Case had shown interest in, to break the vicious cycle caused by Internet games. Case's reliance on Internet gaming was eliminated, thanks to plastic model building, and his life rhythm significantly improved. Case's Vineland-2 Adaptive Behavior Scale scores also improved, and his Maladaptive Behavior Scale score was zero.
Conclusion: The OT's encouragement to build plastic models occurred at the right time to assist Case to break free from his addiction. These findings suggest that home-visit occupational therapy is effective for students who refuse to attend school.

Keywords: school refusal, visiting occupational therapy, activity, attention deficit/hyperactivity disorder

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Introduction

The number of Japanese elementary and junior high school students who refuse to attend school increased from 66,817 in 1991 to 299,048 (105,112 primary school students and 193,936 junior high school students) in 2022, representing a 4.4-fold increase [1]. Currently, the state of support for school-refusal students is limited to a few initiatives outside of school, although some support also appear within school, including comprehensive support approaches and cognitive-behavioral therapy [2–4]. Moreover, few occupational therapists (OTs) visit the homes or rooms of school-refusal students.

Since 2015, OTs have been providing home visits to students refusing to attend school, using a service system based on the Japanese Health Insurance Act. To date, 13 OTs have assisted 108 students who refused to attend school, 77 of whom have returned to school. Numerous cases of school refusal due to Internet gaming addiction have been reported. We examined the effects of an OT's home visit on a junior high school student who was addicted to Internet games.

Case report

The first home-visit occupational therapy interven-

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Table 1 Intervention process for Case and his parents

First period: From February to March in the first year of junior high school	
Case characteristics	Case was highly impulsive, could not stop playing games, and could not switch his thoughts. He was often in trouble with his parents over his gaming and was verbally abusive and violent when angry.
Intervention goal and plan	Establishment of a bilateral relationship; the occupational therapist (OT) made it a priority to establish a bilateral relationship with Case and engaged him in talking about games that interested him and playing games with him.
Case observations	The OT began learning games that interested Case; in turn, Case accepted the OT and began to talk in detail about his daily life and why he refused to go to school.
Family's intervention and relationship	The establishment of a bilateral relationship with the Case was a top priority for the OT. During this period, the only outreach to the parents was to gather information. One day, the father became angry and destroyed the Case's game monitor because the games took too long to finish.
Second period: From April to July in the second year of junior high school	
Case characteristics	Case was highly impulsive, and his thoughts remained centered on gaming. He continued to be verbally abusive and violent toward his parents.
Intervention goal and plan	Improvement of life rhythm; the OT provided interventions to improve Case's daily rhythms. First, based on the results of the Functional Independence Measure and Vineland-2 Adaptive Behavior Scale, he worked with Case to create a daily rhythm chart and he promised to regularize his bedtime. The OT made time to talk with Case's parents to discuss how to engage with Case.
Case observations	For several days following the intervention, the OT checked in with Case. He initially maintained a regular bedtime but was unable to continue. During this period, Case was calmer and had a good demeanor during face-to-face interactions.
Family's intervention and relationship	In each session, the OT set time to meet with Case's parents to discuss how they could approach Case. The parents were asked to fill a daily rhythm checklist to confirm bedtime and waking time. The parents' approach to Case changed, resulting in fewer problems within the family.
Third period: From August to September in second year of junior high school	
Case characteristics	Case was highly impulsive, and he still primarily thought about his games. His outbursts at his parents continued.
Intervention goal and plan	Strengths of current capabilities and adjustments to environmental factors; the plan was based on the Management Tool for Daily Life Performance assessment exercise sheet. The OT suggested that Case's ability to concentrate could be utilized in plastic model making. He encouraged Case to build plastic models with his father and entered them in a plastic model contest.
Case observations	Case spent less time playing games and more time making plastic models. He talked more with his father and spent more time in his father's room. He no longer had problems with his parents.
Family's intervention and relationship	Interviews with the parents continued during the visit. Discussions with Case focused on confirming his living situation and progress in plastic model making. Case was struggling with this process; therefore, to improve the relationship between Case and his father, the OT suggested that Case work on plastic models with his father and obtain his consent. The father was advised to only help Case when he asked for help himself.
Fourth period: From October to March in the second year of junior high school	
Case characteristics	Case's impulsiveness remained. He was better able to switch his thinking. However, it seemed difficult for him to view himself objectively.
Intervention goal and plan	Improved self-awareness and self-efficacy; Case and the OT discussed his high school education and future, encouraging him to consider his own characteristics, self-awareness, and ways of dealing with failure.
Case observations	As a result, Case came to understand his own characteristics and recognized them as his own. He recognized that gaming was ruining his prospects.
Family's intervention and relationship	Interviews with the parents continued during the visits. The discussions confirmed Case's status and their responses. The OT praised the parents for becoming appropriately distanced and involved with Case.

tion began with a 13-year-old boy (Case) who lived with his father, mother, and younger sister. He was diagnosed with attention deficit/hyperactivity disorder (ADHD). The diagnosing doctor stated that "He has a strong obsession with Internet games and is in constant conflicts with his family. Please improve his interpersonal relationships and rhythm of daily life." OT began home-visiting Case in February, 11 months after he began junior high school. He had already missed 48 days of school.

Case's ADHD characteristics and the flow of OT visits are shown in Table 1. We used a flowchart from

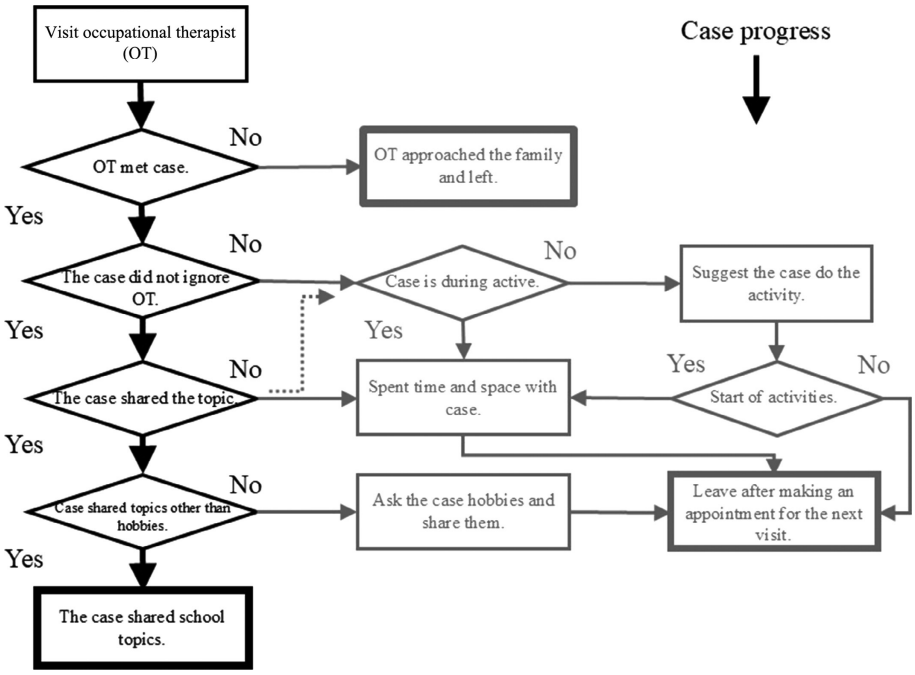

Fig. 1. Flow of first visit occupational therapist.
Intervention process for visiting occupational therapy.

our involvement with the 108 students who refused to attend school to analyze the intervention in the OT's initial visit. The flowchart of the initial OT visit in this case is presented in Fig. 1. From Case's first OT visit, his response proceeded as shown in the arrow in Fig. 1 [5]. Case responded well to the OT, and they spoke about school. Because Case was waiting for instructions, OT focused on open-ended questions to establish a bilateral relationship. Observations and interviews revealed that Case showed disorganization in his self-care, as converted to a Functional Independence Measure (FIM) score points for eating (4 points), grooming (4 points), bathing/showering (4 points), and dressing (4 points). Plastic model boxes and materials covered his room and restricted movement in it. The OT visited weekly, sharing Case's interests and offering career advice. In the fourth OT visit, Case told the OT that he was addicted to competitive online games and usually went to bed around 5:00 a.m. The OT discussed with Case how to improve his daily rhythm, and Case agreed to be in bed by midnight. However, his promises were frequently broken, and there was no improvement in his rhythm or interactions with his family, OT home visits were increased to twice weekly. At each visit, the OT inquired into Case's school attendance, bedtime, and daily activities. Case frequently broke his promises.

Six months into the therapy, the OT took advantage of plastic model making, which Case had shown interest in, to break the vicious cycle of daily rhythms. The OT suggested that Case enter the plastic model creation competition, and Case agreed. With the assistance of his father, Case was able to meet the deadline for submitting an entry to the contest. Case stopped playing Internet games altogether 1 week before registering his work in the competition. He won second place nationwide. This achievement enabled him to break free from his reliance on Internet games and maintain his bedtime routine. Conversations with his father also improved, and his interpersonal interactions with his family and daily routine improved dramatically.

One year after the beginning of visits, Case was hoping to be a professional plastic modeler, and he rarely missed school. During the home visits, the OT reviewed assignment deadlines and checked grades. The OT also discussed Case's strengths and weaknesses, his concerns regarding high school entrance exams, and his post-high school plans. Case was able to enter his high school of choice.

Case's scores on the Vineland-2 Adaptive Behavior Scale improved, and his score on the Maladaptive Behavior Scale was zero (Table 2). The FIM score was perfect.

Discussion

A strong link exists between Internet game dependence and ADHD in children [6, 7]. When the OT first met Case, he had fallen into a game-centric lifestyle

Table 2 Case's Score on the Vineland Adaptive Behavior Scales Second Edition

Domain	Start of visiting OT	Junior high school graduation
Communication	74	113
Skills for daily living	69	109
Socialization	70	111
Internalizing	10	0
Externalizing	12	0

disrupting his daily rhythm. The OT developed a trusting relationship with Case while working to improve his daily rhythms. Overcoming his addiction to Internet games was not easy. OT explained his developmental characteristics and status to his family, gaining their cooperation. As the home visits continued, the OT became more aware of Case's current situation and interests.

The authors speculate that during the 6 months of home visits, Case became aware of his problems, understood them, and considered solutions. To regulate daily rhythms, synchronizing the internal circadian rhythm with the external 24-hour schedule is crucial [8]. Exposure to sunlight is an effective means for this purpose [9, 10]. However, Case's bedtime ranged from late at night to early in the morning. To ensure that his life rhythms were organized, he needed to make sure he got enough sleep at night. It was also very important for Case to be aware of the need to go to bed and wake up earlier. The implementation of the daily rhythm check sheet helped raise Case's awareness of the importance of going to bed early. In addition, the OT's visits to Case's room increased their awareness of the visiting schedule, and, along with the presence of a third party, we suspect that this led to earlier bedtimes and to successfully waking up in the morning.

We hypothesized that Case increased his self-efficacy by completing the plastic model project and winning a prize. His father's involvement was an important factor in this process. Case shared time with his father and examined himself through plastic models. The OT contributed to the creation of this environment. One year after the OT's visit, Case declared that Internet gaming was harmful for him and that he would never play again.

This suggests the effectiveness of OT involvement in home visits for students refusing to attend school due to Internet gaming addiction.

Ethics statement

The case and his family provided written informed consent after receiving a detailed description of the study. The study was approved by the Ethical Committee of Kanon and conducted in accordance with the Declaration of Helsinki.

Conflict of interest

The authors declare no conflicts of interest.

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References

[1] Ministry of Education, Culture, Sports, Science, and Technology. Reiwa 4 Nenndo Jidou Seito no Mondaikoudou Futoukoutou Seito Sidoujou no Shomondai ni Kansuru Chousa Kekka ni Tsuite [online]. [cited 2024 February 25]. Available from: https://www.mext.go.jp/content/20231004-mxt_jidou01-100002753_1.pdf

[2] Nishimura H. Cognitive behavior therapy for a long-term school-refusal child (in Japanese). Jpn Assoc Behav Cogn Ther (Koudouryouhoukenkyu). 2013; 39(1): 45–54.

[3] Masahiko O. Truancy support tools for schools and teachers: a comprehensive support guide to zero truancy (in Japanese). Kazamashobo. 2013.

[4] Naoki M, David H. Rapid return for school refusal: a school-based approach applied with Japanese adolescents. Front Psychol. 2019; 10: 2862.

[5] Fugen O, Naoko M, Kaori I, Shiina I, Atsuko M, Hiromi F. Home-visit rehabilitation of school refusal children (in Japanese). General Rehabil. 2023; 51(9): 955–61.

[6] Aviv W, Yafa Y, Michal M, Pinhas D, Abraham W. Internet addiction and attention deficit hyperactivity disorder among school children. Isr Med Assoc J. 2015; 17(12): 731–4.

[7] Junichi F, Kumi A, Nao T. Internet-game addiction among adolescent patients at a university hospital psychiatry clinic (in Japanese). Jpn J Child Adolesc Psychiatr. 2019; 60(2): 147–9.

[8] Yasuhiko I, Masaki T, Yoshitaka T, Seiji H, Fumio K, Hitoshi O. Time medicine. Expression and synchronous mechanism of biological rhythm (in Japanese). BME. 1996; 10(8): 12–21.

[9] Sato H. Time medicine. Circadian mechanism of humans (in Japanese). BME. 1996; 10(8): 30–6.

[10] Takuro E, Kenichi H. Hito no Gaijtu Rizumu to Suimin (in Japanese). Japanese Journal of Physiological Psychology and Psychophysiology. 2000; 18(1): 3–8.

Effectiveness of Self-Help Device for Hemiplegic Patients to Put on the Knit Cap with a Single Hand: A Retrospective Observational Study

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Abstract: Purpose: Patients forced to use only one hand find wearing a knit cap without a brim difficult. Therefore, we developed a self-help device using a string and clothespin. The device can immobilize the knit cap, making it easy to put on the cap with one hand. This study aimed to demonstrate the device's effectiveness by comparing the action of putting on the cap with the device (usage motion) and without the device (non-usage motion) in hemiplegic patients.
Methods: Twenty-eight hemiplegic patients were recruited as participants. After receiving explanations about the procedures for both the usage and non-usage motions, the participants were asked to put on the knit cap with one hand. Next, the success of the action was evaluated before hearing the feedback provided by participants regarding the ease of wearing. Finally, the time taken to put on the cap was measured from the video footage.
Results: The usage motion made it easier to wear the cap and had a higher success rate than the non-usage motion.
Conclusion: The experimental results suggest that the motion of putting on the cap using the device is an efficient method for hemiplegic patients. Furthermore, it was demonstrated that hemiplegic patients can comfortably wear a knit cap without difficulty using a self-help device combining inexpensive daily items.

Keywords: knit cap, hemiplegia, self-help device

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Introduction

Knit caps collectively refer to all hats made from knitted fabric. They are used as a source of warmth and as fashion accessories [1]. Wearing a knit cap for warmth helps insulate the head, with a better insulating effect achieved by covering the ears [2]. Consequently, individuals living in cold regions are more likely to wear knit caps for warmth. Putting on a knit cap requires a bilateral hand motion that involves inserting both hands into the cap, stretching it to the sides, placing it over the head, and adjusting it [3]. However, this is a difficult operation for individuals who can only use one hand to perform this task. To address this, we developed a self-help device ("device") that is easy to operate and can be created using inexpensive daily items. Although the device was initially developed to close zippers single-handedly [4], we hypothesized that it could also be applied to the task of putting on a cap.

Therefore, this study aimed to demonstrate the effectiveness of the device by comparing the usage motion with the non-usage motion without using the device in patients with hemiplegia attempting to put on a cap.

Materials/Subjects

Participants

We recruited 28 hemiplegic stroke patients (12 males, 16 females) who regularly attended daytime nursing care facilities. All participants were right-handed and in the chronic phase more than one year after stroke onset. The participants' mean age was 70.9 ± 8.5 years.

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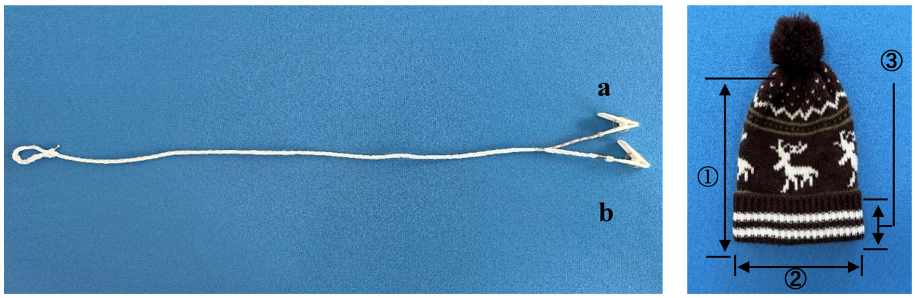

Device structure Knit cap used

Fig. 1. Equipment.
Device structure (left)
The string of the device is made of polypropylene, and one end of the string is divided into two, as shown by "a" and "b." Clothespins are attached at each end of the string. The string is connected to one handle of the clothespin.
Knit cap used (right)
The size of the knit cap is 220 mm in height (①), 200 mm in width (②), and 60 mm in the height of the folding edge (③).

The inclusion criteria for this study were (1) unilateral motor paralysis, (2) a lack of functional impairment, interfering with daily life and manifesting in the upper limbs, fingers, or lower limbs on the non-paralyzed side, (3) an absence of higher brain dysfunction, and (4) a revised Hasegawa Simplified Intelligence Scale score within the normal range of ≥ 21 [5].

Methods

Ethics

This study was approved by the Ethics Committee of Tohoku Medical School (approval number 216; approval date: March 16, 2023) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Equipment

Figure 1 (left) shows the device used in the experiment. The string length for each participant was set as the distance from where the string without the clothespin was secured under the non-paralyzed thigh to the point where the clothespin on the opposite side contacted the forehead. Additionally, the distance was set to the length that the participant felt most comfortable wearing during practice before the experiment, and the length was adjusted by holding the string under the non-paralyzed thigh. Figure 1 (right) shows the knit cap used in the experiment. The experiment was performed in a seated position. The putting-on motion was captured using a web camera (c920r; Logicool Co Ltd., Lausanne, Switzerland) from the front, and the images were uploaded at 30 frames/s in myoVIDEO (NORAXON USA Inc, Scottsdale, AZ, USA) and recorded and analyzed.

Putting-on motion procedure

Figure 2 displays the putting-on procedure using the right hand. The upper and lower rows show the usage and non-usage motions, respectively.

Procedure

We explained both motions to the participants, who then practiced the activities until they were satisfied. Subsequently, they were asked to wear the knit cap using the non-paralyzed hand. After the experiment, we determined whether the participants successfully put on the knit cap and subjectively evaluated the ease of putting it on. Next, we measured the time taken to put on the knit cap ("putting-on time") using the captured video footage.

Analysis

Success or failure

Success was considered when the participants could put on the knit cap to the ears, and failure was defined as the inability to do so. The success rate was analyzed using the chi-squared test with a significance level set to $< 5\%$.

Subjective evaluation of ease of putting on the cap

Participants evaluated the ease of putting on the cap based on the following three scales: easier, the same difficulty, or harder with the device than without it. All participants who failed to perform the usage or non-usage motions were excluded from the comparison. Participants were also asked whether they experienced discomfort while putting on the knit cap.

Putting-on time

The setting, pulling-down, and total (sum of setting and pulling-down times) times were compared between

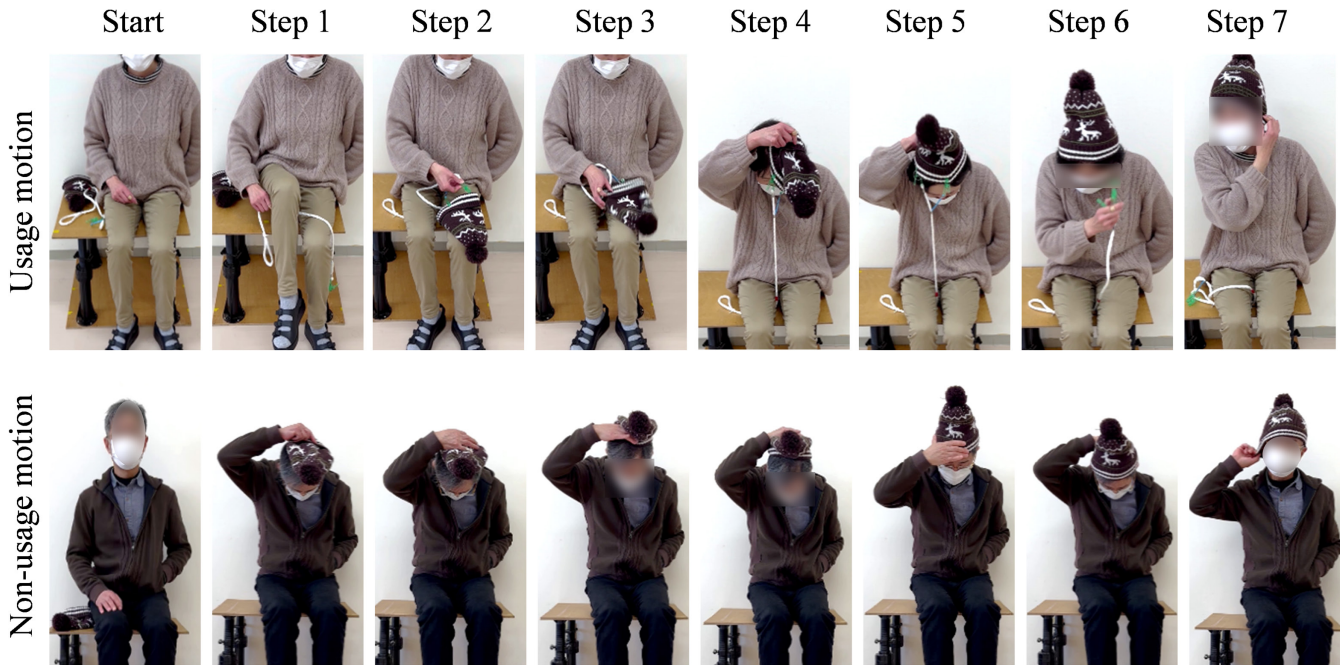

Fig. 2. Procedure for putting-on motion.

Usage motion procedure

The procedure for the usage action with the right hand is outlined in the top row. The device's clothespin side is placed on the paralyzed side's thigh, with the string passed under the unaffected side's thigh (Step 1). The knit cap is placed on the paralyzed side's thigh, and the brim is clipped in two places with a clothespin, leaving approximately 100 mm spacing between them (Step 2). Subsequently, the knit cap is flipped inside out (Step 3); lean forward to place the knit cap on the head from the front (Step 4); the cap is pulled backward (Step 5); the clothespin is removed (Step 6); and both sides of the brim are pulled down to the ears to complete the motion (Step 7). For the left hand, the procedure is identical but performed in reverse order.

Non-usage motion procedure

The procedure for the non-usage motion with the right hand is outlined in the bottom row. The opening is expanded, and the cap is placed on the head (Step 1). The back of the knit cap is held with fingers and slightly lowered backward (Step 2); the front is held diagonally with fingers and slightly lowered forward (Step 3); the back is held and lowered backward (Step 4); the front and back are adjusted (Steps 5 and 6); and both sides of the brim are pulled down to the ears to complete the motion (Step 7). Steps 2–4 are repeated as necessary. For the left hand, the procedure is identical but performed in reverse order.

the usage and non-usage motions. Specifically, the setting time for the usage motion was measured from (Start) to (Step 4) in Fig. 2 (usage motion), and the pulling down time was the time required from (Step 5) to (Step 7). The setting time for the non-usage motion was the time required from (Start) to (Step 1), and the pulling down time was the time required from (Step 2) to (Step 7) in Fig. 2 (non-usage motion). A non-parametric test was used because each group was not normally distributed. The Wilcoxon signed-rank test was used for analysis, and the significance level was set at < 5%. Participants who failed to perform either the usage or non-usage motions were excluded from the comparison.

The putting-on times of the usage motions were compared between patients with left and right hemiplegia. A non-parametric test was used because each group was not normally distributed. Statistical analysis included the Mann–Whitney U test, and the significance level was set to < 5%.

Results

Success or failure

Table 1 shows the participants' success or failure in putting on the knit cap. All participants succeeded when a device was used. However, only nine participants successfully performed the non-usage motion, and 19 who failed could not perform the pulling-down motion. The success rate was significantly higher when participants used the device than when they did not ($p < 0.01$).

Subjective evaluation of the ease of putting on the cap

Data from nine participants who were successful in both motions were used for the comparison. They stated that using the device was easier than not using it. No participant complained of discomfort from using the device. Additionally, comments were received that the device can be folded up compactly, facilitating its easy transport and storage.

Table 1 Success or failure of the putting-on motion and comparison of the putting-on time.

	Usage motion	Non-usage motion	*p*-value
Success or failure of the putting-on motion			
Success	28	9	0.001
Failure	0	19	
Putting-on time (s) $n = 9$			
Setting time	40.9 (35.5–45.3)	4.5 (3.2–9.1)	0.008
Pulling-down time	15.3 (12.6–21.0)	43.2 (34.1–49.7)	0.008
Total time	54.9 (52.2–67.0)	48.9 (39.4–56.3)	0.314

The success rate was analyzed using the chi-squared test with a significance level set to < 5%. Putting-on time was analyzed using the Wilcoxon signed-rank test with a significance level set to < 5%. Putting-on times are shown as median values (interquartile ranges).

Table 2 Comparison of putting-on times of patients with left-sided and right-sided hemiplegia in usage motion.

	Patient with left-sided hemiplegia $n = 14$	Patient with right-sided hemiplegia $n = 14$	*p*-value
Putting-on time (s)			
Setting time	21.5 (12.3–33.7)	18.3 (12.6–26.0)	0.462
Pulling-down time	43.8 (32.8–54.7)	42.2 (36.3–44.9)	0.462
Total time	66.0 (52.1–82.5)	58.6 (53.9–68.0)	0.613

Statistical analysis was analyzed using the Mann–Whitney U test with a significance level set to < 5%. Putting-on times are shown as median values (interquartile ranges).

Putting-on time

Data from nine participants who were successful in both motions were used for the comparison (Table 1). Setting time was significantly shorter for the non-usage motion than for the usage motion ($p < 0.01$). However, the pulling-down time was significantly shorter for the usage motion than for the non-usage motion ($p < 0.01$). Total time did not significantly differ between the usage and non-usage motions. Furthermore, no significant differences in the putting-on times for the usage motion were noted between patients with left-sided and right-sided hemiplegia (Table 2).

Discussion

This study evaluated the effectiveness of the developed self-help device by comparing the action of putting on a knit cap with and without using the device. All participants succeeded when using the device, finding the motion easy without any discomfort and significantly reducing the pulling-down time. These results suggest that putting on a knit cap using the device is more practical for patients with hemiplegia.

The pulling-down task in the usage motion, as shown in Step 5, involves only pulling backward since the front of the knit cap is fixed. Conversely, this task in the non-usage motion requires participants to perform forward and backward pulling motions (Steps 2–4) repeatedly. If the cap is strongly pulled forward or backward, the entire cap moves in the corresponding direction. Therefore, participants must gradually pull forward and backward, adjusting the pull degree each time. The usage motion speculatively shortened the time due to the absence of repetitive action found in the non-usage motion. This supports the notion that prolonged task duration correlates with increased task difficulty [6]. A study demonstrating the effectiveness of self-help devices, such as a one-handed device for folding socks, revealed that using the self-help device shortened the task duration, leading to subjective ease of use [7]. Therefore, the ease of putting on the cap in the usage motion speculatively reflects the difference in difficulty in the pulling down motion.

As shown in Table 2, no significant difference in putting-on times for the usage motion was observed between patients with left-sided and right-sided hemiplegia. Since all participants were right-handed, patients with left-sided and right-sided hemiplegia used their dominant and non-dominant hands, respectively. The difference in difficulty should be evident from variations in task duration [6]. Therefore, in the usage motion, no difference in difficulty may exist between the non-paralyzed hand regardless of whether it is the dominant or non-dominant hand, and a similar effect may occur.

Limitations and future directions

The participants were limited to patients with chronic hemiplegia who were eligible to attend daycare facilities. Therefore, whether this method has a similar efficacy in patients in the acute phase or those with higher brain dysfunction remains unclear. In the future, testing this method on patients with other conditions, such as acute hemiplegia, higher brain dysfunction, and using other types of knit caps will be necessary.

Summary and Conclusions

This study examined the process of putting on a knit cap with and without the use of a self-help device in patients with hemiplegia. Our experimental results show the practicality of putting on a knit cap using a device. This self-help device also allows the user to close the zipper with one hand, demonstrating its versatility. Therefore, a self-help device for patients with hemiplegia made of a combination of inexpensive everyday items could enable them to put on knit caps more easily.

Conflict of interest

There are no conflicts of interest to declare.

Acknowledgments

I sincerely thank all the participants in this study.

References

[1] Tendre. Differences between beanies and watch caps based on their history and origin (in Japanese) [online]. [cited 2023 December 29]. Available from: https://tendre.org/hpgen/HPB/entries/475.html

[2] Imamura R, Negoro H, Fujiki M, Okukubo A. A study on headgear worm by female during winter (in Japanese). Memoirs of Osaka Kyoiku University. Social Science and Home Economics. 1991; 39(2): 131–9.

[3] Casual box. How to wear a BEANIE (in Japanese) [online]. Casual Box. [cited 2023 December 14]. Available from: https://www.casual-box.com/c/gr280/watch-kaburikata.

[4] Sakagawa D, Konda D, Kawato M, Chiba K, Wakasa K, Sasahara S, et al. Effectiveness of self-help device in closing zippers using a single hand in patients with hemiplegia: a retrospective observational study. Asian J Occup Ther. 2023; 19(1): 230–5.

[5] Imai Y, Hasegawa K. The Revised Hasegawa's Dementia Scale (HDS-R) – evaluation of its usefulness as a screening test for dementia. J Hong Kong Coll Psychiatry. 1994; 4: 20–4.

[6] Sakamoto Y, Taniguchi T, Nagao T, Higashi T. Operation time by handedness and non-handedness in works with degree of difficulty differences. Ability of non-handedness and handedness (in Japanese). Bulletin of the School of Allied Medical Science, Nagasaki University. 1994; 8: 93–5.

[7] Atomura N, Sasaki T, Izumi M, Horikirigawa N, Kafuku T. Practicality of using a ladle for sock folding in hemiplegic patients. Asian J Occup Ther. 2022; 18(1): 141–5.

■Rapid Communications

A Self-Help Device for One-Handed Storage of a Folding Umbrella in Its Cover

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Abstract: Purpose: Individuals with limited use of one hand, such as those with hemiplegia, often struggle with handling umbrella. While automatic umbrellas can be opened and closed with one hand, storing them in their covers requires both hands. To address this issue, we developed a self-help device that stores the umbrella without rolling up the fabric. This study aims to assess user satisfaction with the device for practical use.
Methods: Thirty-two stroke participants with hemiplegia due to cerebrovascular disease were instructed to perform a task using their non-paralyzed hand: removing a folding umbrella from the self-help device, opening, and placing it back into the device. Once familiar with the task, their actions were recorded using a digital video camera. Participants then evaluated their satisfaction using the Quebec User Evaluation of Satisfaction with Assistive Technology 2.0 (QUEST 2.0). The average score for each item was calculated.
Results: The motion images showed that most participants performed the task without difficulty, and all successfully used the device. However, only a few tried again when closing the self-help device. The lowest mean score was 3.8 ± 0.9. Some participants provided encouraging feedback for improvement.
Conclusion: All participants were able to complete the task. An average QUEST 2.0 score close to 4 indicates a high level of satisfaction. These results suggest that the self-help device has a high satisfaction rate. While suggestions were made for enhancements, the device shows promise for practical use, especially with proper instruction on closing the clasp.

Keywords: One-handed activity, Self-help device, Folding umbrella

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Introduction

Individuals with limited use of one hand, such as those with hemiplegia due to upper limb orthopedic conditions or cerebrovascular disorders, often struggle with folding umbrellas. While opening and closing a folding umbrella typically requires both hands, recent innovations have introduced automatic folding umbrellas that can be operated with one hand. Additionally, self-help devices have been designed to attach umbrellas to the bodies of the users, allowing individuals who use canes to carry umbrellas hands-free. Zipped umbrella covers that attach to the outside of a bag also exist, making it easier to store and retrieve an umbrella with one hand. However, placing the umbrella in its cover is challenging unless the fabric is rolled up, typically requiring both hands. While standing an umbrella upright is an option, few people are comfortable leaving a wet umbrella unattended in crowded places. Consequently, rolling up the umbrella fabric remains cumbersome [1].

Lee et al. [2] developed an automatic system employing optical sensors and motors to roll up an umbrella with one hand. The system is activated by sensors and motors, which rotate the umbrella and secure the band. However, the device is challenging to create and lacks portability. Therefore, we developed a self-help device that stores the umbrella without requiring the fabric to be rolled up and is easily portable. This study evaluates user satisfaction with the device to assess its practical applicability.

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Methods

Participants

This study included 32 stroke participants (14 men and 18 women) with hemiplegia due to cerebrovascular disease who regularly attended daytime nursing care facilities. The mean age of the participants was 71.3 ± 9.8 years, ranging from 49 to 86 years. Among them, 15 had right hemiplegia, and 17 had left hemiplegia. The Brunnstrom recovery stages on the affected side were categorized as follows: for the upper limb, stage I in one, II in six, III in eight, IV in nine, and V in eight participants; for the finger, stage I in two, II in eight, III in five, IV in 11, and V in six participants; and for the lower limb, stage II in three, III in 19, IV in 10, and V in eight participants. Trunk function was evaluated using the Chedoke-McMaster Stroke Assessment and Postural Control Scale, with 19, 6, and 7 participants scoring 4, 5, and 6, respectively, indicating varying levels of postural control [3, 4]. None of the participants had severe sensory impairments, and all could perform daily activities independently using their non-paralyzed upper limbs. This limb functioned in a coordinated manner for daily activities. Additionally, participants were required to score 21 or above on the revised Hasegawa Dementia Scale [5], ensuring they had sufficient cognitive comprehension to complete the tasks. This study was approved by the ethical review committee of the institution (Shimoda Nursing Home for the Elderly approval number 27, Tohoku Medical School No. 122) and was conducted in accordance with the Declaration of Helsinki. The purpose and intent of the study were thoroughly explained to the participants, and informed consent was obtained.

Self-help device

The self-help device, illustrated in Fig. 1, utilizes a zippered folding umbrella storage bag. A string and carabiner were affixed to the exterior of the bag. The string is straight and sewn at multiple points to accommodate various bag widths. The zipper was replaced with a clasp for easier one-handed operation, and a microfiber towel pocket was added inside to facilitate umbrella storage. The preparation time was approximately 30 min. The bag used in this experiment was a shoulder bag, and the folding umbrella was an automatic opening and closing type. The self-help device, containing the umbrella, was attached to the bag.

Experiment tasks and procedures

Participants used their non-paralyzed hands to remove a folding umbrella from the self-help device, open it, and return it to the device. They assumed positions based on mobility standing for ambulatory individuals and sitting for wheelchair users. Participants were briefed on the tasks and operation of the self-help device, followed by ample time to practice the motions before the experiment. Subsequently, a single experiment was conducted. Motion images were captured at 30 frames per second using a digital video camera (C920r, Logitech) from two angles, the front and lateral sides of the non-paralyzed hand. These recordings were simultaneously stored on a motion analyzer (MyoMOTION, Noraxon Inc.).

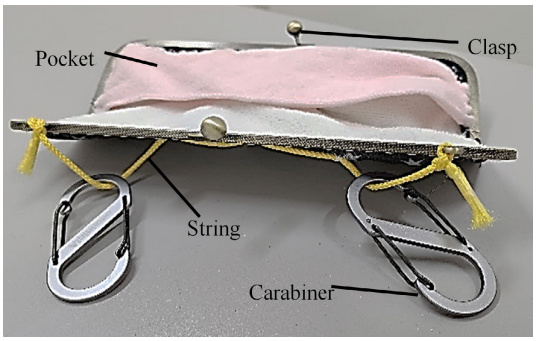

Fig. 1. Device structure
The folding umbrella cover has been improved with a pocket made of microfiber towel. The zipper is replaced with a clasp closure, and a string and carabiner are added to allow it to be attached to a bag.

The procedure for using the self-help device is illustrated in Fig. 2. Participants were instructed to use the self-help device following the sequence A to F, as shown in Fig. 2. A, open the self-help device; B, remove the umbrella; C, open and use the umbrella; D, close the umbrella and retract the center pole; E, straighten the umbrella fabric and place it in the pocket; F, close the self-help device. Upon completing the task, participants rated their satisfaction, excluding service-related items, using the Quebec User Evaluation of Satisfaction with Assistive Technology 2.0 (QUEST 2.0) questionnaire, guided by prior research findings [6–8]. QUEST 2.0 is a survey-based questionnaire divided into welfare equipment and service items. The welfare equipment items consist of eight items. The ratings were on a five-point scale ranging from “not at all satisfied (1 point)” to “very satisfied (5 points),” with a comment section available for additional feedback. The questionnaire could be self-administered or completed with the assistance of an evaluator, preferably with the evaluator present, to ensure comprehension [6]. For this study, the occupational therapist who developed the self-help device was present to assist in filling out the form as necessary.

Analysis method

The number of participants per rating for each item

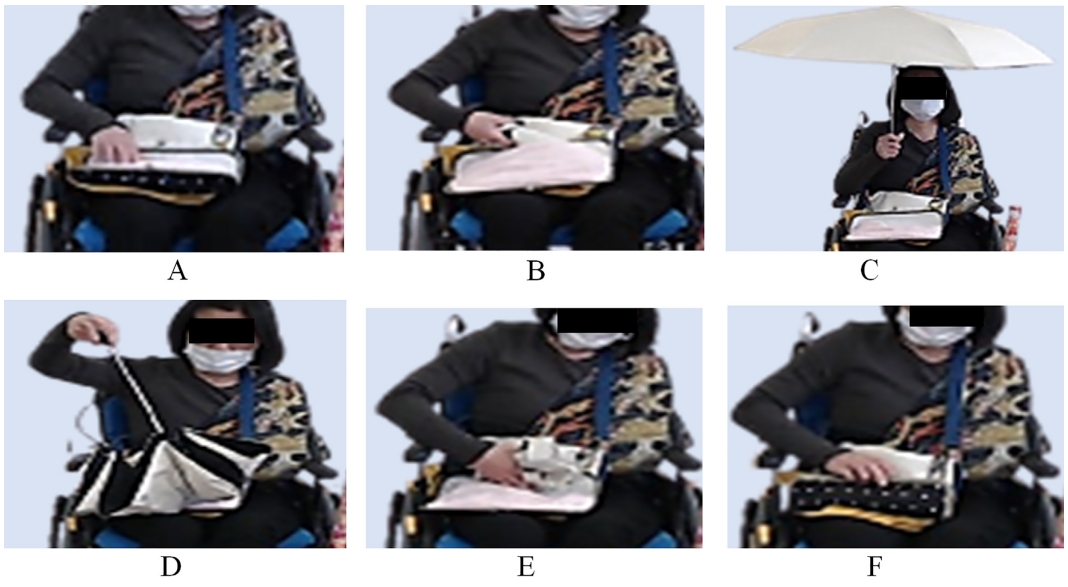

Fig. 2. Instructions for using the self-help device
A: open the self-help device, B: remove the umbrella, C: open and use the umbrella, D: close the umbrella and retract the center pole, E: straighten the umbrella fabric and place it in the pocket, and F: close the self-help device.

Table 1 Satisfaction evaluation

	5 points		4 points		3 points		2 points		1 points		Average score	SD
	Number of individuals	Score	Number of individuals	Score	Number of individuals	Score	Number of individuals	Score	Number of individuals	Score		
1. Size	15	75	10	40	7	21	0	0	0	0	4.3	±0.8
2. Weight	17	85	8	32	7	21	0	0	0	0	4.3	±0.8
3. Adjustability	14	70	9	36	8	24	1	2	0	0	4.1	±0.9
4. Safety	19	95	8	32	5	15	0	0	0	0	4.4	±0.7
5. Durability	11	55	6	24	14	42	1	2	0	0	3.8	±0.9
6. Ease of use	14	70	12	48	5	15	1	2	0	0	4.2	±0.8
7. Comfort of use	18	90	8	32	6	18	0	0	0	0	4.4	±0.8
8. Effectiveness	16	80	11	44	5	15	0	0	0	0	4.3	±0.7

The number of individuals and scores corresponding to the ratings for each item, the average score and standard deviation.

was recorded for the satisfaction evaluation. Subsequently, scores, average scores, and standard deviations were calculated. Similar comments were grouped. The motion method was analyzed using video images.

Results

All participants successfully used the device. Satisfaction ratings are shown in Table 1. The item with the lowest mean score was 3.8 ± 0.9, whereas those with the highest mean scores were 4.4 ± 0.7 and 4.4 ± 0.8. The feedback indicated general satisfaction; however, some concerns were noted, such as difficulties closing the clasp, potential pocket deterioration, and clasp durability.

Figure 3 illustrates examples of the motion of participants while using the device. Most participants who pressed down on the pocket while closing the clasp could do so smoothly without the pocket getting caught. However, participants who did not press down often had the pocket caught in the clasp, preventing it from closing completely. They had to either readjust the pocket or force the clasp closed despite the obstruction.

Discussion

The mean score on the QUEST 2.0 is an important indicator of user satisfaction or dissatisfaction with self-help devices. A mean score of 1 (or approximately 1) indicates “not at all satisfied,” 2 (or approximately 2) indicates “not very satisfied,” 3 (or approximately 3) indicates “somewhat satisfied,” 4 (or approximately 4) indicates “satisfied,” 5 (or approximately 5) indicates “very satisfied” [6]. As shown in Table 1, the lowest average score is 3.8 ± 0.9, suggesting high satisfaction

Fig. 3. Motion examples
The upper image shows the motion of a person closing the clasp while holding their pocket; the lower image shows the motion of a person closing the pocket without holding it. In the former, the clasp can be closed without the pocket getting caught. In the latter, the pocket may get pinched, making it difficult to close.

with the self-help devices. Nonetheless, participants provided constructive feedback highlighting areas for potential improvements. The pocket of the device, made from microfiber towel material, offers flexibility and elasticity, characteristics that differ notably from regular yarns [9]. Feedback and Figure 3 indicated that successful closure of the clasp depended on whether participants held the pocket with their fingers. Thus, by teaching proper techniques for closing the clasp, the characteristics of microfibers can be managed, potentially preventing retries.

Limitations and future directions

This study focused on patients with hemiplegia resulting from cerebrovascular disease who did not have severe sensory impairments or comprehension difficulties. Therefore, the level of satisfaction with the self-help device under different conditions remains unknown. Future research could focus on teaching the correct technique for closing the clasp rather than focusing solely on further device modifications.

Summary and conclusions

We developed a self-help device that enables users to store a folding umbrella in its cover with one hand and assessed its practicality. Analysis using QUEST 2.0 and motion images revealed that all participants successfully used the device. The high mean scores indicate a high level of user satisfaction. Although participants provided constructive feedback for improvement, practical application appears achievable by teaching the correct technique for closing the clasp.

Conflict of interest

There are no conflicts of interest to declare.

Acknowledgments

I sincerely thank all the participants in this study.

References

[1] 2kaku-me [online]. Tokyo: How to fold an umbrella using a paralyzed hand [cited 2024 May 27]. Available from: http://www.nikakume.com/.
[2] Lee K, Serikawa S, Kitazono Y. Development of automatic umbrella rolling system (in Japanese). Proceedings of IIAE Annual Conference 2018. 2018; doi:10.12792/iiae2018.016:29-30.
[3] Gowland C, Stratford P, Ward M, Moreland J, Torresin W, Van Hullenaar S, et al. Measuring physical impairment and disability with the Chedoke-McMaster Stroke Assessment. Stroke. 1993; 24(1): 58–63.
[4] Enishi K, Abe M, Ogata H. Trunk dysfunction and walking ability in hemiplegic patients (in Japanese). Journal of Physical Therapy. 1996; 30(11): 821–6.
[5] Hasegawa K, Katou S. Manual for the Revised Hasegawa Dementia Rating Scale (in Japanese). Tokyo: Chuohoki Publishers Inc; 2020.
[6] Louise D, Rhode W, Bernadette S. Quebec User Evaluation of Satisfaction with Assistive Technology Ver.2.0 (in Japanese): Inoue T, Kamimura T, translator. Okayama: Daigakukyouiku Publishers Inc; 2008.
[7] Nagata Y, Fujita D, Kobara K. Investigation of a survey on the degree of satisfaction and consideration of necessary components of the seating system for children with severe motor and intellectual disabilities at home (in Japanese). Kawasaki Journal of Medical Welfare. 2019; 29(1): 119–25.
[8] Hayashi S, Tanaka H, Hamanaka N. A study on the construction of a field-oriented 3D Platform for self-help tools through model evaluation (in Japanese). Human Interface. 2022; 24(1): 15–24.
[9] Kawada T. Progress in fiber technology for ultrafine fibers —New paradigm toward high performance membrane (in Japanese). Japanese Journal of Polymer Science and Technology. 1995; 44(10): 662–5.

■ORIGINAL ARTICLE

Self-Organized Social Network Service (Peer-to-Peer Support) for Individuals with Schizophrenia: Potential for Social Participation

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Abstract:
Background: Individuals with severe mental disorders are increasingly using social media platforms to discuss their illnesses, seek advice, and support each other. This phenomenon is known as online peer-to-peer support.
Objective: This study aimed to identify the characteristics of online peer-to-peer support in Japan.
Methodology: Data were collected through semi-structured interviews and blog posts.
Results: Inductive thematic analysis revealed three themes: (1) expanding online networks of mutual support as self-organization progresses; (2) cultivating a positive self-identity for individuals with schizophrenia; and (3) taking steps toward social participation and inclusion.
Conclusion: Despite concerns regarding the risks of online communities, self-organized online peer-to-peer support groups promote social participation rather than isolation. However, this result cannot be generalized to all online communities because its quality is influenced by peer support structures and environments. Self-organized online peer-to-peer support groups with a flexible and receptive organizational culture effectively promote social participation. Our results suggest that online interactions that foster positive self-identity may be a prelude to offline social affiliations. In this study, individuals living with schizophrenia who communicated online were provided with a foundation that enabled them to take steps toward engaging in offline social participation. However, a sustainable management system is required. Hence, peer partnership services, in which the service is provided by peers, but its operation is conducted in collaboration with professionals, should be considered.

Keywords: social networking service, peer-to-peer support, schizophrenia, social participation, Japan

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1. Introduction

Individuals with serious mental illnesses, such as schizophrenia, are highly susceptible to loneliness. These individuals commonly encounter socio-environmental challenges, including poverty, limited employment opportunities, and low marriage rates [1], resulting in limited community integration [2]. Loneliness is a significant contributor to diminished quality of life in individuals with schizophrenia [3, 4], necessitating urgent attention.

Previous studies have indicated a growing trend among individuals with severe mental disorders of employing social media platforms to openly discuss their illness experiences, seek advice, and provide mutual support [5, 6]. These platforms allow individuals to share, co-create, and exchange digital content, including information, messages, photos, and videos [7]. Self-formed online communities provide peer-to-peer support by sharing similar experiences of living with mental illnesses [8]. Previous qualitative studies have shown that popular social media platforms can help individuals with serious mental illnesses by alleviating isolation, fostering hope, providing support, enabling the sharing of personal stories, and offering coping strategies for

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daily life challenges [9]. Additionally, online networks among individuals with serious mental illness produce similar psychological effects as offline groups, including emotional, informational, networking, self-esteem, and, to a lesser extent, tangible benefits [10–12]. However, online peer-to-peer support has potential risks, such as individuals developing a dependency on online relationships [13, 14], which may hinder offline communication [15]. Furthermore, online networks may increase social withdrawal and avoidance behaviors [16].

Nevertheless, the trend of utilizing online peer-to-peer support is growing for the following reasons: Many individuals with serious mental illnesses encounter challenges in face-to-face communication due to cognitive and social impairments [17]. Social media platforms allow individuals to determine the extent of their interactions, circumventing challenges associated with interpersonal skill deficits, such as the interpretation of social cues or non-verbal communication [18, 19]. Users can choose whether they actively create content, disclose personal health information, post comments, or passively view content posted by others [6]. Furthermore, the Internet allows for relative anonymity, providing a space for individuals to express themselves without fear of disapproval or the consequences of making mistakes [20]. It is also characterized by text-based communication that does not require immediate responses, allowing individuals to express their thoughts and feelings at their own pace. These characteristics make the online environment a better place for those with schizophrenia to connect than offline social interactions.

Alvarez-Jimenez et al. [21] argued that combining online peer-to-peer support and online psychoeducation could increase employment and return-to-school rates while decreasing emergency room use. However, these interventions were primarily implemented through online environments developed specifically for research, which might lack the norms, dynamics, atmosphere, and user characteristics of spontaneously formed online communities [16]. This makes it difficult to extrapolate the results to naturally occurring online communities.

In Japan, spontaneous online communities are also being formed via social networking services (SNS). However, the characteristics of these communities in Japan have not yet been clarified. In response to this gap in the literature, this study aimed to understand the characteristics of self-organized online peer-to-peer support in Japan. We believe that the findings will inform considerations of how to therapeutically apply such support.

2. Methods

2.1. Methodology

A narrative approach was adopted to explore the individual and social impacts of online peer-to-peer support, involving inquiries directed at human experience narratives and those that produce data in a narrative form [22]. Examples of inquiries include interviews designed to elicit personal stories, oral histories, and written autobiographies and biographies [22]. This study's narrative approach provided a deeper understanding of the individual and social influences of online peer-to-peer support.

Ethical approval for this study was obtained from The Seirei Christopher University Ethical Committee (21-002). All ethical standards laid out in the Declaration of Helsinki were followed. All participants provided written informed consent before participation.

2.2. Participants

Participants were recruited through snowball sampling [23]. The inclusion criteria were as follows: individuals who (1) had schizophrenia, (2) managed their own SNS accounts dedicated to online peer-to-peer support, and (3) were Japanese speakers. This study focused on administrators who provided online peer-to-peer support because they (1) possess an in-depth understanding of online peer-to-peer support activities and (2) can represent the views and experiences of members engaging in online peer-to-peer support. This study initially intended to recruit 6–8 participants for the qualitative analysis; however, only two participants were recruited. Consequently, additional evidential sources were used to obtain a contextual understanding of the phenomenon, including publicly available blog posts written by participants. These were used because archival material, including past blog posts, can reveal information about the target population and the trajectory of views within the population [24].

The first participant (Participant A) was identified through the lead author's network and provided online peer-to-peer support via SNS. This participant introduced the second participant (Participant B).

Participant A was a woman in her 50s with schizophrenia; she used Facebook and a blog to document her daily life. For approximately three years, she offered one-on-one online peer-to-peer support to individuals with mental illnesses who followed her on SNSs through a closed messaging application (LINE). Through her three years of practice, she recognized the benefits of supporting recovery as well as the limitations resulting from the time required and the related financial and mental burdens.

Participant B was a man in his 40s who had managed an online patient community for individuals with schizophrenia for approximately ten years. He regularly shared information on X and his blog about the online patient community and invited individuals who shared their views to become members. This community also operated through LINE which allows members to choose from over 40 subgroups based on their interests. The subgroups are broadly categorized into topics such as illness, relaxation, self-management, romance, career development, and hobbies. Participant B established minimal rules to prevent member-related issues.

2.3. Data collection

Data were collected through semi-structured interviews. The first author conducted the interviews in a private online setting using Zoom between August and September 2021. She has more than ten years of experience as an occupational therapist in the psychiatric field and extensive experience in academic article writing in qualitative research.

The interviews lasted 90 and 120 minutes for Participants A and B, respectively. They were transcribed in a stenographic format in real-time using the Notta Web application, which converts audio to text in real-time, and revised verbatim by the first author shortly after the interviews.

To focus on online peer-to-peer support via SNS and related issues, an interview guide comprising the following open-ended questions was independently prepared by the first author:

- "What inspired you to start offering peer support?"
- "What motivated you to start sharing information and engaging on SNSs?"
- "What type of peer support did you provide on SNSs?"
- "What needs do you envision for peer support on SNSs?"
- "What challenges have you encountered concerning peer support on SNSs?"
- "What are the effects of peer support on SNSs?"

Additional questions were addressed via e-mail and phone after the interviews.

As mentioned, blog posts specified by the participants were used in the analysis. To reinforce the participants' views, we searched for and used blog posts posted between January 2018 and September 2021 that explained the content of the participants' narratives in more detail.

Data collection was conducted in Japanese; all interviews and phone calls were transcribed verbatim for analysis. The analysis was then conducted in Japanese. The participant narratives quoted in this article should ideally be presented in both English and Japanese. However, only the English version is shown. To avoid losing meaning in the translation process, the following steps were taken [25]: First, the Japanese text to be quoted was extracted. Next, the first author translated it from Japanese into English. Subsequently, a professional translator proficient in both Japanese and English performed back-translations from English to Japanese, and the lead author compared the back-translations with the original transcripts to ensure accuracy.

2.4. Data analysis

Following Braun and Clarke [26], a thematic analysis was conducted to identify recurring patterns in the interviews. An inductive approach was adopted to systematically code and categorize the data into extract themes from the text [26]. Using an ethnographic stance, different data formats, such as blog spots, emails, and interviews, were analyzed to understand the complex themes of online peer-to-peer support. All data were coded and analyzed in the same way as the interview data [24].

The analysis was conducted as follows: First, verbatim transcripts of interviews and phone calls, as well as blog posts and emails, were reread to fully understand the narratives. Second, the data were systematically coded across the dataset, and the data associated with each code were collated. Subsequently, the codes were aggregated into potential themes, and all data related to each potential theme were collected. Third, the themes were examined in relation to the coded extracts and the dataset as a whole. Finally, the story conveyed through the details and analysis of each theme was refined, and each theme was defined and named. NVivo 14, a qualitative data analysis software, was used. To ensure accuracy and credibility, the second author, a peer-support researcher, reviewed the codes, categories, and themes after the participants reviewed the analysis results.

3. Results

Three key themes emerged regarding the experience of engaging in online peer-to-peer support: (1) Expanding online networks of mutual support as self-organization progresses (2) Cultivating a positive self-identity for individuals with schizophrenia and (3) Taking steps toward social participation and inclusion (Table 1).

3.1. Expanding online networks of mutual support as self-organization progresses

Both participants emphasized the significance of online peer-to-peer support on SNSs, characterized as anonymous, text-based communication.

Table 1 Themes and definitions

	Theme	Definition
1	Expanding online networks of mutual support as self-organization progresses	As online peer-to-peer support, specifically designed for individuals with schizophrenia, self-organized meaningful online social networks expand to promote mutual self-help.
2	Cultivating a positive self-identity as individuals with schizophrenia	Through online peer-to-peer support, which enables individuals to utilize their experiences with schizophrenia to the benefit of others in similar circumstances, dispel internal prejudices concerning schizophrenia and foster a positive self-identity.
3	Taking steps toward social participation and inclusion	Participants not only enjoy leisure activities, find hope, and become aware of their role in society but also begin to proactively take action to reduce prejudice against individuals with mental illness toward achieving social inclusion.

The Internet is saturated with exaggerated information, portraying the negative aspects of schizophrenia, including statements such as "schizophrenia is an incurable disease" and "we are moving toward despair." Participant B explained that several members exposed to such information felt helpless and dejected. Participant A shared that exaggerated negative information led to members limiting their possibilities and sacrificing their goals because of the negative identities they developed as individuals with schizophrenia, inducing them to adopt the "miserable patient" role. She described her sentiments when she found herself in a similar situation:

> Before I learned about peer support, I was living a reclusive life in my room. Even though I wished I could live my life without problems, I felt frustrated. I thought, "I have to do something." (Participant A)

Participant B explained that while there were some online peer-to-peer support spaces for individuals experiencing mental health problems in Japan, only a few groups were dedicated solely to those living with schizophrenia. Both participants emphasized the importance of online peer-to-peer support specifically designed for individuals with schizophrenia and their families, given that those without direct experience in managing schizophrenia find it difficult to understand the associated concerns. They highlighted the need to leverage their experiences positively, as exemplified below:

> When I began writing my blog, schizophrenia was often viewed as an incurable and untreatable disease. Many of the blogs I read reflected sentiments of "I am moving toward despair." I disliked that. Thus, I approached my blog with a very positive perspective, such as the notion that the more I grappled with schizophrenia, the better I became at coping, making it easier. (Participant B)

According to Participant B, during the initial stages of online peer-to-peer support, members relied on administrators to resolve issues within the group. However, as the group became more self-organized, each member voluntarily assumed the role of a peer-support worker. The group became interdependent, with members empathizing with those who shared their problems and offering advice based on their personal experiences. The following quote illustrates the supportive dynamics among members:

> Some individuals who joined the group stopped attending their counseling sessions. I can empathize with them in ways that other counselors cannot, and as someone who has had similar experiences, the advice I provide is more relevant than that from someone who has not undergone the same experiences. This is akin to an open dialogue for recovery through conversation. (Participant B)

We found that online peer-to-peer support allows for open discussions because individuals can post anonymously using screen names. According to Participant B, members satisfied their need to be heard without being in denial. Both participants appreciated their ability to connect with others who experienced similar difficulties. Additionally, online peer-to-peer support engagement was found to help prevent mental health deterioration. For example, when a member experienced a relapse, others who detected it at an early stage offered guidance on sleep and medication. The following quote discusses the results of a meaningful social network expanded through online peer-to-peer support:

> With the hope that schizophrenia can be successfully managed, I believe there are more individuals here who are inclined to progress, compared with other SNSs. Because it is an intimate group, someone is often connected to the group throughout the day [via telephone], and their presence helps alleviate feelings of loneliness, making it bearable to navigate situations on our own. Some individuals had never interacted with anyone before joining

> the group. This group enables them to connect with other like-minded individuals; just this feeling can help alleviate their symptoms. (Participant B)

With the development of online patient communities, members shifted their focus to helping each other. Although self-organized online peer-to-peer support did not offer tangible rewards, the sense of being useful enhanced individuals' sense of belonging to a community and reduced their feelings of isolation. This provided an opportunity to reaffirm the significance of their existence.

3.2. Cultivating a positive self-identity for individuals with schizophrenia

Online peer-to-peer support dispelled inner prejudices regarding schizophrenia and cultivated a positive identity for living with schizophrenia. Participant A revealed that her family and professionals did not fully understand the extreme symptoms of schizophrenia and that she struggled because they falsely equated resting with laziness. She hoped that professionals would take a more holistic approach to her lifestyle and emotional well-being and support her in maximizing her potential. However, professionals primarily inquired about symptom control, such as medication adherence, sleep patterns, and potential side effects of medication. This focus on her condition shaped her identity as a person with schizophrenia, compelling her to deny her true self and adopt the role of a "miserable patient." Participant A expressed regret over perpetuating negative stereotypes about herself:

> I tend to dwell on what others think of me. As a welfare recipient, I sometimes restrict myself to avoid drawing attention, thinking "I shouldn't dress up" or "I shouldn't indulge in good food," and I refrain from openly expressing myself. (Participant A)

However, Participant A was surprised by the reactions when she shared her experience at a meeting for family caregivers (i.e., relatives and close friends who support a loved one with schizophrenia). She was told that hearing about her experiences with schizophrenia was a great learning experience and asked for advice regarding patients with schizophrenia. She stated:

> I received substantial appreciation for talking about my experiences and was told by professionals that they had learned a lot, making me realize the value of my experiences. Sometimes, I think patients' voices do not reach healthcare professionals. Therefore, I believe patients must articulate in their own words the anguish caused by their mental symptoms and the hardships of living with a mental illness. (Participant A)

Similarly, Participant B noted that mutual support and learning through online peer-to-peer support offered an opportunity to dispel inner prejudices regarding schizophrenia:

> Many individuals continue to work despite grappling with schizophrenia; they are doing their best and do not want to give up because of their illness. Witnessing such individuals motivates me to push myself. Many people in my group share this sentiment and have adopted a positive and forward-looking outlook. Perhaps we, ourselves, possess a more pessimistic outlook toward the disease than the world's preconceived notions about people with schizophrenia. (Participant B)

The discovery that the participants' narratives of living with schizophrenia can be positive and that they were actively participating in society despite their conditions, helped them construct new identities. Through online peer-to-peer support, the participants' social connections expanded, making them realize that schizophrenia was not solely a source of despair; it could also be a wellspring of hope.

3.3. Taking steps toward social participation and inclusion

Online peer-to-peer support paved the way for regular off-site face-to-face meetings with local participants, which provided members with opportunities to combat physical loneliness, raise their spirits, and cultivate enthusiasm for future activities. Before joining peer-to-peer support groups, some members spent substantial time at home following monotonous routines. Off-site meetings allowed them to engage in activities beyond hospital visits, enriching their lives and reinforcing their sense of belonging. Participant B described these off-site meetings' significance:

> Before COVID-19, particularly in the Tokyo area, our group members frequently engaged in activities like karaoke sessions and shared meals. It was common to hear expressions like "I made a friend" or "I made a weekly drinking buddy." I also looked forward to off-site meetings whenever I traveled for work. (Participant B)

Reflecting on her own experiences, Participant A recognized that her knowledge and skills as a peer-

support worker were limited. Consequently, she pursued certification as a professional peer-support worker. According to Participant B, some members aspired to become professional peer-support workers to utilize their experiences of schizophrenia. Engaging in online peer-to-peer support clarified their ideal self-image, with social interaction becoming a vital step toward realizing that vision and marking their progress toward social participation.

> Peer activities, which support my experiences, are most beneficial when initiated by those directly involved. I have set a life goal to acquire extensive knowledge, including participating in peer support workshops and studying mental health conditions. (Participant A)

As online peer-to-peer communities became self-organized, their focus expanded to encompass more socially meaningful activities, such as volunteer cleanups and signature campaigns, to reduce societal prejudice against individuals with mental disabilities. Participant B's passion extended beyond improving mental health and quality of life; he envisioned implementing national policies aimed at fostering social inclusion.

> We submitted the collected signatures to the Ministry of Education, Culture, Sports, Science and Technology. If the petition drive succeeds and mental illness is incorporated into compulsory education, it could impact tens of millions of people within my lifetime. (Participant B)

Participant A discussed the future of online peer-to-peer support:

> Peer support on SNSs is an effective avenue for making connections. Although it is often considered an outlet for emotions, it would be good to see it evolving into a more productive environment. (Participant A)

> Rather than licking each other's wounds, I wanted to convey to people that they can live with greater self-confidence and engage more with local people. (Participant A)

Both participants envisioned the future development of online peer-to-peer support. However, self-organized online communities require time to grow. Participant A recognized the effectiveness and importance of online peer-to-peer support but discontinued its operation owing to time and cost constraints. Participant B emphasized the risk that if the administrator were to suddenly die, then the online community would close down, leaving some people to experience loneliness online. Therefore, he recognized the need for a sustainable management system for stable operations.

4. Discussion

4.1. Effectiveness of self-organized online peer-to-peer support

This study examined the characteristics of online peer-to-peer support in Japan. The findings offer new insights into the potential of online peer-to-peer support for promoting social participation.

Previous studies have identified online forums that support or promote self-harm and other unhealthy or destructive behaviors [8]. Tragically, in 2017, nine young individuals in Japan who posted suicidal thoughts on SNSs were lured and murdered by a malicious criminal, who implied that he could help his victims die by suicide or even die alongside them [27]. This incident highlighted the risks of Internet interaction, leading to personal recommendations by patients' families and psychiatrists to refrain from using SNSs in Japan. The present study's findings in "taking steps toward social participation and inclusion" provide an important counter-perspective, demonstrating that active participation in self-organized online peer-to-peer support groups can foster social participation and combat, rather than exacerbate, isolation.

However, the results cannot be generalized to all types of online peer-to-peer support because the structure and environment in which peer support is implemented influences its quality [28]. Our results in "expanding online networks of mutual support as self-organization progresses" indicate that online peer-to-peer support tailored for individuals with schizophrenia operates in a nurturing environment where participants learn from and support each other. Additionally, as online peer-to-peer support become more self-organized, it can operate in culturally and personally positive ways, with participants focusing on their strengths and talents and the difficulties they face. A flexible and receptive organizational culture can be a facilitator of peer support [29]. This organizational climate may have helped participants "foster a positive self-identity as individuals with schizophrenia" and enabled them to "take steps toward social participation and inclusion."

4.2. Structural features that make online peer-to-peer support effective

Our results in "Cultivating a positive self-identity for individuals with schizophrenia" suggest that online interactions could be a prelude to offline social affilia-

tion. As individuals with severe mental illnesses become more adept at managing their illnesses, they begin to explore avenues for broader social affiliations beyond the family unit [30]. For individuals concerned about being rejected owing to their illness and worried about others' reactions [31], exploring avenues of offline social affiliation is a significant challenge.

Authentically participating in an online network and knowing that others share similar fears, frustrations, and symptoms can foster a sense of belonging and alleviate feelings of isolation [32, 33]. In addition to discussing life challenges, sharing positive recovery stories strengthens feelings of empowerment, positive self-identity, and pride among members [34]. In other words, through participation in self-organized online peer-to-peer support, participants can "foster a positive self-identity as individuals living with schizophrenia." This positive self-identity can be a foundation that enables participants to take "steps towards offline social participation and social inclusion."

4.3. The role that occupational therapists play in peer-to-peer support

This study's results in "taking steps toward social participation and inclusion" indicate that online peer-to-peer support alone can be an effective intervention strategy for social participation. Nevertheless, several issues must be resolved before it can be redesigned as an intervention strategy for stable social participation. First, a sustainable management system is required. One approach is shifting to peer partnership services, where the service is provided by the peers involved, while the operational management is conducted in collaboration with professionals, including occupational therapists. Co-production between peers and professionals distributes the significant burden placed on peers and allows the value of each participant to be supported in an integrated manner [35], enabling occupational therapists to indirectly support social participation.

4.4. Limitations

This study has some limitations. The first is its small sample size and data collection from only two participants. Furthermore, we only interviewed site administrators, placing their perspective at the center of our analysis. Since their perspective is subjective, they could have overemphasized the effectiveness of online peer support. Future studies should include a wider range of participants to provide more insights into the characteristics and complexities of self-organized online peer-to-peer support groups.

Disclosure statement

The authors declare no conflicts of interest.

References

[1] Marwaha S, Johnson S. Schizophrenia and employment - a review. Soc Psychiatry Psychiatr Epidemiol. 2004; 39(5): 337–49, doi:10.1007/s00127-004-0762-4.

[2] Eglit GML, Palmer BW, Martin AS, Tu X, Jeste DV. Loneliness in schizophrenia: construct clarification, measurement, and clinical relevance. PLoS One. 2018; 13(3): e0194021, doi:10.1371/journal.pone.0194021.

[3] Roe D, Mashiach-Eizenberg M, Lysaker PH. The relation between objective and subjective domains of recovery among persons with schizophrenia-related disorders. Schizophr Res. 2011; 131(1–3): 133–8, doi:10.1016/j.schres.2011.05.023.

[4] Weiner A, Roe D, Mashiach-Eizenberg M, Baloush-Kleinman V, Maoz H, Yanos PT. Housing model for persons with serious mental illness moderates the relation between loneliness and quality of life. Community Ment Health J. 2010; 46(4): 389–97, doi:10.1007/s10597-009-9279-3.

[5] Miller BJ, Stewart A, Schrimsher J, Peeples D, Buckley PF. How connected are people with schizophrenia? Cell phone, computer, email, and social media use. Psychiatry Res. 2015; 225(3): 458–63, doi:10.1016/j.psychres.2014.11.067.

[6] Naslund JA, Aschbrenner KA, Marsch LA, Bartels SJ. The future of mental health care: peer-to-peer support and social media. Epidemiol Psychiatr Sci. 2016; 25(2): 113–22, doi:10.1017/S2045796015001067.

[7] Ahmed YA, Ahmad MN, Ahmad N, Zakaria NH. Social media for knowledge-sharing: a systematic literature review. Telemat Inform. 2019; 37: 72–112, doi:10.1016/j.tele.2018.01.015.

[8] Ziebland S, Wyke S. Health and illness in a connected world: how might sharing experiences on the internet affect people's health? Milbank Q. 2012; 90(2): 219–49, doi:10.1111/j.1468-0009.2012.00662.x.

[9] Naslund JA, Grande SW, Aschbrenner KA, Elwyn G. Naturally occurring peer support through social media: the experiences of individuals with severe mental illness using YouTube. PLoS ONE. 2014; 9(10): e110171, doi:10.1371/journal.pone.0110171.

[10] Braithwaite DO, Waldron VR, Finn J. Communication of social support in computer-mediated groups for people with disabilities. Health Commun. 1999; 11(2): 123–51, doi:10.1207/s15327027hc1102_2.

[11] Coursaris CK, Liu M. An analysis of social support exchanges in online HIV/AIDS self-help groups. Comput Hum Behav. 2009; 25(4): 911–8, doi:10.1016/j.chb.2009.03.006.

[12] McCormack A. Individuals with eating disorders and the use of online support groups as a form of social support. Comput Inform Nurs. 2010; 28(1): 12–9, doi:10.1097/

NCN.0b013e3181c04b06.
[13] Caplan SE. Preference for online social interaction: a theory of problematic Internet use and psychosocial well-being. Commun Res. 2003; 30(6): 625–48, doi:10.1177/0093650203257842.
[14] Chung JE. Social interaction in online support groups: preference for online social interaction over offline social interaction. Comput Hum Behav. 2013; 29(4): 1408–14, doi:10.1016/j.chb.2013.01.019.
[15] Crabtree JW, Haslam SA, Postmes T, Haslam C. Mental health support groups, stigma, and self-esteem: positive and negative implications of group identification. J Soc Issues. 2010; 66(3): 553–69, doi:10.1111/j.1540-4560.2010.01662.x.
[16] Lawlor A, Kirakowski J. Online support groups for mental health: a space for challenging self-stigma or a means of social avoidance? Comput Hum Behav. 2014; 32: 152–61, doi:10.1016/j.chb.2013.11.015.
[17] Dickerson FB, Sommerville J, Origoni AE, Ringel NB, Parente F. Outpatients with schizophrenia and bipolar I disorder: do they differ in their cognitive and social functioning? Psychiatry Res. 2001; 102(1): 21–7, doi:10.1016/s0165-1781(01)00247-5.
[18] Highton-Williamson E, Priebe S, Giacco D. Online social networking in people with psychosis: a systematic review. Int J Soc Psychiatry. 2015; 61(1): 92–101, doi:10.1177/0020764014556392.
[19] Mittal VA, Tessner KD, Walker EF. Elevated social Internet use and schizotypal personality disorder in adolescents. Schizophr Res. 2007; 94(1–3): 50–7, doi:10.1016/j.schres.2007.04.009.
[20] Berger M, Wagner TH, Baker LC. Internet use and stigmatized illness. Soc Sci Med. 2005; 61(8): 1821–7, doi:10.1016/j.socscimed.2005.03.025.
[21] Alvarez-Jimenez M, Koval P, Schmaal L, Bendall S, O'Sullivan S, Cagliarini D et al. The Horyzons project: a randomized controlled trial of a novel online social therapy to maintain treatment effects from specialist first-episode psychosis services. World Psychiatry. 2021; 20(2): 233–43, doi:10.1002/wps.20858.
[22] Hoshmand LT. Narratology, cultural psychology, and counseling research. J Couns Psychol. 2005; 52(2): 178–86, doi:10.1037/0022-0167.52.2.178.
[23] Naderifar M, Goli H, Ghaljaie F. Snowball sampling: a purposeful method of sampling in qualitative research. Strides Dev Med Educ. 2017; 14: e67670, doi:10.5812/sdme.67670.
[24] Holloway I, Wheeler S. Qualitative Research in Nursing, 2nd ed. Oxford: Blackwell Science; 2002.
[25] Van Nes F, Abma T, Jonsson H, Deeg D. Language differences in qualitative research: is meaning lost in translation? Eur J Ageing. 2010; 7(4): 313–6, doi:10.1007/s10433-010-0168-y.
[26] Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis: implications for conducting a qualitative descriptive study. Nurs Health Sci. 2013; 15(3): 398–405, doi:10.1111/nhs.12048.
[27] Ministry of Health, Labour and Welfare [online]. Status of suicide prevention for young adults – Counseling efforts via SNS [cited 2024 March 30] (in Japanese) e from: http://www.mhlw.go.jp/content/r1h-2-2.pdf.
[28] Lloyd-Evans B, Mayo-Wilson E, Harrison B, Istead H, Brown E, Pilling S, et al. A systematic review and meta-analysis of randomised controlled trials of peer support for people with severe mental illness. BMC Psychiatry. 2014; 14: 39, doi:10.1186/1471-244X-14-39.
[29] Mutschler C, Bellamy C, Davidson L, Lichtenstein S, Kidd S. Implementation of peer support in mental health services: a systematic review of the literature. Psychol Serv. 2022; 19(2): 360–74, doi:10.1037/ser0000531.
[30] Fox V. An exploration of social participation for young adults following a first psychotic episode. J Occup Sci. 2020; 27(1): 69–81, doi:10.1080/14427591.2019.1650803.
[31] Link BG, Struening EL, Rahav M, Phelan JC, Nuttbrock L. On stigma and its consequences: evidence from a longitudinal study of men with dual diagnoses of mental illness and substance abuse. J Health Soc Behav. 1997; 38(2): 177–90, doi:10.2307/2955424.
[32] Bargh JA, McKenna KYA, Fitzsimons GM. Can you see the real me? Activation and expression of the "true self" on the internet. J Soc Issues. 2002; 58(1): 33–48, doi:10.1111/1540-4560.00247.
[33] Harvey KJ, Brown B, Crawford P, Macfarlane A, McPherson A. 'Am I normal?' Teenagers, sexual health and the internet. Soc Sci Med. 2007; 65(4): 771–81, doi:10.1016/j.socscimed.2007.04.005.
[34] van Uden-Kraan CF, Drossaert CH, Taal E, Seydel ER, van de Laar MA. Participation in online patient support groups endorses patients' empowerment. Patient Educ Couns. 2009; 74(1): 61–9, doi:10.1016/j.pec.2008.07.044.
[35] Voorberg WH, Bekkers VJJM, Tummers LG. A systematic review of co-creation and co-production: embarking on the social innovation journey. Public Manag Rev. 2014; 17(9): 1333–57, doi:10.1080/14719037.2014.930505.

■ORIGINAL ARTICLE

Effect of Remote Exercise Interventions on the Risk of Incident Functional Disability Certification among Community-Dwelling Older Adults: Before-and-After Study

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Abstract: Objective: The Risk Assessment Scale for Incident Functional Disability (RFD) is used to predict the risk of future certification for incident long-term care and support. In this study, we used the RFD to clarify the effect of remote exercise on the functional decline risk of community-dwelling older adults.
Methods: The study population comprised 36 older adults who participated in an exercise class held at a local community center. After written informed consent was obtained, body composition and physical function were measured before the exercise intervention. Participants with a high- and low-risk of certified need for care and support were identified based on the RFD cutoff value (16/17 points). Interim and final follow-up assessments were conducted after the exercise intervention to compare the pre- and post-intervention changes in each measure.
Results: After the intervention, significant improvements were observed in the phase angle between the entire body and both arms ($p = 0.001$ and $p = 0.016$, respectively), handgrip strength ($p < 0.001$), walking speed ($p < 0.008$), and chair standing ($p < 0.001$). In the RFD, although age, a risk factor for needing care and support, increased significantly after the intervention ($p < 0.001$), the number of high-risk individuals did not increase ($p = 0.48$).
Conclusion: Remote exercise interventions for community-dwelling older individuals improves muscle quality and physical function and limits the functional decline risk as measured using the RFD.

Keywords: care prevention, remote exercise, functional decline risk, older adults, before-and-after-study

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1. Introduction

Japan's population is aging rapidly, and the increasing cost of long-term care is a serious issue [1, 2]. Therefore, there is a need to extend healthy life expectancy, which is the period during which a person does not require nursing care and can live without restrictions

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in daily life. Effective strategies for long-term care prevention are needed to extend the healthy life expectancy of community-dwelling older adults. Exercise interventions play a central role in this regard [3].

To verify the effectiveness of these strategies for preventing long-term care, it is desirable to analyze them in terms of reducing the risk of certification as requiring incident long-term care and support under the long-term care insurance system [4]. However, it is difficult to construct longitudinal data that track the certification of older people as requiring incident long-term care and support over a long period [4]. Therefore, in this study, we used the Risk Assessment Scale for Incident Functional Disability (RFD) [5], which is a proxy outcome for the certification of incident long-term care and support, to confirm the effect of exercise interventions on long-term care prevention. The predictive validity of RFD has been verified for the risk of incident long-term care and support in the future [5]. In light of the need to secure human resources for medical and welfare workers in the future, owing to Japan's declining population [6], we incorporated remotely delivered exercises that can efficiently reach a large number of participants. Previous studies have reported that remotely delivered exercises have the same effect as face-to-face exercise guidance [7]. Remote exercise interventions for older adults have been reported with outcomes such as joint range of motion, muscle strength, motor function, and quality of life [7]; however, to the best of our knowledge, there are no reports with indicators related to the effects of long-term care prevention as direct outcomes, such as RFD.

This study aimed to clarify the effects of remotely delivered exercises on long-term care prevention in community-dwelling older adults. To achieve this aim, we used the RFD to measure the risk of requiring support or care certification and compared the changes before and after remotely delivered exercises. This study may be an indicator for incorporating remotely delivered exercises into occupational therapy in the realm of long-term care prevention [8].

2. Methods

2-1. Participants

From 2022 to 2023, we publicly invited community-dwelling older adults in Sakai City and Katsuyama City, Fukui Prefecture, to participate in physical fitness measurement sessions and remote exercise classes. Recruitment was conducted through each local government's public relations magazine and website, and those interested in participating applied to each local government. Consequently, 196 older adults responded to the public call and each local government informed the participants about the physical fitness measurement session and remote exercise class. Of these participants, 40 individuals were selected who attended exercise classes for one year (Sakai City: October 2022 to November 2023; Katsuyama City: July 2022 to July 2023) and participated in all physical fitness measurement sessions (Sakai City: first time: October 2022, interim: May 2023, final: November 2023; Katsuyama City: first time: July 2022, interim: December 2022, final: November 2023). Previous reports suggest that exercise intervention may not achieve optimal effects with short-term (2–3 months) interventions [9]. Therefore, this study analyzed participants who participated in the exercise intervention for one year. The study aimed to test the effectiveness of a remote exercise intervention in long-term care prevention, and we excluded those who had already been certified as requiring incident long-term care and support (two participants) and those with missing measurement data (two participants). Finally, data from 36 participants were analyzed. With the approval of Sakai City and Katsuyama City, we explained in writing to all participants the benefits and risks of the exercise intervention and the medical response in the event of an accident and obtained written informed consent. This study was approved by the Medical Ethics Review Board of Fukui University (approval no. 20220048) and was conducted in compliance with the Declaration of Helsinki (revised in Fortaleza in 2013) and the Ethical Guidelines for Life Science and Medical Research Involving Human Subjects (Notification No. 1 of the Ministry of Education, Culture, Sports, Science and Technology, Ministry of Health, Labor and Welfare, Ministry of Economy, Trade and Industry on March 23, 2021).

2-2. Survey procedures, survey items, and exercise interventions

After obtaining written consent from all participants, body composition (height, weight, body mass index [BMI], skeletal muscle mass index [SMI], muscle mass, leg muscle score, estimated bone mass, basal metabolic rate, fat mass, body fat percentage, visceral fat level, total body muscle score, and phase angle) and physical function (handgrip strength, walking speed, chair standing, and single-leg stance) were measured as the initial assessment before the exercise intervention. Occupational therapists, physical therapists, clinical laboratory technicians, and other personnel with sufficient skills performed the measurements; administrative assistants, technical assistants, and student volunteers conducted measurements under the supervision of these medical professionals. Physicians and nurses also participated, and the risk of unforeseen circumstances such as poor physical condition was managed. The measurement ses-

Table 1 Question items and score table for the Risk Assessment Scale for Incident Functional Disability [5].

	Question Items	Answer	Score
Q1.	Can you go out by bus or train by yourself?	No	2
Q2.	Can you go shopping to buy daily necessities by yourself?	No	3
Q3.	Can you manage your own deposits and savings at the bank?	No	2
Q4.	Do you normally climb stairs without using the handrail or wall for support?	No	3
Q5.	Do you normally stand up from a chair without any aids?	No	2
Q6.	Do you normally walk continuously for 15 min?	No	1
Q7.	Have you experienced a fall in the past year?	Yes	2
Q8.	Are you very worried about falls?	Yes	2
Q9.	Body mass index < 18.5 kg/m^2	Yes	3
Q10.	Do you go out less frequently compared to last year?	Yes	3

Points are awarded for answering "no" to questions 1–6 and "yes" to questions 7–10. Age (65 years: 0 points, to ≥ 90 years: 24 points) and sex (1 point for males) were added to the total score for each item. A total score of 48 points was used for evaluation. Question items consisted of instrumental activities of daily living (Q1–3); physical function (Q4–8); nutritional status (Q9); and frequency of going out (Q10).

sions were conducted with approximately 3–33 people each time depending on the size of the venue. Body composition was measured using a multi-frequency 8-electrode body composition analyzer (MC-780A-N and MC-780A; TANITA Co., Ltd., Tokyo, Japan). Handgrip strength in both hands was measured using a Smedley handgrip dynamometer (TTM; Tsutsumi Seisakusyo Co., Ltd., Tokyo, Japan) to identify the maximum value for analysis. Walking speed (m/s) was measured using a stopwatch to determine the time (s) required for the fastest 5-m walk, and the maximum value of two measurements was used for the analysis. Considering acceleration and deceleration at the start and end of walking, a 3-m preliminary section was set aside before and after the 5-m measurement section, for a total of 11 m as the walking section. The chair standing test was performed five times, starting with the participant sitting in a chair with arms crossed in front of the chest, followed by standing with the trunk and both knee joints fully extended, and then quickly returning to the sitting posture. The time taken to complete the fifth sitting was recorded. For the analysis, the number of chair rises per second (count/s) was determined from the measured chair rise time. For the single-leg stance, the time taken to hold the posture in the open-eye single-leg stand position was measured twice using a stopwatch, with a cut off time of 120 s. The maximum values of the two measurements were used in the analysis. For the risk of certification of the need for care and support, based on the RFD cutoff value (16/17 points) [5], those with a score ≥ 17 were considered to be at high risk, and those with a score < 17 were considered to be at low risk (Table 1).

After initial assessment, an exercise intervention was conducted as part of the general care prevention program in each city. The intervention consisted of a one-hour exercise class held once a week, and the class involved a real-time, remotely delivered exercise course using Zoom (Zoom Communications, Inc). Participants gathered at a local community center where the Zoom broadcast was setup for viewing and received exercise guidance from a trainer (health fitness programmers) from a remote location via a screen monitor. One or two staff from the city sports association or community center prepared the venue, and were adequately equipped for any unforeseen circumstances. The content included stretching while sitting or standing, dual-task training (combined physical and cognitive exercise), muscle training, and coordinated movement, and was generally a low-intensity exercise of less than 3 metabolic equivalent of task (METs) [10, 11]. In addition, the participants were instructed in the same content as that taught in the exercise classes and encouraged to engage in self-training at home (this was voluntary, and the frequency of self-training by participants was unknown). Table 2 presents the details of the exercise program and self-training. At the venue, trainers and participants communicated via screen monitors, and the participants made small talk with each other before and after the exercises and during breaks. Interim and final follow-up assessments were conducted after the exercise intervention (same survey items as in the initial assessment) between initiation of training and after exercise intervention.

2-3. Statistical analysis

All statistical data were analyzed using EZR version 1.61 (Saitama Medical Center, Jichi Medical University) [12]. Body composition, exercise function, and age are shown as means ± standard deviations, the rate of participation in exercise classes is shown as the median (interquartile range), and responses to high- and low-risk participants and RFD are shown as the number of participants in each category. Friedman's test was used

Table 2 Exercise intervention program.

Exercise Program	Time	Contents	Posture	Body Region and Movement Details
Warm-Up	10 min	Stretching	Sitting	Neck - Flexion, extension, lateral flexion - Rotational movement
Main exercise	45 min	Stretching	Sitting	Upper limbs / trunk - Stretching the area around the shoulders and arms - Lateral flexion, rotational movement of the trunk Lower limbs - Stretching of the buttocks and hip joint area - Stretching of the hamstring - Stretching of the ankle
		Dual-task training	Sitting	Dual task of physical and cognitive exercise (e.g., changing the shape of the left and right hands alternately while keeping time to the rhythm, etc.)
		Muscle training Low-intensity	Sitting	- Exercise to strengthen handgrip (Repetitive flexion and extension of both fingers) - Knee extension
			Sitting or Standing	- Ankle joint plantar flexion and dorsal flexion - High knees run (in place) - Adduction and abduction of the hip joint
		Squats	Standing	- Squats while holding onto the back of a chair
		Coordination exercise	Sitting	- Exercises set to music
Cool-down	5 min	Stretching	Sitting	Neck - Flexion, extension, lateral flexion - Rotational movement
		Deep-Breath	Sitting	Deep-Breath
Home self-training	—	Perform the same exercise program as above at home (content and frequency are optional, excluding coordinated exercise).		

to compare continuous variables of body composition and physical function, before and after the exercise intervention. Multiple comparisons (Holm method) were performed when main effects were observed during the initial, intermediate, and final fitness measurement periods [13]. The Wilcoxon signed-rank test was used to compare age before and after the exercise intervention. For multiple comparisons of the time periods of physical fitness measurements and age before and after the exercise intervention, the r-value was calculated as the effect size (ES) [14]. McNemar's test was applied to the high- and low-risk groups in the RFD and to the responses to each question, as these were nominal variables. Significance was set at 5%.

3. Results

Of the 36 participants analyzed, 11 (30.6%) were male and 25 (69.4%) were female, with a mean age of 76.6 ± 6.3 years. Of the participants with chronic diseases, 16 (44.4%) had hypertension, six (16.7%) had diabetes, one (2.8%) had heart disease, eight (22.2%) had dyslipidemia, six (16.7%) had osteoporosis, and one (2.8%) had osteoarthritis. According to the sarcopenia diagnostic criteria of the Asian Working Group for Sarcopenia [15], two (2.8%) patients each had pre-sarcopenia and sarcopenia. Each measurement item, including its basic attributes, is listed in Table 3. The median (interquartile range) participation rate of the participants in the exercise classes over the year was 85.1% (76.6–92.0%).

Comparison of body composition before and after the exercise intervention showed a significant decrease in SMI and a significant increase in body fat percentage. Multiple comparisons revealed a significant decrease in SMI in the middle compared to the initial ($p = 0.030$, ES: 0.471). In addition, significant improvement was observed in the phase angle whole body and both arms, and multiple comparisons revealed significant improvement in the phase angle both arms at the final compared to the middle, and phase angle whole body at the final compared to either the initial or the middle ($p = 0.022$, ES: 0.442; $p = 0.006$, ES: 0.373; $p = 0.013$, ES: 0.570, respectively; Table 4).

Significant improvements in handgrip strength, walking speed, and chair standing were observed in the

Table 3 Basic participant characteristics.

Variable	Unit	Overall	Male	Female
		n = 36	*n* = 11	*n* = 25
Sex Male	n (%)	11 (30.6)	11 (100.0)	0 (0.0)
Female	n (%)	25 (69.4)	0 (0.0)	25 (100.0)
Age	years	76.6 ± 6.3	78.4 ± 3.5	75.8 ± 7.1
MMSE	points	27.9 ± 2.0	27.7 ± 2.6	28.0 ± 1.6
Morbidity				
Hypertension	n (%)	16 (44.4)	8 (72.7)	8 (32.0)
Diabetes	n (%)	6 (16.7)	3 (27.3)	3 (12.0)
Heart disease	n (%)	1 (2.8)	1 (9.1)	0 (0.0)
Dyslipidemia	n (%)	8 (22.2)	1 (9.1)	7 (28.0)
Osteoporosis	n (%)	6 (16.7)	0 (0.0)	6 (24.0)
Osteoarthritis	n (%)	1 (2.8)	0 (0.0)	1 (4.0)
Body composition				
Height	cm	155.3 ± 8.4	164.7 ± 6.7	151.2 ± 5.1
Weight	kg	53.6 ± 9.2	62.1 ± 7.0	49.8 ± 7.5
BMI	%	22.1 ± 2.8	22.9 ± 2.5	21.7 ± 2.9
SMI	kg/m^2	6.7 ± 0.8	7.6 ± 0.6	6.4 ± 0.5
MM	kg	36.8 ± 6.7	45.7 ± 3.7	32.9 ± 3.0
Leg muscle score	point	89.8 ± 8.4	85.3 ± 8.1	91.8 ± 7.8
Estimated bone mass	kg	2.0 ± 0.3	2.5 ± 0.2	1.8 ± 0.2
Basal metabolic rate	kcal	1085.1 ± 175.5	1292.7 ± 114.6	993.8 ± 104.9
FM	kg	14.6 ± 5.3	13.8 ± 5.3	15.0 ± 5.3
Body fat percentage	%	27.1 ± 7.1	21.8 ± 6.7	29.5 ± 6.0
Visceral fat level		6.9 ± 3.6	11.0 ± 3.0	5.2 ± 2.2
Whole body muscle score		−0.5 ± 1.0	−0.7 ± 0.7	−0.4 ± 1.1
PA Whole body	°	−4.6 ± 0.5	−4.8 ± 0.3	−4.5 ± 0.6
Both arms	°	−5.1 ± 0.5	−5.3 ± 0.4	−5.0 ± 0.5
Both legs	°	−4.1 ± 0.6	−4.2 ± 0.4	−4.1 ± 0.7
Physical function				
HG	kg	27.0 ± 5.4	32.4 ± 4.6	24.6 ± 3.9
GS	m/s	2.1 ± 0.4	2.2 ± 0.4	2.1 ± 0.4
CS	count/s	0.7 ± 0.1	0.6 ± 0.2	0.7 ± 0.1
SLS	s	65.8 ± 47.6	52.0 ± 40.1	71.8 ± 50.1
RFD				
High-risk patients (RFD score ≥ 17)	n (%)	18 (50.0)	7 (63.6)	11 (44.0)
Sarcopenia category				
Pre-sarcopenia*	n (%)	2 (5.6)	0 (0.0)	2 (8.0)
Sarcopenia†	n (%)	2 (5.6)	2 (18.2)	0 (0.0)

Values are presented as sex: number (%); age, body composition, and physical function: mean ± standard deviation; RFD: number of high-risk patients (%).

MMSE, mini-mental state examination; BMI, body mass index; SMI, skeletal muscle mass index; MM, muscle mass; FM, fat mass; PA, phase angle; HG, handgrip strength; GS, gait speed; CS, chair standing; SLS, single-leg stance; RFD, Risk Assessment Scales for Incident Functional Disability.

* Pre-sarcopenia was defined as SMI (male < 7.0 kg/m^2, female < 5.7 kg/m^2), with no decrease in muscle strength or physical performance [15].

† Sarcopenia was defined by an SMI (male < 7.0 kg/m^2, female < 5.7 kg/m^2), accompanied by a HG < 28 kg (male) or < 18 kg (female) or a GS < 1.0 m/sec, or both [15].

before-and-after comparison of physical function. Multiple comparisons revealed significant improvements in handgrip strength and walking speed in the middle or final stage compared with the first stage ($p < 0.001$, ES: −0.481; $p < 0.001$, ES: −0.668; $p < 0.001$, ES: −0.491; $p = 0.001$, ES: −0.363, respectively), and a significant improvement was observed in the final chair rise compared to the initial or intermediate rise ($p < 0.001$, ES: −0.550; $p < 0.001$, ES: −0.746, respectively). In contrast, a significant decrease was observed in one-legged standing, and multiple comparisons revealed a significant decrease in the final compared with the initial or intermediate ($p < 0.001$, ES: 0.491; $p = 0.018$, ES: 0.481, respectively; Table 4).

Table 4 Body composition and physical function comparison before and after exercise intervention.

Variable	Unit	Pre[a] $n = 36$	Middle[b] $n = 36$	Post[c] $n = 36$	*P*-value	a vs. b	a vs. c	b vs. c
						P-value, ES	P-value, ES	P-value, ES
Body composition								
Height	cm	155.3 ± 8.4	155.4 ± 8.3	155.3 ± 8.3	0.63	0.85, −0.138	0.85, −0.010	0.50, 0.128
Weight	kg	53.6 ± 9.2	53.9 ± 9.4	53.7 ± 9.7	0.23	0.37, −0.265	0.87, −0.059	0.37, 0.206
BMI	%	22.1 ± 2.8	22.1 ± 2.9	22.1 ± 3.1	0.75	0.39, −0.088	1.00, −0.118	1.00, −0.030
SMI	kg/m^2	6.7 ± 0.8	6.7 ± 0.7	6.7 ± 0.7	0.010*	0.030*, 0.471	0.38, 0.383	0.92, −0.088
MM	kg	36.8 ± 6.7	36.7 ± 6.6	36.5 ± 6.3	0.105	0.40, 0.216	0.20, 0.344	0.40, 0.128
Leg points	point	89.8 ± 8.4	89.6 ± 8.6	90.1 ± 9.5	0.73	0.73, 0.088	0.90, −0.030	0.90, −0.118
Estimated bone mass	kg	2.0 ± 0.3	2.0 ± 0.3	2.0 ± 0.3	0.32	0.76, 0.108	1.00, 0.187	1.00, 0.079
Basal metabolic rate	kcal	1085.1 ± 175.5	1083.3 ± 171.2	1076.4 ± 164.5	0.24	0.43, 0.108	0.21, 0.275	0.43, 0.167
FM	kg	14.6 ± 5.3	15.1 ± 5.5	15.1 ± 5.9	0.140	0.180, −0.255	0.190, −0.305	0.68, −0.049
Body fat percentage	%	27.1 ± 7.1	27.6 ± 7.2	27.7 ± 7.3	0.027*	0.22, −0.236	0.22, −0.442	0.56, −0.206
Visceral fat level		6.9 ± 3.6	7.1 ± 3.8	6.9 ± 3.9	0.70	1.00, −0.098	1.00, −0.079	1.00, 0.020
Whole body muscle score		−0.5 ± 1.0	−0.7 ± 1.0	−0.7 ± 1.2	0.088	0.044*, 0.216	0.190, 0.197	0.82, −0.020
PA Whole body	°	−4.6 ± 0.5	−4.6 ± 0.7	−5.0 ± 0.7	0.001*	0.37, −0.197	0.006*, 0.373	0.013*, 0.570
Both arms	°	−5.1 ± 0.5	−5.0 ± 0.7	−5.3 ± 0.6	0.016*	0.174, −0.295	0.062, 0.147	0.022*, 0.442
Both legs	°	−4.1 ± 0.6	−4.1 ± 0.6	−4.2 ± 0.6	0.105	0.39, 0.118	0.30, 0.324	0.49, 0.206
Physical function								
HG	kg	27.0 ± 5.4	29.0 ± 6.3	29.0 ± 6.7	< 0.001*	< 0.001*, −0.481	< 0.001*, −0.668	0.46, −0.187
GS	m/s	2.1 ± 0.4	2.3 ± 0.4	2.3 ± 0.4	0.008*	< 0.001*, −0.491	0.014*, −0.363	0.194, 0.128
CS	count/s	0.7 ± 0.1	0.7 ± 0.1	0.8 ± 0.2	< 0.001*	0.204, 0.197	< 0.001*, −0.550	< 0.001*, −0.746
SLS	s	65.8 ± 47.6	62.7 ± 47.5	46.0 ± 37.4	0.001*	0.914, 0.010	< 0.001*, 0.491	0.018*, 0.481

Values are presented as mean ± standard deviation.
Pre, before exercise intervention; Middle, midpoint of the exercise intervention period; Post, after exercise intervention; ES, effect size (r-value); BMI, body mass index; SMI, skeletal muscle mass index; MM, muscle mass; FM, fat mass; PA, phase angle; HG, handgrip strength; GS, gait speed; CS, chair standing; SLS, single-leg stance.
Criteria for ES: small effect size, r-value = 0.1; medium effect size, r-value = 0.3; and large effect size, r-value = 0.5.
* *P*-value < 0.05. Friedman test (multiple comparisons—Holm's method).

Pre- and post-RFD comparisons showed a significant increase in age, which was one of the indicators used for evaluation ($p < 0.001$, ES: 0.833). The number (percentage) of high-risk patients with RFD ≥ 17 decreased from 18 (50.0%) before the intervention to 16 (44.4%) after the intervention; however, this difference was not statistically significant ($p = 0.48$). The proportion of respondents to each question who indicated an increased risk did not differ significantly between the pre- and post-intervention periods but was maintained or reduced (Table 5).

4. Discussion

The subjects of this study were older adults aged ≥ 65 years (mean 76.6 ± 6.3 years), and there were more

Table 5 Comparison before and after exercise intervention (risk assessment scale for incident functional disability; RFD).

Variable	Unit	Pre (n = 36)	Post (n = 36)	P-value (ES)
Age†	years	76.6 ± 6.3	77.3 ± 6.2	< 0.001 (0.833)*
High-risk patients (RFD score ≥ 17)‡	n (%)	18 (50.0)	16 (44.4)	0.48
Q1‡	n (%)	2 (5.6)	1 (2.8)	1.00
Q2‡	n (%)	0 (0.0)	0 (0.0)	N/A
Q3‡	n (%)	0 (0.0)	0 (0.0)	N/A
Q4‡	n (%)	10 (27.8)	9 (25.0)	1.00
Q5‡	n (%)	1 (2.8)	1 (2.8)	1.00
Q6‡	n (%)	4 (11.1)	3 (8.3)	1.00
Q7‡	n (%)	10 (27.8)	8 (22.2)	0.75
Q8‡	n (%)	13 (36.1)	10 (27.8)	0.50
Q9‡	n (%)	4 (11.1)	2 (5.6)	0.48
Q10‡	n (%)	4 (11.1)	3 (8.3)	1.00

Values are presented as age: mean ± standard deviation; RFD: number of high-risk patients (%); Q1–6: number (%) of respondents who answered "No"; Q7–10: number (%) of respondents who answered "Yes." Pre, before exercise intervention; Post, after exercise intervention; ES, effect size (r-value); N/A, not applicable.
Criteria for ES: small effect size, r-value = 0.1; medium effect size, r-value = 0.3; and large effect size, r-value = 0.5.
* P-value < 0.05, † Wilcoxon signed-rank test (ES was only calculated for age), ‡ McNemar's test.

female than male participants (25, 69.4%). The characteristics of age and sex, which are important factors determining the effects of exercise interventions in the older adults, were similar to those shown in previous studies [16]. Although the participants in this study had chronic diseases, the prevalence of sarcopenia (two participants, 2.8%) was lower than the prevalence (around 15%) previously determined in the Japanese population [17]. The effects of low-intensity exercise through remote guidance in these participants included significant improvements in phase angle (whole body, both arms), handgrip strength, gait speed, and chair standing, indicating improvements in the older adults' muscle quality and physical function. In contrast, the SMI and single-leg stance decreased, whereas the body fat percentage increased. The RFD scores indicated no increase in the number of high-risk individuals even when age, a risk factor for needing care and support, increased significantly. Also, the number of respondents indicating an increased risk remained constant or decreased for each question.

Remote exercise intervention has been reported to improve range of motion, muscle strength, and gait ability, while displaying the same effect on long-term care prevention as face-to-face exercise [7]. In this study, remote exercise limited future functional decline risk as measured using the RFD, and the same long-term care prevention effect was observed similar to previous studies. This is thought to be due to the improvement in muscle quality (phase angle) [18] and physical function [3], which are related to the functional decline risk, with remote exercise. In addition, the exercise content in this study was characterized by low intensity (generally < 3 METs) and low frequency (once a week). High-intensity exercises, such as resistance training, are necessary to improve muscle quality and physical function in older adults [19]. However, if exercise intensity or frequency is increased (from once to twice a week), it becomes difficult to continue exercising [9, 20]. In this study, the low-intensity, low-frequency exercise content resulted in the participants continuing to exercise over the long term, suggesting that that muscle quality and physical function can be improved without high-intensity, high-frequency exercise. In this study, some indices did not improve after approximately six months of intervention (5–7 months) but improved after one year of intervention (phase angle in the whole body and both arms, and chair standing). Low-frequency (once a week) and short-term (approximately three months) exercise interventions do not produce such an improvement [9, 21]. The results suggest that short-term exercise intervention alone is insufficient to determine the effect of improvement, and that long-term follow-up is necessary. To verify the effects of long-term care prevention, longitudinal data must be constructed using a reduction in the number of people requiring incident long-term care and support as an outcome indicator [4]. However, long-term longitudinal data are difficult to obtain [4]. In this study, we used RFD as a surrogate outcome for longitudinal data on incident long-term care and support certification [5] and showed the effect of remote exercise intervention in reducing the risk of requiring support or care certification. In cases where longitudinal data over a long period are difficult to construct, RFD can be a proxy outcome for demonstrating the effects of long-term care prevention.

Although improvements in muscle quality and

physical function were observed, SMI decreased and body fat percentage increased. The progression from pre-sarcopenia to sarcopenia is associated with decreased muscle mass, increased fat mass, and decreased muscle function [22]. Nutritional interventions are useful for maintaining and improving muscle and fat-free mass to prevent the transition to sarcopenia and further reduce the functional decline risk [23, 24]. The results of this study suggest the need for nutritional interventions. The only physical function regression was the ability to stand on one leg. According to previous reports, not only the locomotor system but also the vestibular, visual, and nervous systems are involved in balance ability, such as standing on one leg [25]; it is possible that these functions are involved, although this was not clear in this study. Decreased balance ability is a contributing factor to physical frailty or sarcopenia [26] and is an important point to consider when considering exercise interventions to reduce the functional decline risk in the future.

The exercise intervention in this study was not conducted at home or individually, but at a local community center, which also served as a place for social participation. Group exercise leads to motivation and good exercise adherence among the participants [27]. Social participation has been reported to reduce the risk of functional disability [4, 28]. For the participants in this study, participating in the exercise intervention program at the community center was a form of social participation, and this may have led to them being able to continue exercising and reduced their risk of requiring support or care certification. It is believed that exercise with stronger social relationships prevents functional impairment compared with individual exercise [28], and it is necessary to consider how to connect individuals to social participation settings where exercise interventions are conducted.

This study had some limitations. Factors that influence body composition and physical function, such as exercise habits [29] and amount and intensity of activity [11], were not measured. Daily exercise habits and the amount and intensity of activity in the target population must be considered to verify the effects of an exercise intervention accurately. In this study, there was no control group without exercise intervention. Randomized controlled trials with control groups are required to demonstrate whether exercise interventions can reduce the functional decline risk. Likewise, detailed information regarding the content and frequency of self-training was lacking. Because self-training may modify the effects of exercise interventions [30], it is necessary to control for self-training and provide sufficient information. The study was limited to two regions—Sakai City and Katsuyama City—and the sample size was small, raising the issue of generalizability. However, to our knowledge, no study until now has shown changes over time in three measurement periods (initial, intermediate, and final) during a one-year long-term exercise intervention, and the present study may help to determine the duration of exercise intervention in community-dwelling older adults. This study should be expanded upon to include more regions and examine the effects of exercise interventions based on regions with different characteristics and a larger number of participants.

5. Conclusion

Remote exercise intervention improves muscle quality and physical function and limits the functional decline risk as measured by the RFD. It is suggested that remote exercise intervention can effectively extend the period until certification for the need for care and support is received and extend the healthy life expectancy of community-dwelling older adults.

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Conflicts of Interest

HO signed a non-disclosure agreement with Nice METS Inc. and Macnica Inc. The authors declare no conflict of interest.

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References

[1] Ministry of Health, Labor and Welfare [online]. Tokyo: Long-term care insurance system of Japan [cited 2024 February 17]. Available from: https://www.mhlw.go.jp/english/policy/care-welfare/care-welfare-elderly/dl/ltcisj_e.pdf.

[2] Ministry of Health, Labor and Welfare [online]. Tokyo: Situation surrounding the long-term care insurance system [cited 2024 February 17]. Available from: https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000044899.pdf.

[3] Ministry of Health, Labor and Welfare [online]. Tokyo: The 4th edition of preventive care manual Chapter 2 Function improvement manual of a movement container [cited 2024 February 17]. Available from: https://www.mhlw.go.jp/content/12300000/001238862.pdf.

[4] Tajika A, Ide K, Iizuka G, Tsuji T, Yokoyama M, Ojima T, et al. Does participation in community gatherings suppress aggravation of functional decline risk among older people? A study based on 2013–2016 data from the Japan Gerontological Evaluation Study (in Japanese). Nihon Koshu Eisei Zasshi. 2022; 69(2): 136–45.

[5] Tsuji T, Kondo K, Kondo N, Aida J, Takagi D. Development of a risk assessment scale predicting incident functional disability among older people: Japan Gerontological Evaluation Study. Geriatr Gerontol Int. 2018; 18(10): 1433–8.

[6] Ministry of Health, Labor and Welfare [online]. Tokyo: Status of the Eighth Medical Care Plan and Regional Medical Care Vision [cited 2024 October 21]. Available from: https://www.mhlw.go.jp/content/10800000/000989555.pdf.

[7] Wicks M, Dennett AM, Peiris CL. Physiotherapist-led, exercise-based telerehabilitation for older adults improves patient and health service outcomes: a systematic review and meta-analysis. Age Ageing. 2023; 52(11): afad207.

[8] Japanese Association of Occupational Therapists [online]. Tokyo: Long-term care prevention initiatives [cited 2024 February 17]. Available from: https://www.jaot.or.jp/seikatukankyou/kaigoyobou/.

[9] Stiggelbout M, Popkema DY, Hopman-Rock M, de Greef M, van Mechelen W. Once a week is not enough: effects of a widely implemented group based exercise programmed for older adults; a randomized controlled trial. J Epidemiol Community Health. 2004; 58(2): 83–8.

[10] Ministry of Health, Labor and Welfare [online]. Tokyo: Physical Activity and Exercise Guide for Health Promotion 2023 [cited 2024 September 30]. Available from: https://www.mhlw.go.jp/content/001194020.pdf.

[11] Sánchez-Sánchez JL, Mañas A, García-García FJ, Ara I, Carnicero JA, Walter S, et al. Sedentary behavior, physical activity, and sarcopenia among older adults in the TSHA: isotemporal substitution model. J Cachexia Sarcopenia Muscle. 2019; 10(1): 188–98.

[12] Kanda Y. Investigation of the freely available easy-to-use software 'EZR' for medical statistics. Bone Marrow Transplant. 2013; 48(3): 452–8.

[13] Holm S. A simple sequentially rejective multiple test procedure. Scand J Stat. 1979; 6(2): 65–70.

[14] Field A. Discovering statistics using IBM SPSS Statistics. 3rd ed. London, SAGE Publications; 2009.

[15] Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, et al. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. J Am Med Dir Assoc. 2020; 21(3): 300–307.e2.

[16] Shen Y, Shi Q, Nong K, Li S, Yue J, et al. Exercise for sarcopenia in older people: A systematic review and network meta-analysis. J Cachexia Sarcopenia Muscle. 2023; 14(3): 1199–211.

[17] Kitamura A, Seino S, Abe T, Nofuji Y, Yokoyama Y, et al. Sarcopenia: prevalence, associated factors, and the risk of mortality and disability in Japanese older adults. J Cachexia Sarcopenia Muscle. 2021; 12(1): 30–8.

[18] Wilhelm-Leen ER, Hall YN, Horwitz RI, Chertow GM. Phase angle, frailty and mortality in older adults. J Gen Intern Med. 2014; 29(1): 147–54.

[19] Hofmann M, Schober-Halper B, Oesen S, Franzke B, Tschan H, Bachl N, et al. Effects of elastic band resistance training and nutritional supplementation on muscle quality and circulating muscle growth and degradation factors of institutionalized elderly women: the Vienna Active Ageing Study (VAAS). Eur J Appl Physiol. 2016; 116(5): 885–97.

[20] Teixeira DS, Andrade AJ, Faria J, Marques P, Bastos V, Rodrigues F, et al. Exercise intensity agreement, need satisfaction, and exercise behavior: A sex-moderated mediation model. Eur J Sport Sci. 2024, doi:10.1002/ejsc.12173.

[21] Nakamura Y, Tanaka K, Yabushita N, Sakai T, Shigematsu R. Effects of exercise frequency on functional fitness in older adult women. Arch Gerontol Geriatr. 2007; 44(2): 163–73.

[22] Mizukami Y, Onishi H, Mifuku Y, Kubota M, Ikeda R, Hayashi H, et al. The role of fat indices as factors leading to sarcopenia in older adults residing in underpopulated areas. J Clin Biochem Nutr. 2023; 74(1): 70–3.

[23] Kim HK, Suzuki T, Saito K, Yoshida H, Kobayashi H, Kato H, et al. Effects of exercise and amino acid supplementation on body composition and physical function in community-dwelling elderly Japanese sarcopenic women: a randomized controlled trial. J Am Geriatr Soc. 2012; 60(1): 16–23.

[24] Zdzieblik D, Oesser S, Baumstark MW, Gollhofer A, König D. Collagen peptide supplementation in combination with resistance training improves body composition and increases muscle strength in elderly sarcopenic men: a randomized controlled trial. Br J Nutr. 2015; 114(8): 1237–45.

[25] Takeshima N, Kamuro R. Age-associated decline of balance ability and the effects of balance exercise in older adults (in Japanese). Sports Health Science Research (Sports kenkou kagaku kenkyu). 2020; 42: 1–15.

[26] Kondo I. Rehabilitation for older adults with frailty (in

Japanese). Jpn J Rehabil Med. 2016; 53(11): 860–5.
[27] Beauchamp MR, Ruissen GR, Dunlop WL, Estabrooks PA, Harden SM, et al. Group-based physical activity for older adults (GOAL) randomized controlled trial: Exercise adherence outcomes. Health Psychol. 2018; 37(5): 451–61.
[28] Kanamori S, Kai Y, Kondo K, Hirai H, Ichida Y, Suzuki K, et al. Participation in sports organizations and the prevention of functional disability in older Japanese: the AGES Cohort Study. PloS one. 2012; 7(11): e51061.
[29] Katayama O, Lee S, Bae S, Makino K, Chiba I, et al. Participation in social activities and relationship between walking habits and disability incidence. J Clin Med. 2021; 10(9): 1895.
[30] Ozawa Y, Ohko H, Sugaya M, Kawasaki S. Effects of home exercise on physical activity and physical functioning in orthopedic clinic outpatients—Pilot intervention for decreased opportunities to go out with COVID-19— (in Japanese). Jpn J Community-based Comprehensive Phys Ther. 2024; 3: 9–16.

■ORIGINAL ARTICLE

Effects of Different Cognitive-Motor Task Teaching Methods Using Limbs on Cerebral Hemodynamics in the Prefrontal Cortex: A Pilot Study

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Abstract: This study aimed to clarify the effects of different cognitive-motor exercise teaching methods using the limbs on prefrontal oxyhemoglobin, number of errors, and subjective difficulty. We also aimed to elucidate relationships between prefrontal oxyhemoglobin and the number of errors and subjective difficulty in 77 healthy adults. Oxyhemoglobin levels in the group taught in third-person perspective (3PP) were higher than those in the group taught in first-person perspective (1PP), as ascertained by a comparison of cerebral blood flow in the anterior halves. The median number of errors was significantly higher in the 3PP group (3.5) than in the 1PP group (3.0), but the subjective difficulty did not differ significantly between these conditions. A significant positive correlation was observed between oxyhemoglobin and the number of errors, whereas no significant correlation was observed between oxyhemoglobin and subjective difficulty. The 3PP group exhibited more errors and higher prefrontal cortex activity than that of the 1PP group. Consequently, occupational therapists and caregivers should consider these indicators when performing cognitive motor exercises involving the limbs in clinical settings to ensure higher efficacy. Future research should target older adults, and use near-infrared spectroscopy probes to cover the activated parietal and occipital lobes associated with mental rotation tasks.

Keywords: prefrontal cortex, cognitive-motor exercises using limbs, oxyhemoglobin

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1. Introduction

Over the next few decades, the worldwide population of individuals with dementia is expected to increase. In 2019, the global number of people with dementia was approximately 57.4 million. This number is projected to reach 152.8 million by 2050 [1]. The number of people with dementia in Japan is expected to reach 6.5–7 million by 2025 and 8–9.5 million by 2040 [2]. Mild cognitive impairment (MCI) with risk of dementia refers to an intermediate state between age-related changes in cognitive function and baseline cognitive function that meets the criteria for dementia [3]. MCI has been reported to progress to dementia in a certain number of patients each year, and appropriate measures are required [4, 5]. Non-pharmacological therapies for MCI include exercise [6], cognitive therapies [7, 8], and combined therapies [9, 10]. Among these options, dual-task training, which combines cognition and physical exercises, has shown significant effects on cognitive function in older adults. Systematic reviews and meta-analyses have associated improvements in memory, executive function, and physical balance with dual-task training [11], and dual-task interventions have shown superiority over single-task approaches in improving cognitive functions

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and in enhancing physical abilities including gait and fall prevention [12]. In addition to improving cognitive and physical function, dual-task training programs that incorporate elements of social interaction have shown social benefits for community-dwelling older adults, emphasizing their importance in dementia prevention [13]. Among these, in the Japanese rehabilitation field, cognitive exercise, a dual-task combining cognition and exercise effectively [14] suppresses brain atrophy and cognitive function decline [15]. In Japan, similar to cognitive exercises, cognitive-motor exercises using the limbs are a dual task combining cognition and exercise and are frequently used in rehabilitation and nursing care [16]. During these exercises, opposing movements are rhythmically alternately performed by left and right upper limbs. They require sustained attention and are useful for activating the prefrontal cortex [17]. The difficulty level was adjusted according to the participants' ability to activate the prefrontal cortex.

In a previous study, the complexity of hand patterns during cognitive-motor exercises using limbs affected prefrontal cortex activity [18]. Accordingly, teaching methods can influence a task's degree of difficulty. Third-person perspective (3PP) imitation, wherein a demonstration is presented from a third-person perspective and imitated, is often used as a teaching method for cognitive-motor exercises using limbs. Another teaching method is first-person perspective (1PP) imitation, in which a sample is presented from a first-person perspective and then imitated. The 1PP does not require mental rotation and is considered easier than 3PP to learn the presented movement [19]. However, the effects of these different teaching methods on the benefits of cognitive motor exercises using limbs have not yet been clarified. The mental rotation required for 3PP instruction refers to the special visuospatial ability to imagine the appearance of an object or person when rotated from its original upright position [20]. Additionally, the prefrontal cortex, a region associated with executive functions, including working memory, is involved in mental rotation [21].

We hypothesized that learning cognitive-motor exercises using limbs after demonstration in 3PP would be more difficult than learning the same exercise demonstrated in 1PP because it requires participants to rotate the mental representation of an object (mental rotation), and that the prefrontal cortex would thus be more active during execution of a learned cognitive-motor exercise using limbs. However, changes in brain activity due to differences in instruction method during cognitive motor exercises using limbs have not yet been reported. We thus used near-infrared spectroscopy (NIRS) [22] to measure prefrontal cortex activity in subjects in sitting position with little physical inhibition to clarify prefrontal cortex activity during cognitive-motor exercises using the limbs. Changing the teaching method while confirming prefrontal cortex activity using NIRS was expected to effectively activate participants' prefrontal cortex. However, in clinical practice, cognitive-motor exercises using the limbs are often performed by participants in groups, and the task cannot be realistically performed while measuring cerebral hemodynamics using NIRS. We thus hypothesized that the number of errors and subjective difficulty, which can be easily measured during cognitive-motor exercises using the limbs, could predict the activation state of a participant's prefrontal cortex. A previous study examined the relationship among cerebral blood flow, number of errors, and subjective difficulty. However, this relationship could not be clarified because the number of participants in this study was too small to conduct a statistical analysis [18].

The purposes of this study were twofold. We aimed to clarify the effects of different methods of teaching cognitive-motor exercises using limbs on prefrontal oxyhemoglobin (oxy-Hb) levels, including changes over time during learning. We also aimed to elucidate the relationships between prefrontal oxy-Hb, number of errors, and subjective difficulty.

2. Subjects

This study was conducted between October 2020 and March 2022. Seventy-seven healthy adults (51 women and 26 men, mean age = 21.1 ± 1.1 years) were included. Inclusion criteria included individuals at least 20 years old suffering no motor paralysis. Individuals with a history of central nervous system disorders or previous cognitive motor exercises using the limbs were excluded. The primary objective of this study was to detect differences in oxy-Hb levels in the prefrontal cortex between subjects exposed to third-person perspective (3PP) and first-person perspective (1PP) instructional tasks by making group comparisons. We thus conducted a power analysis to assess the correlation between the primary outcome and differences in oxy-Hb levels. Using an effect size of 0.5, alpha level of 0.05, and power of 80%, the required sample size was calculated to be approximately 64 participants. Ultimately, 77 healthy adults participated in this study, 36 were assigned to the 3PP group and 41 to the 1PP group, ensuring sufficient statistical power for our analyses.

3. Methods

Cognitive-motor exercises using the limbs are double-movement tasks in which the participant rhythmically performs opposing movements alternating use

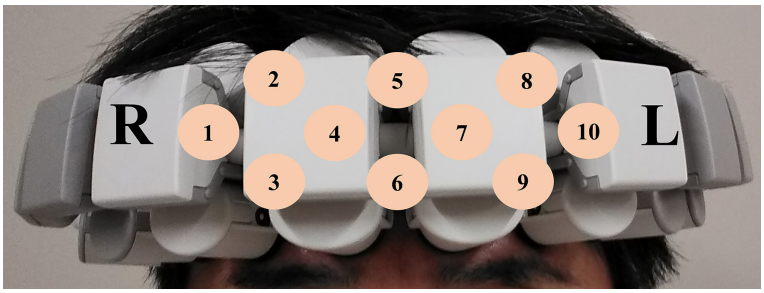

Fig. 1. Placement of NIRS probes on the prefrontal cortex.
The picture depicts the location of the WOT-100 channel. The probe unit covered an area of 30 × 105 mm^2 on the participants' foreheads, including both temples. This arrangement allowed for the monitoring of cortical activation, primarily in the prefrontal cortex. All 10 channels, numbered from 1 to 10, were utilized.

Fig. 2. Cognitive-motor task teaching methods using limbs.
The experimental setup for cognitive-motor task teaching methods is shown. The figure illustrates the cognitive-motor exercises using limbs performed in this study. Task 1: Third-person perspective imitation (3PP). Task 2: First-person perspective imitation (1PP).

of left and right upper limbs. In this study, the left and right hands were placed alternately in front of each other to create a pistol in the front hand and a fox in the rear hand. We randomly assigned participants to either the 3PP group (wherein they imitated the demonstration performed in 3PP) or the 1PP group (wherein they imitated the demonstration performed in 1PP). NIRS (wearable optical topography [WOT-100]; HITACHI, Tokyo, Japan) was used to measure cerebral hemodynamics in the prefrontal cortex. The oxy-Hb concentration was used as an index to confirm activation status of the prefrontal cortex during the task. Participants were assigned to the 3PP (n = 36) or 1PP (n = 41) group. As the prefrontal cortex was the region of interest (ROI), a 10-channel probe was placed on the participant's forehead (Fig. 1) and the average value was used [23]. During the experiment, the participants watched a video of the task, rested with their eyes closed for 30 s, then opened their eyes and gazed at a cross-shaped mark in the center of a PC monitor for 10 s. Subsequently, the participants performed 60 s of cognitive-motor exercises using their limbs (Fig. 2). The cognitive-motor exercises using limb postures were switched once every 2 s, 30 times during the 60 s period. The task was recorded using a video camera (GZ-E242-S Everio; JVC, Yokohama, Kanagawa, Japan) to determine the number of errors. This number was counted during the task and later confirmed by observing a video recorded by the examiner. An error was defined as an incorrectly imitated movement. Next, the participants were asked to complete a visual analog scale to evaluate the subjective difficulty by placing a mark on a 100 mm long line. The left end of the line indicates 'not at all difficult' and the right end indicates 'very difficult.'

The Trail Making Test-Part B (TMT-B), a widely used neuropsychological assessment that evaluates cognitive flexibility, visual attention, and task-switching ability, was used to assess cognitive function.

This study was approved by [Blinded for Review, no. 4644]. All procedures were performed in accordance with the ethical standards of the Declaration of Helsinki, and all participants provided written informed consent. For statistical analysis, during the 60 s period, unpaired t-tests were used to compare oxy-Hb values between participants in the 3PP and 1PP groups during the task. Task duration was divided into anterior (0.2–30.0 s) and

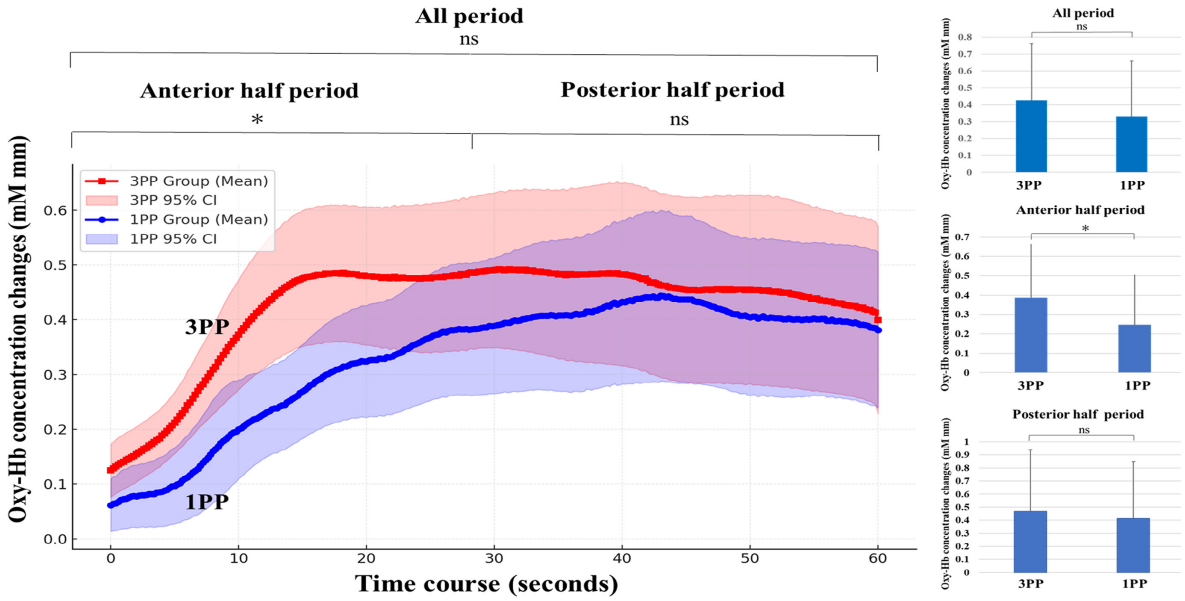

Fig. 3. Changes in prefrontal oxy-Hb concentration during the task.

Temporal changes in prefrontal oxyhemoglobin (oxy-Hb) concentration (mM·mm) during the cognitive-motor exercise using limbs. A significant difference was observed in the anterior period ($p < .05$), while no significant differences were found in the posterior period or across the entire task duration. The 3PP group consistently showed higher oxy-Hb levels compared to the 1PP group, though the difference for the entire duration was not significant (ns).

posterior (30.2–60.0 s) halves, and the average oxy-Hb values in the 3PP and 1PP groups were compared using unpaired t-tests. During the 60 s period, the number of errors and subjective difficulty between groups were also compared using the Mann–Whitney U test. Correlations between oxy-Hb values during the task, visual analog scale score, and number of errors were calculated using Spearman's rank correlation coefficient, with significance level set at 5%. The normality of the oxy-Hb data was assessed using Shapiro–Wilk and Kolmogorov–Smirnov tests. Both tests indicated that the data was normally distributed, as p-values exceeded 0.05, confirming that the data met the normality assumptions for subsequent parametric analyses.

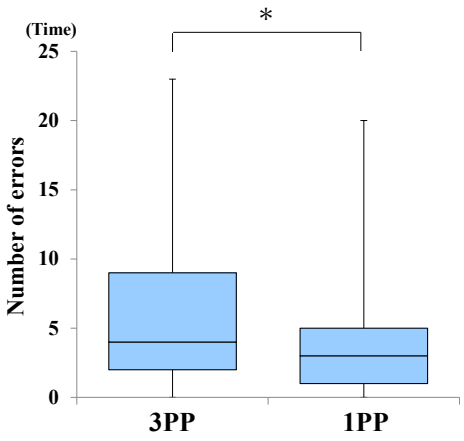

Fig. 4. Number of errors during cognitive-motor tasks.

The Mann-Whitney U test revealed a significant difference in the number of errors between 3PP and 1PP groups. $p < 0.05$.

4. Results

Figure 3 shows the temporal changes in the cerebral hemodynamics of each participant's prefrontal cortex during the task. Throughout the task, the oxy-Hb level in the 3PP group was higher than that in the 1PP group; however, this difference was statistically insignificant. Oxy-Hb spanning the whole period was 0.43 ± 0.34 mM mm for the 3PP group and 0.33 ± 0.33 mM mm for the 1PP group. This difference was insignificant. Cerebral blood flow in 3PP and 1PP groups in the anterior and posterior halves was compared. Oxy-Hb in the anterior half of the brain was significantly higher for the 3PP group (0.39 ± 0.28 mM mm) than for the 1PP group (0.25 ± 0.26 mM mm) ($p < .05$). Oxy-Hb in the posterior half was 0.47 ± 0.47 mM mm for the 3PP group and 0.41 ± 0.44 mM mm for the 1PP group. This difference was not significant. The median number of errors was 3.5 (2–9) in the 3PP group and 3.0 (1–5) in the 1PP group. This difference was significant ($p < .05$; Fig. 4). TMT-B between conditions was 37.1 (30.4–45.1) in the 3PP group and 40.0 (34.9–43.1) in the 1PP group. This difference was insignificant. Median subjective difficulty was 65 mm (56–74 mm) in the 3PP group and 67 mm (55–76

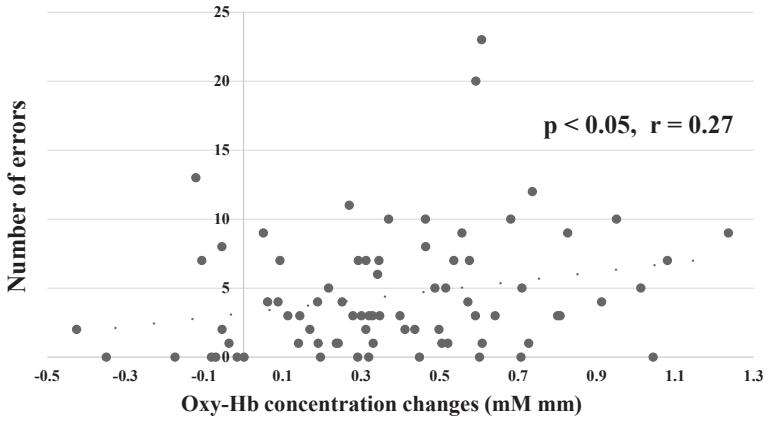

Fig. 5. Correlation between oxy-Hb concentration and number of errors.
Correlations between oxy-Hb concentration changes and number of errors. Spearman's correlation coefficient revealed that prefrontal cortex activation significantly increased with increasing the number of errors.

mm) in the 1PP group, with no significant differences. A significant positive correlation was observed between the oxy-Hb level and the number of errors ($r = 0.27$, $p < 0.05$; Fig. 5), and no significant correlation was observed between the oxy-Hb level and subjective difficulty ($p = .06$).

5. Discussion

During cognitive-motor exercises using the limbs, the oxy-Hb values in the anterior half of the prefrontal cortex were significantly higher in the 3PP group than in the 1PP group. However, values in the posterior half did not differ significantly. Previous studies have reported prefrontal cortex activation during mental rotation experiments using magnetic resonance imaging and positron emission tomography [24, 25]. The 3PP group required mental rotation in addition to intense concentration when imitating the model's movements, resulting in more prefrontal cortex activation than the 1PP group. In the posterior half of the cerebral cortex in the 3PP group, the process of adaptation to the elements of mental rotation led to a state similar to that in the 1PP group. Therefore, 3PP teaching may activate the prefrontal cortex in the early phase of cognitive motor exercises using the limbs. The number of errors observed when using the 3PP method was significantly higher than when using the 1PP method. During mental rotation, the 3PP condition is more difficult to imitate because it requires the identification of the self and model [19] and prolongs the reaction time, resulting in increased errors [26, 27]. Thus, based on current and prior findings, the number of false movements could increase when cognitive-motor exercises using limbs are taught in 3PP compared to 1PP because of the requirement for mental rotation. However, subjective difficulty did not significantly differ between teaching methods, although it was expected that the 3PP group would report higher subjective difficulty than the 1PP group. Even if a significant increase in cerebral hemodynamics is observed with a load that does not exceed cognitive resources, performance remains unchanged [26, 28]. The number of errors was higher in the 3PP group than that in the 1PP group. However, as cerebral blood flow began to decay in the latter half of the task, it did not exceed the cognitive resources of most participants. 3PP teaching does not necessarily increase the subjective difficulty more than 1PP teaching when young participants perform cognitive-motor exercises using their limbs. However, this result could have been largely influenced by the fact that the participants were young adults.

Regarding the relationships between prefrontal oxy-Hb, the number of errors, and subjective difficulty, we found a positive correlation between prefrontal oxy-Hb and the number of errors. In clinical practice, the number of errors can thus be used to infer PFC activation status. In the study setting, many errors indicated low performance capacity for the task. Hence, the current results indicate that the prefrontal cortex is highly activated in individuals with lower performance abilities.

The PFC, which controls executive and attentional functions, is activated during adaptation to new tasks [29]. The task in this study involved learning movements while allocating attention to the elbow and finger molds of both upper limbs, requiring participants to activate their prefrontal cortex to adapt to the task. Those with lower performance abilities were required to mobilize more prefrontal cortex function to prevent movement errors during the tasks. Although a significant relationship was observed between prefrontal oxy-Hb levels and the number of errors, no significant correlation was found between prefrontal oxy-Hb levels and subjective

difficulty.

Regarding clinical application and study limitations, when occupational therapists and care workers perform cognitive-motor exercises using limbs, 3PP teaching may activate the prefrontal cortex more than 1PP teaching. Although cognitive-motor exercises using limbs are generally presented with 3PP, for people with MCI or dementia, when necessary, errors can be reduced and the level of difficulty can be controlled via 1PP teaching. In addition, it is impractical to monitor cerebral hemodynamics in the prefrontal cortex using NIRS in clinical situations. We found a correlation between prefrontal oxy-Hb and the number of errors during cognitive-motor exercises using the limbs, suggesting that number of errors may be used to predict prefrontal cortex activation status. However, weak correlation coefficients should be considered cautiously.

As cerebral blood flow dynamics during task performance [30] and prefrontal cerebral hemodynamics during cognitive-motor tasks [31] may differ between younger and older participants, these findings should be interpreted with caution, and further research should be conducted in older adults. In addition, as the areas activated during the mental rotation task include a wide range of areas including parietal and occipital lobes, further insights can be obtained using an NIRS probe to cover these areas.

Summary and Conclusions

These findings reveal a difference in frontal lobe activity depending on the presence or absence of mental rotation manipulation. Future research should consider whether mental rotation manipulation during cognitive-motor exercises using limbs promotes specific brain activation.

Declaration of conflicting interests

The authors declare that there are no conflicts of interest.

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References

[1] Nichols E, GBD 2019 Dementia Forecasting Collaborators. Estimation of the global prevalence of dementia in 2019 and forecasted prevalence in 2050: an analysis for the Global Burden of Disease Study 2019. Lancet Public Health. 2022; 7(2): e105–e125.

[2] Ninomiya T, MHLW GRANTS SYSTEM [online]. Nihon ni okeru ninchishou no koureisha jinkou no shourai suitei ni kansuru kenkyuu [cited 2024 March 29]. Available from: https://mhlw-grants.niph.go.jp/project/23685.

[3] Petersen RC. Clinical practice. Mild cognitive impairment. N Engl J Med. 2011; 364(23): 2227–34.

[4] Bruscoli M, Lovestone S. Is MCI really just early dementia? A systematic review of conversion studies. Int Psychogeriatr. 2004; 16(2): 129–40.

[5] Shimada H, Makizako H, Doi T, Lee S, Lee S. Conversion and reversion rates in Japanese older people with mild cognitive impairment. J Am Med Dir Assoc. 2017; 18(9): 808.e1–808.e6.

[6] Song D, Yu DSF, Li PWC, Lei Y. The effectiveness of physical exercise on cognitive and psychological outcomes in individuals with mild cognitive impairment: a systematic review and meta-analysis. Int J Nurs Stud. 2018; 79: 155–64.

[7] Greenaway MC, Duncan NL, Smith GE. The memory support system for mild cognitive impairment: randomized trial of a cognitive rehabilitation intervention. Int J Geriatr Psychiatr. 2013; 28(4): 402–9.

[8] Hill NT, Mowszowski L, Naismith SL, Chadwick VL, Valenzuela M, Lampit A. Computerized cognitive training in older adults with mild cognitive impairment or dementia: a systematic review and meta-analysis. Am J Psychiatry. 2017; 174(4): 329–40.

[9] Bruderer-Hofstetter M, Rausch-Osthoff AK, Meichtry A, Münzer T, Niedermann K. Effective multicomponent interventions in comparison to active control and no interventions on physical capacity, cognitive function and instrumental activities of daily living in elderly people with and without mild impaired cognition – a systematic review and network meta-analysis. Ageing Res Rev. 2018; 45: 1–14.

[10] Chuang IC, Liao WW, Wu CY, Yeh TT, Chen CL, Lin CH, et al. Baseline global cognitive function affects cognitive and functional outcomes of combined physical and cognitive training among older adults with cognitive decline. Am J Occup Ther. 2022; 76(2): 7602205140.

[11] Ali N, Bazazian S, Shumway-Cook A. The effects of dual-task training on balance and gait in older adults: A systematic review and meta-analysis. Gait Posture. 2022; 94: 170–81.

[12] Chen Y, Wang Y, Liu H. Dual-task multicomponent exercise combining physical and cognitive training improves cognitive and physical functions in older adults: A randomized controlled trial. J Aging Phys Act. 2023; 31(1): 45–56.

[13] Lee S, Harada K, Bae S, et al. A non-pharmacological

multidomain intervention of dual-task exercise and social activity affects the cognitive function in community-dwelling older adults with mild to moderate cognitive decline: A randomized controlled trial. Front Aging Neurosci. 2023; 15: 1005410.

[14] Shimada H, Makizako H, Doi T, Park H, Tsutsumimoto K, Verghese J, et al. Effects of combined physical and cognitive exercises on cognition and mobility in patients with mild cognitive impairment: a randomized clinical trial. J Am Med Dir Assoc. 2018; 19(7): 584–91.

[15] Suzuki T, Shimada H, Makizako H, Doi T, Yoshida D, Ito K, et al. A randomized controlled trial of multicomponent exercise in older adults with mild cognitive impairment. PLoS One. 2013; 8(4): e61483.

[16] Tokushukai Medical Group Newspaper Digest. Prevention of Dementia with Antagonistic Exercises for Easy Physical Exercise for Both Heart and Body [cited 2024 March 29]. Available from: https://www.tokushukai.or.jp/media/newspaper/1025/article-10.php.

[17] Takayuki Tabira GN, Iso N, Sagari A, Hirase T. The development of antagonistic exercises as part of a cognitive program to prevent dementia in the elderly. Jpn Occup Ther Res. 2012; 31(4): 353–62.

[18] Sagari A, Kanao H, Mutai H, Iwanami J, Sato M, Kobayashi M. Cerebral hemodynamics during a cognitive-motor task using the limbs. Front Hum Neurosci. 2020; 14: 568030.

[19] Watanabe R, Watanabe S, Kuruma H, Murakami Y, Seno A, Matsuda T. Neural activation during imitation of movements presented from four different perspectives: a functional magnetic resonance imaging study. Neurosci Lett. 2011; 503(2): 100–4.

[20] Shepard RN, Metzler J. Mental rotation of three-dimensional objects. Science. 1971; 171(3972): 701–3.

[21] Vogeley K, Fink GR. Neural correlates of the first-person-perspective. Trends Cogn Sci. 2003; 7(1): 38–42.

[22] Okamoto M, Dan I. Functional near-infrared spectroscopy for human brain mapping of taste-related cognitive functions. J Biosci Bioeng. 2007; 103(3): 207–15.

[23] Atsumori H, Kiguchi M, Obata A, Sato H, Katura T, Funane T, et al. Development of wearable optical topography system for mapping the prefrontal cortex activation. Rev Sci Instrum. 2009; 80(4): 043704.

[24] Parsons LM, Fox PT, Downs JH, Glass T, Hirsch TB, Martin CC, et al. Use of implicit motor imagery for visual shape discrimination as revealed by PET. Nature. 1995; 375(6526): 54–8.

[25] Schendan HE, Stern CE. Mental rotation and object categorization share a common network of prefrontal and dorsal and ventral regions of posterior cortex. NeuroImage. 2007; 35(3): 1264–77.

[26] Meng S, Oi M, Saito G, Saito H. The neural correlates of biomechanical constraints in hand laterality judgment task performed from other person's perspective: a near-infrared spectroscopy study. PLoS One. 2017; 12(9): e0183818.

[27] Watanabe R, Higuchi T. Behavioral advantages of the first-person perspective model for imitation. Front Psychol. 2016; 7: 701.

[28] Callicott JH, Mattay VS, Bertolino A, Finn K, Coppola R, Frank JA, et al. Physiological characteristics of capacity constraints in working memory as revealed by functional MRI. Cereb Cortex. 1999; 9(1): 20–6.

[29] Ridderinkhof KR, van den Wildenberg WP, Segalowitz SJ, Carter CS. Neurocognitive mechanisms of cognitive control: the role of prefrontal cortex in action selection, response inhibition, performance monitoring, and reward-based learning. Brain Cogn. 2004; 56(2): 129–40.

[30] Ohsugi H, Ohgi S, Shigemori K, Schneider EB. Differences in dual-task performance and prefrontal cortex activation between younger and older adults. BMC Neurosci. 2013; 14: 10.

[31] Udina C, Avtzi S, Durduran T, Holtzer R, Rosso AL, Tejedor CC, et al. Functional near-infrared spectroscopy to study cerebral hemodynamics in older adults during cognitive and motor tasks: a review. Front Aging Neurosci. 2019; 11: 367.

■CASE REPORTS

The Changes in Agitated Behavior in Severe Dementia in Different Contexts: A Case Report

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Abstract: Objective: To investigate the variability in agitated behaviour due to different contexts in a patient with dementia.
Methods: We describe the case of an 80-year-old male with dementia who scored 0 on the Mini-Mental State Examination. AwareCare was used to assess his agitated behaviour across 14 response categories, including eyes and facial expressions. One occupational therapist observed his behaviour in a context where activity was not provided in the hospital ward (Phase A) and while he was drinking tea in a quiet room (Phase B) for 10 minutes. The Tau-U A vs B coefficient of the Tau-U test was used for analysis.
Results: Tea consumption was associated with a significant reduction in agitated behaviours, e.g. eye flickering, head movements, and shouting or moaning. There was a notable increase in positive behaviours, including more frequent smiling.
Conclusions: The level of agitated behaviour in an individual with severe dementia may vary depending on the context.

Keywords: severe dementia, agitation, BPSD

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1. Introduction

People with severe dementia often exhibit behavioural psychological symptoms of dementia (BPSD), which significantly impact quality of life (QoL). The Progressively Lowered Stress Threshold (PLST) model indicates that dementia-related behaviours emerge from interactions with the environment and are exacerbated by cognitive impairments [1]. Individualised staff training interventions can effectively address agitation in care home residents [2]. Similarly, interventions based on the Need-Driven Dementia-Compromised Behaviour model have demonstrated that activities tailored to functional level and personality can improve behavioural symptoms [3]. However, there is a lack of effective interventions targeting agitation in patients with severe dementia [4]; this is because existing agitation assessment scales cannot capture detailed behavioural changes in this population.

Accordingly, we adopted AwareCare [5], which analyses reactive behaviours in response to environmental stimuli, focusing on eye, head, and arm movements as indicators of agitation [6]. By segmenting each behaviour, AwareCare facilitates the detection of subtle reactive behaviours that may otherwise go unnoticed. Here, we examine how context influences agitation in a patient with severe dementia by analysing behavioural changes using AwareCare in standard ward and controlled occupational therapy settings.

2. Case

An 80-year-old male was admitted to a rehabilitation hospital with cervical spondylotic myelopathy. He had been cognitively impaired for several years, and his Mini-Mental State Examination score was 0. He was easily angered and often acted restlessly and touched nearby objects. His activities of daily living changed depending on the context. BPSDs, as assessed using the

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Japanese version of the Neuropsychiatric Inventory-Nursing Home version (NPI-NH), included only agitation. Agitation had frequency and severity scores of 4 and 3, respectively. One family member stated that he liked drinking Japanese green tea. During occupational therapy, the patient smelt and drank tea, which calmed his agitation. In accordance with the Declaration of Helsinki, the participant's family member provided written informed consent for participation.

We used the AwareCare method, which assesses individual behaviours in response to naturally occurring events in the environment (seven types) and observer-induced events (three types). There were 14 response categories, including eye movements and facial expressions, and each event was evaluated only if it occurred during the initial observation period. An occupational therapist observed the patient's usual behaviour in the hospital ward (Phase A) and while drinking tea in the occupational therapy room (Phase B) for 10 minutes using AwareCare. The ward was a busy environment with frequent disturbances, where the patient exhibited behaviours such as shouting, fidgeting, and repeated object touching. Conversely, the occupational therapy room was quiet with minimal external distractions. During the tea-drinking sessions, the therapist encouraged engagement in sensory experiences, e.g. smelling and tasting the tea, while maintaining eye contact to foster positive interactions. The tea was served at a warm, comfortable temperature in a familiar cup. Observations were conducted first in the ward and then in the occupational therapy room over 5 days, between 13:00 and 15:00. The total number of observed behaviours was recorded and analysed. The Tau-U test was selected owing to its suitability for single-case experimental designs [7] as a non-parametric test that assumes ordinal data and allows for calculating effect sizes while accounting for baseline trends, thus providing a robust method for evaluating contextual differences. Using a free single-case experimental design analysis tool (https://manolov.shinyapps.io/Overlap/), we conducted the Tau-U test to identify differences between phases. We found no significant data trends, allowing us to use the Tau-U A vs B coefficient [7] to conduct the analysis. The effect sizes were defined as follows: < 0.20, small; 0.20–0.60, moderate; 0.60–0.80, large; and > 0.80, very large [8].

3. Results

During the tea-drinking sessions, the patient exhibited increased eye contact and smiling, whereas shouting and head movements significantly decreased. These changes are likely ascribed to the environmental adjustments, sensory engagement through familiar activities, and therapist-facilitated interactions. The differences between phases for each item are presented in Table 1. Several items in AwareCare showed significant changes, including eye flicker (Tau-U = −0.8, $p < 0.05$), smiles (Tau-U = 0.8, $p < 0.05$), head movements (Tau-U = −0.8, $p < 0.05$), and shouts or moans (Tau-U = −0.76, $p < 0.05$). Figure 1 illustrates these differences between Phases A and B. Notably, the NPI-NH scores in these items remained unchanged post-intervention.

Table 1 Tau-U effect sizes and p-values for each item evaluated in this report.

	Item	Tau-U A vs. B	*p*-value
1	Eyes flicker	−0.80	0.03
2	Makes eye contact	0.72	0.07
3	Explores with eyes	−0.60	0.07
4	Smiles	0.80	0.03
5	Frowns	−0.40	0.29
6	Nods or shakes head	0.28	0.49
7	Moves head	−0.80	0.03
8	Reaches	−0.04	1
9	Grasps or holds	0.12	0.82
10	Moves towards	0.00	1
11	Moves away	0.00	1
12	Single words	0.36	0.34
13	Mumbling	0.00	1
14	Shouts or moans	−0.76	0.04

4. Discussion

Agitated behaviour in an individual with severe dementia may vary depending on the surrounding context. Clare et al. demonstrated that training caregivers to use AwareCare for evaluating subtle reactive behaviours in residents with severe dementia improved family-rated QoL [9]. Our study also highlights AwareCare's utility in assessing subtle behavioural changes due to environmental adjustments. While Clare et al.'s study emphasised the impact of caregiver training on family-rated QoL [9], our case report focuses on immediate behavioural changes observed in a controlled environment. Aşiret et al. reported an intervention that provided care plans based on the PLST theory and found that 12-week training for caregivers of persons with moderate-to-severe dementia significantly reduced BPSD [10]. We showed that an appropriate environment has the potential to help reduce agitated behaviour in patients with severe dementia.

This report has certain limitations. The assessment method was observation-based, which may hinder full reproducibility. Additionally, the potential for observational bias exists, as the same therapist conducted the intervention and the observations. The short observation

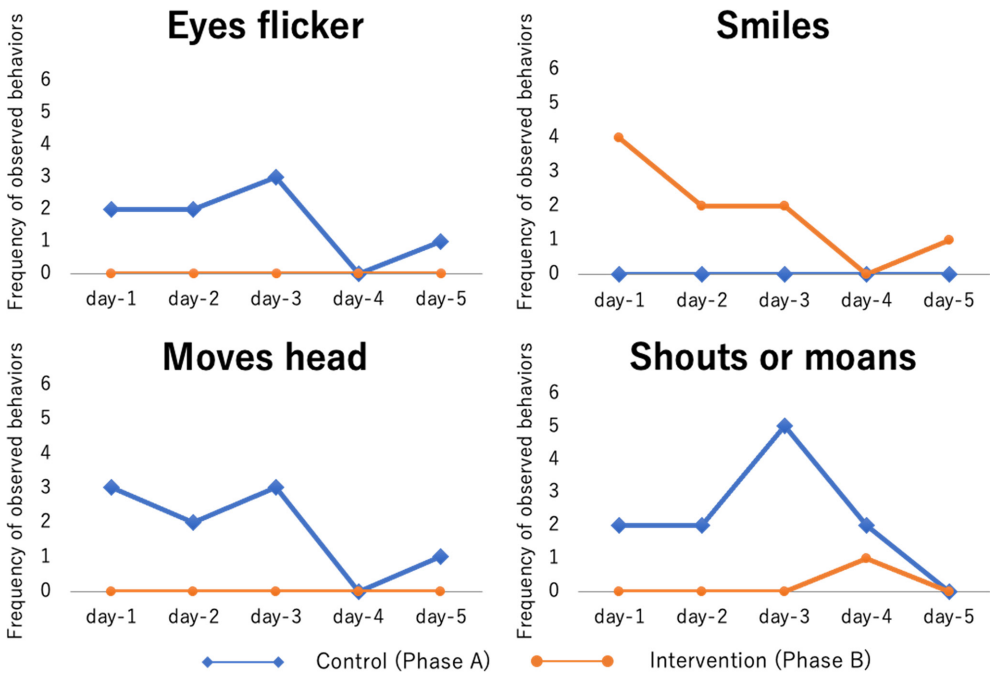

Fig. 1. Four behaviours showing significant differences between the control and intervention phases. The vertical axis represents the frequency of observed behaviours during 10-minute sessions. 'Control' refers to Phase A, depicting usual behaviour in the hospital ward, whereas 'Intervention' refers to Phase B, involving the activity of drinking tea in the occupational therapy room.

periods may also have limited our ability to capture the full variability of agitation behaviours. Furthermore, AwareCare was not originally designed specifically to evaluate agitated behaviour, which could affect the interpretation of the results. While environmental adjustments reduce agitation, factors like patient-therapist familiarity or the tea's calming effect may have influenced the outcomes. Future studies should control these variables to clarify causality. Nevertheless, this case highlights important implications for clinical practice. Occupational therapists may be able to use these findings by integrating personalised interventions, e.g. familiar activities, into routine care settings to manage agitation effectively in individuals with severe dementia. For example, during leisure activities, practitioners might incorporate preferred experiences (e.g. familiar beverages) to create calm environments, thereby reducing agitation. Nonetheless, we observed behavioural changes in response to environmental changes, which may help develop approaches to better manage BPSD in people with severe dementia.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose related to this report or its publication.

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References

[1] Smith M, Gerdner LA, Hall GR, Buckwalter KC. History, development, and future of the progressively lowered stress threshold: a conceptual model for dementia care. J Am Geriatr Soc. 2004; 52(10): 1755–60.

[2] Livingston G, Barber J, Marston L, Stringer A, Panca M, Hunter R, et al. Clinical and cost-effectiveness of the Managing Agitation and Raising Quality of Life (MARQUE) intervention for agitation in people with dementia in care homes: a single-blind, cluster-randomised controlled trial. Lancet Psychiatry. 2019; 6(4): 293–304.

[3] Kolanowski A, Litaker M, Buettner L, Moeller J, Costa PT Jr. A randomized clinical trial of theory-based activities for the behavioral symptoms of dementia in nursing home residents. J Am Geriatr Soc. 2011; 59(6): 1032–41.

[4] Na R, Yang JH, Yeom Y, Kim YJ, Byun S, Kim K, et al. A systematic review and meta-analysis of nonpharmacological interventions for moderate to severe dementia. Psychiatry Investig. 2019; 16(5): 325–35.

[5] Clare L, Whitaker R, Quinn C, Jelley H, Hoare Z, Woods B, et al. AwareCare: development and validation of an observational measure of awareness in people with severe

dementia. Neuropsychol Rehabil. 2012; 22(1): 113–33.
[6] Cohen-Mansfield J, Marx MS, Rosenthal AS. A description of agitation in a nursing home. J Gerontol. 1989; 44(3): M77–84.
[7] Brossart DF, Laird VC, Armstrong TW. Interpreting Kendall's Tau and Tau-U for single-case experimental designs. Cogent Psychol. 2018; 5(1): 1518687.
[8] Vannest KJ, Ninci J. Evaluating intervention effects in single-case designs. J Couns Dev. 2015; 93(4): 403–11.
[9] Clare L, Whitaker R, Woods RT, Quinn C, Jelley H, Hoare Z, et al. AwareCare: a pilot randomized controlled trial of an awareness-based staff training intervention to improve quality of life for residents with severe dementia in long-term care settings. Int Psychogeriatr. 2013; 25(1): 128–39.
[10] Duru Aşiret G, Kütmeç Yılmaz C, Sayın Kasar K. Investigation of the effects of interventions made according to the Progressively Lowered Stress Threshold Model on the care outcomes of Alzheimer patients and their families: a randomized clinical trial. Psychogeriatrics. 2021; 21(5): 738–48.

■ORIGINAL ARTICLE

Characteristics of Occupational Therapists and Their Clinical, Educational, and Research Experiences Related to Evidence-Based Practice Self-Assessment

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Abstract: Background: The decision-making process underlying shared decision-making is evidence-based practice (EBP). However, in Asia, EBP has widely become only a concept, and empirical research on measures to promote its implementation is lacking. Therefore, we first developed the EBP self-assessment (EBPSA) for occupational therapists.
Purpose: To examine the characteristics of occupational therapists and their clinical, educational, and research experiences related to the EBPSA scores.
Methods: The participants were 1216 occupational therapists working in Japanese convalescent rehabilitation wards, who were surveyed by mail using the questionnaire. Data analysis was conducted using a categorical multiple regression analysis with EBPSA scores as the dependent variable, years of clinical experience and sex as adjustment variables, and the characteristics of occupational therapists and their clinical, teaching, and research experiences as independent variables.
Results: In total, 531 occupational therapists (44% response rate) responded to the questionnaire. Of these, 465 who answered all questions were considered valid respondents. As a result, the following five items related to "work environment," "intrinsic motivation," and "self-efficacy" subscale scores in the EBPSA were extracted: final educational background; experience in education on EBP methodology; positive experiences resulting from the implementation of EBP; experience in presenting at academic conferences as the first author; experience in education on high-level evidence-based intervention and assistance methods.
Conclusions: It was discussed the important issues of enhancing EBP education, encouraging academic and research activities, and increasing positive experience resulting from the implementation of EBP for improving the "workplace environment," "intrinsic motivation," and "self-efficacy."

Keywords: evidence-based practice, evidence, occupational therapist, convalescent rehabilitation wards, survey

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Introduction

Until the early 1990s, the provision of medical care often relied solely on opinions and experience [1], often resulting in poor decision-making [2]. In the mid-1990s, when evidence-based medicine (EBM) became widespread, the rate of treatment without evidence clearly decreased owing to its implementation [3]. Furthermore, it was reported that physician practices and patient outcomes were significantly improved using various medical guidelines developed by applying EBM methods [4].

The practice of EBM means integrating individual clinical expertise, patient values, and the best available clinical evidence [5]. The process of EBM entails five steps: (1) asking an answerable clinical question based on the health needs of a specific client; (2) finding the best available evidence by searching the literature; (3) critically appraising the literature (check for validity, clinical relevance, and applicability); (4) applying the evidence in clinical practice; and (5) evaluating steps (1)−(4) [6]. Subsequently, EBM has been widely disseminated throughout health care as evidence-based practice (EBP) since 2000.

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However, EBP does not provide a specific methodology for step (4). Therefore, value-based practice was proposed as a concept to develop EBP, focusing on the "value" of clients, their families, and medical professionals [7]. Moreover, shared decision-making has gained global attention as a method for clinical decision-making and consensus-building against the backdrop of growing social demand to respect the values of clients in medicine and the trend towards EBM [8]. The underlying decision-making common to both is EBP.

Recently, the number of occupational therapists with a positive attitude towards EBP has increased because advances in information technology have made it easier to access high-quality evidence, and various medical guidelines have become more widely used [9]. However, the implementation of EBP is challenging because it requires a diversity of knowledge and skills, such as effective search skills, critical appraisal, understanding of individualization, and an understanding of the context of clients [10]. Specifically, difficulties reported include time constraints [9], utilizing databases [10], high continuing education costs, poor research analysis skills, and a preference for clinical experience over research [11]. To resolve these difficulties in implementing EBP, training sessions and workshops have been held mainly in Europe and the United States [12–13], and scales have been developed to assess the effectiveness of various programs [14–16]. Conversely, in Asia, including Japan, EBP has widely become only a concept, and there is still a lack of empirical research on measures to promote its implementation.

Against this background, we first developed the EBP Self-Assessment (EBPSA) for occupational therapists in Japan and confirmed its reliability and validity [17]. Moreover, it is necessary to clarify the factors related to the EBPSA scores and to examine more specific measures to promote EBP in the pre- and post-graduate education of occupational therapists. Therefore, this study explored the characteristics of occupational therapists and their clinical, educational, and research experiences related to the EBPSA scores. The participants in this study were occupational therapists working in convalescent rehabilitation wards, who play a central role in rehabilitation medicine in Japan. The term "evidence" in this study refers to clinical epidemiological studies (quantitative studies).

Methods

Questionnaire Structure

First, the preliminary survey was conducted based on a questionnaire developed as a prototype version. Thirty occupational therapists (13 males and 17 females, with a median of 7.0 years of clinical experience), working in convalescent rehabilitation wards in the Tokyo metropolitan area, were asked to respond to the questionnaire and provide their opinions [18]. Based on the results of the preliminary survey, we modified the expressions that were difficult to understand and added the questionnaire items. The following two items were added to the characteristics of occupational therapists: progress in lifelong education produced by the Japanese Association of Occupational Therapists (JAOT) and work assignments. The following seven items were added to the clinical, teaching, and research experience: experience in the implementation of EBP; positive experience resulting from the implementation of EBP; experience in education on high-level evidence-based intervention and assistance methods; experience in the implementation of clinical research; experience in presenting at academic conferences as the first author; experience in writing scientific papers as the first author; and experience as a preceptor in the training of junior staff (educating new recruits). Based on the results of the preliminary survey, the questionnaire in this study comprised three parts: the characteristics of occupational therapists; their clinical, educational, and research experiences; and EBPSA. The specific contents of the questionnaire are presented below.

Part 1. Characteristics of occupational therapists

According to the individual factors in the scoping review by Thomas et al. [19], academic degree and post-professional training were reported as factors to support the use of research in practice or EBP. Based on this previous study, in the characteristics section of the questionnaire, participants were asked to respond to years of clinical experience, sex, final educational background, progress in lifelong education produced by the JAOT, work area, and work assignment.

Part 2. Clinical, educational, and research experiences

The clinical, educational, and research experience section required participants to respond "Yes" or "No." The questionnaire comprised the following 12 items, based on a previous study [19]: experience in implementing EBP; positive experience resulting from the implementation of EBP; experience in education on EBP methodology; experience in education on rehabilitation and occupational therapy research methods; experience in education on high-level evidence-based intervention and assistance methods; experience in the implementation of clinical research; positive experience with research; experience in presenting at academic conferences as the first author; experience in writing scientific papers as the first author; work experience in

the professional team such as by disease or intervention method; experience as a preceptor in the training of junior staff (educating new recruits); and experience as a clinical practice supervisor of students.

Part 3. EBPSA

The EBPSA was examined for reliability and validity in a previous study [17]. It comprises the following four factors: "workplace environment" that encourages EBP; "intrinsic motivation" for EBP; "self-efficacy" regarding EBP; and "outcome expectancy" for EBP. EBPSA is also unique in that it was developed based on various theories of behavioral science, including the self-efficacy theory [20], self-determination theory [21], and the theory of planned behavior [22]. The EBPSA response to each question was on a seven-point scale (1 = strongly disagree to 7 = strongly agree). The EBPSA was developed in Japanese, and the Japanese version was used in this study. In this paper, the English version of the EBPSA was included for readers to understand its content.

In preparing the EBPSA English version, the first step was the translation of the Japanese version into English by the first author. In the second step, the EBPSA English version was back-translated into Japanese by a bilingual collaborator who was not familiar with the original Japanese version. In the third step, an American occupational therapist, whose native language is English and who was not familiar with the original Japanese version, checked the translation consistency.

Survey procedure

This study was conducted with 1216 occupational therapists (one per hospital) working in 1216 hospitals, designated regular members of the Kaifukuki Rehabilitation Ward Association in Japan as of April 2020. The breakdown of hospitals by area was as follows: 48 (4%) in the Hokkaido area; 75 (6%) in the Tohoku area; 110 (9%) in the Kanto area excluding the Tokyo metropolitan area; 197 (16%) in the Tokyo metropolitan area; 63 (5%) in the Shinetsu/Hokuriku area; 141 (12%) in the Tokai/Chubu area; 215 (18%) in the Kansai area; 95 (8%) in the Chugoku area; 61 (5%) in the Shikoku area; and 211 (17%) in the Kyushu/Okinawa area.

The survey procedure involved mailing a set of documentss (questionnaire, written request for research collaborators, written explanation to research participants, return envelope) to the occupational therapy department managers of the target institutions and explaining the purpose, significance, methods, and handling of personal information of this study. Furthermore, the occupational therapy department managers were asked to randomly select an occupational therapist working in the convalescent rehabilitation wards to participate in this study and to distribute a set of questionnaires to the study participants. Inclusion criteria for the study participants were occupational therapists working in convalescent rehabilitation wards at the time of the survey. No exclusion criteria were established.

The required sample size was 368 participants, assuming the Z value (λ) corresponding to a confidence level of 95% is 1.96, response ratio of 0.4 based on the previous study [23], and sampling error of 0.05, based on the formula often used in social surveys ($n = \lambda^2 \times p(1 - p)/d^2$, n: required sample size, λ: Z value corresponding to the confidence level, p: response ratio, d: sampling error). To determine the number of participants in this study, the questionnaire collection rate was assumed to be approximately 40% based on a previous study [23].

The collection period was from June 1 to June 30, 2020.

Ethics considerations

The explanatory documents to the research participants clearly stated the following three points: (1) participant response to the questionnaire was voluntary; (2) the data would be statistically processed so that individuals would not be identified; and (3) the data would be stored in a locked locker and destroyed after a certain period of time in an unreproducible form so that participant data are never leaked to the outside. Consent for this study was obtained from the participants by asking them to answer and return the questionnaire.

This study was conducted in compliance with the ethical guidelines of the World Medical Association (Declaration of Helsinki, 1964 and Declaration of Tokyo, 1975, revised 2013). This study was approved by the Research Ethics Committee for Human Sciences at the University of Tsukuba (No. East 2019-76).

Data analyses

First, a descriptive statistical analysis was conducted on the characteristics of occupational therapists; their clinical, educational, and research experiences; as well as the EBPSA response scores. The EBPSA subscale scores were calculated as the median (interquartile range) of the sum of each questionnaire item. In addition, to examine whether the characteristics of occupational therapists in this study reflected national data, we compared them using the JAOT 2021 publicly available membership statistics data [24]. Specifically, we conducted a non-paired t-test to compare the years of clinical experience in this study with that of national data. We also conducted a χ^2 test to compare the male-to-female ratio of participants in this study with that of national

data.

Next, categorical multiple regression analysis (forced entry method) was conducted to analyze the characteristics of occupational therapists and their clinical, educational, and research experience related to the EBPSA scores. The dependent variable was the EBPSA subscales; the adjustment variables were years of clinical experience and sex; and the independent variables were the final educational background, progress in lifelong education produced by the JAOT, and 12 items of clinical, educational, and research experience. The independent variables were selected based on the variance inflation factor ≤ 5.0 in consideration of multicollinearity [23].

For the characteristics of occupational therapists, dummy variables were created as follows: for sex, 0 for male and 1 for female; for final education, 0 for graduation from a vocational school and junior college and 1 for graduation from a university and master's and doctoral programs in graduate school; for progress in lifelong education produced by the JAOT, 0 for basic training not yet completed and 1 for having completed basic training or more. In addition, dummy variables were created for the 12 independent variables of clinical, educational, and research experience, without experience as 0 and with experience as 1.

IBM SPSS Statistics for Windows ver. 26.0 J was used for statistical analysis, and the significance level was set at < 5%.

Results

Characteristics of occupational therapists

Responses were obtained from 515 participants (response rate: 44%). Of these, 465 who answered all questions were considered valid respondents and comprised 298 males (64.1%) and 167 females (35.9%) (Table 1). The duration of their clinical experience was 12.14 ± 5.86 years. According to the JAOT 2021 publicly available membership statistics data [24] as of Fiscal Year 2020, there were 61,633 members, consisting of 24,480 males (38.6%) and 39,018 females (61.4%), with a clinical experience of 10.86 ± 8.33 years calculated from the year they qualified. The data from these two groups were statistically compared. The results showed that the years of clinical experience in this study was significantly higher than the national data (t (478) = 4.67, p < .001), and the number of males who responded to the questionnaire was significantly more than females (χ^2 (1, 63963) = 126.8, p < .001).

The most common educational background was vocational school (56%), followed by university (35%). The most common progress in lifelong education produced by JAOT was basic training completed (48%), followed by basic training not yet completed (47%). The most common work areas were the Kyushu and Okinawa areas (18%), followed by the Tokyo metropolitan area (16%) and the Kansai area (15%). The most common work assignment was working only in convalescent rehabilitation wards (57%); followed by working concurrently in acute care wards, community comprehensive care wards, and home rehabilitation (20%); and working concurrently in administration, management, and education departments (20%).

Table 1 Characteristics of participants (n = 465).

Question Items	*n* (%)
Years of clinical experience	
1~5 years	64 (13.8)
6~10 years	123 (26.5)
11~15 years	148 (31.8)
More than 16 years	130 (27.9)
Means (Standard Deviation)	12.14 (5.86)
Sex	
Male	298 (64.1)
Female	167 (35.9)
Final educational background	
Vocational School	258 (55.5)
Junior College	13 (2.8)
University	163 (35.1)
Master's Programs in Graduate School	30 (6.5)
Doctoral Programs in Graduate School	1 (0.2)
Progress in lifelong education	
Basic training not yet completed	218 (46.9)
Basic training completed	221 (47.5)
Certified Occupational Therapist	26 (5.6)
Specialized Occupational Therapist	0 (0.0)
Work area	
Hokkaido area	27 (5.8)
Tohoku area	26 (5.6)
Kanto area (excluding Tokyo Metropolitan area)	43 (9.2)
Tokyo Metropolitan area	74 (15.9)
Shinetsu and Hokuriku area	25 (5.4)
Tokai and Chubu area	57 (12.3)
Kansai area	68 (14.6)
Chugoku area	39 (8.4)
Shikoku area	21 (4.5)
Kyushu and Okinawa area	85 (18.3)
Work assignment	
Working only in convalescent rehabilitation wards	264 (56.8)
Working concurrently in acute care wards, community comprehensive care wards, and home rehabilitation	95 (20.4)
Working concurrently in administration, management, and education departments	94 (20.2)
Other	12 (2.6)

Table 2 Clinical, educational, and research experience.

Question Items	Experience *n* (%)	
Experience in the implementation of EBP	No	90 (19.4)
	Yes	375 (80.6)
Positive experience resulting from implementation of EBP	No	119 (25.6)
	Yes	346 (74.4)
Experience in education on EBP methodology	No	207 (44.5)
	Yes	258 (55.5)
Experience in education on rehabilitation and occupational therapy research methods	No	176 (37.8)
	Yes	289 (62.2)
Experience in education on high-level evidence-based intervention and assistance methods	No	234 (50.3)
	Yes	231 (49.7)
Experience in the implementation of clinical research	No	252 (54.2)
	Yes	213 (45.8)
Positive experience with research	No	260 (55.9)
	Yes	205 (44.1)
Experience in presenting at academic conferences as the first author	No	195 (41.9)
	Yes	270 (58.1)
Experience in writing scientific papers as the first author	No	411 (88.4)
	Yes	54 (11.6)
Work experience in the professional team such as by disease or intervention method	No	355 (76.3)
	Yes	110 (23.7)
Experience as preceptor in training of junior staff e.g., educating new recruits	No	41 (8.8)
	Yes	424 (91.2)
Experience as clinical practice supervisor of students	No	75 (16.1)
	Yes	390 (83.9)

EBP: evidence-based practice

Clinical, educational, and research experiences and EBPSA

The results of clinical, educational, and research experiences related to EBP are presented in Table 2. The items most participants answered "Yes" to these experiences were as follows: experience as a preceptor in the training of junior staff (educating new recruits) was selected by 424 (91.2%); experience as clinical practice supervisor of students was selected by 390 (83.9%); and experience in the implementation of EBP was selected by 375 (80.6%). Conversely, the items few participants answered "Yes" to these experiences were as follows: experience in writing scientific papers as the first author was selected by 54 (11.6%), and experience in a professional team such as by disease or intervention method was selected by 110 (23.5%).

The results for the EBPSA subscale scores were presented (Table 3). The "work environment" was 20.0 (15.0–25.0), the "intrinsic motivation" was 18.0 (15.0–19.0), the "self-efficacy" was 13.0 (11.0–15.0), and the "outcome expectancy" was 15.0 (13.0–17.0).

Characteristics of occupational therapists and their clinical, educational, research experiences related to the EBPSA scores

Factors related to "workplace environment" were "experience in education on EBP methodology (β = .13, p = .022)" and "final educational background (β = .10, p = .044)" (*Adj* R^2 = .11, F (16, 448) = .444, p < .044). Factors related to "intrinsic motivation" were "positive experiences resulting from implementing EBP (β = .20, p = .010)" and "experience in presenting at academic conferences as the first author (β = .13, p = .016)" (*Adj* R^2 = .16, F (16, 448) = 6.46, p < .001). Factors related to "self-efficacy" were "positive experience resulting from implementing EBP (β = .15, p = .045)" and "experience in education on high-level evidence-based intervention and assistance methods (β = .13, p = .009" (*Adj* R^2 = .25, F (16, 448) = 10.61, p < .001). Factors related to "outcome expectancy" were none (*Adj* R^2 = .02, F (16, 448) = 1.53, p = .085) (Table 4).

Discussion

This study investigated the characteristics of occupational therapists and their clinical, educational, and research experiences related to the EBPSA scores. A mailed questionnaire survey was conducted among 1216 occupational therapists who work in convalescent rehabilitation wards in Japan. A categorical multiple regression analysis (forced entry method) was conducted with 465 valid responses. The following five items related to "work environment," "intrinsic motivation," and "self-efficacy" subscale scores in the EBPSA were extracted: final educational background; experience in education on EBP methodology; positive experiences resulting from the implementation of EBP; experience in presenting at academic conferences as the first author; experience in education on high-level evidence-based intervention and assistance methods.

Characteristics of occupational therapists and their clinical, educational, research experiences related to the EBPSA scores

First, factors related to the "workplace environment" score consisted of experience in education on EBP methodology (β = .13) and final educational background (β = .10). The "workplace environment" consisted of the role of the workplace environment in linking clinical and research activities such as the encouragement of academic activities, accumulation of clinical data, presence of advisors on research, environment for accessing research resources, and opportunities for learning together, including paper reading sessions. Experience in education on EBP methodology was extracted because

Table 3 EBPSA response scores. *n* (%)

Question Items	Median (IQR)	1	2	3	4	5	6	7
Workplace environment that encourages EBP (Workplace environment)	20.0 (15.0–25.0)							
1. In my workplace, there is a system that supports presentations at scientific meetings and writing academic papers.	5.0 (3.0–6.0)	28 (6.0)	32 (6.9)	57 (12.3)	76 (16.3)	121 (26.0)	104 (22.4)	47 (10.1)
2. In my workplace, there is a system for accumulating clinical data on clients.	4.0 (2.0–5.0)	50 (10.8)	67 (14.4)	86 (18.5)	100 (21.5)	97 (20.9)	50 (10.8)	15 (3.2)
3. In my workplace, there are senior staff and colleagues who we can ask about research.	5.0 (3.0–6.0)	53 (11.4)	47 (10.1)	69 (14.8)	44 (9.5)	115 (24.7)	100 (21.5)	37 (8.0)
4. In my workplace, we have access to academic databases and we can browse scientific journals in the library.	4.0 (2.0–5.0)	78 (16.8)	68 (14.6)	64 (13.8)	49 (10.5)	94 (20.2)	79 (17.0)	33 (7.1)
5. In my workplace, we have a habit of learning from each other, such as study groups, where we read and discuss research papers.	4.0 (2.0–5.0)	67 (14.4)	79 (17.0)	77 (16.6)	71 (15.3)	103 (22.2)	50 (10.8)	18 (3.9)
Intrinsic motivation for EBP (Intrinsic motivation)	18.0 (15.0–19.0)							
6. I wish to incorporate EBP in occupational therapy practice.	6.0 (5.0–6.0)	2 (0.4)	1 (0.2)	3 (0.6)	40 (8.6)	152 (32.7)	156 (33.5)	111 (23.9)
7. I wish to learn about EBP.	6.0 (5.0–6.0)	2 (0.4)	1 (0.2)	5 (1.1)	35 (7.5)	134 (28.8)	175 (37.6)	113 (24.3)
8. I think as occupational therapist I need to implement EBP.	6.0 (5.0–6.0)	2 (0.4)	1 (0.2)	5 (1.1)	39 (8.4)	137 (29.5)	168 (36.1)	113 (24.3)
Self-efficacy regarding EBP (Self-efficacy)	13.0 (11.0–15.0)							
9. I can understand the client values, and expectations of interventions and support methods, and determine whether research evidence is applicable to the client.	5.0 (4.0–5.0)	8 (1.7)	28 (6.0)	50 (10.8)	117 (25.2)	193 (41.5)	58 (12.5)	11 (2.4)
10. I can self-appraise the impact of interventions and supporting methods implemented on clients, and apply them to subsequent occupational therapy practice.	5.0 (5.0–6.0)	3 (0.6)	13 (2.8)	25 (5.4)	59 (12.7)	225 (48.4)	118 (25.4)	22 (4.7)
11. I can critically appraise appropriateness of research methods, characteristics of assessments, and validity and generalizability of research findings.	4.0 (3.0–4.0)	32 (6.9)	78 (16.8)	109 (23.4)	136 (29.2)	83 (17.8)	22 (4.7)	5 (1.1)
Outcome expectancy for EBP (Outcome expectancy)	15.0 (13.0–17.0)							
12. I believe that implementation of EBP will make it easier to develop the trust of clients.	5.0 (4.0–6.0)	8 (1.7)	11 (2.4)	25 (5.4)	128 (27.5)	156 (33.5)	107 (23.0)	30 (6.5)
13. I believe that implementation of EBP can support the decision-making of clients.	5.0 (4.0–5.0)	7 (1.5)	13 (2.8)	33 (7.1)	133 (28.6)	169 (36.3)	87 (18.7)	23 (4.9)
14. I believe that implementation of EBP will allow me to keep up-to-date finding on assessments and interventions of occupational therapy.	5.0 (5.0–6.0)	4 (0.9)	2 (0.4)	16 (3.4)	62 (13.3)	185 (39.8)	161 (34.6)	35 (7.5)

IQR: interquartile range; EBP: evidence-based practice; EBPSA: EBP self-assessment
For each question, responses were requested on 7-points scale. (1: Strongly Disagree, 2: Disagree, 3: Somewhat Disagree, 4: Neither Agree nor Disagree, 5: Somewhat Agree, 6: Agree, 7: Strongly Agree)

workplaces that encourage academic activities and research may actively provide EBP education to occupational therapists. Novak et al. [25] reported that EBP education in the workplace environment that encouraged EBP improved EBP knowledge and skills of occupational therapists and led to long-term behavioral change. Moreover, in a semi-structured interview study of 30 Australian occupational therapists, Bennett et al. [26] reported that the workplace environment that encourages EBP may lead to changes in EBP-oriented occupational therapy practice and attitudes that link practice and clinical research. In short, creating a workplace environment that promotes EBP and provides occupational therapists with EBP education, may lead to the implementation of EBP. In addition, it is also possible that occupational therapists who have received EBP education in pre- and post-graduate education, and not just in the workplace environment, will also become more aware of the need to create a workplace environment that promotes EBP. Experience in education on EBP methodology: 207

Table 4 Participants' characteristics and clinical, educational, and research experiences related to the EBPSA.

Question Items	EBPSA			
	Workplace environment	Intrinsic motivation	Self-efficacy	Outcome expectancy
Characteristics of participants				
Years of clinical experience	.07	−.05	.07	−.02
Sex	.05	−.13**	−.08	−.05
Final educational background	.10*	.03	−.02	−.02
Progress in lifelong education	.00	.04	.02	.02
Clinical, educational, and research experience				
Experience in the implementation of EBP	−.08	.10	.02	.09
Positive experience resulting from implementation of EBP	.06	.20*	.15*	.06
Experience in education on EBP methodology	.13*	.01	.09	.12
Experience in education on rehabilitation and occupational therapy research methods	.06	.04	.06	.04
Experience in education on high-level evidence-based intervention and assistance methods	.04	.00	.13**	−.07
Experience in the implementation of clinical research	.07	−.01	.05	−.10
Positive experience with research	.13	.05	.13	.06
Experience in presenting at academic conferences as the first author	.04	.13*	.07	.04
Experience in writing scientific papers as the first author	.01	.02	.04	−.02
Work experience in the professional team such as by disease or intervention method	.04	.00	.06	.01
Experience as preceptor in training of junior staff e.g., educating new recruits	−.03	−.02	.04	−.03
Experience as clinical practice supervisor of students	.07	−.05	.01	.01
Adj R^2	.11	.16	.25	.02
F	4.44	6.46	10.61	1.53
p	< .001	< .001	< .001	.085

EBP: evidence-based practice
* $p < .05$, ** $p < .01$

respondents (44.5%) answered "No" and 258 respondents (55.5%) answered "Yes". This result suggests that EBP education is not being provided sufficiently. We believe that actively implementing EBP education in the workplace environment and in pre- and post-graduate education is important for the future. Moreover, it is considered that the reason for the extraction of final educational background is related to the experience of conducting research. At universities, there are many opportunities for graduate research, and at graduate schools, research activities are the main focus; hence, it is suggested that occupational therapists with a university degree or higher tend to prefer a workplace environment where they can engage in academic and research activities. At the same time, it is also possible that occupational therapists with a high final educational background are working to create a workplace environment that makes it easier to engage in academic and research activities. This study supports a previous study, which reported that academic degrees are the strongest predictor of research use [27]. In this study, 271 (58.2%) participants were graduates of vocational schools or junior colleges, and 194 (41.8%) were graduates of universities or graduate schools. There were few participants who had completed graduate school, hence statistical analysis was difficult; however, the results suggest that there is a possibility that the number of occupational therapists who implement EBP will increase if they are supported in their postgraduate studies in the workplace environment. Parkinson et al. [28] reported that expert guidance, regular feedback, and supervision by knowledgeable colleagues are important ways to ensure the application of new knowledge and have a positive impact on the work environment. This may suggest that occupational therapists with higher levels of education may lead to improvements in the work environment.

Second, factors related to the "intrinsic motivation" score included positive experiences resulting from the implementation of EBP (β = .20) and experience in presenting at academic conferences as the first author (β = .13). The "intrinsic motivation" scale is composed of items that measure the perception of occupational therapist if they want to use EBP in clinical practice, such as behavioral intention, positive attitude, motivation to learn, and occupational identity. The reason positive experiences resulting from the implementation of EBP were extracted is considered to be because positive experiences with EBP improve attitudes and motivation to implement EBP. The fulfillment of three psychological needs - autonomy, competence, and relatedness - is

a prerequisite for increasing intrinsic motivation [21]. In short, positive experience resulting from the implementation of EBP may promote autonomy, competence, and relatedness resulting in improved intrinsic motivation. The reason that experience in presenting at academic conferences as the first author was extracted suggests that EBP and academic and research activities are highly interrelated. Academic conference presentations are a place to publicize one's clinical practice, academic and research activities. Therefore, it is hoped that this opportunity will lead to a virtuous cycle in which intrinsic motivation for EBP is improved, and that this in turn will lead to more academic conference presentations. Positive experiences resulting from the implementation of EBP: 119 respondents (25.6%) answered "No" and 346 respondents (74.4%) answered "Yes". Experience in presenting at academic conferences as the first author: 195 respondents (41.9%) answered "No" and 270 respondents (58.1%) answered "Yes". For these two factors, there were more "Yes" responses than "No" responses. This may be related to the fact that the scores for the three items included in the "intrinsic motivation" scale are higher than the scores for the items included in the other subscales. It is thus important to provide educational support so that they can have a positive experience for EBP and develop a human and environmental system to support their presentations at conferences.

Third, factors related to the "self-efficacy" score included positive experience resulting from the implementation of EBP (β = .15) and experience in education on high-level evidence-based intervention and assistance methods (β = .13). The "self-efficacy" consists of questions that test confidence in specific knowledge and skills of EBP, such as STEP 3: critical appraisal, STEP 4: application to client, and STEP 5: self-appraise. The reason positive experiences resulting from the implementation of EBP were extracted is considered to be because the knowledge and skills of EBP improve through experiencing the series of processes of EBP and gaining positive experiences. We also surveyed the item experience in the implementation of EBP; however, this was not extracted as a related factor. Therefore, positive experience with EBP maybe an important factor. Positive experience resulting from the implementation of EBP may be strongly related to success experience that promoting self-efficacy [20]. Successful experiences are those of having done things well in the past. In other words, occupational therapists are expected to incorporate EBP into occupational therapy practice and accumulate successful experiences, thereby improving their self-efficacy and promoting the implementation of EBP. Clyde et al. [15], who have recently developed scales in the occupational therapy field, identified factors related to self-efficacy regarding EBP, including EBP knowledge and skills, educational opportunities, and training experiences. In Europe and the United States, training sessions and workshops on EBP have been held as educational opportunities and training experiences to promote EBP knowledge and skills, and their effectiveness has been reported [12–13]. In addition, post-professional training is associated with confidence in the ability to incorporate EBP into clinical practice, search for evidence, and generating clinical questions [29]. By enhancing EBP education in pre- and post-graduate education, it is considered that occupational therapists will accumulate positive experiences with EBP and increase their self-efficacy regarding it. The reason experience in education on high-level evidence-based intervention and assistance methods was extracted is because receiving education on specific treatment methods with high levels of evidence makes it easier to incorporate EBP into clinical practice and promotes understanding of evidence. Moreover, by experiencing specific interventions with high-level evidence, it is considered that occupational therapists can accumulate positive experiences with EBP, and that their self-efficacy with regard to EBP will improve. Experience in education on high-level evidence-based intervention and assistance methods: 234 respondents (50.3%) answered "No" and 231 respondents (49.7%) answered "Yes". Education on high-level evidence-based intervention and assistance methods is not being provided sufficiently. It is possible that positive experience resulting from the implementation of EBP and education on high-level evidence-based intervention and assistance methods in pre- and post-graduate education in Japan could lead to an improvement in self-efficacy.

Finally, the results of the categorical multiple regression analysis with "workplace environment," "intrinsic motivation," and "self-efficacy" scores as dependent variables showed low Adj R2 values of .11–.25. This is likely due to the characteristics of occupational therapists, including their clinical, educational and research experience, being diverse and complex; hence, only a small number of items could be surveyed in this study. However, this study is significant because and some of the occupational therapists' characteristics and their clinical, educational, and research experience were clarified as factors that promote EBP.

Limitations and future issues

In this study, the years of clinical experience of the occupational therapists was significantly higher than the national data, and significantly more males than females responded to the questionnaire compared to the national data. This suggests that the occupational therapists who

responded to the questionnaire in this study may have had a high level of interest in EBP. In short, it may have caused selection bias among the participants in this study. The cause of the selection bias may be that this study only targeted one occupational therapist per hospital.

Since this study was conducted on occupational therapists working in convalescent rehabilitation wards in Japan, it is not certain whether similar results would be obtained in different participants, fields, or types of occupation. Thus, the generalizability of our results poses a limitation. Furthermore, since this is a cross-sectional study, it was not possible to determine causal relationships among the data.

In the future, through longitudinal surveys and intervention studies, the influence of characteristics of occupational therapists and their clinical, educational, and research experiences on EBP implementation need to be clarified from a causal perspective.

Conclusion

In this study, we examined the factors related to the EBPSA subscales. We discussed the important issues of enhancing EBP education, encouraging academic and research activities, and increasing positive experience resulting from the implementation of EBP as future issues for improving the "workplace environment," "intrinsic motivation," and "self-efficacy."

Conflict of interest

The authors have no conflicts of interest to disclose.

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References

[1] Dubinsky M, Ferguson JH. Analysis of the National Institutes of Health Medicare coverage assessment. Comparative Study Int J Technol Assess Health Care. 1990; 6(3): 480–8.

[2] The Cardiac Arrhythmia Suppression Trial II Investigators. Effect of the antiarrhythmic agent moricizine on survival after myocardial infarction. N Engl J Med. 1992; 327(4): 227–33.

[3] Michaud G, McGowan JL, van der Jagt R, Wells G, Tugwell F. Are therapeutic decisions supported by evidence from health care research? Arch lntern Med. 1998; 158(15): 1665–8.

[4] Grimshaw JM, Hutchinson A. Clinical practice guidelines-do they enhance value for money in health care? Br Med Bull. 1995; 51(4): 927–40.

[5] Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. BMJ. 1996; 312: 71–2.

[6] Sackett DL. Evidence-based medicine. Semin Perinatol. 1997; 21(1): 3–5.

[7] Brown GC. Value-based medicine: the new paradigm. Curr Opin Ophthalmol. 2005; 16(3): 139–40.

[8] Barry MJ, Edgman-Levitan S. Shared decision making-pinnacle of patient-centered care. N Engl J Med. 2012; 366(9): 780–1.

[9] Lindstrom A, Bernhardsso S. Evidence-based practice in primary care occupational therapy: A cross-sectional survey in Sweden. Occup Ther Int. 2018; 5376764.

[10] McCluskey A. Occupational therapists report a low level of knowledge, skill and involvement in evidence-based practice. Aust Occup Ther J. 2003; 50(1): 3–12.

[11] Dysart AM, Tomlin GS. Factors related to evidence-based practice among U.S. occupational therapy clinicians. Am J Occup Ther. 2002; 56(3): 275–84.

[12] Boruff JT, Thomas A. Integrating evidence-based practice and information literacy skills in teaching physical and occupational therapy students. Health Info Libr J. 2011; 28(4): 264–7.

[13] Thomas A, Saroyan A, Dauphinee WD. Evidence-based practice: a review of theoretical assumptions and effectiveness of teaching and assessment interventions in health professions. Adv Health Sci Educ Theory Pract. 2011; 16(2): 253–76.

[14] Salbach NM, Jaglal SB. Creation and validation of the evidence-based practice confidence scale for health care professionals. J Eval Clin Pract. 2011; 17(4): 794–800.

[15] Clyde JH, Brooks D, Cameron JI, Salbach NM. Validation of the Evidence-Based Practice Confidence (EPIC) Scale with occupational therapists. Am J Occup Ther. 2016; 70(2): 1–9.

[16] McEvoy MP, Williams MT, Olds TS. Development and psychometric testing of a trans-professional evidence-based practice profile questionnaire. Med Teach. 2010; 32(9): e373–80.

[17] Masuda Y, Yaeda J, Aida T. Development of new Evidence-Based Practice Self-Assessment (EBPSA) for occupational therapists (in Japanese). The Japanese Occupational Therapy research (sagyouryouhou). 2023; 42(1): 68–79.

[18] Masuda Y, Yaeda J, Aida T. Preliminary survey of factors associated with promoting evidence-based practice among occupational therapists working in convalescent rehabilitation wards. Asian J Occup Ther. 2023; 19(1): 1–7.

[19] Thomas A, Law M. Research utilization and evidence-based practice in occupational therapy: a scoping study. Am J Occup Ther. 2013; 67(4): e55–65.

[20] Bandura A. Self-efficacy: toward a unifying theory of behavioral change. Psychol Rev. 1977; 84(2): 191–215.

[21] Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development,

and well-being. Am Psychol. 2000; 55(1): 68–78.
[22] Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process. 1991; 50(2): 179–211.
[23] Jamal I, Daoud. Multicollinearity and Regression Analysis. J Phys: Conf Ser. 2017; 949 012009.
[24] The Japanese Association of Occupational Therapists [Online]. Members Portal Site: statistics data 2021 [cited September 19, 2023]. Available from: https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.jaot.net%2Fmm%2Fkaiintoukei2021-1.xlsx.
[25] Novak I, McIntyre S. The effect of education with workplace supports on practitioners' evidence-based practice knowledge and implementation behaviours. Aust Occup Ther J. 2010; 57(6): 386–93.
[26] Bennett S, Allen S, Caldwell E, Whitehead M, Turpin M, Fleming J, et al. Organizational support for evidence-based practice: occupational therapist perceptions. Aust Occup Ther J. 2016; 63(1): 9–18.
[27] Brown T, Tseng MH, Casey J, McDonald R, Lyons C. Research knowledge, attitudes, and practices of pediatric occupational therapists in Australia, the United Kingdom, and Taiwan. J Allied Health. 2010; 39(2): 88–94.
[28] Parkinson S, Lowe C, Keys K. Professional development enhances the occupational therapy work environment. Br J Occup Ther. 2010; 73(10): 470–6.
[29] Bennett S, Tooth L, McKenna K, Rodger S, Strong J, Ziviani J, et al. Perceptions of evidence-based practice: A survey of Australian occupational therapists. Aust Occup Ther J. 2003; 50: 13–22.

Evaluating the Impact of Caregiver Skill and Spatial Constraints on Postural Load in Care Tasks Using Robots: A Preliminary Study

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Abstract: Objective: This study examines how care robot use, spatial constraints, and caregiver proficiency affect torso and pelvic posture during toileting assistance, focusing on lower garment manipulation - a physically demanding task in excretion care.
Methods: Twenty-four participants (12 experts and 12 nonexperts) performed toileting assistance tasks using an excretion assistance device across three bathroom layouts: a 1.34 m^2 residential layout (1.34 plan), a 2.11 m^2 care facility layout (2.11 plan), and a modified 1.34 m^2 residential layout with a widened entrance (1.34 W plan). The IMU-based motion capture system measured the torso and pelvic angles during robot positioning and garment lowering.
Results: Significant differences were observed between experts and nonexperts across all movement types (flexion, lateral flexion, and rotation), with nonexperts exhibiting consistently higher angles, suggesting increased biomechanical loading. Spatial design significantly influenced rotational movements, with the modified residential layout (1.34 W plan) reducing angles compared to the standard residential layout (1.34 plan). However, no significant interaction effect was found between skill level and spatial conditions.
Conclusion: When implementing care robots, caregiver proficiency and environmental factors should be considered separately. The findings indicate that optimizing only the spatial design or training alone may not be sufficient, but addressing both factors can enhance caregiving efficiency and reduce physical burden. Specifically, appropriate spatial design alleviates movement strain, while skilled caregivers demonstrate more efficient motion patterns, even in constrained spaces. These insights contribute to optimizing caregiving environments in home and small-scale facilities, facilitating the effective utilization and adoption of excretion care robots.

Keywords: care robots, caregiver proficiency, ergonomics, home care, motion capture

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Introduction

Japan has been advancing the development and adoption of care technologies, including care robots, to maintain quality caregiving services and reduce the physical burden on caregivers. Since 2018, it has strengthened its development system and implemented support measures to promote its introduction and utilization [1]. Under this initiative, the Japanese government prioritizes nine areas: transfer assistance, mobility, excretion, bathing, monitoring, meal support, functional training, dementia care, and care work support. However, the adoption rates vary significantly across these areas, ranging from 0.5% in excretion care to 30% in monitoring and communication support [2].

While care technologies have demonstrated the potential to alleviate caregivers' physical strain [3, 4], their successful implementation faces several challenges. The introduction of care technologies without adequate consideration of their interaction with the caregiving environment may diminish their effectiveness and lead to unintended negative consequences, including exacerbation of lower back pain [5, 6]. Particularly, there is

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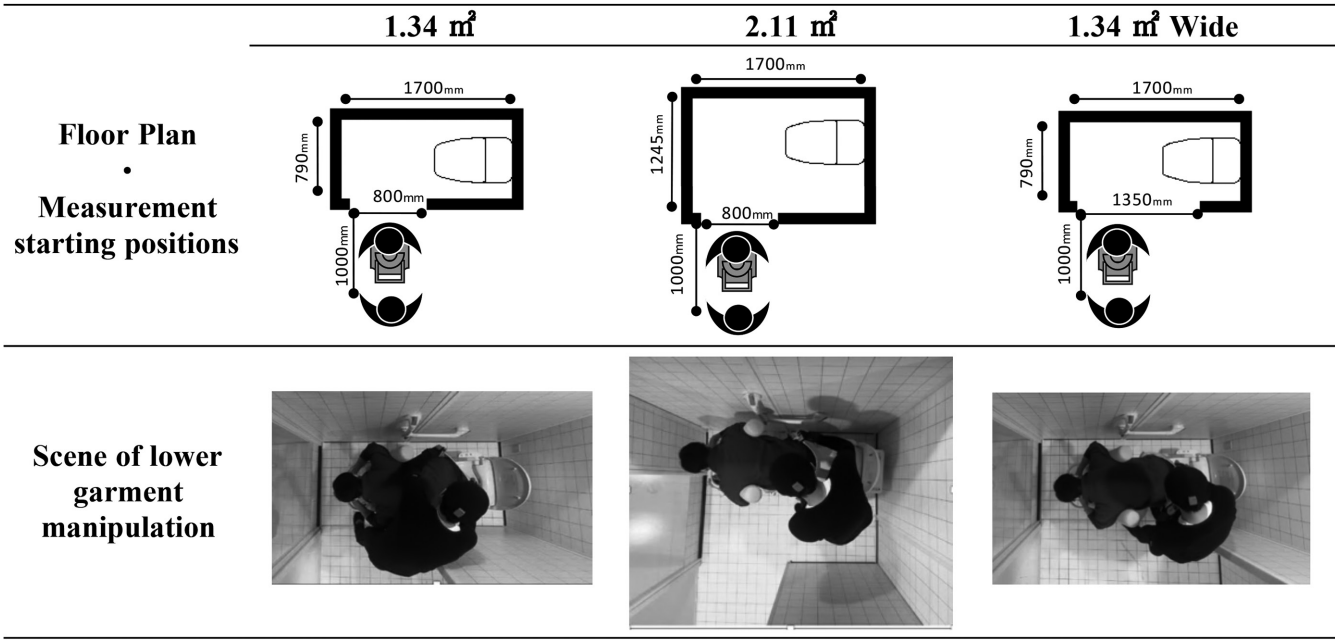

Fig. 1. Work Postures During Lower Garment Manipulation with Care Robots (Hug-L1) by Floor Plan.
Toilet Internal Dimensions: The internal dimensions of the toilet are based on the traditional Japanese module and are presented in SI units. Hug-L1: The robot provides standing support and stability, allowing caregivers to perform lower garment manipulation with reduced physical burden.

insufficient evidence supporting the implementation guidelines for these devices and their operators in resource-limited environments, such as homes and small-scale facilities where productivity improvements are required. As the demand for care increases in these settings, the use of care technologies in confined spaces is expected to increase, underscoring the need to better understand how spatial constraints and caregiver proficiency influence their operation.

Given the particularly low adoption rate of excretion care devices (0.5%), we focused on caregiver postures and physical burdens when providing toileting assistance, specifically in tasks involving lower garment manipulation, which impose remarkable physical and psychological strains on caregivers [7]. We explored how spatial constraints, varying bathroom layouts, and caregiver proficiency levels influence these factors.

Our study findings will contribute to optimizing bathroom layouts for home care, developing effective care technology operation protocols, and establishing practical guidelines for toileting assistance, which may help increase the adoption of excretion care devices.

Method

Participants

The study participants included experts (occupational therapists, physical therapists, and care workers with experience as assistive device training instructors) and nonexperts without experience operating care robots.

In addition to basic demographic information such as age, gender, height, and weight, data on physical disability levels were collected from all participants. The Roland–Morris Disability Questionnaire (RMDQ) assessed the degree of physical disability related to lower back pain [8]. The RMDQ is a 24-item self-reported questionnaire that measures the impact of back pain on daily activities, with higher scores indicating greater disability. Herein, the RMDQ scores were analyzed to examine differences in physical function between the expert and nonexpert caregiver groups.

All participants provided informed consent after explaining the study procedures, risks, and rights. Sample size was determined through a priori power analysis using G*Power 3.1.9.6, indicating that 24 participants (12 per group) were required with parameters set to effect size $f = 0.45$, $\alpha = 0.05$, and power = 0.70. This design considered the anticipated substantial differences between experts and complete novices, in addition to the preliminary nature of the study and recruitment constraints for expert participants. The study was approved by the local ethics committee (no. R2301) and conducted per the guidelines stipulated in the Declaration of Helsinki.

Procedure

Figure 1 illustrates the measurement environment used in this study. We examined three different floor

Table 1 Characteristics of Participants.

Characteristics		Expert (n = 12)	Non-expert (n = 12)	p-value
Age (years)		46.83 ± 7.00	43.75 ± 16.29	.553[a]
Gender	Male	5 (41.7%)	8 (66.7%)	.219[b]
	Female	7 (58.3%)	4 (33.3%)	
Height (cm)		167.42 ± 7.49	168.08 ± 7.19	.826[a]
Weight (kg)		66.17 ± 14.75	64.58 ± 12.17	.777[a]
RDQ (mini-max)		0 (0–1)	0 (0–3)	.890[c]
Job (PT/OT/CW)		6 (50.0%)/2 (16.7%)/5 (33.3%)	—	
Experience (years)		20.58 ± 7.04	—	

Numerical values are represented as mean ± standard deviation.
RDQ, Roland–Morris Disability Questionnaire
[a] t-test
[b] χ^2-test
[c] Mann–Whitney U test

plans: a 1.34 m^2 layout (1.34 plan) representing typical residential bathrooms, a 2.11 m^2 layout (2.11 plan) commonly found in care facilities, and a modified 1.34 m^2 layout (1.34W plan) that incorporates architectural improvements such as an entrance widened with three sliding doors to accommodate side approaches. The measurements were conducted in this order. For each plan, we utilized an excretion movement support device (Hug-L1, Fuji) designed to assist in nursing care by supporting forward-standing posture and minimizing caregiver burden.

Each participant completed the toileting assistance sequence (approaching, lowering garments, sitting, standing, raising garments, and exiting) with motion data collected throughout. Participants performed a rehearsal followed by two measurement trials per layout.

The care receiver (male, 176 cm, 64 kg) met the Techno-Aid Association's criteria [9] for maintaining a sitting position with a substantial weight burden (Fig. 1).

Working postures during toileting assistance were measured using an inertial measurement unit (IMU)-based motion capture system (myoMOTION, Noraxon, Scottsdale, AZ, USA) in the shielded spaces. Two IMUs sampled at 200 Hz were used to measure the relative angles of the torso and pelvis. The participants wore measuring suits with hook-and-loop fasteners attached to the upper chest and sacrum to ensure accurate data collection.

Data Analysis

The period of analysis spanned from robot positioning to garment lowering completion. The average torso–pelvic angles were calculated for the experts and nonexperts during this task. A two-way analysis of variance (ANOVA) was used to examine the effects of Skill and Plan with their interaction (Skill × Plan). The partial eta squared (η_p^2) was calculated to determine the effect sizes. For layouts showing significant effects, post-hoc analysis was conducted using Tukey's HSD test to identify the specific differences between the plans.

Python 3.14.0 was used for data analysis. The pandas library was employed for data processing and management, whereas the statsmodels library was used for two-way ANOVA and constructing models with Skill and Plan, as well as their interaction (Skill × Plan), as independent variables. Moreover, a custom function based on the total sum of squares was implemented to calculate effect sizes (η_p^2). For post-hoc analysis, Tukey's HSD test was performed using scipy.

Results

Altogether, 24 participants, comprising 12 experts and 12 nonexperts, participated as caregivers. Table 1 summarizes the participants' demographic and professional characteristics, including age, gender, height, weight, and RMDQ score. The texts below describe how the layout changes influenced the flexion, lateral flexion, and rotational movements in both the expert and nonexpert groups (Fig. 2).

Flexion

Experts demonstrated the highest average angle in the 1.34 plan (22.38° ± 10.15°), while showing similar lower values in the 2.11 (19.88° ± 6.11°) and 1.34W (19.63° ± 8.84°) plans. Nonexperts exhibited their highest angles in the 2.11 plan (31.69° ± 16.32°), followed by the 1.34 (29.63° ± 13.19°) and 1.34 (26.29° ± 9.87°) plans. The results of the two-way ANOVA revealed only a significant main effect for Skill (F = 10.51, p = 0.002, η_p^2 = 0.134). Neither the Plan (F = 0.11, p = 0.895, η_p^2 = 0.003) nor the Skill × Plan interaction (F = 0.82, p = 0.447, η_p^2 = 0.021) showed significant effects (Table 2).

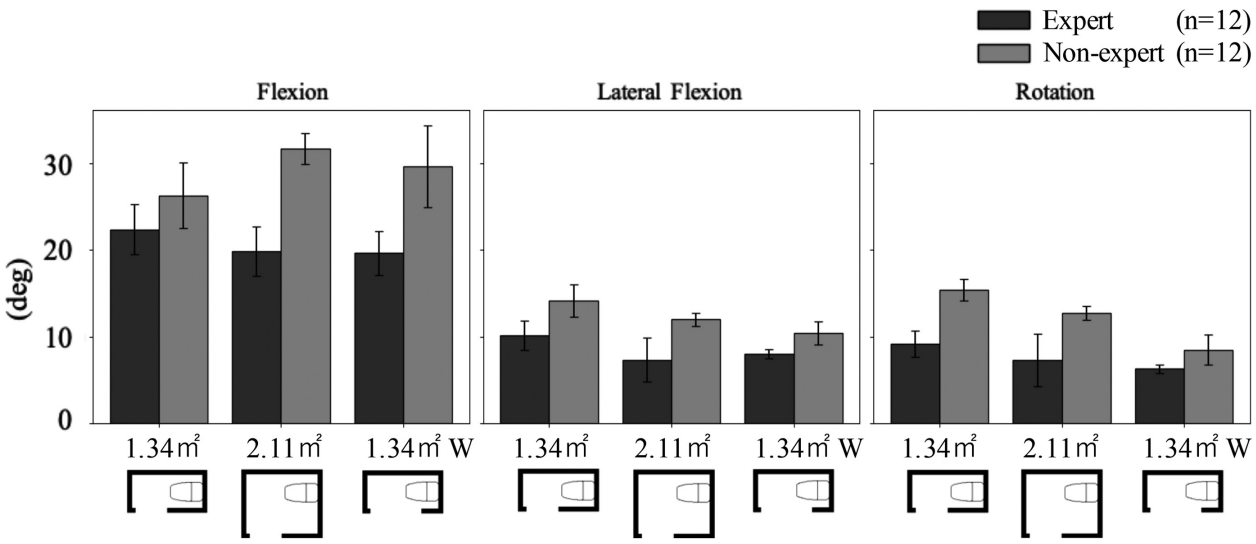

Fig. 2. Average Posture Angle by Floor Plan for Each Skill Level.
Error bar: Standard deviation of each dataset.

Table 2 The Effect of Skill Level and Floor Plan on Posture.

Flexion

	sum_sq	*df*	*F*	*p*-value[a]	η_p^2
Skill	1324.58	1	10.51	.002	0.134
Plan	28.14	2	0.11	.895	0.003
Skill : Plan	205.66	2	0.82	.447	0.021
Residual	8319.40	66			

Lateral Flexion

	sum_sq	*df*	*F*	*p*-value[a]	η_p^2
Skill	243.21	1	7.831	.007	0.100
Plan	121.20	2	1.951	.150	0.050
Skill : Plan	15.82	2	0.255	.776	0.007
Residual	2049.81	66			

Rotation

	sum_sq	*df*	*F*	*p*-value[a]	η_p^2
Skill	379.91	1	11.280	.001	0.129
Plan	288.97	2	4.290	.018	0.098
Skill : Plan	53.61	2	0.796	.456	0.018
Residual	2222.90	66			

[a] Significance, determined with an analysis of Two-way ANOVA, was set at a *p*-value of < .05.

Lateral Flexion

Experts displayed their highest angles in the 1.34 plan with an average of 10.17° ± 5.95°, whereas lower angles were observed in the 2.11 (7.33° ± 2.63°) and 1.34W (8.00° ± 1.88°) plans. Similarly, nonexperts showed their highest angles in the 1.34 plan with an average of 14.14° ± 8.75°, followed by the 2.11 (11.99° ± 4.62°) and 1.34W (10.41° ± 6.54°) plans. Statistical analysis revealed only a significant main effect for Skill (F = 7.831, p = 0.007, η_p^2 = 0.100). Neither the Plan (F = 1.951, p = 0.150, η_p^2 = 0.050) nor the Skill × Plan interaction (F = 0.255, p = 0.776, η_p^2 = 0.007) showed significance (Table 2).

Rotation

Experts exhibited their highest angles in the 1.34 plan (9.21° ± 5.29°), followed by decreasing angles in the 2.11 (7.35° ± 2.85°) and 1.34W (6.30° ± 1.59°) plans. Nonexperts showed a similar pattern, showing maximum angles in the 1.34 plan (15.40° ± 10.44°) but decreasing in the 2.11 plan (12.73° ± 6.09°) and reaching their minimum in the 1.34W plan (8.50° ± 4.18°). Statistical analysis revealed significant main effects for both Skill (F = 11.280, p = 0.001, η_p^2 = 0.129) and Plan (F = 4.290, p = 0.018, η_p^2 = 0.098), whereas the Skill × Plan interaction was not significant (F = 0.796, p = 0.456, η_p^2 = 0.018) (Table 2). Post-hoc analysis using Turkey HSD test showed a significant difference in the angles between the 1.34 and 1.34W plans (mean difference = −4.90°, p = 0.021, 95% CI [−9.19°, −0.61°]). However, no significant differences were found between the 1.34 and 2.11 plans (mean difference = −2.26°, p = 0.420, 95% CI [−6.56°, 2.03°]) or between the 1.34W and 2.11 plans (mean difference = 2.64°, p = 0.310, 95% CI [−1.65°, 6.93°]).

Discussion

The present study investigated the interaction between the environmental layout and caregiver proficiency in caregiving environments involving nursing-care

robots. The analysis revealed that caregiver skill level and spatial conditions were significant independent factors influencing work efficiency and postural strain. Notably, no significant interaction was found between these factors, suggesting they should be optimized separately.

The relationship between trunk angles and the physical burden has been well-established in ergonomic literature. Studies have indicated that increased trunk flexion angles (> 20°) are associated with higher biomechanical loads on the lower back [10]. In contrast, combined movements involving lateral flexion and rotation can further elevate the risk of musculoskeletal disorders [11]. In the present study, the higher angles observed in the nonexperts than in the experts across all movement types suggest increased biomechanical loading, particularly in constrained spaces. Skilled caregivers demonstrated more efficient movement patterns, mitigating physical strain even under spatial limitations.

The impact of spatial design was evident in its relationship with movement efficiency. Opening width was critical in facilitating movement, with wider openings improving performance during rotational tasks. However, an excessive width could lead to unnecessary movement adjustments. These findings underscore the importance of integrating optimal spatial design with caregiving practices to enhance caregiver performance and safety. These results are important for implementing nursing-care robots in home-based and small-scale facilities. Similar to Goto et al.'s study involving shower chairs [12], our results emphasize the necessity of aligning spatial constraints with equipment operation to optimize caregiving environments. Moreover, technological advancements and caregiver training programs remain essential to further reduce the physical burden among caregivers and improve operational efficiency [13–15].

Despite its contributions, this study has several limitations. As we only evaluated one specific model of care robot, our results cannot be generalized to other care robots or caregiving scenarios. Additionally, the study was conducted in a controlled experimental setting, which may not completely capture the complexities of real-world caregiving environments. Herein, postural angles were used as the primary measure of physical load. However, future studies could benefit from incorporating subjective workload assessments and muscle activity measurements for a more comprehensive analysis. This can clarify the effectiveness of robotic assistance and its impact on the caregiver burden. A broader range of care robots and caregiving scenarios will be examined to validate these findings and explore the long-term impact of spatial modifications and skill development on caregiving productivity and efficiency.

The study results indicate that merely using a care robot does not automatically reduce caregiver burden; rather, proper training in movement skills and appropriate spatial design are essential. Moreover, experienced caregivers demonstrated more efficient movement patterns, effectively minimizing physical strain even in constrained spaces. Conversely, less experienced caregivers exhibited high physical burden despite using the robot, suggesting that for maximizing the benefits of care robots, environmental adjustments and adequate caregiver training are crucial. Thus, the successful implementation of care robots requires device adoption and optimization of caregiving environments and skill enhancement.

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Conflict of Interest

The authors declare no competing interests.

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References

[1] Ministry of Health, Labor and Welfare. Strengthening the development and dissemination system of care robots: Establishment of Care Robot Development and Promotion Office and appointment of Care Robot Advisor [online]. Tokyo: MHLW [cited 2025 Jan 20]. Available from: https://www.mhlw.go.jp/stf/houdou/0000201028.html.

[2] Ministry of Health, Labor and Welfare. Priority Areas and Adoption Rates of Care Technologies [online]. Tokyo: MHLW [cited 2025 Jan 20]. Available from: https://www.mhlw.go.jp/content/12300000/001268135.pdf

[3] Mizuno F, Narita K, Hamada S. Development of a transfer-assisting robot system using a posture-supporting wear and support robot. J Robot Mechatron. 2021; 33(4): 893–9.

[4] Greenhalgh M, Blaauw E, Deepak N, St Laurent COLM, Cooper R, Bendixen R, et al. Usability and task load comparison between a robotic-assisted transfer device and a mechanical floor lift during caregiver-assisted

transfers of a care recipient. Disabil Rehabil Assist Technol. 2022; 17(7): 833–9.
[5] Persson M, Redmalm D, Iversen C. Caregivers' use of robots and their effect on work environment–a scoping review. J Technol Hum Serv. 2022; 40(3): 251–77.
[6] Iwakiri K, Takahashi M, Toyama M, Liu X, Koda S. Low back pain among workers in care facilities for the elderly after introducing welfare equipment (in Japanese). Sangyou Eisei GakuZasshi. 2016; 58(4): 130–42.
[7] Ministry of Health, Labor and Welfare. Report on the FY 2017 Model Project for Supporting the Development of Caregiving Techniques Utilizing Care Robots: A Study on the Development of Caregiving Techniques for Achieving Efficient Support in Each Process of Excretory Care [online]. Tokyo: MHLW [cited 2025 Jan 20]. Available from: https://www.mhlw.go.jp/file/06-Seisakujouhou-12300000-Roukenkyoku/31.pdf.
[8] Fukuhara S. RDQ (Roland-Morris Disability Questionnaire) Japanese Manual (in Japanese). Tokyo: Iryobunkasha; 2004.
[9] Techno Aid Association. Introduction to the First Standing Lift. Welfare Equipment Series [online]. Tokyo: Techno Aid Association [cited 2024 May 30]. Available from: https://www.techno-aids.or.jp/research/vol23.pdf.
[10] Hignett S, McAtamney L. Rapid entire body assessment (REBA). Applied Ergonomics. 2000; 31(2): 201–5.
[11] Jäger M, Jordan C, Theilmeier A, Wortmann N, Kuhn S, Nienhaus A, et al. Lumbar-load analysis of manual patient-handling activities for biomechanical overload prevention among healthcare workers. Ann Occup Hyg. 2013; 57(4): 528–44.
[12] Goto Y, Sagara J, Tanaka N, Nakajima Y, Tanaka S, Hotta A. Experiments on space of toilet and bath room for assisting action (in Japanese). Nihon Kenchiku Gakkai Keikakukei Ronbunshu. 1998; 63(512): 145–51.
[13] Ji X, Hettiarachchige RO, Littman ALE, Piovesan D. Using digital human modeling to evaluate the risk of musculoskeletal injury for workers in the healthcare industry. Sensors. 2023; 23(5): 2781.
[14] Zhou Y, Takamido R, Kanai-Pak M, Maeda J, Kitajima Y, Nakamura M, et al. Development of a Nursing Skill Training System Based on Manipulator Variable Admittance Control. IEEE ASME Int Conf Adv Intell Mechatron. 2023; 1226–31.
[15] Itami T, Otsuka K, Yoneyama J, Seki K, Senda M, Itami K. Portable smart device that can warn of dangerous forward tilting and twisting posture for the purpose of reducing the burden on the lower back during nursing support (in Japanese). Baiomedikaru Fuaji Shisutemu Gakkaishi. 2023; 25(1): 9–19.

■ORIGINAL ARTICLE

Effect of Computerized Training in Logical Thinking on Autistic Children: A Pilot Study

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Abstract: Background: Autism spectrum disorder (ASD), a neurodevelopmental condition, is defined by deficits in social communication interaction. Social skills in ASD have been associated with executive functions (EFs), which include working memory (WM).
Objective: This preliminary study investigated the effect of computerized training in logical thinking as an EFs (specifically WM) and social skills intervention via RehaCom on autistic children.
Methods: Participants were eight children diagnosed with ASD (mean age: 7.6 ± 0.6 years) who attended rehabilitation. Intervention effects were measured via Raven's Coloured Progressive Matrices as an intelligence test, questionnaires on ASD characteristics, which included social skills, the Autism Spectrum Quotient (AQ) for children, and a visuo-spatial memory task and digit span memory test (to assess visuo-spatial and verbal WM, respectively) as EFs abilities. The intervention was conducted twice a week for six weeks in two sets of 10 min. Effects were measured pre- and post-intervention and at the six-week follow-up.
Results: No differences were observed in participants' intelligence. Participants' visuo-spatial WM ability improved immediately after training. However, the intervention had no significant effect on verbal WM or ASD characteristics, especially social skills.
Conclusion: Despite the limited participants owing to the preliminary nature of this study, our results suggest that logical thinking training via a computer program is effective for temporarily improving EFs, including visuo-spatial WM, in autistic children.

Keywords: autism spectrum disorder, computerized training, working memory, social skills

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1. Introduction

Autism spectrum disorder (ASD), a neurodevelopmental condition, is characterized by deficits in social communication and restricted repetitive patterns of behavior [1]. The American Psychiatric Association unified pervasive developmental disorders, which included ASD, Asperger's syndrome, Rett syndrome, and other non-specified disorders, under the name ASD [1]. The prevalence of ASD in the USA was approximately 1.7% (1 in 59 people) [2]. Furthermore, its prevalence in Japan was approximately 3.2%, which indicated that approximately 1 in 32 children could have ASD [3]. Hence, one or two children per class in nursery and primary schools could have ASD. Therefore, ASD was not an uncommon disorder. Recent studies have indicated the importance of rehabilitation and education for autistic children [4, 5]. Many studies have suggested the importance of early intervention by rehabilitation therapists, such as occupational therapists, parental education, and support for children with developmental disorders [4–7]. Rehabilitation for ASD includes early intensive behavioral, art, and animal-assisted interventions and music therapy [5, 8–10]. However, many rehabilitation methods that require specialized clinical training have insufficient

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supporting evidence. Furthermore, general interventions have not been established [5, 9, 10].

Recent interventions for autistic children have attempted to use computer programs. A systematic review investigated the effectiveness of computerized cognitive training of executive functions (EFs) on ASD symptomatology and social skills as social skills in ASD were associated with EFs [11]. Although most interventions that used computer programs effectively enhance EFs and reduced symptoms in autistic children, evidence regarding their generalization to social skills remains unclear [11]. EFs are defined as the cognitive processes that underlie goal-directed behavior and include skills such as shifting, inhibition, and working memory (WM) [12, 13]. Several studies have demonstrated that EFs impacted daily life and were closely related to the ability to communicate with others, which included social skills [14, 15]. In general, EFs were impaired in autistic children particularly compared with children with typical development (TD); however, this was not always true [12, 16]. Autistic children were equal or superior in their logical thinking and decision-making abilities based on EFs compared with children with TD [17, 18]. Taken together, the association between the intervention effects of EFs and social skills in autistic children remains unclear.

Therefore, we conducted a preliminary intervention experiment with autistic children via RehaCom (HASOMED Inc.), a software used to train logical thinking. RehaCom, a training system with 19 interventions tailored to specific cognitive functions, had beneficial effects on cognitive impairment and were effective in recovering memory and attention in patients post-stroke [19, 20]. A previous study revealed a significant improvement in inattention among children with attention-deficit hyperactivity disorder (ADHD) via RehaCom training [21]. Since the task levels of logical thinking could be slightly adjusted, even primary school children could train with it. Additionally, the intervention time could be set and easily used in rehabilitation. Computerized intervention was a useful tool for the rehabilitation of autistic children [11, 22]. However, improvements in social skills related to EFs have not been sufficiently examined. This study investigated whether computerized interventions that focused on EFs in autistic children improved their social skills. We predicted that computerized training in logical thinking via RehaCom would improve the EFs, including WM, of autistic children and lead to the achievement of social skills. Clarifying the association between improving EFs via computer programs and social skills will help in the development of useful and convenient interventions for autistic children.

Table 1 Participants' Attributes

Sub	Age (yr)	Sex	Diagnosis	RCPM score		
				Pre	Post	Follow-up
A	8.1	F	ASD	29	24	29
B	6.9	M	ASD	26	24	18
C	7.3	F	ASD	27	29	28
D	8.9	M	ASD	24	26	28
E	7.5	M	ASD	27	31	29
F	7.8	M	ASD, ADHD	24	24	23
G	7.1	M	ASD, ADHD	22	23	25
H	7.0	M	ASD, ADHD	28	30	33

Note. Sub = Participant, M = male, F = female, ASD = Autism Spectrum Disorder, ADHD = Attention Deficit/Hyperactivity Disorder, RCPM = Raven's Coloured Progressive Matrices

2. Materials and Methods

2.1. Participants

The participants were eight children diagnosed with ASD (six boys, two girls, mean age: 7.6 ± 0.6 years). This sample size was based on those in several previous studies [23–25]. All participants were primary school children who attended rehabilitation (Table 1). Prior to the study, written informed consent was obtained from the parents of each child according to the principles of the Declaration of Helsinki and its future amendments. This study was approved by the Life Science Ethics Committee of Kumamoto Health Science University (approval number: 22028).

2.2. Assessment of Characteristics and Social Skills

We utilized Raven's Coloured Progressive Matrices (RCPM) to determine participants' intellectual ability. The RCPM, a quick and easy screening intelligence test, asked participants to select one of six choice designs that matched the missing part of a standard design [26]. Although designed for those aged 45 years and older, it was useful as an intelligence test for children [27].

Characteristics, such as social skills specific to autistic children, were measured via the Japanese version of the Autism-spectrum Quotient (AQ-J) [28]. The AQ-J, developed as an indicator to clarify the characteristics of ASD, was a reliable and valid tool [29]. It comprised five subscales that characterized ASD with 50 questions (10 items each for social skills, attention switching, attention to detail, communication, and imagination). Parents completed the questionnaire for their child. The higher the score on the relevant question, the more likely their child was to have ASD tendencies.

2.3. Assessment of Working Memory (WM) and Logical Thinking Abilities

We assessed verbal and visuo-spatial WM as EFs abilities [30, 31]. For verbal WM, we used the Digit span backward task from the Wechsler Intelligence Scale for Children-IV (WISC-IV) [32]. Participants memorized sequences of digits and reiterated them in reverse. Digit sequence began with two numbers. If participants responded correctly, the number increased by one up till eight (e.g., 6, 9, 1, 7, 3, 2, 5, 8). If participants answered it incorrectly, a new sequence of the same length was presented. If participants answered incorrectly twice, the test was terminated. The longest digit sequence was recorded as verbal WM ability.

The Visuo-Spatial Memory Test (VSMT) measured WM capacity related to spatial memory configuration [33, 34]. We adopted the modified task proposed by Maki et al. [34]. Numbered circles were displayed on a computer monitor for 8s and participants were required to memorize their location sequentially. In the first trial, three numbers (1, 2, 3) were displayed. They disappeared after 8s and three blank white circles remained. Participants were required to touch the circles sequentially in ascending order based on their memory. The number of circles increased if the participants answered correctly. If answered incorrectly, the number decreased in the subsequent trial. When the sequence switched from ascending to descending or vice versa, the number of stimuli was recorded as a reversal point score. This experiment continued until four reversal points were obtained. Furthermore, the number of trials in one session was not fixed. We used the longest sequence as visuo-spatial WM ability. A higher number indicated higher visuo-spatial WM ability.

Logical-thinking ability was measured via tests in the level check module within RehaCom. Participants were required to identify the regularity of a sequence of four figures on the computer screen and select the fifth figure from a list of four candidates. This level check had 13 sequences, and each sequence had a time limit of 2 min, with an overall time limit of 13 min. If participants provided no response or three consecutive wrong answers, the level check was terminated. We used the number of correct answers as their logical-thinking ability.

2.4. Computerized Training in Logical Thinking (Intervention of EFs including WM)

Computerized training used the training module in RehaCom (see Fig. 1). A series of pictures with simple graphic figures or illustrations were displayed. Participants were required to identify the relationship between the individual pictures and derive a rule (figure reasoning) via induction that clarified what the next picture would be. Once the participants had established a rule, they selected the relevant picture from a matrix of pictures. Several properties could be changed, such as shape, color, size, rotation, and quantity. Difficulty level was modified via alteration of the series' length and complexity. After participants worked through all the tasks in a level (20 trials), a percentage was computed for the number of correct decisions with the total number of tasks. If the percentage value was higher or lower than that of the one set for level-up (> 80%) or level-down (< 60%), the module increased or decreased the difficulty level for the next task, respectively. Maximum solution time was set at 5 min per trial. All participants started the training at level one (max level 25).

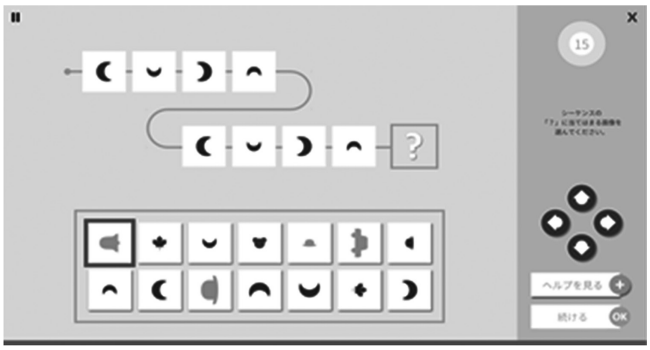

Fig. 1. RehaCom's (HASOMED Inc.) Computerized Training in Logical Thinking.

2.5. Procedure

The intervention was conducted via computerized training twice a week for six weeks in two sets of 10 min (max 240 min). It followed the total intervention time based on Fisher's study on autistic children [35]. Interventions were prioritized to continue regularly rather than be implemented for the maximum time and considered participants' fatigue and physical condition. Effects were assessed pre- and post-intervention and at the six-week follow-up.

2.6. Data Analysis

To evaluate participants' intelligence, a one-way repeated-measures analysis of variance (ANOVA) was performed on the RCPM score, with measuring period as a factor (pre-, post-, and follow-up). Changes in the characteristics of ASD in the AQ-J total and social skills scores were assessed via a one-way repeated-measures ANOVA (pre-, post-, and follow-up). We also investigated the effects of training in logical-thinking ability (number of correct answers in the level check module) via a one-way ANOVA, with measuring period as a factor. To further evaluate participants' WM abilities

Table 2 Results of the AQ-J Scores in the Five Subscales for Each Measurement Period

	AQ-score (M ± SE)		
	Pre	Post	Follow-up
Social Skill	4.38 ± 0.64	3.63 ± 0.93	4.25 ± 0.63
Attention Switching	5.00 ± 0.47	5.25 ± 0.42	5.63 ± 0.53
Attention to Detail	4.63 ± 1.03	3.88 ± 0.93	5.50 ± 0.83
Communication	3.63 ± 0.66	4.63 ± 0.35	3.38 ± 0.56
Imagination	5.13 ± 0.41	5.31 ± 0.55	5.88 ± 0.48
Total	21.88 ± 1.82	22.69 ± 1.82	24.00 ± 1.16

Note. AQ-J = Autism-Spectrum Quotient Japanese version. M = mean, SE = standard errors.

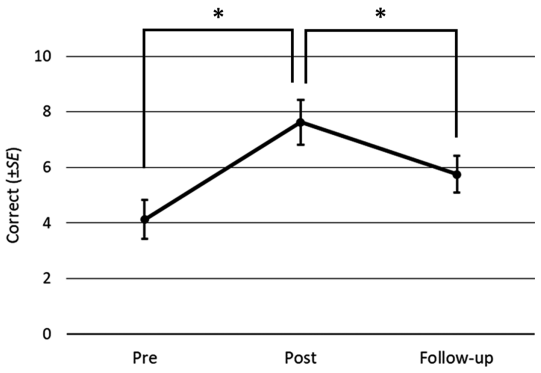

Fig. 2. Number of Correct Answers in the Logical Thinking Task of the Level Check Module for Each Measurement Period.
Note. Error bars indicate standard errors (SE). * $p < 0.05$.

(verbal and visuo-spatial), a one-way ANOVA was performed for each WM score.

For the ANOVAs, we assessed whether the assumption of sphericity was met via Mauchly's sphericity tests [36, 37]. When violated, we adjusted the degrees of freedom via Greenhouse-Geisser correction. The Holm-Bonferroni method [38] was used when pairwise comparisons were required ($\alpha < 0.05$). We calculated the effect size generalized η^2 (η^2_G) for ANOVAs and r for t-tests, and used Cohen's criteria to interpret it [39]. We also calculated the 95% confidence interval (CI) for the mean difference in all t-tests to investigate whether it included zero. For differences that were not statistically significant, we calculated the Bayes factor (BF_{10}) to estimate the probability that the null hypothesis was supported [40].

3. Results

3.1. Participants' Characteristics and Social Skills

One-way repeated-measures ANOVA on the RCPM score revealed no significant main effects of the measurement period [F (1.72, 12.03) = 0.19, p = 0.796, η^2_G = 0.01] (see Table 1). Furthermore, ANOVA on the AQ-J total and social skills scores revealed no significant main effects of the measurement period (total, [F (1.26, 8.83) = 2.23, p = 0.171, η^2_G = 0.06]; social skills [F (1.41, 9.89) = 0.69, p = 0.474, η^2_G = 0.02]; Table 2). These results indicated no differences in participants' intelligence and ASD characteristics, which included social skills, across the intervention period.

3.2. Effects of Training in Logical Thinking

Although all the participants completed the six-week intervention, training time varied between individuals ($M \pm SE$: 202.25 ± 9.96 min). Furthermore, all the participants demonstrated an improvement in the level of logical thinking tasks in the RehaCom training module, which started at level 1 (final level, $M \pm SE$: 14.13 ± 0.87). A one-way ANOVA on the number of correct answers revealed significant main effects of the measurement period [F (1.67, 11.7) = 9.48, p = 0.005, η^2_G = 0.33]. Furthermore, their post-hoc multiple comparisons revealed significant differences between the pre- and post-, post- and follow-up measurements (pre and post, p = 0.021, 95% CI [−5.69, −1.31], r = 0.82; post and follow-up, p = 0.021, 95% CI [−3.32, −0.43], r = 0.75). However, no significant differences were observed between the pre and follow-up measurements (p = 0.096, 95% CI [−0.37, 3.62], r = 0.59, BF_{10} = 1.18) (Fig. 2). This indicated that the intervention effects of the logical thinking task were observed immediately after the training.

Regarding WM data, one-way repeated-measures ANOVA on the VSMT (visuo-spatial WM) score revealed a significant trend in the main effects of the measurement period [F (1.22, 8.54) = 5.65, p = 0.038, η^2_G = 0.24]. Subsequent multiple comparisons revealed significant differences between pre- and post- and post and follow-up measurements (pre and post, p = 0.016, 95% CI [−1.99, −0.51], r = 0.83; post and follow-up, p = 0.049, 95% CI [−1.25, −0.003], r = 0.77). However, no significant differences were observed between the pre- and follow-up measurements (p = 0.250, 95% CI [−0.55, 1.80], r = 0.49, BF_{10} = 0.62) (Fig. 3A). However, one-way repeated-measures ANOVA on the backward (verbal WM) score revealed no significant main effects of measurement period [F (1.56, 10.91) = 1.36, p = 0.289, η^2_G = 0.06]. This indicated that visuo-spatial WM ability improved immediately after the training; however, there was no improvement in verbal WM ability (Fig. 3B).

4. Discussion

This study investigated whether computerized in-

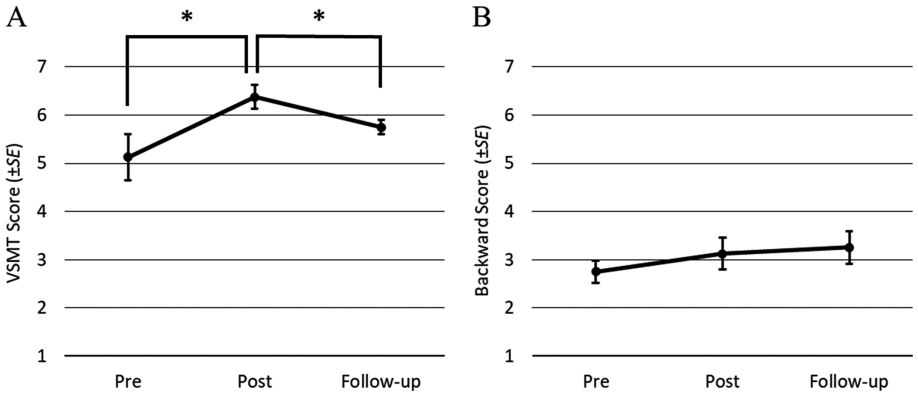

Fig. 3. Results of Visuo-spatial Working Memory (WM) and Verbal WM abilities for Each Measurement Period.
Note. Each plot shows the average score of the Visuo-spatial Memory Test (VSMT) (A) and Backward score (B) across measurement periods. The VSMT and Backward scores indicate visuo-spatial and verbal WM ability, respectively. Error bars indicate standard errors (SE). * $p < 0.05$.

terventions that focused on EFs via RehaCom improved social skills among autistic children. While the main results revealed no differences in participants' intelligence, visuo-spatial WM ability, which included EFs, improved after training. However, the intervention did not significantly impact participants' ASD characteristics, especially social skills. Previous studies reported that autistic children were equal or superior in their logical thinking and decision-making abilities based on EFs compared with children with TD [17, 18]. Additionally, computerized training could improve WM and executive functions (EFs) in autistic children [41–43]. Furthermore, another study indicated that visual training effectively enhanced EFs in autistic children [44]. In this study, effect size in visuo-spatial WM ability (VSMT-score) was large between pre- and post- intervention (r = 0.83). This result was larger than the effect sizes reported in a previous study that used EFs for outcomes [45]. Another study that provided an intervention for approximately weeks observed no significant improvement in visuo-spatial WM [42]. Taken together, although the outcomes and intervention periods differed from those in previous studies, our results suggested that visual training via computer programs (i.e. RehaCom) was effective in improving visuo-spatial WM in autistic children.

In contrast, no significant difference was observed between pre- and post- intervention for social skills and verbal WM in autistic children. Although a previous study revealed social skills, language, and EFs were correlated [12], this study's logical thinking task relied on visual information. Moreover, autistic children were considered as having language delays and deficits [12, 46]. Furthermore, their verbal WM was inferior to that of children with TD [47]. Therefore, although our logical thinking task alone was acceptable for autistic children, it may be an insufficient approach for language delays and social skills. In addition, previous studies indicated that early intervention and long-term follow-up for social skills were important in pre-school children [4–6, 48]. Since our participants were primary school children, early and long-term interventions may be necessary. However, computerized training via RehaCom allowed detailed level settings and tailored intervention for the target child and could be effective in improving EFs, which included visuo-spatial WM.

This study has several limitations. First, the duration of the intervention and sustained effects were unclear. Pasqualotto et al. suggested that evidence on their generalization to untrained skills (social skills) and the long-term effects of cognitive training programs on EFs in autistic children are unclear [11]. Moreover, several studies have indicated that variations in training interventions were effective for EFs, which included WM [11, 41, 45, 49]. However, the single-task intervention effects did not persist over time due to decreased logical thinking and visuo-spatial WM ability during our follow-up period. A recent study reported that autistic children developed visuo-spatial WM similarly to children with TD [50]. In contrast, another study indicated that while children with TD demonstrated rapid development from 5 to 6 years, autistic children exhibited delayed development for WM capacity, which included social skills, especially until 6 years [51]. Therefore, although the autistic children in this study exhibited a temporary intervention effect on visuo-spatial WM, the effect may not have been sustained. Hence, future research confirming the long-term effects is necessary. Second, we did not clarify the intervention effects of the logical thinking task on the functioning of other EFs (except WM). EFs include several higher-order cognitive functions, such as WM, task switching, attention allocation, and inhibition, which could also be involved in social skills [12,

44]. Additionally, training social skills should involve the child's interest and motivation (social motivation) toward improving social skills [52, 53]. Although all autistic children completed the tasks in this study, incorporating multiple tasks or combining the intervention with training programs, such as programs for education and enrichment of relational skills that directly enhance social skills, may be necessary [48, 52, 53]. Finally, while the number of participants followed that reported in previous studies, it was small owing to the preliminary nature of this study. Therefore, further research should investigate these issues and address them with a larger sample.

5. Conclusion

This preliminary study investigated the effects of computerized training in logical thinking via RehaCom on autistic children. Participants' visuo-spatial WM ability improved after the training; however, the intervention effect did not persist in the long term. Additionally, the intervention did not significantly affect verbal WM and ASD characteristics. Although this study had a small number of participants owing to its preliminary nature, our results suggested that visual training via a computer program was effective in temporarily improving EFs, especially visuo-spatial WM, in autistic children.

Declaration of interests

None.

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Author contributions

All the authors contributed to the data collection and interpretation and critically reviewed the manuscript. All the authors approved the final version of the manuscript, agreed to be accountable for all aspects of the work, and ensured that any questions related to the accuracy and integrity of any part of the study were appropriately investigated and resolved.

References

[1] American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Arlington: American Psychiatric Publication Inc; 2013.

[2] Hyman SL, Levy SE, Myers SM, COUNCIL ON CHILDREN WITH DISABILITIES, SECTION ON DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS. Identification, evaluation, and management of children with autism spectrum disorder. Pediatrics. 2020; 145(1): e20193447.

[3] Saito M, Hirota T, Sakamoto Y, Adachi M, Takahashi M, Osato-Kaneda A, et al. Prevalence and cumulative incidence of autism spectrum disorders and the patterns of co-occurring neurodevelopmental disorders in a total population sample of 5-year-old children. Mol Autism. 2020; 11(1): 35.

[4] Kodak T, Bergmann S. Autism spectrum disorder: characteristics, associated behaviors, and early intervention. Pediatr Clin North Am. 2020; 67(3): 525–35.

[5] Reichow B, Hume K, Barton EE, Boyd BA. Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). Cochrane Database Syst Rev. 2018; 5(5): CD009260.

[6] Neimy H, Pelaez M, Carrow J, Monlux K, Tarbox, J. Infants at risk of autism and developmental disorders: establishing early social skills. Behav Dev Bull. 2017; 22(1): 6–22.

[7] Minjarez MB, Williams SE, Mercier EM, Hardan AY. Pivotal response group treatment program for parents of children with autism. J Autism Dev Disord. 2011; 41(1): 92–101.

[8] Bernier A, Ratcliff K, Hilton C, Fingerhut P, Li CY. Art interventions for children with autism spectrum disorder: a scoping review. Am J Occup Ther. 2022; 76(5): 7605205030.

[9] Geretsegger M, Elefant C, Mössler KA, Gold C. Music therapy for people with autism spectrum disorder. Cochrane Database Syst Rev. 2014; 2014(6): CD004381.

[10] O'Haire ME. Animal-assisted intervention for autism spectrum disorder: a systematic literature review. J Autism Dev Disord. 2013; 43(7): 1606–22.

[11] Pasqualotto A, Mazzoni N, Bentenuto A, Mulè A, Benso F, Venuti P. Effects of cognitive training programs on executive function in children and adolescents with autism spectrum disorder: a systematic review. Brain Sci. 2021; 11(10): 1280.

[12] Friedman L, Sterling A. A review of language, executive function, and intervention in autism spectrum disorder. Semin Speech Lang. 2019; 40(4): 291–304.

[13] Kaushanskaya M, Park JS, Gangopadhyay I, Davidson MM, Weismer SE. The relationship between executive functions and language abilities in children: a latent variables approach. J Speech Lang Hear Res. 2017; 60(4): 912–23.

[14] Akbar M, Loomis R, Paul R. The interplay of language on executive functions in children with ASD. Res Autism

Spectr Disord. 2013; 7(3): 494–501.
[15] Gilotty L, Kenworthy L, Sirian L, Black DO, Wagner AE. Adaptive skills and executive functions in autism spectrum disorders. Child Neuropsychology. 2002; 8(4): 241–8.
[16] Pellicano E. Individual differences in executive function and central coherence predict developmental changes in theory of mind in autism. Dev Psychol. 2010; 46(2): 530–44.
[17] Nuske HJ, Bavin EL. Narrative comprehension in 4-7-year-old children with autism: testing the Weak Central Coherence account. Int J Lang Commun Disord. 2011; 46(1): 108–19.
[18] Vella L, Ring HA, Aitken MR, Watson PC, Presland A, Clare IC. Understanding self-reported difficulties in decision-making by people with autism spectrum disorders. Autism. 2018; 22(5): 549–59.
[19] Amiri S, Hassani-Abharian P, Vaseghi S, Kazemi R, Nasehi M. Effect of RehaCom cognitive rehabilitation software on working memory and processing speed in chronic ischemic stroke patients. Assist Technol. 2023; 35(1): 41–7.
[20] Veisi-Pirkoohi S, Hassani-Abharian P, Kazemi R, Vaseghi S, Zarrindast MR, Nasehi M. Efficacy of RehaCom cognitive rehabilitation software in activities of daily living, attention and response control in chronic stroke patients. J Clin Neurosci. 2020; 71: 101–7.
[21] Amonn F, Frölich J, Breuer D, Banaschewski T, Doepfner M. Evaluation of a computer-based neuropsychological training in children with attention-deficit hyperactivity disorder (ADHD). NeuroRehabili. 2013; 32(3): 555–562.
[22] Rafiei Milajerdi H, Sheikh M, Najafabadi MG, Saghaei B, Naghdi N, Dewey D. The effects of physical activity and exergaming on motor skills and executive functions in children with autism spectrum disorder. Games Health. 2021; 10(1): 33–42.
[23] Dunlap G, Fox L. A demonstration of behavioral support for young children with autism. J Posit Behav Interv. 1999; 1(2): 77–87.
[24] Hilton CL, Cumpata K, Klohr C, Gaetke S, Artner A, Johnson H, et al. Effects of exergaming on executive function and motor skills in children with autism spectrum disorder: a pilot study. Am J Occup Ther. 2014; 68(1): 57–65.
[25] Takahashi J, Yasumura A, Nakagawa E, Inagaki M. Changes in negative and positive EEG shifts during slow cortical potential training in children with attention-deficit/hyperactivity disorder: a preliminary investigation. Neuroreport. 2014; 25(8): 618–24.
[26] Raven JC. Coloured Progressive Matrices Sets A, Ab, B. Manual Sections 1 & 2. Oxford, UK: Oxford Psychologists Press; 1995.
[27] Smirni D. The Raven's Coloured Progressive Matrices in healthy children: a qualitative approach. Brain Sci. 2020; 10(11): 877.
[28] Baron-Cohen S, Wheelwright S, Skinner R, Martin J, Clubley E. The Autism-Spectrum Quotient (AQ): evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. J Autism Dev Disord. 2001; 31(1): 5–17.
[29] Wakabayashi A, Uchiyama T, Tojo Y, Yoshida Y, Kuroda M, Baron-Cohen S, et al. The Autism-Spectrum Quotient (AQ) Japanese children's version comparison between high-functioning children with autism spectrum disorders and normal controls (in Japanese). The Japanese Journal of Psychology (shinrigakukenkyu). 2007; 77(6): 534–40.
[30] Jenkins L, Myerson J, Hale S, Fry AF. Individual and developmental differences in working memory across the life span. Psychon Bull Rev. 1999; 6(1): 28–40.
[31] Nee DE, Brown JW, Askren MK, Berman MG, Demiralp E, Krawitz A, et al. A meta-analysis of executive components of working memory. Cereb Cortex. 2013; 23(2): 264–82.
[32] Acosta-Rodríguez VM, Ramírez-Santana GM, Hernández-Expósito S. Intervention for oral language comprehension skills in preschoolers with developmental language disorder. Int J Lang Commun Disord. 2022; 57(1): 90–102.
[33] Kawai N, Matsuzawa T. Numerical memory span in a chimpanzee. Nature. 2000; 403: 39–40.
[34] Maki Y, Yoshida H, Yamaguchi H. Computerized visuospatial memory test as a supplementary screening test for dementia. Psychogeriatrics. 2010; 10(2): 77–82.
[35] Fisher N, Happé F. A training study of theory of mind and executive function in children with autistic spectrum disorders. J Autism Dev Disord. 2005; 35(6): 757–71.
[36] Geisser S, Greenhouse SW. An extension of Box's results on the use of the *F* distribution in multivariate analysis. Ann Math Statist. 1958; 29(3): 885–91.
[37] Mauchly JW. Significance test for sphericity of a normal *n*-variate distribution. Ann Math Statist. 1940; 11(2): 204–9.
[38] Holm S. A simple sequentially rejective multiple test procedure. Scand J Stat. 1979; 6(2): 65–70.
[39] Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum; 1988.
[40] Jeffreys H. Theory of Probability. 3rd ed. Oxford, UK: Oxford University Press; 1961.
[41] Chen MT, Chang YP, Marraccini ME, Cho MC, Guo NW. Comprehensive attention training system (CATS): a computerized executive-functioning training for school-aged children with autism spectrum disorder. Int J Dev Disabil. 2020; 68(4): 528–37.
[42] de Vries M, Prins PJ, Schmand BA, Geurts HM. Working memory and cognitive flexibility-training for children with an autism spectrum disorder: a randomized controlled trial. J Child Psychol Psychiatry. 2015; 56(5): 566–76.
[43] Wagle S, Ghosh A, Karthic P, Ghosh A, Pervaiz T, Kapoor R, et al. Development and testing of a game-based digital intervention for working memory training in autism spectrum disorder. Sci Rep. 2021; 11(1): 13800.
[44] Ji C, Yang J, Lin L, Chen S. Executive function improvement for children with autism spectrum disorder: a comparative study between virtual training and physical

exercise methods. Children (Basel). 2022; 9(4): 507.
[45] Hilton CL, Attal A, Best J, Reistetter T, Trapani P, Collins DM. Exergaming to improve physical and mental fitness in children and adolescents with autism spectrum disorders: pilot study. Int J Sports Exerc Med, 2015; 1(3): 1510015.
[46] Naigles LR. Input and language development in children with autism. Semin Speech Lang. 2013; 34(4): 237–48.
[47] Russell J, Jarrold C, Henry L. Working memory in children with autism and with moderate learning difficulties. J Child Psychol Psychiatry. 1996; 37(6): 673–86.
[48] Tripathi I, Estabillo JA, Moody CT, Laugeson EA. Long-term treatment outcomes of PEERS® for preschoolers: a parent-mediated social skills training program for children with autism spectrum disorder. J Autism Dev Disord. 2022; 52(6): 2610–26.
[49] Kerns KA, Macoun S, MacSween J, Pei J, Hutchison M. Attention and working memory training: a feasibility study in children with neurodevelopmental disorders. Appl Neuropsychol Child. 2017; 6(2): 120–37.
[50] Lynn A, Luna B, O'Hearn K. Visual working memory performance is intact across development in autism spectrum disorder. Autism Res. 2022; 15(5): 881–91.
[51] Gong L, Guo D, Gao Z, Wei K. Atypical development of social and nonsocial working memory capacity among preschoolers with autism spectrum disorders. Autism Res. 2023; 16(2): 327–39.
[52] Neuhaus E, Webb SJ, Bernier RA. Linking social motivation with social skill: the role of emotion dysregulation in autism spectrum disorder. Dev Psychopathol. 2019; 31(3): 931–43.
[53] Neuhaus E, Bernier RA, Webb SJ. Social motivation across multiple measures: caregiver-report of children with autism spectrum disorder. Autism Res. 2021; 14(2): 369–79.

■CASE REPORTS

Digital Engagement in AYA Cancer Survivors: Case Reports on the Role of Social Media Video Posting in Vocational Support

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Abstract: Background: Since the 1980s, illness memoirs have been recognized for their therapeutic and educational value. Recently, young adults have increasingly utilized video platforms for self-expression, social support, and meaning-making. AYA cancer survivors often face socioeconomic challenges, particularly regarding employment, even after treatment. Therefore, long-term career support and reintegration are crucial. Sharing cancer experiences on platforms like YouTube may serve as "meaningful work," enabling selfexpression, social connection, and potential income. This study presents two AYA cancer survivors who used YouTube post-treatment, highlighting aspects of recovery, reintegration, and employment.

Case 1: A patient with peripheral T-cell lymphoma (PTCL) underwent hematopoietic stem cell transplantation. An occupational therapist (OT) supported physical activity during hospitalization and introduced video creation post-discharge. At 1,828 days posttransplant, the patient achieved full ADL independence (SPPB 12/12, A-QOA probit 3.55 ± 0.27). The videos showed natural engagement but reflected uncertainty in collaborating with healthcare professionals to improve information quality.

Case 2: A patient with a left forearm bone/soft tissue tumor adapted to one-handed ADLs and produced videos on adaptive techniques and social interaction. One year post-surgery, the patient was ADL-independent (TESS 97.2%, A-QOA probit 4.47 ± 0.28). While socially reintegrated, the patient struggled to articulate the concept of "disability."

Conclusion: Post-treatment video creation functioned as meaningful occupational engagement with therapeutic and social benefits. OTs played a vital role in support. Further research should explore candidate selection and integration into rehab and employment programs.

Keywords: AYA (Adolescent and Young Adult), Cancer, Employment, YouTube, client-centered practice

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Background

Since the 1980s, disease-related memoirs have gained prominence alongside the growing interest in publishing and medical welfare. These memoirs provide therapeutic benefits to both authors and readers while deepening their understanding of the lived experience of illness [1]. More recently, young adults have increasingly turned to video platforms as a means of self-expression, social support, and meaning-making [2]. Social networking sites further facilitate self-advocacy and community building [3].

Adolescent and young adult (AYA) cancer patients often balance their education and careers while facing economic and social challenges, particularly regarding employment, even after completing treatment [4]. As a result, ongoing support for career development and reintegration into the workforce remains essential.

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Table 1 2 Case Studies.

Characteristic	Case 1	Case 2
Age	20s	20s
Gender	Male	Male
Occupation	University student	University student
Medical Diagnosis	Peripheral T-cell lymphoma	Bone and soft tissue tumor in the upper limb
Inpatient OT intervention	Maintenance and improvement of physical activity during the transplant phase, muscle strengthening, return-to-work consultation. Post-discharge motor function assessment.	ADL training using the shoulder and remaining hand, prosthetic consultation, return-to-work consultation, and post-discharge ADL evaluation. Introduction to similar video content and discussion of video topics.
OT final assessment	SPPB: 12/12 at last evaluation (4 year post-HSCT); independent in ADLs.	TESS: 97.2% at last evaluation (1 year surgery); independent in ADLs.
YouTube Channel Initiation	Post-cancer diagnosis	Post-cancer diagnosis
Occupational Therapy Interventions	1. Observed and analyzed YouTube videos, conducting an observational evaluation based on A-QOA criteria. 2. Held a listening session in the occupational therapy room following the post-discharge medical consultation. 3. Discussed rehabilitation and occupational therapy-related aspects of video production. 4. Explained and interpreted the evaluation results of the SPPB and TESS. 5. Provided guidance on the appropriate levels of physical activity during different life stages. 6. Explored how the patient's cancer experience could be integrated into an educational setting. 7. Advised on the selection and usage of appropriate assistive devices. 8. Reviewed the accuracy and appropriateness of rehabilitation-related terminology and concepts presented in the video content. 9. Addressed the patient's concerns through active listening and discussion.	
Number of Subscribers (as of June 2024, approx.)	40,000	100,000
Current Employment Status	Not engaged in traditional job-seeking	Not engaged in traditional job-seeking
Primary Source of Income	YouTube video postings	YouTube video postings
A-QOA Score (Post-discharge Video Analysis)	63 points (probit 3.55)	88 points (probit 4.47)

The occupational therapist helped the patient improve their motor function during hospitalization. After discharge, the therapist supported the patient by getting involved in the content of the videos they created.

Sharing cancer experiences through YouTube can serve as a form of meaningful work, offering opportunities for self-expression, social connection, and even potential financial benefits. This report presents two cases of AYA cancer patients who utilized YouTube after treatment, shedding light on new aspects of recovery, reintegration, and employment.

Case Presentations

Case 1

The patient underwent hematopoietic stem cell transplantation (HSCT) following a diagnosis of peripheral T-cell lymphoma. During hospitalization, an occupational therapist provided interventions to maintain and improve physical activity. After discharge, the patient was introduced to a care continuity program that facilitated support for video content creation (Table 1). At 1,828 days post-transplant, the patient demonstrated full independence in activities of daily living (ADLs), with a Short Physical Performance Battery (SPPB) score of 12/12 and an Assessment of Quality of Occupational Performance (A-QOA) score (probit value) of 63 points, probit 3.55 (±0.27) [5], indicating strong engagement in meaningful activities. Compared to hospitalization, the patient's videos displayed more natural smiling and a heightened awareness of the audience. Additionally, the patient expressed concerns about the need for collaboration with healthcare professionals to provide high-quality information for young transplant patients but was uncertain about seeking a professional consultation.

Case 2

The patient underwent surgery for a bone and soft

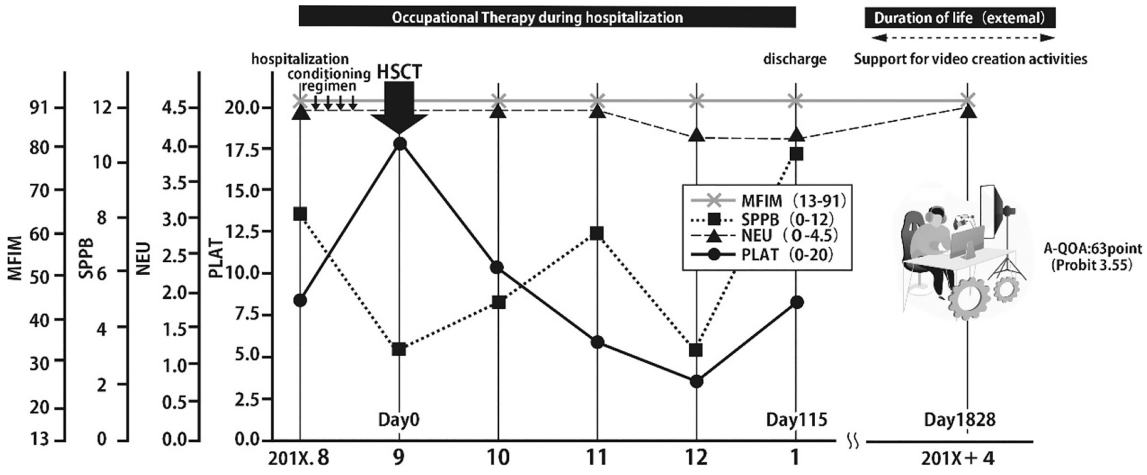

Fig. 1. Motor function and blood counts in Case A.
Case A has maintained motor function from pre-transplant to present.

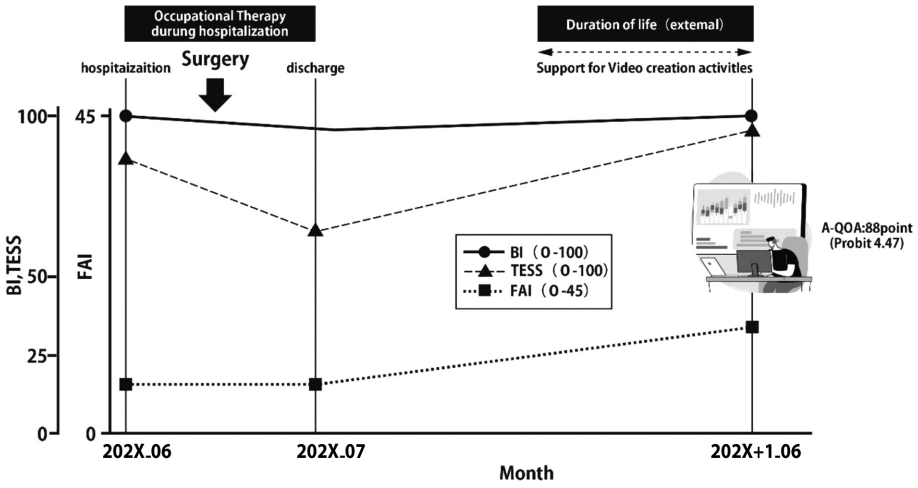

Fig. 2. ADL and upper extremity functional assessment in Case B.
Case B had a decline in upper limb function immediately after surgery. However, one year later, the patient was fully independent in terms of ADLs and upper limb function had improved.

tissue tumor in the left forearm. Following the procedure, they adapted to performing ADLs with one hand and shared videos showcasing innovative techniques and social engagement as a person with a disability. One year post-surgery, the patient had regained full independence in ADLs, with a Toronto Extremity Salvage Score (TESS) score of 97.2% and an A-QOA score (probit value) of 88, probit 4.47 (±0.28), indicating a strong engagement with meaningful activities. Through video creation, the patient gained more opportunities to interact with peers and rebuild social connections. However, they encountered difficulties in articulating their experience and identity within the theme of disability.

Consideration

In this report, rehabilitation [6] was initiated during hospitalization to improve ADLs, followed by post-discharge support for video production. The findings offer valuable insight into the patients' post-treatment lives and suggest that facilitating video dissemination could serve as a meaningful occupational therapy intervention. The activity was assessed using the A-QOA, highlighting new possibilities for occupational therapy in the context of digital engagement.

In Japan, cancer rehabilitation is primarily conducted during hospitalization [7], with a strong emphasis on improving motor function, physical activity, and ADLs. However, there are currently few interventions that specifically target occupational activities. In this study,

video production support was introduced as an occupational activity during the post-discharge period. This initiative not only provided patients with a sense of meaningful work but also had potential implications for employment support [8]. In both cases, the dissemination of videos via YouTube attracted widespread attention, leading to an increase in subscribers and media coverage. This visibility may have influenced both the general public and other AYA cancer patients. Video production emerged as a valuable activity, fostering self-expression and contributing to the reconstruction of social roles [9]

During the process of video creation and dissemination, patients encountered various challenges. While occupational therapists may not be able to address all these concerns, they can help organize and clarify key aspects of support [10] to enhance the effectiveness of interventions. The notably high A-QOA scores suggest that video production support had therapeutic significance. Furthermore, the video creation process encouraged patients to reflect on their hospitalization experiences. Specifically, they demonstrated an understanding of assessment results, such as TESS and the SPPB, integrating these insights into their videos. However, further research is needed to contextualize A-QOA scores in relation to additional indicators [5].

Support for video creation was provided for a You Tube channel that patients had voluntarily established. This engagement enabled therapists to gain a deeper understanding of patients' post-discharge lives. However, such support may not be suitable for all AYA cancer patients or for everyone involved in video dissemination. Further research is needed to identify the characteristics of patients who would benefit most from this type of intervention.

A key consideration is the need to identify both verbal and nonverbal cues that indicate a need for support during conversations with younger patients, such as those in the AYA population. Occupational therapists should actively demonstrate a willingness to collaborate and provide meaningful support. Additionally, understanding the evolving interests and concerns of AYA cancer patients, both during hospitalization and after discharge, is crucial for tailoring inventions to their needs. Future studies should explore how video production support can be integrated with broader rehabilitation and employment support programs to maximize its therapeutic and vocational benefits.

This study is limited by its small sample size of two cases, which restricts the generalizability of the findings and the interpretation of A-QOA scores. Moreover, patients engage with a wide range of individuals in their social lives and obtain information from various social media platforms. Consequently, improvements in mood, motor function, and engagement in activities cannot be solely attributed to rehabilitation interventions, as they may be influenced by multiple external factors. To better understand the role of occupational therapy in post-discharge activity support, future research should involve a larger sample size and a more detailed analysis of the significance of these activities. Specifically, further studies should examine how meaningful work can be effectively supported in cancer patients and assess its applicability to other patient populations.

Ethical statement

Participants provided written informed consent after receiving an explanation of the study. The study was conducted in accordance with the ethical code of the National Cancer Center Hospital and the Declaration of Helsinki.

Conflicts of Interest

The authors declare no conflicts of interest related to this manuscript.

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References

[1] Frank AW. The wounded storyteller: Body, illness, and ethics. Chicago: University of Chicago Press; 1995.
[2] Lange PG. Kids on YouTube: Technical identities and digital literacies. New York: Routledge; 2014.
[3] Boyd D. Social network sites as networked publics: Affordances, dynamics, and implications. In: Papacharissi Z, editor. A networked self: Identity, community, and culture on social network sites. New York: Routledge; 2010. p. 39–58.
[4] Zebrack BJ. Psychological, social, and behavioral issues for young adults with cancer. Cancer. 2011; 117(10 Suppl): 2289–94.
[5] Ogawa M, Fujita K, Ishii R, Shindo M, Umeda M, Yamaguchi T, et al. Rasch analysis of the Assessment of Quality of Activities (A-QOA), an observational tool for clients with dementia. Am J Occup Ther. 2021; 75(1): 7501205040p1–9.
[6] Pergolotti M, Deal AM, Williams GR, Bryant AL, Mc-

Carthy L, Nyrop KA, et al. Occupational therapy for adults with cancer: Why it matters. Oncologist. 2016; 21(3): 314–9.
[7] Fukushima T, Tsuji T, Watanabe N, Sakurai T, Matsuoka A, Kojima K, et al. The current status of inpatient cancer rehabilitation provided by designated cancer hospitals in Japan. Jpn J Clin Oncol. 2021; 51(7): 1094–9.
[8] Chang H, Tian Y. Psychological experience on engaging in employment rehabilitation post in long-time hospitalized patients with psychosis. 2016.
[9] Barnett A, Ball L, Coppieters M, Morris NR, Kendall E, Campbell KL. Patients' experiences with rehabilitation care: a qualitative study to inform patient-centred outcomes. BMJ Open. 2022; 12(10): e060726.
[10] Sintay RKM. Lived experiences of patients undergoing cardiac rehabilitation [dissertation]. Ann Arbor (MI): ProQuest Dissertations Publishing; 2019.

■ORIGINAL ARTICLE

Factors that Influence the Improvement of Handwriting Skills of Children with Handwriting Difficulties: Scoping Review

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Abstract: Objective: This scoping review identifies and synthesises the factors—child, task, environment, and intervention-related—that are associated with improved handwriting performance in children with handwriting difficulties.
Materials and Methods: Using Arksey and O'Malley's five-step framework and reported in line with PRISMA-ScR, we searched PubMed, CINAHL, MEDLINE, Web of Science and ERIC in May 2023. Articles were evaluated by three reviewers based on the inclusion criteria: (1) children under 18 years of age with handwriting difficulties, (2) studies involving interventions, assessments, and/or observations, and (3) studies conducted in diverse geographical contexts.
Results: The review included 29 studies, of which six were conducted in the United States. Occupational therapists served as the principal investigators in 21 studies, while the remaining studies were led by speech-language pathologists, physical therapists, psychologists, special educators, or system designers. A qualitative thematic analysis of the selected studies identified two key themes: (1) the rationale for designing handwriting programs and (2) additional programs to support handwriting programs.
Conclusion: This study highlights that integrating multiple interventions, including alphabetic tasks, cognitive strategies, and ergonomic exercises, can significantly enhance handwriting performance. Additionally, incorporating home and classroom exercises as supplementary programs can enrich handwriting curricula by leveraging the involvement of parents and instructors, which plays a critical role in motivating and improving children's handwriting abilities. Future research should test these combined approaches in large, controlled trials and explore under-represented regions to strengthen the evidence base.

Keywords: handwriting difficulties, children, handwriting program, parents, occupational therapy

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Introduction

Handwriting is a complex neuromotor skill that integrates cognitive and physical abilities, including intellectual, perceptual, attentional, linguistic, and fine motor skills [1–5]. Perceptual and motor ability development are critical for children to acquire handwriting proficiency, as emphasized by Bara and Gentaz (2011). The combination of these skills serves as a reliable indicator of children's handwriting abilities [6].

Handwriting acquisition involves learning visual representations of letters, which guide the production of specific motor patterns for each letter. In the initial stages, writing movements are slow and heavily reliant on visual and kinesthetic feedback mechanisms [7]. During the writing process, visual control directs the hand to form letters, position them within the designated area, and align them with the writing line. This process transitions from unstructured drawing movements, guided by physical sensations, to deliberate and purposeful sequences of strokes [8].

Handwriting experience significantly influences young children's capacity to recognize letters, with

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fluency and legibility serving as key determinants of handwriting effectiveness [9, 10]. Handwriting outcomes can be assessed through readability or legibility, using either global scales or comparisons to standardized handwriting samples classified as readable or unreadable [11].

Handwriting is an essential skill for academic success, particularly for school-age children [12]. During the early years of elementary school, more than half of classroom activities involve handwriting tasks, such as copying and writing to dictation [13, 14]. Acquiring literacy at this stage is challenging, requiring fundamental component skills, significant practice, and guidance from teachers, as highlighted by Drijboom, Groen, and Verhoeven (2017) and Bazerman et al. (2017) [15, 16]. Challenges in developing legible handwriting can negatively impact self-esteem and lead to distorted self-assessment, especially when children face criticism [17]. Handwriting difficulties affect 10–30% of school-age children, regardless of whether they have specific disabilities [2].

Occupational therapy practitioners consider handwriting a critical performance skill and frequently address it using developmental frameworks [18]. By leveraging students' strengths, identifying preferred learning modes, collaborating with teachers, implementing environmental modifications, and exploring compensatory strategies such as technology, occupational therapists aim to enhance children's occupational performance [19]. Additionally, therapists assess the unique characteristics of activities, considering all aspects of engagement, and use these insights as therapeutic tools to achieve intervention objectives [20].

Currently, limited research exists on the factors influencing handwriting performance, despite their potential utility for evidence-based occupational therapy practice. To clarify the intended scope, this scoping review identifies and synthesises the factors—child, task, environment, and intervention-related—that are associated with improved handwriting performance in children with handwriting difficulties.

Materials and Methods

This scoping study adhered to Arksey and O'Malley's (2005) five-step methodological framework: (1) identifying the research question, (2) identifying relevant studies, (3) selecting studies, (4) charting the data, and (5) collating, summarizing, and reporting the results [21]. To enhance the structure and transparency of the scoping review process, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist and the PRISMA extension for Scoping Reviews (PRISMA-ScR) were employed [22].

Identifying the Research Question

The research question was broad yet goal-oriented: What factors influence the improvement of handwriting abilities of children with handwriting difficulties?

Identifying Relevant Studies

The literature search was conducted in May 2023 using the following terms: "handwriting" AND "children" OR "child" AND "improve*" OR "enhance*" OR "increase*" OR "enrich*." Databases searched included PubMed, CINAHL Complete, MEDLINE, Web of Science, and ERIC. Additional manual searches of reference lists in relevant articles were conducted to identify further publications. No restrictions were placed on discipline, year of publication, study design, or location to ensure a comprehensive review.

Study Selection

Two researchers (DF and DAK) conducted the initial search and reviewed relevant abstracts based on predefined inclusion criteria. Articles were eligible if they:

1. Focused on children under 18 years of age with handwriting difficulties.
2. Were written in English.
3. Were peer-reviewed.

Abstracts were screened to determine eligibility, and search keywords were refined as needed. When discrepancies arose between researchers, a consensus was reached through discussions involving a third researcher (SP). Final decisions were made collaboratively to ensure methodological rigor.

Study Design

Studies employing qualitative, quantitative, mixed, and exploratory methods were included, provided they contributed relevant knowledge on the subject.

Discipline

The scope of this study extended beyond occupational therapy to include research from fields such as teaching, psychology, speech-language pathology, and physical therapy, acknowledging the interdisciplinary nature of addressing handwriting difficulties in children.

Charting the Data

Two researchers (DF and DAK) systematically extracted and mapped relevant data to organize and operationalize the findings. The extracted data were reviewed collaboratively by DF, DAK, and SP to ensure consistency with the research objectives and inclusion

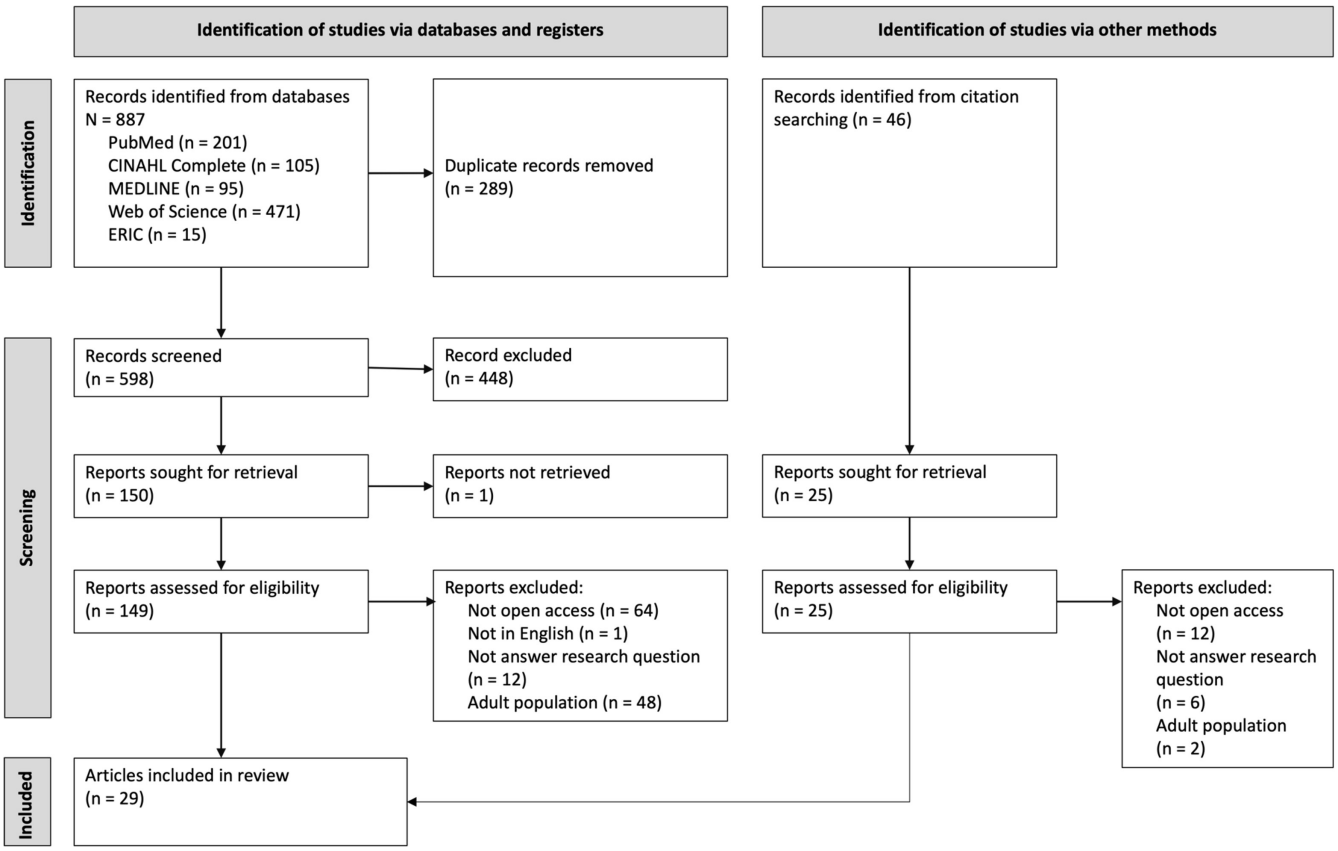

Fig. 1. Details of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart

PRISMA-ScRflow diagram illustrating the identification, screening, eligibility and inclusion of studies that examined factors influencinghandwriting improvement in children with handwriting difficulties. A comprehensive search of PubMed, CINAHL Complete, MEDLINE, Web of Science and ERIC conducted in May 2023 retrieved 887 records. Title-and-abstract screening removed 448 records, leaving 150 that appeared to meet the broad inclusion criteria. Full-text assessment was possible for 149 articles; 125 were excluded for reasons such as lack of open access, irrelevance to children or failure to address the review question. Reference-list screening of 24 provisional papers and a complementary forward search produced 46 additional records, 41 of which were excluded at full-text stage. Five additional articles met all criteria and were retained. In total, 29 studies were included in the final scoping review dataset. The diagram shows the count of records at each decision node and the cumulative attrition across the review process, in line with PRISMA-ScRrecommendations.

criteria.

Critical Appraisal

Consistent with PRISMA-ScR guidance, formal risk-of-bias appraisal was not undertaken; instead, methodological heterogeneity is considered in the Discussion as a limitation of interpretability.

Ethics Statement

As this study is a scoping review, no primary data collection involving human participants was conducted. According to the institutional guidelines of Tokyo Metropolitan University University scoping reviews that do not involve direct data collection from human subjects do not require ethical approval. Nevertheless, the procedures adhered to the ethical standards outlined in the Declaration of Helsinki.

Results

According to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart (Fig. 1), 598 abstracts met the inclusion criteria, while 439 did not. DF and DAK reviewed the remaining 149 full-text articles, excluding 125 due to reasons such as lack of open access, irrelevance to children, or failure to address the research question. After a manual search of 24 included papers and an additional 46 articles, 41 were excluded for not meeting the inclusion criteria. Five additional studies were included after eligibility screening, resulting in 29 articles for full data extraction. Table 1 details these 29 studies and explains how each fulfilled the search criteria and addressed the research questions. Explicit definitions of every abbreviation are provided in footnotes to make the table self-contained.

Table 1 Data Charting Table

Summarizes the scoping review findings, including publication details, author disciplines, study objectives, designs, participant characteristics, assessment tools, tasks, settings, and key outcomes.

Year of Publication	Authors	Title	Main author disciplines	Country of origin	Purposes	Study design	Sample size, age, diagnose	Evaluation tool	Tasks	Settings	Findings
1990	Oliver, CE	A Sensorimotor Program for Improving Writing Readiness Skills in Elementary-Age Children	Occupational Therapist	USA	To develop a pilot program to teach writing readiness skills and use it with children of varying abilities.	Pretest-posttest	$N = 24$ $\bar{x}$ 71 months normal intelligence ($n = 12$), learning disabilities ($n = 6$), mental retardation ($n = 6$)	Developmental Test of Visual-Motor Integration	1st part: direct therapy, conduct by OT, 30-min session 1x/week for 1 year 2nd part: supplementary program (warm-up activities, structured worksheets, manuscript letter practice), conduct by teacher or parent using outlined from OT, 10-min session 3x/week for 1 year	Group of two	1. Children with writing readiness deficits will be benefited from individualized instruction that emphasize multisensory training. 2. IQ level and gender has correlation with improvement of handwriting performance. 3. With the involvement of teachers and parents, the new skills that the child learns in therapy can be reinforced through practice.
2001	Smits-Engelsman B, Niemeijer A, Van Galen G	Fine motor deficiencies in children diagnosed as DCD based on poor grapho-motor ability	Physiotherapist	Netherlands	Research questions: (1) the prevalence of more general motor dysfunction, fine motor dysfunction and noisy or immature motor patterns in children with poor writing performance, (2) the effectiveness of intervention on readability and writing speed, (3) the changes in the movement kinematics of children with poor grapho-motor skills after physiotherapy.	Pretest-posttest	$N = 24$	BHK SQT M-ABC MSRT M-ABC (manual dexterity)	Physiotherapists intervention: prewriting exercises, fine motor training (if manipulation skills is insufficient), gross motor function training (only if one or more of prerequisites for sitting and independent arm movements were lacking)	Quiet room Individual	Improvement in using movement strategy of higher phasic stiffness in poor writers. No differences in pen pressure, mean number of velocity peaks,
2002	Case-Smith	Effectiveness of school-based occupational therapy intervention on handwriting	Occupational Therapist	USA	To examine the effects of school-based occupational therapy services on students' handwriting and associated school functions.	Pretest-posttest	$N = 44$	DTVP BOTMP In-hand manipulation components ETCH SFA	SBOT	Quiet room Group and individual	In-hand manipulation and visual-motor control increased. As well as visual-perceptual, HW speed, HW and letter legibility (not in numeric).
2003	Jongmans MJ, Linthorst-Bakker E, Westenberg Y, Smits-Engelsman BC	Use of a task-oriented self-instruction method to support children in primary school with poor handwriting quality and speed	Psychologist	Netherlands	To examine whether children experiencing significant handwriting problems improve in both quality and speed of handwriting following a task-oriented intervention using a self-instruction method.	Study 1: Pre-post design Study 2: Quasi-experimental case-control design	Study 1: $N = 10$ Study 2: $N = 24$	BHK	Study 1: 18 lessons of handwriting self-instruction method with semantic exercises Study 2: Handwriting self-instruction with dynamic writing and strict letter form instruction	Study 1: Individual Study 2: Group	Task-oriented self-instruction (know the shape of a letter, control over the route, and write letters in a word or short story) shows significance to improve handwriting performance in speed and quality.

Table 1 Continue

Year of Publication	Authors	Title	Main author disciplines	Country of origin	Purposes	Study design	Sample size, age, diagnose	Evaluation tool	Tasks	Settings	Findings
2006	Denton PL, Cope S, Moser C	The Effects of Sensorimotor-Based Intervention Versus Therapeutic Practice on Improving Handwriting Performance in 6- to 11-Year-Old Children	Occupational Therapist	USA	To investigate the effects of two interventions (sensorimotor and therapeutic practice) on handwriting and selected sensorimotor components in elementary-age children.	Three-group, pretest-posttest experimental design	$N = 38$ $\bar{x}$ 107.6 months	THS DTVP-2 TMP IHM	Sensorimotor intervention and therapeutic practice	Not specified	1. Therapeutic practice has a significant impact for the improvement in visual perception. No change noted on in-hand manipulation, proprioceptive functioning, and visual-motor integration. 2. Sensorimotor does not show impact for the improvement of handwriting performance.
2006	Volman MJ, van Schendel BM, Jongmans MJ	Handwriting difficulties in primary school children: A search for underlying mechanisms	Occupational Therapist	Netherlands	To investigate the contribution of perceptual-motor dysfunction and cognitive planning problem to the quality or speed of handwriting in children with handwriting problems (HWP).	Comparison study	$N = 49$ Grade 2: $\bar{x}$ 89.9 months Grade 3: $\bar{x}$ 98.9 months	BHK VMI TMT-B M-ABC	1st session: administration of BHK 2nd session: administration of VMI, TMT-B, and M-ABC	Not specified	HWP group: Found significantly correlated between quality of handwriting and VMI-integration; Unimanual Dexterity and VMI-integration; Unimanual Dexterity and VMI-motor coordination; VMI-motor coordination and VMI-integration; VMI-motor coordination and VMI-visual perception.
2008	Weintraub N, Yinon M, Hirsch IB-E, Parush S	Effectiveness of Sensorimotor and Task-Oriented Handwriting Intervention in Elementary School-Aged Students with Handwriting Difficulties	Occupational Therapist	Israel	To compare the effects of two handwriting intervention programs.	Pretest-posttest experimental design with random assignment	$N = 55$ $\bar{x}$ 7y8m	BATH MAC DTVP-2 BOTMP PEERAMID HHE	Sensorimotor and task-oriented	Classroom Group of six	Stage 1 1. Task-oriented group improved in overall legibility and letter formation with large effect size. 2. Sensorimotor group improved in letter formation with medium effect size. Stage 2 1. In the long term, both intervention group improve in overall legibility, letter formation and spatial organization. But only task-oriented groups improved in speed.
2010	Mackay N, McCluskey A, Mayes R	The Log Handwriting Program Improved Children's Writing Legibility: A Pretest–Posttest Study	Occupational Therapist	Australia	To determine the feasibility and outcomes of the Log Handwriting Program, an 8-week training program based on task-specific practice of handwriting.	Pretest-posttest single-group design	$N = 16$ 6–8 y.o	MHA	The Log Handwriting Program with homework	Group of two or three	Except for speed, letter form, alignment, size, and space showed significant gains and percentage changes in handwriting performance. Handwriting legibility has improved significantly.

Table 1 Continue

Year of Publication	Authors	Title	Main author disciplines	Country of origin	Purposes	Study design	Sample size, age, diagnose	Evaluation tool	Tasks	Settings	Findings
2010	Poon K, Li-Tsang C, Weiss T, Rosenblum S	The effect of a computerized visual perception and visual-motor integration training program on improving Chinese handwriting of children with handwriting difficulties	Occupational Therapist	Hong Kong	To investigate the effect of a computerized visual perception and visual-motor integration training program to enhance Chinese handwriting performance among children with learning difficulties, particularly those with handwriting problems.	Experimental study	$N = 26$	VMI MVPT-R POET ICHTP	Computerized visual perception and visual-motor integration training program Home program	Not specified	1. Computerized visual perception and visual-motor integration training program shows significant improvement for handwriting performance in increasing visual perception and decreasing on paper time and in air time. 2. Computerized visual perception and visual-motor integration training programs have not significantly improved handwriting performance in increasing visual-motor integration and handwriting legibility.
2010	Roberts GI, Siever JE, Mair JA	Effects of a Kinesthetic Cursive Handwriting Intervention for Grade 4–6 Students	Occupational Therapist	Canada	To determine whether Grade 4–6 students who participated in a kinesthetic writing intervention improved in legibility, speed, and personal satisfaction with cursive handwriting.	Repeated measures design with four time points	$N = 18$ $\bar{x}$ 10.5 y.o	TOWL HES	Remediation program based on the Loops and Other Groups program. Homework sheets to be completed nightly with their parents for 15–20 mins	Therapy room Group	Improved in legibility, letter formation, and legibility features of baseline, closure, and line quality. Increases handwriting speed and personal satisfaction of handwriting.
2012	Palsbo SE, Hood-Szivek P	Effect of Robotic-Assisted Three-Dimensional Repetitive Motion to Improve Hand Motor Function and Control in Children with Handwriting Deficits: A Nonrandomized Phase 2 Device Trial	Occupational Therapist	USA	To evaluate the safety and efficacy of a small gaming console, the Falcon is delivering three-dimensional repetitive fine motor training to children with poor functional handwriting.	Uncontrolled pretest-posttest design in two cohorts	$N = 18$ 5–11 y.o CP, ASD, ADD, ADHD	ETCH THS-R VMI VMI motor control subtest	Haptic software to generate three-dimensional haptic pathways, coded based on HWT	Not specified	1. Robotic Assisted has a significant improvement for handwriting performance in speed and consistency of letter shapes. 2. Improved motor control for children with learning difficulties and those age 9 or older but not for CP or younger.
2013	Cheng HYK, Lien YJ, Yu YC, Ju YY, Pei YC, Cheng CH, Wu DBC	The effect of lower body stabilization and different writing tools on writing biomechanics in children with cerebral palsy	Occupational Therapist	Taiwan	To investigate the influence of lower body stabilization and pencil design on body biomechanics in children with CP.	Crossover repeated measures design	$N = 14$ CP w/ MACS levels 1–3	Surface EMG Electro goniometer	Writing tasks, 30-min rest between the use of different pencils	Not specified	Wrist angle was not directly influenced by the stability of lower body, or by the pencil used. sitting position also improved the upper extremity function. Body posture is generally considered to have an important influence on the efficiency of the writing process and product.

Table 1 Continue

Year of Publication	Authors	Title	Main author disciplines	Country of origin	Purposes	Study design	Sample size, age, diagnose	Evaluation tool	Tasks	Settings	Findings
2013	Tse LF, Thanapalan KC, Chan CC	Visual-perceptual-kinesthetic inputs on influencing writing performances in children with handwriting difficulties	Occupational Therapist	Hong Kong	To investigate the roles of visual-feedback inputs (or feedback) on modulating production of Chinese characters.	Pretest-posttest	$N = 88$ $\bar{x}$ 10 y.o CHD	DTVP-2	Chinese character writing test and Developmental Test of Visual Perception (2nd edition)	Group	CHD group performed significantly slower than the control group on recognizing the stroke formation of characters and in producing the characters. Position in space ability predicted HW legibility as measured by DTVP2.
2014	Chang SH, Yu NY	The effect of computer-assisted therapeutic practice for children with handwriting deficit: A comparison with the effect of the traditional sensorimotor approach	Occupational Therapist	Taiwan	To develop a motor learning-based computer-assisted program for the remediation of handwriting problems.	RCT	$N = 42$ 6y8m–8y7m Dysgraphia	CHEQ	Computer-assisted handwriting remediation program and sensorimotor training	Quiet room Group and individual	1. Computer-assisted group showed improvement in handwriting fluency and mean peak measurement (paragraph copying). Changes in muscle forces. 2. Sensorimotor intervention has not given significant improvement for handwriting performance.
2016	Alhusaini AA, Melam GR, Buragadda S	Short-term sensorimotor-based intervention for handwriting performance in elementary school children	Physiotherapist	Saudi Arabia	To evaluate the additive effects of SM intervention on the child's handwriting.	Prospective, one-group, pretest-posttest experimental design	$N = 10$ $\bar{x}$ 77.1 ± 1.45 months	MHA HPSQ	Sensori-motor based intervention group	Quiet and private room Small group	1. Short-term sensorimotor based intervention has significant improvement for handwriting in legibility, form, alignment, size, spacing also hand grip strength. 2. Increase in teacher perception on HPSQ (legibility, performance time, physical and emotional components). 3. Improvement in hand-grip strength.
2016	Zylstra SE, Pfeiffer B	Effectiveness of a Handwriting Intervention with At-Risk Kindergarteners	Occupational Therapist	USA	To examine the outcomes of a handwriting intervention, the Size Matters Handwriting Program, provided to kindergarten children currently receiving individualized education program (IEP) or RtI support.	Two groups, pretest-posttest design	$N = 35$	THS-R North Dakota Title I Kindergarten Reading Standards Assessment (Letter Identification Subtest)	Size Matters Handwriting Program (SMHP)	Classroom Group of three	SMHP that is grounded in motor learning theory, cognitive theory, and motivation theory has a significant improvement in handwriting performance in legibility better than only standard handwriting instruction.

Table 1 Continue

Year of Publication	Authors	Title	Main author disciplines	Country of origin	Purposes	Study design	Sample size, age, diagnose	Evaluation tool	Tasks	Settings	Findings
2017	Chang SH, Yu NY	Visual and Haptic Perception Training to Improve Handwriting Skills in Children with Dysgraphia	Occupational Therapist	Taiwan	To investigate whether a program addressing visual-perceptual and haptic-perceptual skills can improve handwriting performance in children with handwriting deficits.	Pretest-posttest	$N = 2877–100$ months	TVPS-3 TPT BCBL	Training visual–perceptual and haptic–perceptual activities. Additional training activities required active touch without vision	Classroom Group	Improvement in visual-perceptual skills, and handwriting speed in the far-point copy test. No improvement in tactile performance test and haptic perception.
2017	Van Waelvelde H, De Roubaix A, Steppe L, Troubleyn E, De Mey B, Dewitte G, Debrabant J, Van De Velde D	Effectiveness of a self-regulated remedial program for handwriting difficulties	Occupational Therapist	Belgium	To investigate the effectiveness of the 'I Can!' program in children from mainstream schools, between 7 and 8 years old with handwriting difficulties.	Cross-over design	$N = 31$ $\bar{x}$ 7y9m	M-ABC-2 VMI OMT	I Can!' program with home program	Classroom Group of eight	Self-regulated remedial program (stickers reward, fine motor coordination game and self-regulated) shows significant improvement for handwriting performance.
2018	Capodieci A, Lachina S, Cornoldi C	Handwriting difficulties in children with attention deficit hyperactivity disorder (ADHD)	Educational Psychologist	Italy	To examine handwriting in a simple situation (which involved rapid writing a simple series of words for a limited amount of time), and in two cognitive loading conditions, one with a verbal and the other with a spatial WM load.	Experimental study	$N = 32$ $\bar{x}$ 121.3 months ADHD	Handwriting legibility scale	Experimental group: individual handwriting task adapted from the BVSCO-2. Three conditions were adopted: simple condition, verbal condition, and spatial condition	Quiet room Individual	ADHD group was generally less legible than the control group, significantly in the verbal condition and spatial condition.
2018	Reybroeck MV, Michiels N	Finger-writing intervention impacts the spelling and handwriting skills of children with developmental language disorder: a multiple single-case study	Speech Language Pathologist	Belgium	To demonstrate the effectiveness of a finger-writing intervention on reading, spelling, and handwriting performances.	Pretest-posttest multiple single-case intervention study	$N = 57.5–10.2$ y.o DLD	NBA	Finger-writing and control—focused on the learning of five grapheme-phoneme correspondences (GPCs)	Classroom Individual	2/3 children showed improvement in HW quality.
2018	Tse LF, Siu AM, Li-Tsang CW	Developmental skills between kindergarten children with handwriting difficulties in Chinese and/or English.	Occupational Therapist	Hong Kong	To examine handwriting difficulties in a bilingual (English and Chinese) language learning environment among Hong Kong kindergarten children as well as investigating the competence of developmental skills between children with and without handwriting difficulties.	Observational Study	$N = 64$ TD ($n = 21$), learning handwriting difficulties in Chinese ($n = 20$), handwriting difficulties in Chinese and English ($n = 23$)	CHEST RAST-K randomly assessment: DEM-2, TVPS-3, BOT-2, VMI-6	Administration of assessment task: CHEST, RAST-K, and one of randomly assessment, 30–35-min test sessions with 15-min break	Research lab or kindergarten Individual	Children with HW difficulties have significantly poorer visual motor integration, some aspects of visual perception and fine motor skills than TD children. Visual and fine motor integration and spatial relationship were the significant predictors of Chinese and English handwriting performance.

Table 1 Continue

Year of Publication	Authors	Title	Main author disciplines	Country of origin	Purposes	Study design	Sample size, age, diagnose	Evaluation tool	Tasks	Settings	Findings
2019	Gosse C, Reybroeck MV	Do children with dyslexia present a handwriting deficit? Impact of word orthographic and graphic complexity on handwriting and spelling performance	Speech Language Pathologist	Belgium	To better understand the difficulties met by children with dyslexia (DYS) in handwriting, by examining both the orthographic and graphic levels of complexity.	Experimental study	$N = 69$ $\bar{x}$ 8y6m dyslexia ($n = 23$), TD on chronological age ($n = 23$), TD on spelling age ($n = 23$)	BHK Word reading Spelling accuracy	Single-word dictation task	Empty classroom Groups of four	Children with HW difficulties have significantly poorer visual motor integration, some aspects of visual perception and fine motor skills than TD children. Visual and fine motor integration and spatial relationship were the significant predictors of Chinese and English handwriting performance.
2019	Rahim N, Jamaludin Z	Write-Rite: Enhancing Handwriting Proficiency of Children with Dysgraphia	System design	Malaysia	To provide activities and exercises that can help children with dysgraphia improve visual-motor integration that is correlated with writing skills.	Quantitative evaluation approach by observing	$N = 5$ dysgraphia	Write-Rite	Write-rite applications: Level 1: Model with dotted line Level 2: Model marked with numbers of arrows Level 3: Self writing	Quiet classroom Individual	Improved legibility (improved in letter formation, size, and proportion, spacing, slant, alignment, and line quality.
2019	Saleem GT, Gillen G	Mental practice combined with repetitive task practice to rehabilitate handwriting dysfunction in school-age children	Occupational Therapist	USA	To examine the effectiveness of mental practice (MP) in conjunctions with repetitive task practice (RTP) for the rehabilitation of handwriting dysfunction in typically developing school-age children.	Repeated-measures, non randomized experimental design (Level 3)	$N = 20$ 6.5–7.5 y.o	MHA KIAQ	Mental practice & repetitive task practice using HWT curriculum	Classroom	MP combined with RTP has significantly improved handwriting performance in legibility, form, alignment, size and spacing.
2020	Prunty MM, Pratt A, Raman E, Simmons L, Steele-Bobat F	Grip Strength and Pen Pressure Are Not Key Contributors to handwriting difficulties in children with developmental coordination disorder	Occupational Therapist	UK	To examine grip strength and pen pressure in children with DCD and their relationship with measures of handwriting.	Comparison study	$N = 36$ $\bar{x}$ 9.85 y.o DCD ($n = 16$), TD ($n = 20$)	DASH EP2 software Jamar hand Pinch dynamometer Goniometer	Measures of grip strength (ASHT then handwriting assessment	Room	1. Palmar grip has no significant correlation with handwriting performance in both groups. 2. Pinch grip has significant correlation with handwriting performance in DCD group. 3. Tripod grip has significant correlation with handwriting performance in both groups. 4. Pen pressure has significant correlation with handwriting performance.

Table 1 Continue

Year of Publication	Authors	Title	Main author disciplines	Country of origin	Purposes	Study design	Sample size, age, diagnose	Evaluation tool	Tasks	Settings	Findings
2022	Abu-Ata A, Green D, Sopher R, Portnoy S, Ratzon NZ	Upper Limb Kinematics of Handwriting among Children with and without Developmental Coordination Disorder	Occupational Therapist	Israel	To investigate the relationship between handwriting and upper limb kinematics to characterize movement patterns of children with DCD and typically developing (TD) children.	Comparison study	$N = 30$ 7–9 y.o DCD ($n = 15$), TD ($n = 15$)	MABC-2 HHE Qualisys 3D motion capture system	Handwriting task: seated on a height-adjustable chair with both feet touching the floor (or footplate) in front of a height-adjustable table and markers fitted and completed copying and dictation task of HHE	Not specified	Greater wrist flexion and extension correlated significantly with handwriting improvement in legibility both copying, and dictation also maintain the margin during copying.
2022	Li-Tsang CW, Li TM, Yang C, Cheung PP, Au K, Chan Y, Cheung K, Ho K, Kwok K, Leung HW	Evaluation of a group-based sensorimotor intervention programme to improve Chinese handwriting of primary school students	Occupational Therapist	Hong Kong	To evaluate a sensorimotor-based intervention to improve handwriting in the mainstream primary schools.	Two group pretest-posttest	$N = 34$ 7–9 y.o	SHARP HAC TVPS-4 DEM-2 COMPS-2	Group-based sensorimotor intervention or intervention	Classroom Group	Improvement in the handwriting performance, motor skills, and visual perceptual skills.
2023	Mathwin K, Chapparo C, Hinitt J	Children with handwriting difficulties: Impact of cognitive strategy training for acquisition of accurate alphabet-letter-writing	Occupational Therapist	Australia	To investigate the impact of cognitive strategy training for children struggling to correctly write alphabet-letters.	Non-concurrent, single-system research design	$N = 10$ $\bar{x}$ 6y1m TD with handwriting difficulties	The Perceive, Recall, Plan and Perform System of Task Analysis (cognitive strategies)	Stage 1: alphabet task (letter-formation & letter-placement) evaluate with procedural task analysis. Stage 2: measures cognitive strategy application during functional task performance using cognitive task analysis.	Individual	Facilitates significant improvement in cognitive strategy application. The importance of memory, executive function (attention & working memory) to children's acquisition in alphabet-letter-writing skills.
2023	Vecchini A, Buratta L, Fogassi L	Grapho-motor imitation training in children with handwriting difficulties: A single-center pilot study	Special Education	Italy	To verify whether children who observe the experimenter writing can imitate her/his motor gestures and improve the quality of their writing.	Preliminary study	$N = 5$	BHK Observation of biomechanical and postural ergonomics aspects	Imitation training created on lined sheets of notebooks.	Not specified	Handwriting imitation training (fine motor imitation) that involved ergonomic and biomechanical aspects produced a significant improvement of handwriting performance.

Abbreviations:
BHK = Concise Assessment Scale for Children's Handwriting
SQT = School Questionnaire for Teachers
M-ABC test = Movement Assessment Battery for Children
MSRT = Motor Performance School Readiness Test
DTVP = Developmental Test of Visual Perception
BOTMP = Bruininks-Oseretsky Test of Motor Proficiency
ETCH = Evaluatoin Tool of Children's Handwriting
SFA = School Function Assessment
THS = The Test of Handwriting Skills
TMP = Test of Manual Pointing
IHM = In Hand Manipulation
VMI = The Beery-Buktenica Developmental Test of Visual-otor Integration
TMT-B = The Trail Making Test, Part B
BATH = Brief Assessment Tool for Handwriting
MAC = The Motor Accuracy Test
PEERAMID = The Pediatric Examination of Educational Readiness at Middle Childhood
HHE = The Hebrew Handwriting Evaluation
MHA = Minnesota Handwriting Assessment
MVPT-R = The Motor-free Visual Perception Test-Revised
POET = Penmanship Objective Evaluation Tool
ICHTP = Interactive Computerized Handwriting Training Program
TOWL = Test of Written Language
HES = The Handwriting Evaluation Scale
THS-R = The Test of Handwriting Skills-Revised
EMG = Electromyography
CHEQ = Chinese Handwriting Evaluation Questionaire
HPSQ = Handwriting Proficiency Screening Questionnaire
TPT = Tactual Performance Test
BCBL = Battery of Chinese Basic Literacy
OMT = One Minute Test
NBA = Assessment scale of prerequesites for Grade 1 and Analytical battery of reading/spell
CHEST = Chinese and English handwriting screening test for kindergarten children
RAST-K = The Hong Kong Reading Ability Screening Test for Preschool Children
DEM-2 = Developmental Eye Movement, 2nd edition
TVPS-3 = Test of Visual Perceptual Skills-3
BOT-2 = Bruininks-Osteretsky Test of Motor Proficiency, Second Edition
KIAQ = Kids Imaging Ability Questionnaire
DASH = Detailed Assessment of Speed of Handwriting
EP2 = Eye & Pen version 2
SHARP = Smart Handwriting Analysis and Recognition Platform
HAC = The Handwriting Assessment Checklist
COMPS-2 = The Clinical Observation of Motor and Postural Skills – 2nd Edition

Table 2 Geographic distribution, lead-author discipline, and methodological designs of the 29 studies included in the scoping review.

The table summarises three key characteristics of the evidence base, each presented as a simple frequency count

Main Author Discipline		Country		Method/design	
OT	*n* = 21	USA	*n* = 6	Pretest-posttest design	*n* = 14
SLP	*n* = 2	Hong Kong	*n* = 4	Experimental study	*n* = 3
PT	*n* = 2	Belgium	*n* = 3	Repeated measure design	*n* = 3
Psychologist	*n* = 1	Netherlands	*n* = 3	Comparative study	*n* = 3
Educational Psychologist	*n* = 1	Taiwan	*n* = 3	RCT	*n* = 1
Special Educator	*n* = 1	Australia	*n* = 2	Single-system research sedign	*n* = 1
System Design	*n* = 1	Israel	*n* = 2	Cross-over design	*n* = 1
		Italy	*n* = 2	Preliminary investigation	*n* = 1
		Canada	*n* = 1	Observational study	*n* = 1
		UK	*n* = 1	Quantitative study	*n* = 1
		Saudi Arabia	*n* = 1		
		Malaysia	*n* = 1		

Study characteristics and representativeness

The included studies employed a variety of methodologies, designs, geographical locations, and disciplines. Among the 29 studies, the following designs were observed: 14 pretest-posttest designs [23–36], three experimental studies [37–39], three repeated-measures designs [40–42], three comparative studies [43–45], one randomized controlled trial [46], one single-system research design [47], one crossover design [48], one preliminary investigation [49], one observational study [50], and one quantitative study [51].

Geographically, six studies were conducted in the United States [23, 25, 27, 30, 33, 42], four in Hong Kong [31, 36, 37, 50], three each in Belgium [35, 39, 48] and the Netherlands [24, 26, 43], three in Taiwan [34, 41, 46], two each in Australia [29, 47], Israel [28, 45], and Italy [38, 49], and one each in Canada [40], the United Kingdom [44], Saudi Arabia [32], and Malaysia [51]. Of the principal investigators, 21 were occupational therapists [23, 25, 27–31, 33, 34, 36, 37, 40–48, 50], while the others included speech-language pathologists (2) [35, 39], physical therapists (2) [24, 32], psychologists (1) [26], educational psychologists (1) [38], special educators (1) [49], and system designers (1) [51].

The studies demonstrated a wide range of methodological rigor, from observational studies to randomized controlled trials. For example, three experimental studies included small sample sizes, with one study involving 10 participants [32] and two studies involving five participants [35, 49]. Table 2 summarises design, country, and disciplines for all 29 studies.

Qualitative Results

Employing qualitative thematic analysis, DF utilizing hand-written visual mapping, enabling DF and SP to identify two main themes: (1) the rationale for designing handwriting programs and (2) additional programs to support handwriting interventions. These themes highlight factors influencing children's handwriting improvement and provide insights for developing occupation-based handwriting models in Indonesia.

The Rationale for Designing Handwriting Programs

This theme was identified across all studies and divided into four categories: intervention types, evaluation tools, writing styles, and activity settings.

Intervention Types:

Among the 25 studies employing interventions, 11 used direct handwriting task [23, 25, 26, 29, 35, 38, 39, 41, 45, 49, 51], two used sensorimotor approaches [32, 36], two employed remediation programs [40, 48], two focused on visual-perceptual training [34, 37], and one used computer-assisted [30]. Other studies combined approaches, such as direct handwriting task and cognitive task [33, 47], task-oriented approach and sensorimotor [28], prewriting practice, fine motor activity, and gross motor activity [24], direct handwriting task and mental practice [42]. Then two studies compared approaches, instance direct handwriting task and sensorimotor [27], and sensorimotor and computer-assisted [46]. For example, sensorimotor interventions were found to have limited effects on handwriting skills [27, 46], while incorporating ergonomic and biomechanical aspects significantly improved performance [49]. Gradual interventions, including prewriting exercises and motor skill activities, also showed notable improvements in children with handwriting difficulties [24].

Evaluation Tools:

Evaluation tools frequently assessed motor, visual-perceptual, visual-motor, cognitive, kinesthetic, and postural abilities, as well as handgrip and hand movement. Handgrip and hand movement tests, although less commonly used, demonstrated significant correlations with handwriting performance. For instance, tripod and pinch grips were associated with better handwriting outcomes, whereas palmar grips were not. Pen pressure also significantly affects handwriting performance [44]. It has also significantly improved children's handwriting abilities [41].

Writing Styles:

Three writing styles were identified: alphabetic manuscript, alphabetic cursive, and non-alphabetic characters. Studies revealed that children struggling with multiple writing styles performed worse across all tests compared to those with difficulties in a single style [50]. More complex words were associated with lower handwriting quality and speed in children with handwriting challenges [39].

Activity Settings:

Of the 20 studies detailing intervention settings, 11 employed group settings [23, 28, 29, 31–34, 36, 39, 40, 48], six used individual settings [24, 35, 38, 47, 50, 51], and three combined both [25, 26, 46]. Studies found significant benefits from individual and group settings, although one study indicated that individual interventions yielded more substantial improvements [46].

Additional Programs to Support Handwriting Programs

Seven studies emphasized the importance of supplementary programs [23, 29, 33, 36, 37, 40, 48]. Home-based exercises, such as worksheets and supervised practice with parental involvement, increased children's confidence and reinforced skills learned in handwriting programs [23, 29, 36, 37, 40, 48]. Classroom-based interventions, involving verbal and visual demonstrations, motivated students to practice handwriting [23, 29, 33]. The involvement of parents and teachers in structured activities, such as warm-up exercises and reward systems, enhanced student engagement and shared responsibility for handwriting progress [23, 29].

Discussion

This scoping review set out to map the factors that facilitate or hinder handwriting improvement in children with handwriting difficulties. We included 29 studies, representing 15 countries and six professional disciplines, and identified two main themes: (1) the rationale for designing handwriting programs and (2) additional programs to support handwriting interventions. Findings confirm that effective handwriting improvements result from integrated interventions addressing motor, cognitive, ergonomic, and environmental dimensions, reinforced consistently across settings [52, 53]. The quantitative results indicate that most primary investigators were occupational therapists, with the United States producing the largest body of research in this field. However, in Southeast Asia, only one study met the necessary criteria. This gap may be due to the limited use of the databases included in this review within Southeast Asia and the exclusive reliance on English-language publications. Consequently, this review does not comprehensively represent this specific region.

Occupational Therapist-Led Interventions

Most primary investigators were occupational therapists (OTs), with substantial contributions from the United States. Interventions led by OTs were characterized by integrative methods combining motor-cognitive strategies, direct handwriting practice, and ergonomic adjustments [47, 49]. Common OT challenges included resource constraints, high caseloads, and time limitations within school schedules, affecting intervention comprehensiveness [33].

Designing Handwriting Programs

The rationale for designing handwriting programs, as highlighted in the included studies, underscores the importance of diverse interventions. For example, Mathwin, Chapparo, and Hinitt combined alphabet tasks and cognitive strategies, resulting in significant improvements in handwriting skills [47]. This finding aligns with Berninger and Richard (2010), who noted that executive functions—such as planning, translating, reviewing, and revising—play a critical role in managing the self-regulation of handwriting processes [52]. Moreover, low-level executive functions support these high-level processes, directly impacting children's ability to write letters.

Zylstra and Pfeiffer demonstrated that handwriting programs integrating manual writing activities with cognitive tasks significantly enhanced legibility compared to traditional handwriting training [33]. The success of these interventions derives from principles of motor learning, cognition, and motivation. Similarly, Montgomery and Zwicker (2020) found that occupational therapy programs incorporating cognitive techniques effectively impart procedural and spatial information for letter production [53], fostering the motor skills required for precise and efficient handwriting.

Vecchini, Buratta, and Forgasi conducted a study

addressing ergonomic and biomechanical factors in handwriting, such as body posture, arm and wrist positioning, and pencil grip. They observed that improper posture and grip patterns negatively impacted handwriting proficiency [49]. However, after implementing interventions combining direct handwriting assignments with ergonomic and biomechanical considerations, children demonstrated notable improvements. These findings highlight the critical role occupational therapists play in assessing and addressing posture and biomechanical factors to optimize handwriting performance. Prior research also supports the importance of addressing biomechanical and ergonomic variables, such as body alignment and pencil grip, as these factors significantly influence handwriting abilities [54–56].

Furthermore, studies by Prunty et al. demonstrated that pinch and tripod grips strongly correlate with handwriting performance, whereas the palmar grip does not [44]. This finding is consistent with Karakostis et al. (2018), who emphasized the importance of handgrip and pinch strength in fine motor movements and handwriting performance [57]. These abilities rely on the coordinated activity of robust muscles that manipulate finger movements, underscoring the importance of assessing grip patterns in handwriting programs.

Diagnostic Variability and Intervention Effectiveness

Variability in disability and diagnostic groups among participants emerged as a key limitation, influencing the generalizability and effectiveness of intervention outcomes. For instance, children with Developmental Coordination Disorder (DCD) benefited more from explicit motor learning and repetitive practice interventions [44]. Conversely, children with Autism Spectrum Disorder (ASD) showed improved outcomes with multisensory approaches that utilized their strengths in visual processing [53]. Future research should stratify interventions by diagnosis, enhancing the specificity and effectiveness of tailored approaches.

Additional Programs

Supplementary programs, including home- and school-based training, significantly improve handwriting skills by providing consistent practice in varied environments. Collaboration between parents and teachers enhances children's exposure to training, increases confidence, and fosters greater engagement with handwriting activities. Given the critical role of handwriting in enabling successful participation in educational activities, it remains a key area of concern for occupational therapists, educators, and parents [58].

To address the factors influencing handwriting interventions, occupational therapists should collaborate with parents and teachers to develop appropriate, occupation-focused programs tailored to children's needs [59]. Mastering handwriting is a multifaceted skill that requires extensive training and practice [60]. According to Schneck and Amundson (2010), handwriting difficulties can hinder children's ability to complete written tasks [61], necessitating comprehensive evaluations to identify factors that can enhance handwriting abilities. Further research is needed to explore these factors and their implications for evidence-based handwriting interventions.

Impact of Disabilities and Diagnoses on Intervention Outcomes

An additional consideration that emerged from this review relates to the variability of disability or diagnosis among the children included in the analyzed studies. As the inclusion criteria did not limit the studies based on specific diagnoses or disabilities, differences in children's conditions may have influenced the outcomes and effectiveness of the interventions. For example, interventions that benefit children with developmental coordination disorders may differ from those that are optimal for children with autism spectrum disorders or intellectual disabilities. This variability may limit the comparability and direct generalizability of the findings. Thus, in the future, researchers should carefully look into how certain disabilities or diagnoses affect the results of handwriting interventions. This will enable the development of targeted intervention programs that consider specific diagnoses.

Relationship to, and Advancement of, Previous Literature

Earlier systematic reviews have examined single intervention types—sensorimotor activities, direct handwriting curricula, or technology-based training—and reported modest or domain-specific improvements. Our synthesis advances that work by demonstrating that hybrid approaches consistently outperform single-component programmes and by highlighting the amplifying role of parent–teacher collaboration. It also updates the geographical and methodological landscape, revealing a recent growth in Asian studies and greater diversification of outcome measures than was evident in reviews published a decade ago.

Implication for occupational therapy:

The findings of this scoping review hold significant implications for occupational therapists. First, this study provides evidence of factors that support or hinder the enhancement of handwriting abilities in children. Second, it highlights the strong connection between posture and handwriting performance. Third, the study

emphasizes the importance of collaboration among occupational therapists, parents, and teachers in improving children's handwriting skills through additional home- and school-based programs.

Our findings underscore several factors that are strongly associated with handwriting performance and should be considered by occupational therapists when designing handwriting interventions. These findings contribute to both clinical and school-based occupational therapy settings. However, further research is needed to analyze children's handwriting performance by identifying and assessing the associated components and factors in greater detail.

Limitations:

While this scoping review offers a comprehensive overview, it has certain limitations. First, it did not rigorously evaluate the methodological quality of the included studies, resulting in a lack of critical analysis regarding the rigor of the evidence. Second, any constraints identified in the examined studies were considered as inherent limitations of this scoping review itself. Third, since this study did not apply a specific time frame, some findings may not fully reflect current practices. Fourth, this review did not restrict inclusion based on specific disabilities or diagnoses, which may affect the generalizability and specificity of the findings. Fifth, the studies used heterogeneous designs, intervention lengths, and outcome measures, making direct comparisons difficult. Sixth, most papers offered only limited detail on the real-world constraints occupational therapists face, leaving feasibility under-explored.

Additionally, relatively few studies identified factors that hinder handwriting performance, limiting insights into barriers to improvement. The review process was further constrained by the restricted availability of certain articles, leading to their exclusion. By focusing only on English-language publications, this study may have introduced language bias and overlooked valuable references in other languages. Future research should explore culturally specific interventions to address these gaps as well as limited the time frame for studies that published within 10 years.

Direction for Future Research:

Further research should involve rigorous, diagnosis-specific randomized controlled trials (RCTs) to determine optimal interventions for various developmental conditions. Research must also prioritize geographically diverse contexts, particularly low- and middle-income countries, to close evidence gaps. Implementation science methodologies should systematically address service delivery constraints, guiding the development of practical, sustainable intervention models suited to educational environments [49, 53].

Conclusion

This scoping review identified significant rationales and supporting strategies that influence handwriting improvement in children with handwriting difficulties. Different types and combinations of interventions, like direct handwriting tasks, cognitive strategies, ergonomic factors, and gradual prewriting and motor skill activities, were found to be critical for improving handwriting skills. Moreover, specific evaluation tools assessing motor skills, visual perception, visual motor integration, and handgrip strength provided essential insight for designing a handwriting program. The effectiveness of the intervention also varied based on writing styles, with children facing more challenges when managing multiple styles or more complex words. Individual settings for providing interventions showed a slightly better impact on enhancements rather than group interventions, although both settings offer significant improvements. Furthermore, additional programs involving home- and classroom-based exercises were shown to significantly improve handwriting performance, as the involvement of parents and teachers plays a crucial role in boosting children's motivation and outcomes. The findings of this study are valuable for occupational therapists as they provide a reference for designing effective handwriting intervention programs. These findings also encourage occupational therapists to develop additional programs that actively involve parents and teachers. Furthermore, this study serves as a foundation for developing occupation-based handwriting models in future research.

Conflict of interest

The authors declare no conflict of interest.

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References

[1] Bourdin B, Fayol M. Is graphic activity cognitively costly? A developmental approach. Reading and Writing. 2000; 13(3/4): 183–96.

[2] Feder KP, Majnemer A. Handwriting development, competency, and intervention. Developmental Medicine & Child Neurology. 2007; 49(4): 312–7.

[3] McCutchen D. From novice to expert: language and memory processes in the development of writing skill. Journal of Writing Research. 2011; 3(1): 51–68.

[4] Julius MS, Meir R, Shechter-Nissim Z, Adi-Japha E. Children's ability to learn a motor skill is related to handwriting and reading proficiency. Learning and Individual Differences. 2016; 51: 265–72.

[5] Lichtsteiner SH, Wicki W, Falmann P. Impact of handwriting training on fluency, spelling and text quality among third graders. Reading and Writing. 2018; 31(6): 1295–318.

[6] Bara F, Gentaz E. Haptics in teaching handwriting: The role of perceptual and visuo-motor skills. Human Movement Science. 2011; 30(4): 745–59.

[7] Chartrel E, Vinter A. The impact of spatio-temporal constraints on cursive letter handwriting in children. Learning and Instruction. 2008; 18(6): 537–47.

[8] Lopez C, Vaivre-Douret L. Influence of visual control on the quality of graphic gesture in children with handwriting disorders. Scientific Reports. 2021; 11(1).

[9] James KH. The importance of handwriting experience on the development of the literate brain. Current Directions in Psychological Science. 2017; 26(6): 502–8.

[10] Christensen CA. The role of Orthographic–Motor integration in the production of creative and Well-Structured written text for students in secondary school. Educational Psychology. 2005; 25(5): 441–53.

[11] Rosenblum S, Weiss PL, Parush S. Handwriting evaluation for developmental dysgraphia: Process versus product. Reading and Writing. 2004; 17(5): 433–58.

[12] Lam SST, Au RKC, Leung HWH, Li-Tsang CWP. Chinese handwriting performance of primary school children with dyslexia. Research in Developmental Disabilities. 2011; 32(5): 1745–56.

[13] McHale K, Cermak SA. Fine motor activities in Elementary School: Preliminary findings and provisional implications for children with fine motor problems. American Journal of Occupational Therapy. 1992; 46(10): 898–903.

[14] Tseng MH, Chow SMK. Perceptual-Motor Function of School-Age Children with slow handwriting speed. American Journal of Occupational Therapy. 2000; 54(1):83–8.

[15] Drijbooms E, Groen MA, Verhoeven L. How executive functions predict development in syntactic complexity of narrative writing in the upper elementary grades. Reading and Writing. 2016; 30(1): 209–31.

[16] Applebee AN, Bazerman C, Berninger VW, Brandt D, Graham S, Matsuda PK, et al. Forum: Taking the Long View on Writing Development. Research in the Teaching of English. 2017; 51(3): 351–60.

[17] Kadar M, Yunus FW, Tan E, Chai SC, Razaob@Razab NA, Kasim DHM. A systematic review of occupational therapy intervention for handwriting skills in 4–6 year old children. Australian Occupational Therapy Journal. 2019; 67(1): 3–12.

[18] Howe TH, Roston KL, Sheu CF, Hinojosa J. Assessing handwriting intervention Effectiveness in elementary school students: a Two-Group controlled study. American Journal of Occupational Therapy. 2012; 67(1): 19–26.

[19] Roston K. A Frame of Reference for Developing Handwriting. In: Kramer P, Hinojosa J, Howe T-S, editors. Frame of Reference Pediatric Occupational Therapy. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2020. 427–60.

[20] Occupational Therapy Practice Framework: Domain and Process—Fourth Edition. American Journal of Occupational Therapy. 2020; 74(Supplement_2): 7412410010 p1–87.

[21] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International Journal of Social Research Methodology. 2005; 8(1): 19–32.

[22] Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-SCR): Checklist and explanation. Annals of Internal Medicine. 2018; 169(7): 467–73.

[23] Oliver CE. A sensorimotor program for improving writing readiness skills in Elementary-Age children. American Journal of Occupational Therapy. 1990; 44(2): 111–6.

[24] Smits-Engelsman BCM, Niemeijer AS, Van Galen GP. Fine motor deficiencies in children diagnosed as DCD based on poor grapho-motor ability. Human Movement Science. 2001; 20(1–2): 161–82.

[25] Case-Smith J. Effectiveness of School-Based Occupational Therapy Intervention on Handwriting. American Journal of Occupational Therapy. 2002; 56(1): 17–25.

[26] Jongmans MJ, Linthorst-Bakker E, Westenberg Y, Smits-Engelsman BCM. Use of a task-oriented self-instruction method to support children in primary school with poor handwriting quality and speed. Human Movement Science. 2003; 22(4–5): 549–66.

[27] Denton PL, Cope S, Moser C. The Effects of Sensorimotor-Based Intervention versus therapeutic Practice on improving handwriting performance in 6- to 11-Year-Old Children. American Journal of Occupational Therapy. 2006; 60(1): 16–27.

[28] Weintraub N, Yinon M, Hirsch IBE, Parush S. Effectiveness of Sensorimotor and Task-Oriented Handwriting Intervention in Elementary School-Aged Students with Handwriting Difficulties. OTJR Occupational Therapy Journal of Research. 2008; 29(3): 125–34.

[29] Mackay N, McCluskey A, Mayes R. The Log Handwriting Program Improved Children's writing Legibility: A Pretest–Posttest study. American Journal of Occupational Therapy. 2010; 64(1): 30–6.

[30] Palsbo SE, Hood-Szivek P. Effect of Robotic-Assisted Three-Dimensional repetitive Motion to improve hand

motor function and control in children with handwriting deficits: a nonrandomized phase 2 device trial. American Journal of Occupational Therapy. 2012; 66(6): 682–90.
[31] Tse LFL, Thanapalan KC, Chan CCH. Visual-perceptual-kinesthetic inputs on influencing writing performances in children with handwriting difficulties. Research in Developmental Disabilities. 2013; 35(2): 340–7.
[32] Alhusaini AA, Melam GR, Buragadda S. Short-term sensorimotor-based intervention for handwriting performance in elementary school children. Pediatrics International. 2016; 58(11): 1118–23.
[33] Zylstra SE, Pfeiffer B. Effectiveness of a handwriting intervention with At-Risk kindergarteners. American Journal of Occupational Therapy. 2016; 70(3): 7003220020 p1–8.
[34] Chang SH, Yu NY. Visual and haptic perception training to improve handwriting skills in children with dysgraphia. American Journal of Occupational Therapy. 2017; 71(2): 7102220030p1–10.
[35] Van Reybroeck M, Michiels N. Finger-writing intervention impacts the spelling and handwriting skills of children with developmental language disorder: a multiple single-case study. Reading and Writing. 2018; 31(6): 1319–41.
[36] Li-Tsang CWP, Li TMH, Yang CN, Cheung PPP, Au KY, Chan YP, et al. Evaluation of a group-based sensorimotor intervention programme to improve Chinese handwriting of primary school students. Heliyon. 2022; 9(2): e12554.
[37] Poon KW, Li-Tsang CWP, Weiss TPL, Rosenblum S. The effect of a computerized visual perception and visual-motor integration training program on improving Chinese handwriting of children with handwriting difficulties. Research in Developmental Disabilities. 2010; 31(6): 1552–60.
[38] Capodieci A, Lachina S, Cornoldi C. Handwriting difficulties in children with attention deficit hyperactivity disorder (ADHD). Research in Developmental Disabilities. 2018; 74: 41–9.
[39] Gosse C, Van Reybroeck M. Do children with dyslexia present a handwriting deficit? Impact of word orthographic and graphic complexity on handwriting and spelling performance. Research in Developmental Disabilities. 2019; 97: 103553.
[40] Roberts GI, Siever JE, Mair JA. Effects of a Kinesthetic Cursive Handwriting intervention for Grade 4–6 students. American Journal of Occupational Therapy. 2010; 64(5): 745–55.
[41] Cheng HYK, Lien YJ, Yu YC, Ju YY, Pei YC, Cheng CH, et al. The effect of lower body stabilization and different writing tools on writing biomechanics in children with cerebral palsy. Research in Developmental Disabilities. 2013; 34(4): 1152–9.
[42] Saleem GT, Gillen G. Mental practice combined with repetitive task practice to rehabilitate handwriting in children. Canadian Journal of Occupational Therapy. 2019; 86(1): 19–29.
[43] Volman MJM, Van Schendel BM, Jongmans MJ. Handwriting difficulties in primary school children: A search for underlying mechanisms. American Journal of Occupational Therapy. 2006; 60(4): 451–60.
[44] Prunty MM, Pratt A, Raman E, Simmons L, Steele-Bobat F. Grip strength and pen pressure are not key contributors to handwriting difficulties in children with developmental coordination disorder. British Journal of Occupational Therapy. 2020; 83(6): 387–96.
[45] Abu-Ata A, Green D, Sopher R, Portnoy S, Ratzon NZ. Upper Limb Kinematics of Handwriting among Children with and without Developmental Coordination Disorder. Sensors. 2022; 22(23): 9224.
[46] Chang SH, Yu NY. The effect of computer-assisted therapeutic practice for children with handwriting deficit: A comparison with the effect of the traditional sensorimotor approach. Research in Developmental Disabilities. 2014; 35(7): 1648–57.
[47] Mathwin K, Chapparo C, Hinitt J. Children with handwriting difficulties: Impact of cognitive strategy training for acquisition of accurate alphabet-letter-writing. British Journal of Occupational Therapy. 2023; 86(6): 451–61.
[48] Van Waelvelde H, De Roubaix A, Steppe L, Troubleyn E, De Mey B, Dewitte G, et al. Effectiveness of a self-regulated remedial program for handwriting difficulties. Scandinavian Journal of Occupational Therapy. 2017; 24(5): 311–9.
[49] Vecchini A, Buratta L, Fogassi L. Grapho-motor imitation training in children with handwriting difficulties: A single-center pilot study. Cogent Education. 2023; 10(1).
[50] Tse LFL, Siu AMH, Li-Tsang CWP. Developmental skills between kindergarten children with handwriting difficulties in Chinese and/or English. Australian Occupational Therapy Journal. 2018; 66(3): 292–303.
[51] Rahim N, Jamaludin Z. WRITE-RITE: ENHANCING HANDWRITING PROFICIENCY OF CHILDREN WITH DYSGRAPHIA. Journal of Information and Communication Technology. 2019; 18(3): 253–71.
[52] Berninger V, Richards T. Inter-relationships among behavioral markers, genes, brain and treatment in dyslexia and dysgraphia. Future Neurology. 2010; 5(4): 597–617.
[53] Montgomery I, Zwicker JG. Use of Printing like a Pro! in a School-Based Printing Club to Improve Handwriting Legibility in Primary Grade Students. Journal of Occupational Therapy Schools & Early Intervention. 2019; 13(1): 40–54.
[54] Ziviani J. QUALITATIVE CHANGES IN DYNAMIC TRIPOD GRIP BETWEEN SEVEN AND 14 YEARS OF AGE. Developmental Medicine & Child Neurology. 1983; 25(6): 778–82.
[55] Yeats B. Factors that may influence the postural health of schoolchildren (K-12). Work. 1997; 9(1): 45–55.
[56] Parush S, Levanon-Erez N, Weintraub N. Ergonomic factors influencing handwriting performance. Work. 1998; 11(3): 295–305.
[57] Karakostis FA, Hotz G, Tourloukis V, Harvati K. Evidence for precision grasping in Neandertal daily activities. Science Advances. 2018; 4(9).

[58] Sudsawad P, Trombly CA, Henderson A, Tickle-Degnen L. Testing the effect of kinesthetic training on handwriting performance in First-Grade students. American Journal of Occupational Therapy. 2002; 56(1): 26–33.
[59] Phoenix M, Vanderkaay S. Client-centred occupational therapy with children: A critical perspective. Scandinavian Journal of Occupational Therapy. 2015; 22(4): 318–21.
[60] Hoy MMP, Egan MY, Feder KP. A systematic review of interventions to improve handwriting. Canadian Journal of Occupational Therapy. 2011; 78(1): 13–25.
[61] Schneck CM, Amundson SJ. Prewriting and Handwriting Skills. In: Case-Smith J, O'Brien JC, editors. Occupational Therapy for Children. 6th ed. Missouri: Mosby; 2010. 555–8.

■ORIGINAL ARTICLE

Survey on Occupational Therapy and Postgraduate Education in Intensive Care Units in Japan

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Abstract: Objective: The purpose of this study was to identify the prevalence of and need for occupational therapist interventions in intensive care units in Japan, as well as the need for postgraduate learning and education in the practice of occupational therapy.
Method: Occupational therapists were invited to respond to questionnaire that was distributed to 359 facilities with intensive care units.
Result: A total of 139 responses were received from the 359 facilities contacted, representing a response rate of 38.7%. The frequency of intervention by occupational therapists in intensive care units was 74.3%, and 93.5% of occupational therapists felt that the interventions were justified. Self-learning was the most common method of post-graduate learning (95.1%), followed by instruction from other professions (85.3%). The vast majority of occupational therapists (98.0%) indicated that postgraduate education was a necessary component of their professional development.
Conclusion: The current postgraduate education system for occupational therapists working in intensive care units needs to be revised to improve its effectiveness. The development of a dedicated postgraduate education system for occupational therapists, particularly in the intensive care setting, would be a valuable addition to the existing training framework.

Keywords: intensive care unit, occupational therapy, questionnaire survey

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1. Introduction

Intensive care is defined as “the intensive treatment of critically ill patients in life-threatening situations under close observation for 24 hours a day using advanced medical technology”, while intensive care unit (ICU) is defined as “a medical unit equipped with an intensive care system, monitoring equipment, and advanced medical equipment such as life-support systems for intensive care” [1]. In 2009, Schweickert et al. [2] reported that early mobilization of occupational and physical therapy for critically ill patients in the ICU reduced the duration of ventilator management and delirium, and improved activities of daily living (ADL). Therefore, early rehabilitation in the intensive care setting has garnered attention in Japan in recent years, as expectations for occupational- and physiotherapists have increased greatly. Additionally, while the survival rate of critically ill patients has improved with advances in medical technology, many patients still develop sequelae after discharge from the ICU. The concept of post-intensive care syndrome (PICS) was proposed, therefore, to address any post-discharge sequelae, and efforts to improve PICS have since gained momentum [3]. Occupational therapy has been reported to be effective in reducing the incidence and duration of delirium, while improving cognitive function, grip strength, and

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ADL [4]. Although the continued examination of the effectiveness of occupational therapy is warranted, the level of evidence for the use of occupational therapy in the intensive care setting remains lacking [5]. Although this may be unique to ICU, In Japan, difficulties in the practice of occupational therapy and demonstration of expertise have been reported [6].

In previous survey studies conducted in Japan, among other countries, 27% of occupational therapists employed at 15 hospitals in 2 Canadian provinces reported that they provide occupational therapy in the ICU on a daily basis [7]. In the United States, 34% of respondents indicated that their facility had an occupational/physical therapy team dedicated to the ICU [8], and in Japan, 45% of responding facilities reported that they provided occupational therapy in the ICU [9]. These results indicate that the utilization of occupation therapy in the ICU setting is still in its infancy worldwide.

An Australian survey revealed that the primary factors presenting a significant challenge for occupational therapists seeking to gain entry into the ICU were a shortage of personnel (84.4%) and lack of in-hospital education (62.5%) [10]. In Japan, educational institutions rarely offer curricula dedicated to the intensive care setting, and while there has been an increase in the number of courses provided by various academic societies and organizations, the primary focus remains on didactic education at each facility. The content and quality of each program vary considerably among schools [11]. In recent years, a series of minimum standards for physical therapists working in the intensive care setting have been reported, based on clinical practice from other countries. In response, the Intensive Care Physical Therapy/Occupational Therapy/Speech Therapy Committee of the Japanese Society of Intensive Care Medicine has developed minimum standards for physical therapists [12], as well as a certification system for physical therapists in the Society of Intensive Care Medicine, which was established in 2023. In contrast, however, the role of occupational therapists has not been extensively discussed or defined, and it is becoming increasingly evident that education requires further attention. Therefore, the objective of this study was to ascertain the frequency and necessity of occupational therapy interventions in intensive care settings in Japan and to determine the necessity of postgraduate learning and education for those practicing occupational therapy.

2. Subjects

This study collaborated with 359 specialized research facilities in the Japanese Society of Intensive Care Medicine (January 2024). The study subjects were one occupational therapist in charge of intensive care or one occupational therapy department head from each facility.

Table 1 Questions about the participants' basic attributes, practice, and postgraduate education

No.	Questions
Basic attributes	
1	How many years have you been a licensed OTR?
2	What educational institution did you graduate from?
3	How many OTRs does your facility have?
4	How many total beds does your facility have?
5	How many ICU beds does your facility have?
Frequency and need for OTR intervention	
6	How often do OTRs treat patients in the ICU at your facility?
7	What do you think about the need for OTR interventions in the ICU?
8	Why do OTRs intervene less frequently in the ICU at your facility?
9	How many years were you an OTR before you began interventions in the ICU?
Learning methods and the need for postgraduate education	
10	Is there a need for postgraduate education in OT?
11	How did you learn to practice OT in the ICU?
12	What type of postgraduate education program for OT is needed in the ICU?
13	What type of content is needed as postgraduate education in OT for the ICU?
14	Why is postgraduate education in OT necessary for the ICU? (free writing)

OTR: Occupational Therapist Registered
ICU: Intensive Care Unit
OT: Occupational therapy

3. Methods

A research request form, which included the URL and quick response (QR) code for a Google Form (Google LLC, Tokyo, Japan), was sent to 359 eligible institutions, encouraging participation and allowing respondents to complete questionnaires over the Internet. The response period was January 29–February 9, 2024. The questionnaire consisted of 14 questions, which asked about the basic characteristics of the subjects and their institutions, the frequency and need for occupational therapist intervention in the ICU, learning methods, and the need for postgraduate training (Table 1). All subjects were asked to answer questions 1–7. Those who responded "always intervene", "somewhat frequently intervene", or "moderately frequently intervene" were considered to be practitioners, while those who selected "rarely intervene" or "never intervene" were considered to be non-practitioners. Question 8 was asked of non-practitioners, and questions 9–14 were asked of practitioners. Questions 8, 11, 12, and 13 were multiple-choice

and required the top three responses, while question 14 was open-ended. The questionnaire was developed with the collaboration of four co-authors: three occupational therapists working in ICUs who are members of the Japanese Society of Intensive Care Medicine, and an occupational therapist experienced in qualitative research. A preliminary survey was conducted with subjects outside of the target institutions, and the survey items were modified and finalized by asking the test subjects to respond to questions about the ease of answering the questionnaire and any questions they had about the questionnaire.

3.1 How to develop the questionnaire

During the development of the questionnaire, the first author initially formulated a draft by integrating feedback from the four co-authors. Thereafter, a pilot study was conducted with three occupational therapists working in the ICU of a nearby emergency hospital. Based on the insights obtained from this preliminary investigation, the questionnaire items were refined, resulting in the final version.

3.2 Analysis

For numerical data, such as years of experience, the mean and standard deviation were calculated, and the percentage of the total was calculated in a simple tabulation. Questions with multiple responses were summed and calculated as a percentage of the total. Berelson's content analysis method was used to analyze the content of the open-ended questions [13]. The content analysis was conducted by the first author and a co-author, both of whom have experience in qualitative research, following the procedures outlined below.1) The free-text responses were segmented into contextual units based on meaning. All expressions and content related to "reasons why postgraduate education is necessary" were extracted. Contextual units with similar expressions or meanings were grouped and organized into recording units. 2) The recording units were grouped based on similarity and organized as subcategories, which were then named accordingly. Subsequently, these subcategories were further classified by identifying expressions that accurately reflected their similarities, and the final categories were developed and named. 3) A summary table was created to illustrate the relationships among the recording units, subcategories, and categories. 4) As a procedure to ensure reliability, two additional co-authors calculated the inter-rater agreement among categories using Scott's formula [14]. An agreement rate of 70% or higher was considered to indicate sufficient reliability [15]. Scott's formula is a statistical method used to assess the agreement between two raters, accounting for the agreement expected by chance. It calculates the true agreement rate (π) by taking the difference between the observed agreement (Po) and the agreement expected by chance (Pe). The formula is as follows:

$$\pi = (\mathrm{Po} - \mathrm{Pe})/(1 - \mathrm{Pe})$$

(π: Inter-rater agreement, Po: Observed agreement, Pe: Agreement expected by chance)

Table 2 Basic participant and target facility attributes (n = 139)

Items	n (%)	Average	Median
OTR information			
Years of OTR experience		17.6 ± 7.2	17
Educational institution			
University	57 (41.0)		
Vocational school (3 years)	56 (40.3)		
Vocational school (4 years)	26 (18.7)		
Facility information			
Total number of beds		604.2 ± 226.4	583
Number of ICU beds		20.6 ± 25.1	12
Number of OTRs		10.4 ± 8.4	8

OTR: Occupational Therapist Registered
ICU: Intensive Care Unit

3.3 Ethical considerations

The study was conducted in accordance with the ethical standards of the Declaration of Helsinki. It was explained in writing that the study would be conducted anonymously and in such a way that respondents could not be identified, so there would be no invasion of privacy, and that responses to the web-based questionnaire would be regarded as consent to participate. The study was approved by the Institutional Ethics Committee (approval number: 2023-203-B).

4. Results

4.1 Response rate

Of 359 institutions, 139 (response rate: 38.7%) responded to the survey and were included in the analysis. There were 102 ICU practitioners and 37 non-practitioners.

4.2 Basic subject and target facility attributes

The respondents had an average of 17.6 ± 7.2 years of occupational therapy experience, and the most common type of educational institution from which they graduated was a university (41%). At the respondent facilities, the mean number of occupational therapists was 10.4 ± 8.4, the mean total number of beds was 604.2 ± 226.4, and the mean number of ICU beds was 20.6 ± 25.1 (Table 2).

Table 3 Frequency and need for OT intervention

	Items	*n* (%)
Frequency of Intervention *n* = 139	Daily intervention (7 days/week)	16 (11.5)
	Frequent intervention (5–6 days/week)	56 (40.3)
	Moderate intervention (3–4 days/week)	30 (21.6)
	Minimal intervention (1–2 days/week)	25 (18.0)
	No intervention (0 days/week)	12 (8.6)
Need for intervention *n* = 139	Absolutely necessary	37 (26.6)
	Somewhat necessary	53 (38.1)
	Moderately necessary	40 (28.8)
	Not really necessary	6 (4.3)
	Unsure	3 (2.2)
Years of experience at the onset of intervention in the ICU *n* = 102	1–3 years	42 (41.2)
	4–6 years	21 (20.6)
	7–9 years	18 (17.6)
	> 10 years	21 (20.6)
Reasons for infrequent intervention *n* = 37 Multiple answers	Insufficient manpower	21 (56.8)
	Inadequate training	16 (43.2)
	System for intervention by PT	11 (29.7)
	No needs	10 (27.0)
	Unsure of medical knowledge or intervention	7 (18.9)
	Lack of OT recognition	6 (16.2)
	Lack of OT guidelines	5 (13.5)
	Fear/anxiety	3 (8.1)
	Difficult to respond to emergencies	3 (8.1)

PT: Physical therapist
OT: Occupational therapy

4.3 Frequency of and need for occupational therapist intervention

The frequency of intervention by occupational therapists in the ICU was "somewhat intervenes" for all subjects, accounting for 40.3% of the total, which increased to 73.4% when "always intervenes" and "moderately intervenes" were included. The most common reason for infrequent intervention was "insufficient manpower" (56.8%), followed by "inadequate training system" (43.2%). "Somewhat necessary" was the most common response regarding the need for intervention, accounting for 38.1% of the total, increasing to 93.5% when "absolutely necessary" and "moderately necessary" were included. The most common response to years of experience at the onset of intervention in the ICU was "1–3 years of experience" (41.2%) (Table 3).

4.4 Learning methods and the need for postgraduate education

"Self-learning" was the most common method of learning, accounting for 95.1% of the respondents, while 85.3% of the respondents also chose "guidance from other professions". "Absolutely necessary" was the most common response (43.1%) regarding the necessity of postgraduate education, which increased to 98.0% when "somewhat necessary" and "moderately necessary" were included, indicating that the majority of occupational therapists felt that postgraduate education was necessary The most common desired educational system was "in-hospital study sessions" and "outside study sessions" at 49.0% and 68.6%, respectively, and the most common desired educational content was "risk management" at 78.4%, followed by "medical knowledge" at 50.0% (Table 4).

4.5 Why is postgraduate education necessary?

A total of 106 recording units were extracted from the 92 contextual units, with those exhibiting similar semantic content subsequently summarized. A total of 14 subcategories in 4 categories were extracted, which are presented in Table 5. The four categories were designated as follows: 1) Lack of specialized education and learning, 2) Difficulties in occupational therapy practice, 3) Expectations regarding the efficacy and importance of occupational therapy, and 4) Lack of participation in occupational therapy. The extracted categories are indicated using 【】, and subcategories are indicated using 〈〉.

Table 4 Learning methods and need for postgraduate education (n = 102)

		n (%)
Learning methods	Self-learning	97 (95.1)
	Guidance from other professions	87 (85.3)
	Out-of-hospital study sessions	70 (68.6)
	In-hospital study sessions	50 (49.0)
	Guidance from OTRs	38 (37.3)
	Qualifications (breathing related)	4 (3.9)
Need for postgraduate education	Absolutely necessary	44 (43.1)
	Somewhat necessary	33 (32.4)
	Moderately necessary	23 (22.5)
	Not really necessary	1 (1.0)
	Unnecessary	1 (1.0)
Desired education system	Enhancement of in-hospital study sessions	50 (49.0)
	Enhancement of out-of-hospital study sessions	50 (49.0)
	Training future leaders	47 (46.1)
	Curriculum development	44 (43.1)
	Establishment of a professional OTR system	40 (39.2)
	In-hospital training	37 (36.3)
	Establishment of a qualification training system	36 (35.3)
	Personnel replacement	26 (25.5)
	Out-of-hospital training	2 (2.0)
	Information exchange	1 (1.0)
Desired educational content	Risk management	80 (78.4)
	Medical knowledge	51 (50.0)
	Knowledge of medical equipment	48 (47.1)
	OTR expertise	44 (43.1)
	Assessment	41 (40.2)
	Skill	35 (34.3)
	Multidisciplinary cooperation	33 (32.4)
	All necessary	2 (2.0)

OTR: Occupational Therapist Registered

1)【Lack of specialized education and learning】

【Lack of specialized education and learning】consisted of six subcategories: 〈Education and learning are important for practice〉, 〈Lack of specialized knowledge and skills〉, 〈Lack of learning opportunities〉, 〈Knowledge needed in a wide range of fields〉, 〈Lack of education in educational institutions〉, and 〈Experience in self-study〉. The category frequency was 50.0%. Occupational therapists felt that they lacked specialized education and learning, indicating a high need for postgraduate education.

2)【Difficulties in occupational therapy practice】

【Difficulties in occupational therapy practice】consisted of five subcategories: 〈Difficulty in practice and lack of response〉, 〈Inability to manage risk〉, 〈Inability to collaborate with multiple professions〉, 〈Guidance from other professions〉, and 〈Difficulty in practice due to easy loss of expertise〉. The category frequency was 33.3%. Occupational therapists felt that they experienced difficulty in practicing in the ICU, indicating a high need for postgraduate education in order to practice effectively.

3)【Expectations regarding the efficacy and importance of occupational therapy】

【Expectations regarding the efficacy and importance of occupational therapy】consisted of two subcategories: 〈Recognition of high importance〉 and 〈Expectations for the efficacy of occupational therapy〉. The category frequency was 13.7%. Occupational therapists feel that area is of high importance for the efficacy of occupational therapy, indicating a need for postgraduate education.

4) Lack of participation in occupational therapy

【Lack of participation in occupational therapy】consisted of one subcategory: 〈Lack of participation by occupational therapists〉. The category frequency was 3.0%. Occupational therapists felt that the number of interventions in the ICU was low, and cited the lack of

Table 5 Reasons postgraduate education is needed

Category (NRU)	FR (%)	Subcategory (NRU)	Example of recording units
Lack of specialized education and learning (51)	50.0	Education and learning are important for practice (20)	A facility with an ICU is absolutely necessary
		Lack of specialized knowledge and skills (13)	OT requires specialized knowledge and skills
		Lack of learning opportunities (8)	No opportunity for OTRs to study on an individual basis
		Knowledge needed in a wide range of fields (5)	It is good to know regardless of your field
		Lack of education in educational institutions (3)	There was no opportunity to learn at an educational institution
		Experience in self-study (2)	Self-study does not motivate me
Difficulties in OT practice (34)	33.3	Difficulty in practice and lack of response (13)	Unable to respond without knowing what type of OT to provide
		Inability to manage risk (7)	Failure to notice changes in a patient's condition causes problems
		Inability to collaborate with multiple professions (5)	Cannot speak from the same perspective as other professions
		Guidance from other professions (5)	Receiving guidance from a non-OT
		Difficulty in practice due to easy loss of expertise (4)	It is easy to lose sight of OTR expertise
Expectations regarding the efficacy and importance of OT (14)	13.7	Recognition of high importance (8)	Need intervention from ICU to live and retain cognitive function
		Expectations for the efficacy of OT (6)	Early intervention by an OTR can speed recovery
Lack of participation in OT (3)	3.0	Lack of participation in OT (3)	Low number of OT interventions

NRU: Number of recording units
FR: Frequency
OT: Occupational therapy
OTR: Occupational Therapist Registered
ICU: Intensive Care Unit

postgraduate education as one of the reasons behind this. This indicated a need for postgraduate education.

5) Category agreement rate

The agreement rate for categorization determined using Scott's formula was 78.8%.

5. Discussion

The occupational therapy intervention in the ICU was 73.4%, indicating that a relatively large number of occupational therapists practice in the ICU in Japan. Additionally, 93.5% of occupational therapists felt that the intervention was warranted, indicating that each respondent felt that the role of occupational therapists in the ICU was important. Occupational therapists have the skills to address cognitive [16, 17] and psychological [18, 19] dysfunction as well as early weaning from physical disabilities in PICS, and may be able to address these disabilities through cognitive and psychological interventions [20, 21]. However, the level of evidence for the effectiveness of occupational therapy for these disorders is low, and further research, including randomized controlled trials and long-term follow-up, is needed.

"Lack of staff" was the most common reason for infrequent intervention, followed by "inadequate education system", similar to the findings of an Australian survey [10]. Lack of staff was also a barrier to occupational therapy practice in other countries [22, 23]. The median number of occupational therapists in the target facilities was 8 for a total of 583 beds (median), while the intervention system for occupational therapists is almost exclusively dual appointment [24], making it difficult to respond appropriately to the ICU. Additionally, the "inadequate educational system" may be a barrier to further occupational therapy practice. In Japan, the importance of occupational therapy in ICU field has been steadily increasing, as the occupational therapist's job title is listed as part of the team for the additional fee for early bed release and rehabilitation, which was

newly established by the revision of medical service fees in fiscal year (FY) 2018. The additional fee for acute rehabilitation was newly established by the revision of medical service fees in FY2024; therefore, occupational therapists should appropriately deal with patients in the ICU, which we believe is an important issue.

While expectations for rehabilitation in the ICU are increasing, most of the respondents had 1–3 years of experience when they began intervention in the ICU, and were expected to practice effectively, despite their lack of experience in the field. We found that most subjects responded to the demand for occupational therapy in the ICU through "self-learning" or "guidance from other professions". Occupational therapists are not often lecturers at workshops held by various academic societies and organizations, highlighting the absence of such educators and the challenges of the postgraduate education system in occupation therapy. The lack of dedicated educators may have led to difficulties in the practice of occupational therapy in the ICU, especially in demonstrating expertise [6, 22]. The respondents felt that the role of occupational therapists in the ICU was highly necessary; however, the most common methods for practicing in the ICU were "self-learning" and "guidance from other professions", as opposed to formal training. Therefore, the majority of occupational therapists (98%) felt that postgraduate education was necessary. One of the main reasons why postgraduate education is considered necessary for occupational therapists is that many of them perceive a【Lack of specialized education and learning】opportunities. In addition to the insufficiency of specialized education at the undergraduate level, opportunities for specialized education and learning after graduation are also limited. As a result, due to the failure to acquire advanced and specialized knowledge and skills, occupational therapists may face significant challenges in ICU practice, where various diseases, medical equipment, and treatment methods exist. In actual clinical settings, many reports indicated【Difficulties in occupational therapy practice】, Including comments such as〈Difficulty in practice and lack of response〉, such as〈Inability to manage risk〉 and〈Inability to collaborate with multiple professions〉. These voices reflect the reality that many therapists are struggling and unable to respond effectively in practice. These findings strongly underscore the importance of postgraduate education. That is to say, this【Lack of specialized education and learning】opportunities is closely related to the【Difficulties in occupational therapy practice】, and it has become clear that the establishment of a more advanced and specialized postgraduate education system is urgently needed for occupational therapists to work effectively in the ICU.

Currently Japanese Society of Intensive Care Medicine, there are certification systems such as the "Intensive Care Physical Therapist" and the "Intensive Care Registered Nurse", which aim to foster professionals with specialized knowledge and skills to care for critically ill patients and to ensure the quality of their practice. These systems contribute significantly to providing safe and effective care in the ICU, where advanced, multidisciplinary collaboration is essential. However, there is currently no specialized certification system for occupational therapists in the field of intensive care. Moreover, lifelong education opportunities, such as training sessions or workshops on ICU practice, provided by the Japanese Association of Occupational Therapists and Prefectural Occupational Therapist Association, are limited. In the ICU, patients require not only physical rehabilitation but also support for cognitive and psychological issues, as well as early reintegration into society and daily life. These areas are where the expertise of occupational therapists is particularly valuable. While further research and development of guidelines are needed [25], the current lack of structured educational systems remains a major issue. Therefore, for occupational therapists as well, the development of training sessions or workshops in intensive care provided by the Japanese Association of Occupational Therapists and Prefectural Occupational Therapist , and along with the establishment of a certification system, is considered essential for ensuring the quality of clinical practice and making their professional expertise more visible. Such efforts would help ensure the quality of practice and make their specialized skills more visible. Moving forward, it is necessary to clarify the unique roles and contributions of occupational therapy in the ICU and explore the possibility of creating a certification system, taking existing models for physical therapists and nurses as references.

The present study had several limitations. Although occupational therapists who did not work in ICUs were included, self-selection bias may still have been present, and the results cannot be generalized to all occupational therapists in ICUs in Japan, as they represent only 38.7 % of the total subjects. Additionally, this study did not address the perspectives of other professionals in the ICU regarding the necessity of occupational therapy, which could be considered a limitation. Moreover, the need for post-graduate education may vary depending on the level of experience in the ICU, and regional differences in educational needs were not explored, which could influence the findings.

In conclusion, based on the responses to the survey, the occupational therapy intervention rate among ICUs in Japan was 73.4%, with the majority of the respon-

dents feeling that intervention was warranted and that postgraduate education was needed. Currently, the postgraduate education system is ineffective, and occupational therapists in ICUs practice primarily through self-learning and guidance from other professions. Therefore, more advanced and specialized postgraduate education system for occupational therapists needs to be considered.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declaration of conflicting interests

The authors declares that there is no conflict of interest regarding the publication of this article.

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References

[1] Imai T. Definition of intensive care medicine (in Japanese). J Jpn Soc Intensive Care Med. 2009; 16: 503–4.
[2] Schweickert WD, Pohlman MC, Pohlman AS, Nigos C, Pawlik AJ, Esbrook CL, et al. Early physical and occupational therapy in mechanically ventilated, critically ill patients. A randomised controlled trial. Lancet. 2009; 373(9678): 1874–82.
[3] Needham DM, Davidson J, Cohen H, Hopkins RO, Weinert C, Wunsch H, et al. Improving long-term outcomes after discharge from intensive care unit: Report from a stakeholders' conference. Crit Care Med. 2012; 40(2): 502–9.
[4] Álvarez EA, Garrido MA, Tobar EA, Prieto SA, Vergara SO, Briceño CD, et al. Occupational therapy for delirium management in elderly patients without mechanical ventilation in an intensive care unit: A pilot randomized clinical trial. J Crit Care. 2017; 37: 85–90.
[5] Weinreich M, Herman J, Dickason S, Mayo H. Occupational therapy in the intensive care unit: a systematic review. Occup Ther Health Care. 2017; 31(3): 205–13.
[6] Komaba K, Suzuki H. Recognition process of professionalism of occupational therapists engaged in life-saving medical care (in Japanese). J Kanagawa Occup Ther Res. 2021; 11(1): 17–25.
[7] Foreman J. Occupational therapists' roles in intensive care. Occup Ther Now. 2005; 7(2): 15–8.
[8] Bakhru RN, Wiebe DJ, McWilliams DJ, Spuhler VJ, Schweickert WD. An environmental scan for early mobilization practices in U.S. ICUs. Crit Care Med. 2015; 43(11): 2360–9.
[9] Committee of Early Rehabilitation in Intensive Care Unit, Japanese Society of Intensive Care Medicine. The actual situation survey of the rehabilitation in ICU (in Japanese). J Jpn Soc Intensive Care Med. 2020; 27: 45–51.
[10] Rapolthy-Beck A, Fleming J, Turpin M. Occupational therapy service provision in adult intensive care units in Australia: A survey of workload practices, interventions and barriers. Aust Occup Ther J. 2022; 69(3): 316–30.
[11] Obata K. A suggestion for expanding early rehabilitation in the lCU - from a physical therapeutic perspective (in Japanese). ICU&CCU. 2018; 42: 189–94.
[12] Committee for Intensive Care Physical Therapists, Occupational Therapists, and Speech Therapists, Japanese Society of Intensive Care Medicine Working Group for Ability Factor Examination of Physical Therapists and Occupational Therapists engaged in ICU. Minimum standards of clinical practice for physiotherapists working in critical care settings: consensus building by doctors, nurses and physiotherapist (in Japanese). J Jpn Soc Intensive Care Med. 2021; 28: 237–54.
[13] Funashima N. Qualitative Research Methodologies That Have Been Used in Nursing Research. 2nd ed (in Japanese). Tokyo: Igaku-Shoin; 2007.
[14] Scott WA. Reliability of content analysis: the case of nominal scale coding. Public Opin Q. 1995; 19: 321–5.
[15] Funashima N. Challenges of qualitative research, 2nd ed (in Japanese). Tokyo: Igaku-Shoin Ltd: 2007; 42–80.
[16] Iwashyna TJ, Ely EW, Smith DM, Langa KM. Long-term cognitive impairment and functional disability among survivors of severe sepsis. JAMA. 2010; 304(16): 1787–94.
[17] Pandharipande PP, Girard TD, Jackson JC, Morandi A, Thompson JL, Pun BT, et al. Long-term cognitive impairment after critical illness. N Engl J Med. 2013; 369(19): 1306–16.
[18] Jackson JC, Pandharipande PP, Girard TD, Brummel NE, Thompson JL, Hughes CG, et al. Depression, post-traumatic stress disorder, and functional disability in survivors of critical illness in the BRAIN-ICU study: a longitudinal cohort study. Lancet Respir Med. 2014; 2(5): 369–79.
[19] Hatch R, Young D, Barber V, Griffiths J, Harrison DA, Watkinson P. Anxiety, depression and post-traumatic stress disorder after critical illness: a UK-wide prospective cohort study. Crit Care. 2018; 22(1): 310.
[20] Costigan FA, Duffett M, Harris JE, Baptiste S, Kho ME. Occupational therapy in the ICU: a scoping review of 221

documents. Crit Care Med. 2019; 47(12): e1014–21.
[21] Komaba K, Watabe T, Aoki K. Occupational therapy in Japanese critical and intensive care: a scoping review (in Japanese). Jpn Occup Ther Res. 2023; 42: 43–51.
[22] Wilding C, Whiteford G. Occupation and occupational therapy in acute settings. Aust Occup Ther J. 2008; 55(3): 180–7.
[23] Algeo A, Aitken LM. The evolving role of occupational therapists in adult critical care in England: a mixed methods design using role theory. Irish J Occup Ther. 2019; 47(2): 74–94.
[24] Fujimoto Y, Matsumoto T. A study through a national survey on occupational therapy in critical care centers (in Japanese). Jpn Occup Ther Res. 2019; 38: 28–36.
[25] Brown SM, Rozenblum R, Aboumatar H, Fagan MB, Milic M, Lee BS, et al. Defining patient and family engagement in the intensive care unit. Am J Resp Crit Care Med. 2015; 191(3): 358–60.

■ORIGINAL ARTICLE

Preliminary Estimates of Minimal Important Change and Responsiveness of the Canadian Occupational Performance Measure in a Home-Based Rehabilitation Context

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Abstract: Background: The Canadian Occupational Performance Measure (COPM) is widely used to assess client-centered outcomes in occupational therapy. However, its psychometric properties, particularly responsiveness and minimal important change (MIC), require further validation in specific populations.
Objective: This study aimed to determine the MIC values for COPM performance (COPM-P) and satisfaction (COPM-S) scores using MICpredict and MICadjust methods in a Japanese home rehabilitation context, and to evaluate the responsiveness of the COPM compared to the EQ-5D-5L.
Methods: A multicenter prospective cohort study was conducted with 45 participants who received home-based rehabilitation services. MIC values were calculated using predictive modeling methods, whereas responsiveness was assessed using standardized response means (SRM) and Spearman's correlation coefficients with EQ-5D-5L scores.
Results: MICpredict values were 1.35 (95% CI: 0.88–1.80) for COPM-P and 1.37 (95% CI: 0.81–1.88) for COPM-S, with adjusted values (MIC_{adjust}) accounting for unequal group proportions at 1.23 (95% CI: 0.73–1.72) and 1.24 (95% CI: 0.60–1.77), respectively. The COPM demonstrated high responsiveness (SRM: 1.09 COPM-P and 1.01 for COPM-S), whereas no significant correlations were found between COPM change scores and EQ-5D-5L scores. These findings reflect the individualized nature of COPM and its sensitivity to client-specific outcomes.
Conclusions: This study underscores the utility of MICpredict and MICadjust in establishing MIC values tailored to the Japanese home-based rehabilitation population. The results highlight strong responsiveness of the COPM and the complementary use of individualized and comprehensive patient-reported outcomes for a holistic evaluation of rehabilitation outcomes.

Keywords: Canadian Occupational Performance Measure, minimal important change, homebased rehabilitation

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I. Introduction

Client-centered practice in occupational therapy promotes health through engagement in meaningful activities [1]. This approach emphasizes collaboration with clients to identify and achieve their personal goals, leading to diverse outcomes across self-care, productivity, and leisure domains [1, 2].

The Canadian Occupational Performance Measure (COPM) is a widely used tool that operationalizes this philosophy by enabling clients to identify and rate their performance and satisfaction with key occupational tasks [3, 4]. Despite its global adoption and versatility, gaps remain in validating its psychometric properties, particularly its responsiveness and interpretability for

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specific populations [5, 6].

A critical metric for interpreting changes in COPM scores is the minimal important change (MIC), which represents clinically meaningful improvement. Although the COPM manual suggests a 2.0-point threshold, its methodological basis and applicability across populations remain unclear [3, 7]. Recent advancements in MIC estimation have highlighted the superiority of predictive modeling approaches, such as $MIC_{predict}$ and MIC_{adjust}, over traditional ROC-based methods. The $MIC_{predict}$ method identifies the change score at which the post-test probability of improvement equals the pre-test probability, providing a statistically principled threshold for minimal important change. MIC_{adjust} further improves precision by correcting for imbalances in the proportions of improved versus non-improved participants, making it particularly suitable for real-world clinical studies where equal group sizes are uncommon [8–10]. These approaches have been increasingly recommended in recent methodological reviews as more robust and precise alternatives to conventional ROC curve-based methods, especially in small or skewed samples [8–10].

In particular, these models allow researchers to account for sample-specific factors, such as unequal proportions of improvement, thereby reducing bias and increasing the accuracy of MIC estimation. This enables a more tailored and population-relevant application of MIC thresholds in clinical research [8–11].

Building on prior studies that applied to subacute rehabilitation inpatients [12], the present study extends its use to a Japanese home-based rehabilitation population, aiming to establish context-specific MIC values for COPM. This extension may improve the utility of COPM in individualized rehabilitation.

II. Methods

1. Study design and ethics

This study was designed as a multicenter, prospective, longitudinal cohort study and conducted in subacute rehabilitation hospitals in Japan. The study adhered to the ethical principles outlined in the Declaration of Helsinki, and was approved by the Ethics Committee of Tokyo University of technology (Approval No. Approval No. E20HS-008). Potential participants were provided with written information about the study, including its purpose, procedures, and implications. Only individuals who provided informed consent by signing the consent form, after having sufficient time to consider their participation, were included in the study.

Participating facilities were recruited through purposive and snowball sampling. Initially, the principal investigator directly contacted occupational therapists working in home-based rehabilitation, and these individuals subsequently referred additional collaborators through their professional networks. Participating therapists received detailed study materials and implementation guidance prior to data collection. At each facility, therapists identified eligible clients, provided both verbal and written explanations of the study, and obtained written informed consent. This pragmatic recruitment strategy reflected the realities of clinical practice and facilitated collaboration across diverse home-based rehabilitation settings.

2. Participants

The participants in this study were selected from 12 facilities across Japan that provide home-based occupational therapy services between November 2022 and August 2023. Inclusion criteria were as follows: (a) adults aged ≥ 18 years; (b) receiving home-based rehabilitation occupational therapy; (c) having no significant cognitive impairment as determined by clinical assessment or screening tests; and (d) ability to communicate effectively. Exclusion criteria included the following: (a) individuals with conditions that impaired verbal communication, such as dementia, aphasia, or higher brain dysfunction; (b) individuals whose primary physician did not permit study participation; (c) individuals with severe progressive complications; and (d) individuals who did not provide informed consent for participation in the study.

3. COPM

The COPM assesses self-perceived performance and satisfaction in daily activities [3]. For each prioritized activity, clients rated their perceived COPM performance (COPM-P) and satisfaction (COPM-S) on a 10-point ordinal scale, with 1 indicating “not able to do it at all” or “not satisfied at all,” and 10 representing “able to do it extremely well” or “extremely satisfied” [3]. Mean performance score was calculated by summing the performance ratings across all prioritized activities and dividing them by the number of activities. The satisfaction scores were processed using the same method to derive an average satisfaction score [3].

4. Transition index (TI)

To determine MIC values, an anchor-based method was employed using the TI as the external criterion. Anchor-based methods statistically compared changes in the primary evaluation metric with changes in an external gold-standard measure to establish MIC thresholds. In this study, TI was selected as the anchor because of its extensive use in prior MIC validation studies on patient-reported outcomes (PROs) [13, 14].

The participants were asked the following question for each occupational task identified through the COPM: "To what extent has the difficulty you experienced in performing this occupation changed?" Responses were recorded using a seven-point Likert scale, where "1" indicated "difficulty has completely resolved" and "7" represented "very much worsened." This scale provides insight into both the magnitude and direction of changes in perceived difficulty. In line with previous studies by Tuntland et al. [15] and Ohno et al. [12], the participants were categorized based on their TI responses for the majority of their prioritized occupations: those who rated "1 = totally diminished," "2 = diminished," or "3 = slightly diminished" for at least three of the five occupations were classified as "Improved" (responders). Participants rating "4 = no change" were labeled as "No change" (non-responders), while those indicating "5 = slightly worse," "6 = worse," or "7 = much worse" for the majority of occupations were labeled as "Deteriorated."

Given the focus of this study on identifying cut-off points that differentiate "Improved" from "No change" groups, participants categorized as "Deteriorated" were excluded from further analyses. By employing this approach, this study ensured a clear determination of MIC values based on perceived improvements in occupational performance.

To ensure validity of the TI as an anchor, the Spearman's correlation coefficients were calculated to examine the relationship between the TI and respective change scores of the COPM-P and COPM-S. A correlation coefficient of at least 0.30 was considered necessary to establish validity of the anchor, as this level is generally regarded as the minimum threshold for demonstrating a meaningful association between a Patient-Reported Outcomes Measurement (PROM) and its external criterion [16]. This step reinforced the reliability of using TI as a robust anchor for determining MIC values, aligning with best practices in anchor-based methods.

5. Data Collection

Data were collected at two time points: at initial assessment (T1) and reassessment at approximately three months later (T2). The T1 assessment was conducted within one week of admission, while the T2 reassessment was scheduled collaboratively between the participant and occupational therapist, occurring either approximately three months post-T1 or prior to therapy completion, if earlier.

To minimize response shift, a phenomenon in which participants' self-perceptions change over time and affect the validity of longitudinal PROM scores [17–19], specific modifications were made to the COPM interview process. A structured format based on the "Five Ws and How" framework was used to identify occupational problems in detail during T1 [12]. This framework includes the following questions.

- "Who does the occupation?" (subject)
- "When do you do the occupation?" (duration/frequency)
- "Where do you do the occupation?" (place)
- "Why do you do the occupation?" (reason/purpose)
- "How do you do the occupation?" (methods/procedures/means)

At T2, therapists revisited the occupations identified in T1 using the "Five Ws and How" framework to ensure consistency in participants' internal standards before reassessing their COPM-P and COPM-S scores. This approach aims to mitigate the effects of recalibration and maintain the accuracy of the longitudinal COPM measurements [12].

In addition to the COPM and TI, demographic and clinical data were collected to understand participants' baseline characteristics, including age, sex, diagnosis, care level, independence level in daily living, and cognitive function as assessed by the mini-mental state examination (MMSE).

6. Statistical Analysis

a) Descriptive and Comparative Analyses

The baseline characteristics of the participants were summarized using counts for categorical variables and medians with interquartile ranges (IQRs) for continuous variables. The Wilcoxon tests were used to compare change scores between the initial assessment (T1) and reassessment (T2), as well as for between-group comparisons. The Spearman's correlation coefficients were calculated to examine the relationship between COPM-P and COPM-S change scores and the TI.

b) Calculation of MIC

The anchor-based method employed to determine the MIC was $MIC_{predict}$, a predictive modeling approach that provides higher accuracy than traditional MIC estimates derived from ROC curves (MIC_{ROC}) [8–10]. This method identifies the amount of change at which the likelihood ratio (sensitivity/specificity) equals one, offering a more precise MIC calculation. A bias-correction was applied due to unequal group sizes [8]. The MIC_{adjust} formula used in this study is as follows:

$$MIC_{adjust} = MIC_{predict} - (0.090 + 0.103 * Cor) * SD_{change} * \log(odds_{improved})$$

Where:

- Cor: Correlation coefficient between COPM change scores and anchors.
- SD_{change}: Standard deviation of COPM change scores.

- $\log(odds_{improved})$: Natural logarithm of the ratio of improved to no-change participants.

c) Evaluation of Responsiveness

Two methods were used to evaluate the responsiveness of COPM.

(1) Standardized Response Means (SRM)

SRM was calculated as the mean change divided by its standard deviation. The interpretation thresholds for the SRM were as follows: small ($0.2 < SRM < 0.5$), moderate ($0.5 < SRM < 0.8$), and large (> 0.8) [20].

(2) Correlation with External Criterion

Following the COSMIN guidelines [21], the responsiveness of COPM was also assessed by calculating the Spearman's correlation coefficients between the COPM change scores and an external criterion, EuroQol 5-Dimension 5-Level (EQ-5D-5L) [22], which measures health-related quality of life.

EQ-5D-5L: EQ-5D-5L evaluates five dimensions of health: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension is rated on a five-point scale ranging from "1: No problems" to "5: Extreme problems." Scores are converted into utility values ranging from 0 (worst possible quality of life) to 1 (best possible quality of life) [22].

The EQ-5D-5L, a validated HRQOL measure, served as the external criterion. While it does not capture individualized occupational concerns, its broad scope allows for comparison with general health status changes. This complementary perspective was considered suitable for evaluating the responsiveness of the COPM, which focuses on client-identified performance issues in daily life.

The correlation between EQ-5D-5L scores and COPM-P/COPM-S change scores was analyzed to establish the external validity of COPM responsiveness.

d) Confidence Intervals and Statistical Software

To provide robust estimates, 95% confidence intervals (CI) were calculated for all relevant parameters, including MIC, the Spearman's correlation coefficients, and SRM. All statistical analyses were conducted using RStudio (version 4.4.2), a widely used platform in biostatistics, to ensure transparency and reproducibility.

The following R packages were used to conduct the analyses: psych (descriptive statistics), stats (nonparametric tests and correlations), pROC (ROC-based comparisons), boot (confidence interval estimation), and ggplot2 (visualization). These tools ensured analytical rigor and reproducibility throughout the study.

e) Sample Size Consideration for MIC Estimation

Although the sample size ($n = 45$) was smaller than the recommended number of approximately 100 participants for anchor-based MIC estimation [8–10], the use of $MIC_{predict}$ and MIC_{adjust} methods was intended to improve estimation accuracy even under limited sample conditions. These methods have been shown to outperform ROC-based approaches in terms of precision and bias reduction in small or unbalanced samples [8–10]. Nonetheless, the limited sample size is acknowledged as a constraint, and the derived MIC values should be interpreted with caution. This limitation is further discussed in the Limitations section.

III. Results

1. Participant population (Table 1)

Forty-nine participants were initially recruited for this study during the study period. Of these, four participants were excluded because their TI indicated "Deteriorated." The final analysis included 45 participants. Median age of the participants was 75 years (IQR: 66–84 years), and 21 (46.7%) participants were females. Diagnostic categories included cerebrovascular disease (35.6%), spinal and spinal cord disease (20.0%), fracture (13.3%), mental disorders (13.3%), intractable neurological diseases (6.7%), internal disorders (4.4%), rheumatoid arthritis (2.2%), amputation (2.2%), and cardiac disease (2.2%).

Cognitive status, as assessed by the MMSE, had a median score of 28 (IQR: 26–30). Regarding care levels, the distribution was as follows: support level 1 (2.2%), support level 2 (15.6%), care level 1 (11.1%), care level 2 (26.7%), care level 3 (15.6%), care level 4 (11.1%), and care level 5 (8.9%). Data for care levels were missing for four (8.9%) participants who were users of psychiatric home rehabilitation services and did not utilize long-term care insurance.

The occupational therapists involved in the study ($n = 18$) had a median of nine years of clinical experience (IQR: 7–14).

2. Identified occupations

A total of 189 occupations were identified through COPM interviews and distributed across three domains: self-care (46.0%), productivity (25.4%), and leisure (28.6%). The most frequently prioritized aspects in the self-care domain were personal care (22.2%), functional mobility (15.3%), and community management (8.5%). In the productivity domain, paid or unpaid work (19.6%) and household arrangements (4.8%) were more frequently reported. For leisure, active recreation (16.4%), quiet recreation (6.3%), and socialization (5.8%) were highlighted.

Table 1 Participants characteristics and identified occupations in the Canadian Occupational Performance Measure

Participants (n = 45)

Varieable	Category	Median (IQR) or *n* (%)
Age		75 (66–84)
Female		21 (46.7%)
Diagnosis	Cerebrovascular disease	16 (35.6%)
	Spinal and spinal cord disease	9 (20.0%)
	Fracture	6 (13.3%)
	Mental disorder	6 (13.3%)
	Intractable neurological diseases	3 (6.7%)
	Internal disorder	2 (4.4%)
	Rheumatoid arthritis	1 (2.2%)
	Amputation	1 (2.2%)
	Cardiac disease	1 (2.2%)
MMSE		28 (26–30)
Care Level	Support Level 1	1 (2.2%)
	Support Level 2	7 (15.6%)
	Care Level 1	5 (11.1%)
	Care Level 2	12 (26.7%)
	Care Level 3	7 (15.6%)
	Care Level 4	5 (11.1%)
	Care Level 5	4 (8.9%)
	Not assessed (not applied for LTCI)	4 (8.9%)

Occupations identified by the COPM (*n* = 189)

Domain	Aspect	Count
Self-care (*n* = 87, 46.0%)	Personal care	42 (22.2%)
	Functional mobility	29 (15.3%)
	Community management	16 (8.5%)
Productivity (*n* = 48, 25.4%)	Paid/unpaid work	37 (19.6%)
	Household arrangement	9 (4.8%)
	Play/school	2 (1.1%)
Leisure (*n* = 54, 28.6%)	Quiet recreation	12 (6.3%)
	Active recreation	31 (16.4%)
	Socialization	11 (5.8%)

Occupational therapist (*n* = 18)

Experience year	9 (7–14)

MMSE: Mini-Mental State Examination, COPM: Canadian Occupational Performance Measure, LTCI: Long-Term Care Insurance
MMSE and Care level were not assessed in four participants who had not applied for LTCI. These variables were not used in the MIC analysis.

3. Comparison of COPM Scores between Improved and No Change Groups

Table 2 presents the distribution of COPM-P and COPM-S scores for the "Improved" and "No change" groups. Among participants in the "Improved" group (*n* = 30), significant increases were observed between the initial assessment (T1) and reassessment (T2) for both COPM-P (median: 4.2 [IQR: 2.3–5.3] to 6.7 [IQR: 5.4–7.9], $p < 0.001$) and COPM-S (median: 3.8 [IQR: 2.1–5.0] to 6.4 [IQR: 5.4–7.7], $p < 0.001$). In contrast, the "No change" group (*n* = 15) showed smaller, although statistically significant, increases in COPM-P (median: 3.2 [IQR: 2.3–6.1] to 4.7 [IQR: 4.1–6.4], $p = 0.003$) and COPM-S (median: 3.0 [IQR: 2.3–5.3] to 4.7 [IQR: 3.6–6.3], $p = 0.010$).

When comparing the change scores (T2-T1) between the groups, the "Improved" group demonstrated significantly higher median change scores compared with the "No change" group for both the COPM-P (1.7 [IQR: 1.2–3.5] vs. 0.7 [IQR: 0.2–1.7], $p = 0.005$) and COPM-S (2.0 [IQR: 0.6–4.4] vs. 0.7 [IQR: 0.1–1.8], $p = 0.020$). These results highlight the greater magnitude of improvement in performance and satisfaction among participants classified as "Improved" compared with those in the "No change" group.

4. Distribution of COPM-P and COPM-S Change Scores

The distribution of COPM-P and COPM-S change scores across the "Improved" and "No change" groups is illustrated in Fig. 1. It is important to note that although MIC values in this study were calculated as the mean of the identified occupations for each participant, the violin plots represent the distribution of all individual occupation scores rather than averaging scores per participant. This approach was used to maximize the visualization of the data given the relatively small sample size (*n* = 45). Violin plots illustrate the distribution and density of change scores.

For COPM-P, the "Improved" group showed a wider, positively skewed distribution (range: −4 to +9 points). The most frequent improvement was +1 point (*n* = 19, 17.8%). In contrast, the "No change" group showed a more condensed distribution, with change scores ranging from −5 to +5. The most frequent change score in this group was 0 (*n* = 55, 67.1%). Regarding COPM-S, the "Improved" group similarly demonstrated a broader range of positive change scores, with a maximum improvement of +9 points and minimum score of −5 points. The most frequent improvement was 0 (*n* = 13, 12.1%). Conversely, the "No change" group presented a narrower distribution, with change scores ranging from −5 to +5 points. The most frequent outcome in this group was 0 point (*n* = 53, 64.6%).

These violin plots highlight the distinct patterns of change between the two groups, with the "Improved" group showing a more pronounced and consistent positive shift in both the COPM-P and COPM-S scores. This visual representation underscores the greater magnitude and variability of improvement observed in the "Improved" group compared with the "No change" group.

Table 2 Results of the Canadian Occupational Performance Measure ($n = 45$)

Variable	Group	T1 Initial assessment Median (IQR)	T2 Reassessment Median (IQR)	T2–T1 Change score Median (IQR)	T1 vs T2 *P*-value	T2–T1: Change score Improved vs No change *P*-value
COPM-P	Improved ($n = 30$)	4.2 (2.3–5.3)	6.7 (5.4–7.9)	1.7 (1.2–3.5)	< 0.001	0.005
	No change ($n = 15$)	3.2 (2.3–6.1)	4.7 (4.1–6.4)	0.7 (0.2–1.7)	0.003	
COPM-S	Improved ($n = 30$)	3.8 (2.1–5.0)	6.4 (5.4–7.7)	2.0 (0.6–4.4)	< 0.001	0.020
	No change ($n = 15$)	3.0 (2.3–5.3)	4.7 (3.6–6.3)	0.7 (0.1–1.8)	0.010	

COPM-P: Canadian Occupational Performance Measure Performance score, COPM-S: Canadian Occupational Performance Measure Satisfaction score

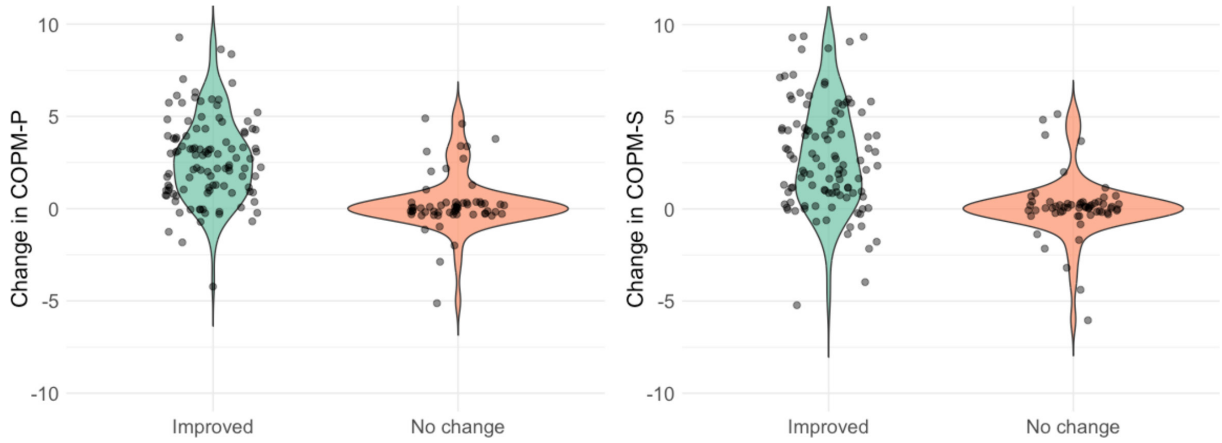

Fig. 1. Violin plots illustrating the distribution of change scores for COPM-P (left) and COPM-S (right) in the "Improved" and "No change" groups. The width of each violin represents the density of data across score levels, with individual data points overlaid to enhance interpretability. "Improved" denotes participants who reported significant positive changes, whereas "No change" indicates minimal or no improvement. These plots depict all identified occupations rather than participant-level averages, providing a comprehensive visualization of individual occupational data.

Table 3 MIC Estimates and Adjustments for COPM Performance and Satisfaction Scores

Parameters	COPM-P			COPM-S		
	Estimate	95% Confidence Interval		Estimate	95% Confidence Interval	
		Lower	Upper		Lower	Upper
$MIC_{predict}$	1.35	0.88	1.80	1.37	0.81	1.88
MIC_{adjust}*	1.23	0.73	1.72	1.24	0.60	1.77

COPM-P: Canadian Occupational Performance Measure Performance score, COPM-S: Canadian Occupational Performance Measure Satisfaction score

* MIC_{adjust}: Calculated by adjusting $MIC_{predict}$ to account for the proportion of participants classified as 'Improved.'

5. MIC Calculation Using Predictive Modeling and Anchor Validity (Table 3)

The $MIC_{predict}$ values were 1.35 (95% CI: 0.88–1.80) and 1.37 (95% CI: 0.81–1.88) points for the COPM-P and COPM-S, respectively. The proportion of participants classified as "Improved" was 66.7% ($n = 30$), compared with 33.3% ($n = 15$) in the "No change" group. To account for this imbalance, the MIC_{adjust} values were calculated, resulting in 1.23 points (95% CI: 0.73–1.72) for COPM-P and 1.24 points (95% CI: 0.60–1.77) for COPM-S.

The validity of TI as an anchor was supported by strong correlations with the COPM change scores. Using the Spearman's correlation coefficients, the association was $r = -0.683$ ($p < 0.001$) for COPM-P and $r = -0.648$ ($p < 0.001$) for COPM-S. These findings confirm the robust relationship between the anchor and measured changes in occupational performance and satisfaction, ensuring the reliability of the MIC calculations.

These results underscore the importance of using

MIC_{adjust} to account for unequal group proportions, ensuring that thresholds for meaningful changes in COPM scores accurately reflect sample characteristics.

6. Responsiveness Evaluation

1) SRM

The SRM values, calculated as the ratio of the mean change scores to the standard deviation of the change scores, were 1.09 (95% CI: 0.874–1.42) for COPM-P and 1.01 (95% CI: 0.797–1.29) for COPM-S. These values suggest a large effect size, indicating that the COPM demonstrated robust responsiveness to changes in both the performance and satisfaction scores.

2) Correlation with EQ-5D-5L

The Spearman's rank correlation coefficients between the COPM change and EQ-5D-5L scores were analyzed to assess convergent validity. The correlation coefficient for COPM-P and EQ-5D-5L was −0.0293 (p = 0.8), and that for COPM-S and EQ-5D-5L was −0.00265 (p = 1). Both correlations were weak and not statistically significant, suggesting limited convergent validity between the COPM and EQ-5D-5L.

IV. Discussion

1. Comparison with Previous Studies on MIC

The determination of MIC for COPM has been extensively studied in chronic-phase community-dwelling populations. For example, Eyssen et al. identified optimal COPM-P and COPM-S cut-off points of 0.90 points (area under the curve; AUC: 0.85) and 1.45 points (AUC: 0.85), respectively, using ROC curve analysis with the TI as the external anchor [5]. Similarly, Tuntland et al. employed a five-point rating scale as an external anchor to calculate MIC [15], while Kjeken et al. relied on distribution-based methods to determine the smallest detectable difference for the COPM [23].

Although these studies share a common focus on chronic-phase populations, such as community-dwelling older adults and outpatients with stable conditions, the present study differs in two significant ways. First, unlike the traditional ROC curve-based approaches utilized in prior investigations, our study adopted predictive modeling methods ($MIC_{predict}$ and MIC_{adjust}), which offer improved accuracy by accounting for unequal group proportions and other population-specific factors. This methodological distinction enhances the precision of the MIC thresholds in dynamic clinical settings. $MIC_{predict}$ and MIC_{adjust} offer individualized, bias-corrected thresholds, improving precision in real-world, small-sample studies [8–10].

Second, this study was conducted within the context of Japan's unique healthcare and long-term care system, specifically targeting individuals receiving home-based rehabilitation services. This study highlights the utility of COPM in Japan's aging society and the need for culturally adapted psychometric analyses. Collectively, these factors demonstrate the novelty of the present study in advancing the application of COPM in diverse healthcare contexts.

2. Measurement Accuracy and Individualized Nature of the COPM

The COPM's strength lies in its individualized approach, which enables clients to identify and rate their own priorities in occupational performance and satisfaction. This structure enhances clinical relevance and person-centeredness in rehabilitation outcome measurement [24].

However, the individualized format poses challenges such as response shift and variability in selected occupations, which may affect score consistency. Studies have reported that concordance in prioritized problems between initial and follow-up COPM assessments ranges only from 66% to 74% [25, 26], and response shift has been documented as a relevant phenomenon in the COPM context [27]. Additionally, the use of a 10-point numerical scale may pose challenges for some participants, particularly older adults [28, 29].

A structured interview guide helped maintain consistency in goal conceptualization [12]. This likely minimized recall bias and recalibration effects, thereby enhancing the validity of the change scores used in MIC estimation. These methodological precautions support the credibility of the COPM-derived MIC values in this study, despite the inherent subjectivity of individualized outcome measures.

3. Responsiveness and Comparison with EQ-5D-5L

The individualized nature of the COPM is also reflected in its responsiveness, as demonstrated by the high SRM observed in this study. These results highlight the sensitivity of COPM to changes in personally significant occupational performance and satisfaction. The strong responsiveness of COPM underscores its unique ability to capture changes that are highly specific to each participant's prioritized occupational concerns [24].

However, lack of a significant correlation between the COPM change and EQ-5D-5L scores suggests that these instruments measure distinct constructs. Although the EQ-5D-5L focuses on broader aspects of health-related quality of life [22], the COPM targets specific occupational concerns, making it particularly useful for evaluating individualized outcomes. This difference reflects the highly personalized nature of the COPM,

which allows participants to identify and evaluate the tasks and roles most meaningful to them. As such, it excels in capturing client-centered changes that may not align with the standardized domains assessed by broader PROMs, such as the EQ-5D-5L [22, 30].

Given the complementary strengths of individualized and comprehensive PROMs, combining these measures may provide a more holistic evaluation of rehabilitation outcomes. Although individualized tools like the COPM can assess client-specific progress in occupational performance and satisfaction, broader instruments like the EQ-5D-5L can contextualize these changes within overall health-related quality of life [22, 30]. Previous studies have also highlighted the importance of combining PROMs to address both specific and general aspects of health, ensuring a comprehensive understanding of intervention effects [31]. By leveraging both types of measures, clinicians and researchers can achieve a more nuanced understanding of recovery by capturing both the specific and general dimensions of rehabilitation outcomes.

V. Limitation and Future Directions

This study has some limitations. The small sample size ($n = 45$) may restrict the generalizability of the findings, and the lack of long-term follow-up data may limit the understanding of the sustainability of improvements. In particular, while anchor-based methods for determining minimal important change (MIC) often recommend a sample size of approximately 100 participants, our use of $MIC_{predict}$ and MIC_{adjust} was intended to enhance estimation accuracy despite this limitation. Nevertheless, the limited sample size may reduce the precision and stability of the derived MIC values, and findings should be interpreted with appropriate caution.

Moreover, predictive modeling methods such as $MIC_{predict}$ and MIC_{adjust} are based on certain assumptions regarding the distribution of change scores and the reliability of the anchor. Although MIC_{adjust} compensates for group imbalance, its performance may still be influenced by anchor misclassification or sampling variability, particularly in small and culturally specific populations.

Future studies should include larger and more diverse samples and investigate whether COPM score improvements persist over time. Despite these limitations, this study highlights the value of the $MIC_{predict}$ and MIC_{adjust} methods in Japan's home-based rehabilitation context.

VI. Conclusion

Predictive modeling ($MIC_{predict}$, MIC_{adjust}) helped establish MIC values for Japanese home rehab users. This study demonstrates the potential of predictive modeling methods () in establishing context-specific MIC values for COPM, specifically tailored to a Japanese home rehabilitation population. By addressing unique cultural and healthcare contexts, this study underscores the importance of aligning psychometric analyses with specific population characteristics.

The findings confirm the COPM's strong responsiveness, as evidenced by high SRM values, and its ability to capture nuanced changes in personally significant occupational concerns. However, the lack of a significant correlation with EQ-5D-5L scores highlights the complementary role of individualized and comprehensive PROMs in achieving a holistic understanding of patient outcomes. These results suggest that COPM can serve as a valuable tool for tailoring rehabilitation strategies to meet individual needs in diverse clinical settings.

Although this study provides valuable insights, further studies with larger sample sizes and long-term follow-up are warranted to validate these findings and expand their applicability.

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Conflict of interest

The authors declare no conflicts of interest related to this study.

References

[1] Whalley Hammell KR. Client-centred occupational therapy: the importance of critical perspectives. Scand J Occup Ther. 2015; 22(4): 237–43.

[2] Law MC, Baptiste S, Carswell A, McColl MA, Polatajko H, Pollock N. Canadian occupational performance measure: COPM: CAOT Publ. ACE; 2019.

[3] Law M, Baptiste S, McColl M, Opzoomer A, Polatajko H, Pollock N. The Canadian occupational performance measure: an outcome measure for occupational therapy. Can J Occup Ther. 1990; 57(2): 82–7.

[4] Carswell A, McColl MA, Baptiste S, Law M, Polatajko H, Pollock N. The Canadian Occupational Performance Measure: a research and clinical literature review. Can J Occup Ther. 2004; 71(4): 210–22.

[5] Eyssen ICJM, Steultjens MPM, Oud TAM, Bolt EM, Maasdam A, Dekker J. Responsiveness of the Canadian Occupational Performance Measure. The Journal of Rehabilitation Research and Development. 2011; 48(5): 517.
[6] Ohno K, Tomori K, Sawada T, Seike Y, Yaguchi A, Kobayashi R. Measurement Properties of the Canadian Occupational Performance Measure: A Systematic Review. Am J Occup Ther. 2021; 75(6).
[7] Revicki D, Hays RD, Cella D, Sloan J. Recommended methods for determining responsiveness and minimally important differences for patient-reported outcomes. J Clin Epidemiol. 2008; 61(2): 102–9.
[8] Terluin B, Eekhout I, Terwee CB, de Vet HC. Minimal important change (MIC) based on a predictive modeling approach was more precise than MIC based on ROC analysis. J Clin Epidemiol. 2015; 68(12): 1388–96.
[9] Terluin B, Eekhout I, Terwee CB. The anchor-based minimal important change, based on receiver operating characteristic analysis or predictive modeling, may need to be adjusted for the proportion of improved patients. J Clin Epidemiol. 2017; 83: 90–100.
[10] Terwee CB, Peipert JD, Chapman R, Lai JS, Terluin B, Cella D, et al. Minimal important change (MIC): a conceptual clarification and systematic review of MIC estimates of PROMIS measures. Qual Life Res. 2021; 30(10): 2729–54.
[11] Terwee CB, Prinsen CAC, Chiarotto A, Westerman MJ, Patrick DL, Alonso J, et al. COSMIN methodology for evaluating the content validity of patient-reported outcome measures: a Delphi study. Qual Life Res. 2018; 27(5): 1159–70.
[12] Ohno K, Tomori K, Sawada T, Kobayashi R. Examining minimal important change of the Canadian Occupational Performance Measure for subacute rehabilitation hospital inpatients. J Patient Rep Outcomes. 2021; 5(1): 133.
[13] Husted JA, Cook RJ, Farewell VT, Gladman DD. Methods for assessing responsiveness: a critical review and recommendations. J Clin Epidemiol. 2000; 53(5): 459–68.
[14] Hagg O, Fritzell P, Oden A, Nordwall A, Swedish Lumbar Spine Study G. Simplifying outcome measurement: evaluation of instruments for measuring outcome after fusion surgery for chronic low back pain. Spine (Phila Pa 1976). 2002; 27(11): 1213–22.
[15] Tuntland H, Aaslund MK, Langeland E, Espehaug B, Kjeken I. Psychometric properties of the Canadian Occupational Performance Measure in home-dwelling older adults. J Multidiscip Healthc. 2016; 9: 411–23.
[16] Devji T, Carrasco-Labra A, Qasim A, Phillips M, Johnston BC, Devasenapathy N, et al. Evaluating the credibility of anchor based estimates of minimal important differences for patient reported outcomes: instrument development and reliability study. BMJ. 2020; 369: m1714.
[17] Barker RN, Sealey CJ, Polley ML, Mervin MC, Comans T. Impact of a person-centred community rehabilitation service on outcomes for individuals with a neurological condition. Disabil Rehabil. 2017; 39(11): 1136–42.
[18] van Leeuwen CM, Post MW, van der Woude LH, de Groot S, Smit C, van Kuppevelt D, et al. Changes in life satisfaction in persons with spinal cord injury during and after inpatient rehabilitation: adaptation or measurement bias? Qual Life Res. 2012; 21(9): 1499–508.
[19] Sajobi TT, Brahmbatt R, Lix LM, Zumbo BD, Sawatzky R. Scoping review of response shift methods: current reporting practices and recommendations. Qual Life Res. 2018; 27(5): 1133–46.
[20] Middel B, van Sonderen E. Statistical significant change versus relevant or important change in (quasi) experimental design: some conceptual and methodological problems in estimating magnitude of intervention-related change in health services research. Int J Integr Care. 2002; 2: e15.
[21] Mokkink LB, de Vet HCW, Prinsen CAC, Patrick DL, Alonso J, Bouter LM, et al. COSMIN Risk of Bias checklist for systematic reviews of Patient-Reported Outcome Measures. Qual Life Res. 2018; 27(5): 1171–9.
[22] Ikeda S, Shiroiwa T, Igarashi A, Noto S, Fukuda T, Saito S, et al. Developing a Japanese version of the EQ-5D-5L value set. Journal of the National Institute of Public Health. 2015; 64(1): 47–55 (in Japanese).
[23] Kjeken I, Dagfinrud H, Uhlig T, Mowinckel P, Kvien TK, Finset A. Reliability of the Canadian Occupational Performance Measure in patients with ankylosing spondylitis. J Rheumatol. 2005; 32(8): 1503–9.
[24] Deshpande PR, Rajan S, Sudeepthi BL, Abdul Nazir CP. Patient-reported outcomes: A new era in clinical research. Perspect Clin Res. 2011; 2(4): 137–44.
[25] Eyssen IC, Beelen A, Dedding C, Cardol M, Dekker J. The reproducibility of the Canadian Occupational Performance Measure. Clin Rehabil. 2005; 19(8): 888–94.
[26] Verkerk GJ, Wolf MJ, Louwers AM, Meester-Delver A, Nollet F. The reproducibility and validity of the Canadian Occupational Performance Measure in parents of children with disabilities. Clin Rehabil. 2006; 20(11): 980–8.
[27] Ohno K, Oi R, Harada A, Tomori K, Sawada T. Response Shifts in the Canadian Occupational Performance Measure: A Convergent Mixed-Methods Study. Am J Occup Ther. 2024; 78(3).
[28] Wressle E, Marcusson J, Henriksson C. Clinical Utility of the Canadian Occupational Performance Measure – Swedish Version. Can J Occup Ther. 2016; 69(1): 40–8.
[29] Kjeken I, Slatkowsky-Christensen B, Kvien TK, Uhlig T. Norwegian version of the Canadian Occupational Performance Measure in patients with hand osteoarthritis: validity, responsiveness, and feasibility. Arthritis Rheum. 2004; 51(5): 709–15.
[30] Oppe M, Devlin NJ, van Hout B, Krabbe PF, de Charro F. A program of methodological research to arrive at the new international EQ-5D-5L valuation protocol. Value Health. 2014; 17(4): 445–53.
[31] Liu JB, Rothrock NE, Edelen MO. Selecting patient-reported outcome measures: “what” and “for whom”. Health Aff Sch. 2024; 2(4): qxae038.

■CASE REPORTS

Improving Behavioral and Psychological Symptoms of Dementia with Activity-Based Practice Using the Assessment of Quality of Activities Tool: A Case Study

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Abstract: Introduction: Interventions using meaningful activities based on a client's interests and roles improve the behavioral and psychological symptoms of dementia (BPSD). However, as dementia progresses, it becomes increasingly difficult to identify meaningful activities. In this study, we report the effectiveness of activity-based practices using the Assessment of Quality of Activities (A-QOA) in a client with severe dementia.
Case Presentation: A woman in her 80s (Mrs. A) with Alzheimer's disease was diagnosed with severe dementia. After being admitted to the hospital, she spent a lot of time doing nothing and showed BPSD such as aggression and resistance to care, which made it difficult for the ward staff (the staff) to care for her. Therefore, we used the A-QOA to identify meaningful activities and appropriate care for her. We found two activities that could be engaged in as "roles" and five "care innovations". Over the course of a week, Mrs. A performed her "role", and the staff could implement care. Consequently, she became more active in her "role", her interactions with others increased, and her BPSD improved.
Conclusions: Mrs. A's situation improved as a result of the provision of personalised activities and care tailored to her needs. Mrs. A's case showed that the A-QOA is useful for identifying meaningful activities for clients with severe dementia and implementing care accordingly. This case also highlights the importance of identifying meaningful activities and strengthening connections to support clients with severe dementia.

Keywords: Assessment of Quality of Activities, dementia, meaningful activities, activity-based practice, behavioral and psychological symptoms of dementia

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1. Introduction

Interventions involving meaningful activities based on a client's interests and roles can gratify psychological needs and improve behavioral and psychological symptoms of dementia (BPSD) [1–3]. However, as dementia progresses, verbal communication and identifying meaningful activities become more difficult [4, 5]. Additionally, caregivers may lack the skills required to identify and provide meaningful activities [6]. These factors could make implementation of activity-based practices difficult for people with dementia. The Assessment of Quality of Activities (A-QOA) [7, 8] was developed to address these issues.

The A-QOA scores 21 items on a four-point scale based on observations and calculates probit values using the software. The A-QOA can be used to identify meaningful activities for people with dementia, plan support, and measure intervention outcomes [9]. Additionally, its reliability and validity have been evaluated [7, 10].

Herein, we describe the case of a client with Alzheimer's disease and severe dementia that showed BPSD improvement following a short-term intervention using the A-QOA. We demonstrated how the A-QOA aids in the treatment of clients with severe dementia. To our knowledge, published evidence regarding A-QOA use in practice is lacking.

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Table 1 Mrs. A's activities and their qualities

Activity	Activity report	Probit value (probit)	State of activity*	Strength of activity engagement by the client*
Towel folding[a)]	**Mrs. A said with a smile to the staff in the ward folding towels next to her, 'You're quick'. She was concentrating on the task with practiced hands.**	**2.89**	**Average**	**Average**
3D origami[b)]	**Mrs. A smiled when others praised her for her work. After the activity, she showed no resistance to being cared for and the transition was smooth.**	**2.56**	**Average**	**Average**
Rolling paper flowers[c)]	Mrs. A rolled the paper herself, using the pattern as a reference. She worked quietly, with little interaction with those around her.	2.24	Average	Average
Karaoke[d)]	Mrs. A stared at the karaoke screen. Her expression barely changed and she moved her mouth in a matter-of-fact way. She was passive throughout.	1.9	Poor	Weak
Baby doll[e)]	Mrs. A held the baby doll in her anns and looked very comfortable. However, her interest was only temporary and she put the doll back on the desk.	1.64	Poor	Weak

A-QOA: Assessment of Quality of Activities

The * symbol is used to indicate the numerical interpretation of the pro bit values in reference [8]. The pro bit value range (state of activity, strength of activity engagement by the client) is as follows: –0.99 (very poor, very weak), 1.00–1.99 (poor, weak), 2.00–2.99 (average, average), 3.00–3.99 (good, strong), and 4.00– (very good, very strong).

a) Towel folding: In the ward, the face towels used daily are washed and hung out to dry every day. This activity involves folding about 30 dry towels. Mrs. A carried out this activity in the day room of the ward. b) 3D origami: Folding a 9 × 5 cm rectangle of paper into a triangle using a set procedure. Once you have made the required number of pieces, assemble the pieces to make the 3D shape you want. Mrs. A was in charge of the activities that involved only one step, such as 'folding in half. c) Rolling paper flowers: This activity involved cutting the flower paper into eight equal pieces with scissors and rolling each piece up individually. The rolled flower paper was then pasted along a rough sketch to make a collage. Mrs. A was in charge of the activity of rolling up each piece of cut flower paper. d) Karaoke: About 30 people gathered in the day room of the ward and sang songs they wanted to sing while the visuals were projected on a big screen. Mrs. A participated as a member of the audience. e) Baby doll: This activity involved holding and cuddling a baby doll. Mrs. A borrowed a baby doll from someone else.

This study was conducted in accordance with the Declaration of Helsinki and approved by the hospital ethics committee (approval number: 2020-32). The client and her family provided informed consent.

2. Methods

2.1. Case presentation

A woman in her 80s (Mrs. A) with Alzheimer's disease was diagnosed with severe dementia. She lived alone with the support of long-term care insurance and was originally a caring and kind person. However, she gradually started showing signs of violence and agitation toward her caregivers and was admitted to the dementia ward at a nearby hospital.

2.2. Status and policy

Following admission to the hospital, Mrs. A was idle, uncooperative, and aggressive, and the ward staff (the staff) struggled to care for her. After discussing the situation, we decided to find meaningful activities for Mrs. A and provide time for her to engage in them. The staff then agreed to provide appropriate care for Mrs. A.

2.3. Assessment

Mrs. A scored 0/30 on the Revised Hasegawa's Dementia Scale (HDS-R), indicating severe cognitive decline; 33/50 on the Nishimura Activity of Daily Living (N-ADL) scale, indicating the need for help with daily tasks; 11/50 on the New Clinical Scale for Rating Mental States of the Elderly (NM) scale, and 41/120 on the Neuropsychiatric Inventory-Nursing Home (NPI-NH) version scale. She had low motivation and interest as well as anxiety and agitation.

We selected five activities she was interested in at the hospital by observing with the staff, based on information gathered from her family about her interests and roles. After observing and scoring these activities using the A-QOA, we calculated the probit values using the AqoaPro software (ver.1.1.0) and compared the activities (Table 1). Among these, two high-quality activities (towel folding and 3D origami) were incorporated into Mrs. A's daily life "roles". Furthermore, together with the staff, upon extracting factors improving the quality of activities from the A-QOA, we identified five frameworks as "care innovations" for implementation in daily life (Table 2).

These assessments were performed by occupational

Table 2 Care innovations to improve the quality of Mrs. A's activities

Factors that improve the quality of activities as evaluated on the A-QOA	Framework for Mrs. A's care	Specific examples of care
When Mrs. A was thanked with a smile, she looked relieved and smiled back. She also became more receptive to the care provided by the staff in the ward.	**Communication that reassures**	● Look Mrs. A in the eye, smile, and speak to her ● Thank Mrs. A (e.g. 'Thank you')
Visual information such as 'using gestures' and 'showing the objects used in the activity' helped to communicate information to Mrs. A more easily. Also, 'giving information slowly and as simply as possible' and 'waiting for Mrs. A's response before speaking again' helped improve her understanding.	**Provide information that is concise andeasy to understand**	● Using gestures ● Explaining using real objects ● Talking in words and short sentences ● Wait for Mrs. A's answer ● After Mrs. A has responded, continue with the next step
Rather than ordering Mrs. A to do something, the staff in the ward supported her in choosing what she wanted to do. This gave Mrs. A the opportunity to express her wishes.	**Offering choices**	● Provide a choice for Mrs. A to make (e.g. Which do you think is better, B or C? What do you think, Mrs. A?)
Involving the staff in the ward or familiar people in activities with her, 'preparing examples of activities,' and 'breaking activities into discrete processes rather than continuous, complex processes' encouraged Mrs. A to take the initiative in activities and promote interpersonal interactions.	**Environmental adaptation**	● The staff in the ward or familiar people take part in activities together. ● The procedures and results are presented in such a way that they can be seen as a model for the activity. ● The activity is broken down into individual processes and provided. ● The environment in which the activity is carried out (e.g. a desk) is well organized and tidied up.
For Mrs. A, her refusal to accept care was reduced by engaging in quality activities. In other words, engaging in meaningful activities made it easier for Mrs. A to accept care.	**Transitioning to post-activity care**	● After Mrs. A has participated in activities such as towel folding and origami, the staff in the ward provide her with personal care.

When the elements that improved the quality of Mrs. A's activities were extracted from the A-QOA, the above five care frameworks emerged. As mentioned above, these were incorporated into Mrs. A's care in the abovementioned ways.

therapists not involved in the intervention.

3. Results

3.1. Progress

Over the next week, Mrs. A performed the two activities as her "role", and the staff provided the care shown in Table 2.

Mrs. A performed the activities without refusal, based on the approach in Table 2. When towel folding, she would take towels from the staff and fold them herself, concentrating on the task. During 3D origami, she taught others how to do it, and her interactions with others increased. After these activities, she was more compliant when guided with gestures to take a bath or go to the toilet. The staff did not force the issue when she refused but rather tried again later.

In addition to her "role", Mrs. A began to show interest in other activities, such as knitting and the coffee shop, and spent more time chatting with others in the day room.

The staff noted: "It was reassuring to know how to take care of Mrs. A, and it facilitated provision of care".

3.2. Reassessment

Mrs. A's condition was reassessed one week after the intervention (Table 3). On the A-QOA, the towel folding and 3D origami probit scores improved. She scored 0/30 on the HDS-R, indicating no change; 29/50 on the N-ADL scale, with decreases in the "bathing" and "toileting" categories; 13/50 on the NM scale, with an increase in the "interacting with others" category; and 31/120 on the NPI-NH scale, with decreases in the "anxiety" and "irritability" categories.

Additionally, Mrs. A spent about an hour and a half in the morning doing 3D origami and 30 minutes in the evening folding towels every day, and these activities became part of her daily routine. During these activities, Mrs. A interacted with others and had a calm expression. The staff also became familiar with the care techniques, which continued until she was discharged.

4. Discussion

Personalised activities involving several individual factors can significantly and moderately affect BPSD [1]. In this case, activities were personalised to Mrs. A's

Table 3 Pre- and post-interventional outcome indicators

outcome indicators	Pre		Post	
	Towel folding	3D origami	Towel folding	3D origami
A-QOA's 21 Observed Items (points)				
1 Initiation	3	3	3	3
2 Gaze	3	3	3	3
3 Position	3	3	3	3
4 Continuation	3	3	3	3
5 Focus	3	3	3	3
6 Mastery	3	3	3	3
7 Choice	1	2	2	2
8 Inventiveness	3	3	3	3
9 Satisfaction	3	3	3	3
10 Competence	2	2	2	2
11 Willingness	2	2	2	2
12 Smiling	2	2	2	2
13 Animation	1	1	1	1
14 Interaction	3	2	3	3
15 Cooperation	3	1	3	2
16 Instruction	1	1	2	3
17 Communication	2	2	2	2
18 Caring	3	1	3	2
19 Sharing	2	2	2	2
20 Verbalizing	2	2	2	2
21 Reminiscence	1	1	1	1
A-QOA Total score (points)	49	45	51	50
Probit value (probit)	2.89	2.56	3.07	2.98
State of activity*	Average	Average	Good	Average
Strength of activity engagement by the client*	Average	Average	Strong	Average
HDS-R (points)	0/30		0/30	
N-ADL (points)	33/50		29/50	
NM-Scale (points)	11/50		13/50	
NPI-NH (points)	41/120		31/120	

A-QOA: Assessment of Quality of Activities, HDS-R: Hasegawa's Dementia Scale-Revised, N-ADL: Nishimura Activity of Daily Living Scale, NM-Scale: New Clinical Scale for Rating of Mental States of the Elderly, NPI-NH: Neuropsychiatric Inventory Nursing Home

The A-QOA consists of 21 items. Each item is rated on a four-point scale: 4, very strongly/exceptionally observed; 3, observed; 2, observed but limited/questionable; 1, not observed.

The * symbol is used to indicate the numerical interpretation of the probit values in reference [8]. The probit value range (state of activity, strength of activity engagement by the client) is as follows: –0.99 (very poor, very weak), 1.00–1.99 (poor, weak), 2.00–2.99 (average, average), 3.00–3.99 (good, strong), and 4.00– (very good, very strong).

preferences, interests, abilities, and pre-illness personality and environment, which improved the quality of activities, BPSD, and her condition. Additionally, the N-ADL score decrease was thought to be influenced by the decrease in her refusal of care and the fact that she could receive adequate care.

Mrs. A had severe dementia and difficulty verbally communicating, making it difficult for hospital staff to identify meaningful activities and provide appropriate care, as was the case in previous studies [4–6]. People with dementia sometimes find meaning in activities through emotions such as joy, pleasure, connection, and a sense of belonging [5, 6]. A-QOA [7–9] assesses this as engagement in activities. Therefore, we identified meaningful activities based on Mrs A's actions during her activities, such as smiling and initiating conversations with others. In other words, The A-QOA allowed quantification and identification of meaningful activities. Considering the factors influencing the A-QOA enabled appropriate care for Mrs. A. As in previous research [9], the A-QOA proved useful for identifying meaningful activities and implementing care for Mrs. A.

As the study activities were limited to a hospital setting and as this was a short, one-week intervention, there were limitations in identifying activities and examining outcomes. It was also necessary to reflect on the meaning of activities and to re-evaluate them from different perspectives. Thus, further research is required

on this topic.

5. Summary and Conclusions

This practical application of the A-QOA highlights the importance of finding meaningful activities for clients with severe dementia.

Conflicts of interest

The authors declare no competing interests.

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References

[1] Lu S, Zhang AY, Liu T, Choy JCP, Ma MSL, Wong G, et al. Degree of personalisation in tailored activities and its effect on behavioural and psychological symptoms and quality of life among people with dementia: a systematic review and meta-analysis. BMJ Open. 2021; 11(11): e048917.

[2] Möhler R, Renom A, Renom H, Meyer G. Personally tailored activities for improving psychosocial outcomes for people with dementia in community settings. Cochrane Database Syst Rev. 2020; 8(8): CD010515.

[3] de Oliveira AM, Radanovic M, de Mello PC, Buchain PC, Vizzotto AD, Celestino DL, et al. Nonpharmacological Interventions to Reduce Behavioral and Psychological Symptoms of Dementia: A Systematic Review. Biomed Res Int. 2015; 2015: 218980.

[4] Ripich DN, Wykle M, Niles S. Alzheimer's disease caregivers: the focused program. A communication skills training program helps nursing assistants to give better care to patients with disease. Geriatr Nurs. 1995; 16(1): 15–9.

[5] Phinney A, Chaudhury H, O'Connor DL. Doing as much as I can do: the meaning of activity for people with dementia. Aging Ment Health. 2007; 11(4): 384–93.

[6] Harmer BJ, Orrell M. What is meaningful activity for people with dementia living in care homes? A comparison of the views of older people with dementia, staff and family carers. Aging Ment Health. 2008; 12(5): 548–58.

[7] Ogawa M, Shirai H, Nishida S, Tanimukai H. Rasch analysis of the Assessment of Quality of Activities (A-QOA), an Observational Tool for Clients With Dementia. Am J Occup Ther. 2021; 75(1): 7501205040p1-p9.

[8] Ogawa M, Shirai H, Sakamoto C, Nishida S. A-QOA (Assessment of Quality of Activities) Beginner's Guide. 21 observation points and 20 support points to enrich the lives of people with dementia (in Japanese). Kyoto: Creates Kamogawa; 2022; 16–75.

[9] Nishida S, Ogawa M. QOL of people with dementia using Assessment of Quality of Activities (A-QOA) (in Japanese). MB Med Reha (Medical Rehabilitation). 2022; 273: 19–24.

[10] Database of Grants-in-Aid for Scientific Research [online]. Tokyo: Development of the Assessment of Quality of Activities for People with Dementia (A-QOA): Examining Reliability, Validity, and Feasibility (in Japanese) [cited 2024 October 17]. Available from: https://kaken.nii.ac.jp/ja/grant/KAKENHI-PROJECT-20K11055/.

■ORIGINAL ARTICLE

Poststroke Attention Function: A Rasch Analysis of Neuropsychological Tests

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Abstract: Objectives: The aim of this study was to determine the hierarchy of neuropsychological tests and behavioral observational scale of attention function, using levels of consciousness.
Methods: This single-center, cross-sectional study was conducted at St. Marianna University Yokohama Seibu Hospital (Yokohama, Japan). The study included 54 patients who were admitted to an acute hospital for stroke between September 2022 and February 2023 and consented to participate. The primary outcome was the Wessex Head Injury Matrix (WHIM). The secondary outcomes were tests related to attentional function: Mini-Mental State Examination (MMSE), Digit Span (DS), Trail Making Test (TMT), Frontal Assessment Battery, Symbol Digit Modalities Test (SDMT), and Moss Attention Rating Scale (MARS). We investigated the difficulty levels of five neuropsychological tests, according to levels of consciousness impairment identified by the WHIM.
Results: One hundred and sixty-three measurements were included in the analysis. The WHIM phases showed nearly the same hierarchy as that of the original version. The neuropsychological tests, ranked in decreasing order of difficulty, were TMT-Part B, SDMT, TMT-Part A, DS backward, MMSE, and MARS.
Conclusion: The findings underscore the importance of carefully selecting tests and interpreting results. Certain assessments may be feasible, even in patients with impaired consciousness, whereas other tests may pose challenges, even in patients with relatively good levels of consciousness.

Keywords: stroke, consciousness, cognitive dysfunction, neuropsychological test

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INTRODUCTION

Disorders of consciousness often occur after an acute stroke [1, 2]. In addition, cognitive impairment after a stroke is a poor prognostic factor for functional recovery, thereby making early and accurate assessment crucial [3]. The presence of impaired consciousness in patients who have experienced a stroke may lead to varying degrees of difficulty in completing neuropsychological tests. However, no report to date has determined the extent to which each neuropsychological test is measurable in the presence of impaired consciousness; thus, whether impaired consciousness should be considered when interpreting the results of the tests is difficult to determine.

Attentional functions, which include fundamental and cognitive function, are the second-lowest function on the neuropsychological pyramid, after consciousness [4]. Therefore, we believe that the key factor differentiating cognitive impairment and consciousness impairment is the ability to perform an attention test. Furthermore, attention deficits occur in approximately 80% of patients after a stroke and are a focus for improvement in the rehabilitation process [5].

Tests of attentional function are generally desk-based tasks, but the results of neuropsychological tests often do not correlate well with activities of daily living [6]. Therefore, behavioral observational scales of attention function, such as the Moss Attention Rating Scale (MARS), are recommended in clinical practice [7]. In addition, extracting the specific attention deficit (i.e.,

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sustained, selective, alternating, or divided attention) for targeted rehabilitation is necessary [8].

We hypothesized that impaired consciousness may lead to a hierarchy of difficulty levels among neuropsychological tests of attentional function. Understanding this hierarchy may help in the selection of attentional function assessments, the interpretation of their results, and the choice of whether rehabilitation should approach consciousness disorders or attention deficits by component. Therefore, the purpose of this study was to investigate the difficulty levels of five neuropsychological tests and the MARS, in relation to the levels of consciousness impairment in patients who have experienced an acute stroke.

METHODS

Study design and participants

This single-center, cross-sectional study was approved by the Ethics Committee of St. Marianna University and Kobe University (No. 5376) and was conducted in accordance with the Declaration of Helsinki. The study enrolled 54 patients who were admitted to an acute-care hospital for stroke treatment between September 2022 and February 2024 and who consented to participate. All participants in this study gave written consent. For participants with impaired consciousness, written consent was obtained from a surrogate. A total of 163 measurements were made, including neuropsychological tests and behavioral observations. Patients with any of the following factors were excluded: a Wessex Head Injury Matrix (WHIM) total number of behavior (TNB) score of 62 points, unilateral spatial neglect, aphasia, motor paralysis affecting writing ability with the dominant hand, tracheostomy, severe respiratory or cardiovascular conditions, pre-existing dementia or psychiatric diagnoses, apraxia, and inability to provide consent.

Outcome measures and assessments

Assessments and tests were conducted by five occupational therapists, with one therapist administering the MARS and the other therapists administering different tests. All neurological and neuropsychological evaluations listed below were performed weekly from the start of occupational therapy in the rehabilitation unit until discharge.

The primary outcome was the WHIM score, which is a measure of impaired consciousness. The secondary outcomes included clinical background factors, neurological tests, neuropsychological tests, and the behavioral observational scale.

Clinical background factors included sex, age, days elapsed since stroke onset, date of discharge, diagnosis, presence or absence of surgery, lesion, dominant hand, and discharge destination. Neurological tests included the WHIM, presence of motor paralysis, Brunnstrom recovery stage, and grip strength.

Neuropsychological tests, which primarily focus on attentional function, included the Mini-Mental State Examination (MMSE), Digit Span (DS), Trail Making Test (TMT), Frontal Assessment Battery (FAB), Symbol Digit Modalities Test (SDMT), and MARS. Tests involving practice tasks, such as the TMT and SDMT, were judged unfeasible if the practice tasks were difficult for a patient to perform. The other tests were judged as unfeasible if the patient became somnolent and unresponsive during the test or if performing the test was difficult for the patient because of distraction. In this study, we considered the difficulty levels of five neuropsychological tests and the MARS in relation to levels of consciousness as defined by the WHIM.

WHIM

The WHIM is a 62-item scale used to assess consciousness impairment in people with brain injury [9]. It is recommended for evaluating impaired consciousness and is useful for diagnosing prolonged disorders of consciousness such as a minimally conscious state and unresponsive wakefulness syndrome [10]. Each item is scored with 0 point or 1 point, with higher scores indicating milder impairment [11]. The scoring items are hierarchical and are based on the most advanced behavior (MAB) and the TNBs. In this study, WHIM items 1–28 were excluded; these items correspond to the stages of unresponsive wakefulness syndrome and lower-level minimally conscious state, as identified in previous studies [11]. Items 29 onward were scored, using the two-case method in which each item was given a score of 0 or 1.

MMSE

The MMSE is a general cognitive screening test consisting of 11 sub-items, with a maximum score of 30 [12]. A score of 23 or less indicates cognitive decline. In Japan, a contract was signed with Psychological Assessment Resources, and the Japanese version of the MMSE was produced with permission for its translation. In this study, we used the MMSE with permission from Psychological Assessment Resources.

DS

The DS is a test of working memory [13]. It consists of two parts: forward recitation and backward recitation of numbers, ranging from two digits to nine digits. Higher scores indicate better performance. The DS is widely used to assess working memory because of

its simplicity and suitability for bedside administration.

TMT

The TMT is composed of Part A and Part B (TMT-A and TMT-B, respectively), and is used to assess mental flexibility, attention, and motor speed [14]. TMT-A requires sequential connections of numbered circles, which demands sustained and selective attention. TMT-B involves connecting numbers and letters alternately, which requires working memory, alternating attention, divided attention, and executive function, in addition to sustained and selective attention functions. Shorter completion times and fewer errors indicate good performance. The test has age-specific cutoff values to indicate normal, borderline, or abnormal function and it is used worldwide to assess attentional function after stroke.

FAB

The FAB, which was created by Dubois et al. [15], is used to assess frontal lobe function and consists of six sub-items with a maximum score of 18 points. Higher scores indicate better frontal lobe function. The FAB is advantageous because of its ease of administration and suitability for bedside administration.

SDMT

The SDMT is used to assess divided and conversion attention and is often used in neuropsychological tests of attentional function [16]. It lasts for 90 s, during which time the participants match specific symbols and corresponding numbers. The results are expressed as a percentage of achievement, with higher scores indicating better attentional function.

MARS

The MARS, which was developed by Whyte et al. [17], was developed for patients with traumatic brain injury but has been applied to patients who have experienced a stroke and to children who have mild intellectual disability [7, 18]. It consists of 22 items, each scored from 1 to 5 (1 indicating "definitely false"; 2, "false for the most part"; 3, "sometimes true and sometimes false"; 4, "true for the most part"; and 5, "definitely true"). The total raw MARS score ranges from 22 to 110, with higher scores indicating better attention. The MARS items may also be used to compute three-factor scores: Restlessness/Distractibility, Initiation, and Sustained/Consistent Attention. Based on these facts, the large number of items allows for a multifaceted behavioral assessment of attention function. In this study, evaluations were deemed unfeasible if observations were not possible or scoring was difficult.

Statistical analysis

A Rasch analysis of the WHIM and each neuropsychological test was performed by using the Rasch Reporting Guideline for Rehabilitation Research framework with the statistical software Winsteps 5.7.1 (Winsteps, Beaverton, OR, USA) [19, 20]. Rasch analysis is an analytical method used to assess the distribution of patient ability and task difficulty, normalize the relationship between them, and interpret the distance between scores as a sensory scale. The Consensus-Based Standards for the Selection of Health Measurement Instruments recommends a sample size of 100–199 to provide adequate quality evidence for estimating psychometric properties [21].

Rasch analysis requires the confirmation of unidimensionality, for which principal component analysis of residuals was performed. The total raw variation explained by the measurement should ideally be > 50%, the eigenvalue explained by the first principal component should be < 2.0, and the percent variance should be < 10% [20].

The desired item fit was an infit/outfit mean-square between 0.5 and 1.5, with values < 0.5 interpreted as overfits and values > 1.5 interpreted as underfits. Regarding item difficulty, an item was considered "harmful" if it was an underfit [22]. Person fit should ideally be ≤ 2.0, because higher values lead to unpredictable results and unmodeled noise. Rasch analysis was conducted, excluding items with infit/outfit mean-square value > 1.5 and those with a person fit > 2.0, to create a valid model without introducing the aforementioned noise. Person separation reliability statistics with coefficients > 0.7 are acceptable for group- and individual-level decision-making, respectively [23].

RESULTS

Table 1 shows the clinical background factors, neurological findings, and neuropsychological findings of 54 patients (29 men and 25 women). The median (interquartile range) age was 76.0 (65.3–84.0) years. The median number of evaluations was 3.0 (2.0–4.0). The diagnoses were cerebral infarction (n = 28), cerebral hemorrhage (n = 15), and subarachnoid hemorrhage (n = 11). All patients were right-handed.

Regarding neurological findings, 27 (50%) patients had some form of motor paralysis. One patient with right upper limb motor paralysis had a mild Brunnstrom recovery stage score of VI for the upper extremity and the hand but had no problems performing the neuropsychological tests. For the WHIM, the MAB score had a median of 58.0 (47.8–59.0) points, and the TNB score had a median of 56.0 (47.8–59.0) points. The median

Table 1 Participant clinical characteristics and neurological and neuropsychological findings

Characteristic	All (n = 54)
Sex, male/female, n/n	29/25
Age, y	76.0 (65.3–84.0)
Number of evaluation, p	3.0 (2.0–4.0)
First evaluation date, d	4.5 (3.0–8.0)
Last evaluation date, d	21.0 (11.5–29.0)
Discharge day, d	23.0 (16.0–31.8)
Diagnosis, CI, n	28
CH, n	15
SAH, n	11
Surgery, present/absent, n	16/38
Lesion, right/left/both, n	39/9/6
front/back/both, n	44/9/1
Dominant hand, right/left, n	54/0
Destination, home/transfer, n	19/35
WHIM MAB, p	58.0 (47.8–59.0)
TNB, p	56.0 (47.8–59.0)
Motor paralysis, n	27 (50.0%)
Paralytic side, right / left, n	1/26
BRS (arm) I/II/III/IV/V/VI, n	4/10/0/2/2/9
(finger) I/II/III/IV/V/VI, n	7/5/1/2/3/9
(leg) I/II/III/IV/V/VI, n	1/9/2/1/2/10
Grip (right), kg	16.0 (11.3–20.4)
(left), kg	10.0 (0.0–16.0)
(average), kg	16.0 (16.0–16.0)
MMSE, acceptable, n	45 (83.3%)
score, p	18.0 (12.0–24.0)
DS, Forward acceptable, n	46 (85.1%)
Forward score, p	5.0 (4.0–5.0)
Backward acceptable, n	41 (75.9%)
Backward score, p	3.0 (2.0–3.8)
TMT, Part A acceptable, n	28 (51.9%)
Part A time, s	131.5 (73.3–180.0)
Part B acceptable, n	16 (29.6%)
Part B time, s	270.0 (160.3–300.0)
FAB, acceptable, n	40 (74.1%)
score, p	7.5 (0.3–11.0)
SDMT, acceptable, n	22 (40.7%)
Achievement rate, %	0.0 (0.0–18.0)
MARS, acceptable, n	54 (100.0%)
Total score, p	69.0 (54.0–80.0)

Data are presented as the median (interquartile range), unless otherwise indicated.
n, number of people; y, years; p, points; d, days; s, seconds; CI, cerebral infarction; CH, cerebral hemorrhage; SAH, subarachnoid hemorrhage; WHIM, Wessex Head Injury Matrix; MAB, most advanced behavior; TNB, Total Number of Behaviour; BRS, Brunnstrom motor recovery stage; MMSE, Mini-Mental State Examination; DS, Digit Span; TMT: Trail Making Test; FAB, Frontal Assessment Battery; SDMT, Symbol Digit Modalities Test; MARS, Moss Attention Rating Scale

right-hand grip strength was 16.0 (11.3–20.4) kg.

The number of patients who were able to perform each neuropsychological test was as follows: MARS, 54 (100%) patients; DS forward, 46 (85.1%) patients; MMSE, 45 (83.3%) patients; DS backward, 41 (75.9%) patients; FAB, 40 (74.1%) patients; TMT-A, 28 (51.9%) patients; SDMT, 22 (40.7%) patients; and TMT-B, 16 (29.9%) patients. The implementation rates of TMT and SDMT were slightly lower at the age of 80 years, but no significant differences existed in the implementation rates of the other items.

Measurement accuracy

Table 2 shows the item fit results. Underfit items (i.e., items Q34, Q44, Q52, Q53, Q56, Q57, Q59, Q60, Q61, and Q62 in the WHIM; DS forward; and FAB) and individuals with a person fit ≥ 2.0 (obtained from 14 individuals) were excluded from the Rasch analysis. Finally, Rasch analysis was conducted, using 149 data points and 30 items from 48 individuals. The person separation reliability was 0.94, indicating good reliability.

Unidimensionality

The principal component analysis of residuals results confirmed that the unidimensionality of the test was preserved because the total raw variance was 71.3%, the eigenvalue explained by the first principal component was 3.4, and the percent variance was 4.1%. These findings met two of the three conditions.

Item difficulty

Figure 1 shows the person–item map of the WHIM and neuropsychological tests. The numbers on the y-axis are logits, which indicate the range of item difficulty estimates. The narrower the range of logits, the more desirable it is. The WHIM phases demonstrated a hierarchy similar to that of the original 2009 version of the WHIM. The neuropsychological tests, ranked in difficulty from most to least difficult, were as follows: TMT-B, SDMT, TMT-A, DS backward, MMSE, and MARS. The TMT and SDMT were particularly challenging for many individuals with low levels of consciousness.

DISCUSSION

In this study, we investigated the difficulty levels of five neuropsychological tests related to attentional functions and the MARS, in relation to the levels of consciousness impairment defined by the WHIM. The results showed that the order of difficulty for the neuropsychological tests was TMT-B, SDMT, TMT-A, DS backward, MMSE, and MARS. The TMT-B and SDMT were difficult to implement, even for patients with a good level of awareness. By contrast, DS backward, MMSE, and MARS could be performed, even by patients with a low level of consciousness.

Table 2 Results of item fit

Item	Measure	SE	Infit		Outfit	
			MNSQ	ZSTD	MNSQ	ZSTD
WHIM Q29	−43.03	19.25	0.00	0.00	0.00	0.00
Q30	30.80	4.28	1.01	0.12	0.25	−1.40
Q31	−43.03	19.25	0.00	0.00	0.00	0.00
Q32	−27.99	11.79	0.40	−0.72	0.01	−5.31
Q33	−5.10	6.98	1.00	0.14	0.14	−2.54
Q34	−17.45	9.01	1.53	0.97	0.08	−4.12
Q35	13.14	5.30	0.41	−2.26	0.06	−2.91
Q36	20.70	4.76	0.65	−1.39	0.15	−1.83
Q37	28.94	4.35	1.09	0.42	0.61	−0.45
Q38	20.70	4.76	0.65	−1.39	0.15	−1.83
Q39	15.84	5.09	0.87	−0.36	0.16	−2.05
Q40	−5.10	6.98	0.50	−1.38	0.04	−3.62
Q41	28.94	4.35	0.82	−0.69	0.21	−1.60
Q42	62.01	3.09	1.07	0.43	0.69	−0.29
Q43	60.07	3.14	1.26	1.42	1.42	0.77
Q44	25.01	4.52	1.81	2.72	0.67	−0.33
Q45	55.98	3.27	0.74	−1.51	0.53	−0.57
Q46	28.94	4.35	0.57	−2.02	0.10	−2.17
Q47	30.80	4.28	0.71	−1.23	0.17	−1.74
Q48	39.27	3.96	0.58	−1.86	0.18	−1.70
Q49	49.07	3.53	1.05	0.32	1.16	0.45
Q50	45.14	3.71	0.77	−0.99	0.24	−1.37
Q51	42.30	3.83	0.60	−1.82	0.31	−1.14
Q52	20.70	4.76	1.95	2.85	0.66	−0.34
Q53	63.88	3.04	1.54	2.76	2.16	1.55
Q54	84.10	2.71	0.88	−0.75	0.70	−0.44
Q55	71.73	2.88	0.57	−3.08	0.26	−1.53
Q56	112.46	2.73	1.10	0.78	3.37	2.90
Q57	58.07	3.20	0.73	−1.63	2.80	1.97
Q58	76.54	2.80	0.67	−2.41	0.30	−1.48
Q59	122.16	3.00	1.36	2.07	8.18	5.46
Q60	108.82	2.68	0.88	−0.91	2.40	2.14
Q61	114.73	2.77	0.82	−1.33	3.72	3.12
Q62	113.97	2.76	0.72	−2.19	3.43	2.90
MMSE	27.01	4.43	0.79	−0.84	0.20	−1.62
SDMT	97.63	2.64	0.79	−1.49	0.41	−1.64
TMT-A	89.88	2.68	0.88	−0.80	0.61	−0.77
TMT-B	111.72	2.72	1.23	1.64	0.62	−0.64
DS Forward	27.01	4.43	1.91	3.03	0.82	−0.06
DS Backward	53.79	3.34	0.89	−0.56	0.37	−0.89
FAB	53.79	3.34	1.58	2.66	1.08	0.36
MARS	−43.03	19.25	0.00	0.00	0.00	0.00

SE, standard error; ZSTD, z standard; MNSQ, mean-square; WHIM, Wessex Head Injury Matrix; MMSE, Mini-TMT, Trail Making Test; DS, Digit Span; FAB, Frontal Assessment Battery; MARS, Moss Attention Rating Scale

The items in the WHIM were in an order similar to that of the original version, suggesting that the WHIM can effectively be used to assess the process of recovery from impaired consciousness in patients who have experienced a stroke. However, examining whether all items are consistent with the recovery process of impaired consciousness in these patients is necessary because items Q1 (i.e., “eyes open briefly”) to Q28 (i.e., “imitates gesture”) were excluded in the present study.

Neuropsychological tests of attentional function were considered in terms of the components of attentional function: sustained, selective, alternating, and divided attention [8]. Sustained and selective attention are lower-order attentional functions [24]. Alternating and divided

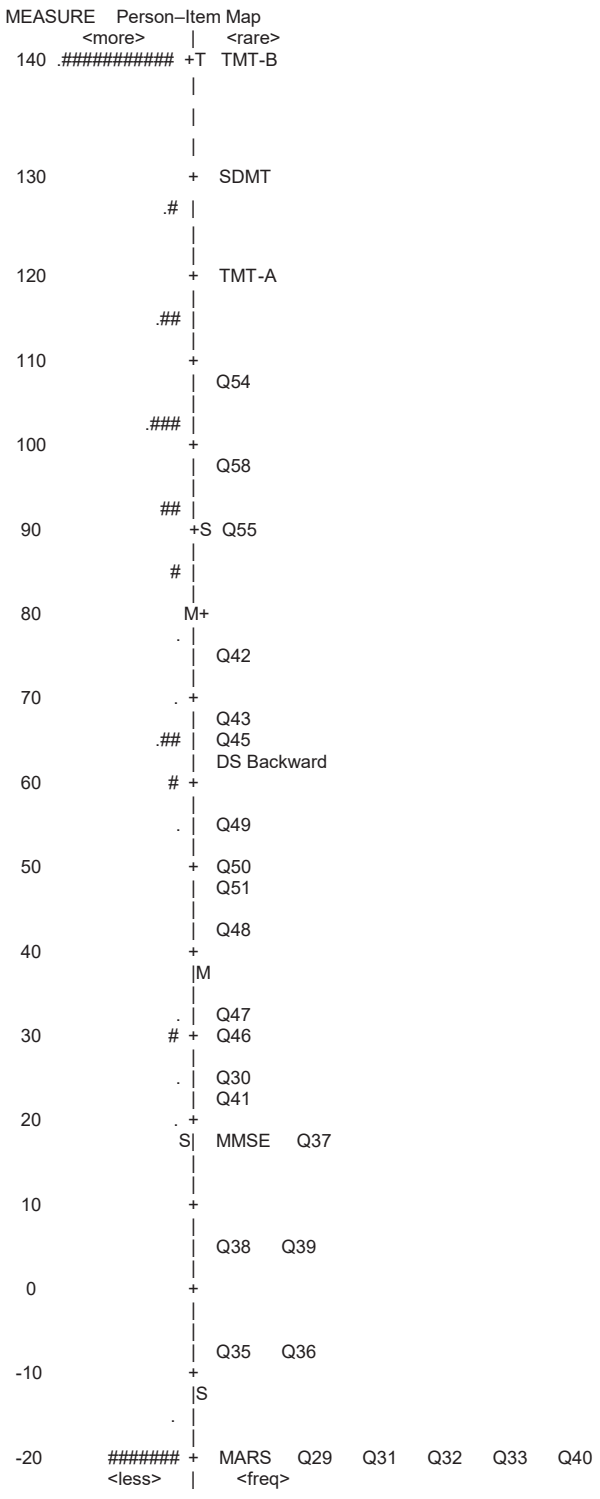

Fig. 1. Person–item map of the WHIM and neuropsychological tests with thresholds. The lower the placement, the lower is the difficulty level. The symbol "X" represents two individuals.

Abbreviations: M, mean; S, one standard deviation (SD) from the mean; T, two SDs from the mean; TMT-B, Trail Making Test-Part B; SDMT, Symbol Digit Modalities Test; TMT-A, Trail Making Test-Part A; DS, digit span; MMSE, Mini-Mental State Examination; MARS, Moss Attention Rating Scale; WHIM, Wessex Head Injury Matrix

attention are higher-order attentional functions, with divided attention being particularly complex [25]. In the person–item map, TMT-B, SDMT, TMT-A, and DS backward (listed in order of decreasing difficulty) were also more difficult and aligned with the components of attentional function. DS backward, which had the lowest difficulty level among the tests, is used to evaluate working memory, which is believed to work under conscious control [26, 27]. Whether DS backward can or cannot be performed may be the dividing line between impaired consciousness and attention deficits. The WHIM items suggest that Q49 (i.e., "1 or 2 orientation items correct [day of week, month, year, age, place]") and Q50 (i.e., "knows the price of three common objects") are the points at which the effect of attention deficits begins to overshadow consciousness disorders. Given the high degree of difficulty of TMT-B and SDMT, these tests were difficult, even for patients with relatively good levels of consciousness. Although no age-related difference existed in the rates in most tests, the rates of the TMT and SDMT were lower in patients in their 80s than in the younger patients. Thus, age should also be taken into account in the selection of tests. Therefore, evaluating them after considering an individual's intelligence, age, and ability to understand instructions is advised.

The MARS, being the least difficult assessment, aside from the WHIM, is a behavioral observational assessment and thus could be administered to all individuals. This finding suggested that the MARS can be conducted, even in individuals with severe impairment of consciousness or significant attention deficits due to stroke [28]. However, consciousness disorders and attention deficits should be differentiated. Therefore, when interpreting the evaluation results, considering the previously mentioned dividing line is necessary.

We discussed DS forward and FAB, which were both judged to be noncompliant, and the MMSE, which was less difficult to perform than was DS backward. DS forward was feasible for some patients because of the influence of perseveration observed in impaired consciousness. FAB and MMSE were also feasible for some patients, even when the patient exhibited some degree of consciousness impairment because verbal stimuli were provided for each question. Hence, the results of DS forward, FAB, and MMSE should be interpreted, based on a patient's level of consciousness.

Person–item map logits ranged from 140 to −20, which may have been because of the more detailed items in the WHIM and the wide range of difficulty of the neuropsychological tests, reflecting the diversity of neuropsychological tests used in clinical practice. To narrow the range of these logits, a more focused approach, such as employing a single neuropsychological

test, may be necessary.

Study limitations

This study has several limitations. First, some items did not fit within the Rasch analysis; therefore, not all neuropsychological tests could be included. Second, many patients with a relatively good level of consciousness were included, resulting in a skewed sample. Third, various neuropsychological tests of attentional function were used, which prevented a singular focus and resulted in extensive logits in the person–item map. Fourth, the strict inclusion criteria prevent the generalizability of the results to patients who present with aphasia. Future studies should expand the inclusion criteria such as aphasia patients and compare their results with those of this study to show reasonable results in terms of evaluation difficulty. Furthermore, conducting studies using only a single neuropsychological test, such as the SDMT, may enable a more detailed examination of its association with impaired consciousness and allow for a more comprehensive interpretation of the results.

CONCLUSIONS

The order of difficulty of the neuropsychological tests (in decreasing order of difficulty) was TMT-B, SDMT, TMT-A, DS backward, MMSE, and MARS. Selecting the appropriate tests and interpreting the results, based on the varying levels of performance observed across different levels of consciousness, is necessary. Some tests may be feasible, even for patients with residually impaired consciousness, whereas other tests may pose challenges, even for individuals with relatively good levels of consciousness.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Data availability

Data cannot be released under the direction of the Ethics Committee.

References

[1] Tsai Y-H, Yuan R, Huang Y-C, Yeh M-Y, Lin C-P, Biswal BB. Disruption of brain connectivity in acute stroke patients with early impairment in consciousness. Front Psychol. 2014; 4: 956.

[2] Li J, Wang D, Tao W, Dong W, Zhang J, Yang J, et al. Early consciousness disorder in acute ischemic stroke: incidence, risk factors and outcome. BMC Neurol. 2016; 16(1): 140.

[3] Stolwyk RJ, Mihaljcic T, Wong DK, Chapman JE, Rogers JM. Poststroke cognitive impairment negatively impacts activity and participation outcomes: a systematic review and meta-analysis. Stroke. 2021; 52(2): 748–60.

[4] Ben-Yishay Y, Daniels-Zide E. Examined lives: outcomes after holistic rehabilitation. Rehabil Psychol. 2000; 45(2): 112–29.

[5] Spaccavento S, Marinelli CV, Nardulli R, Macchitella L, Bivona U, Piccardi L, et al. Attention deficits in stroke patients: the role of lesion characteristics, time from stroke, and concomitant neuropsychological deficits. Behav Neurol. 2019; 2019: 7835710.

[6] Romero-Ayuso D, Castillero-Perea Á, González P, Navarro E, Molina-Massó JP, Funes MJ, et al. Assessment of cognitive instrumental activities of daily living: a systematic review. Disabil Rehabil. 2021; 43(10): 1342–58.

[7] Miyauchi T, Sasaki S, Sasaki Y, Mogamiya T, Tanemura R, Shirahama K. Observational rating scale of attention function is associated with independence in activities of daily living. Asian Journal of Occupational Therapy. 2023; 19(1): 236–42.

[8] Sohlberg MM, Mateer CA. Theory and Remediation of Attention Disorders. In: Sohlberg MM, Mateer CA, editors. Introduction to Cognitive Rehabilitation. New York: The Guilford Press; 1989. 110–35.

[9] Shiel A, Horn SA, Wilson BA, Watson MJ, Campbell MJ, McLellan DL. The Wessex Head Injury Matrix (WHIM) main scale: a preliminary report on a scale to assess and monitor patient recovery after severe head injury. Clin Rehabil. 2000; 14(4): 408-16.

[10] American Congress of Rehabilitation Medicine, Brain Injury-Interdisciplinary Special Interest Group, Disorders of Consciousness Task Force; Seel RT, Sherer M, Whyte J, Katz DI, Giacino JT, et al. Assessment scales for disorders of consciousness: evidence-based recommendations for clinical practice and research. Arch Phys Med Rehabil. 2010; 91(12): 1795–813.

[11] Turner-Stokes L, Bassett P, Rose H, Ashford S, Thu A. Serial measurement of Wessex Head Injury Matrix in the diagnosis of patients in vegetative and minimally conscious states: a cohort analysis. BMJ Open. 2015; 5(4): e006051.

[12] Folstein MF, Folstein SE, McHugh PR. "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975; 12(3): 189–98.
[13] Milner B. Disorders of learning and memory after temporal lobe lesions in man. Clin Neurosurg. 1972; 19: 421–46.
[14] Lezak MD. Neuropsychological Assessment. New York: Oxford University Press, 1995.
[15] Dubois B, Slachevsky A, Litvan I, Pillon B. The FAB: A Frontal Assessment Battery at bedside. Neurology. 2000; 55(11): 1621–6.
[16] Smith A. Symbol Digit Modalities Test. Los Angeles: Western Psychological Services, 1982.
[17] Whyte J, Hart T, Ellis CA, Chervoneva I. The Moss Attention Rating Scale for traumatic brain injury: further explorations of reliability and sensitivity to change. Arch Phys Med Rehabil. 2008; 89(5): 966–73.
[18] Jacob US, Pillay J, Oyefeso EO. Attention span of children with mild intellectual disability: does music therapy and pictorial illustration play any significant role? Front Psychol. 2021; 12: 677703.
[19] Mallinson T, Kozlowski AJ, Johnston MV, Weaver J, Terhorst L, Grampurohit N, et al. Rasch reporting guideline for rehabilitation research (RULER): the RULER statement. Arch Phys Med Rehabil. 2022; 103(7): 1477–86.
[20] Van de Winckel A, Kozlowski AJ, Johnston MV, Weaver J, Grampurohit N, Terhorst L, et al. Reporting guideline for RULER: Rasch reporting guideline for rehabilitation research: explanation and elaboration. Arch Phys Med Rehabil. 2022; 103(7): 1487–98.
[21] Mokkink LB, de Vet HCW, Prinsen CAC, Patrick DL, Alonso J, Bouter LM, et al. COSMIN risk of bias checklist for systematic reviews of patient-reported outcome measures. Qual Life Res. 2018; 27(5): 1171–9.
[22] Linacre JM. A User's Guide to Winsteps Ministep 5.7.1: Rasch Model Computer Programs. Chicago: Winsteps; 2024.
[23] Kondo Y, Bando K, Ariake Y, Katsuta W, Todoroki K, Nishida D, et al. Test-retest reliability and minimal detectable change of the Balance Evaluation Systems Test and its two abbreviated versions in persons with mild to moderate spinocerebellar ataxia: a pilot study. Neuro Rehabilitation. 2020; 47(4): 479–86.
[24] Langner R, Eickhoff SB. Sustaining attention to simple tasks: a meta-analytic review of the neural mechanisms of vigilant attention. Psychol Bull. 2013; 139(4): 870–900.
[25] Sohlberg MM, Mateer CA. Cognitive Rehabilitation: An Integrative Neuropsychological Approach. New York: The Guilford Press, 2001.
[26] Baars BJ, Franklin S. How conscious experience and working memory interact. Trends Cogn Sci. 2003; 7(4): 166–72.
[27] Stein T, Kaiser D, Hesselmann G. Can working memory be non-conscious? Neurosci Conscious. 2016; 2016(1): niv011.
[28] Miyauchi T, Sasaki S, Tanemura R. Behavioral problems and self-feeding independence among patients with acute stroke: a single-center study. Am J Occup Ther. 2024; 78(5): 7805205080.

Long-term Recovery of Mental Health and Social Participation Following Severe COVID-19 with Occupational Therapy: A Case Report

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Abstract: Introduction: This case report aims to elucidate the potential of occupational therapy (OT) for patients with severe COVID-19 by highlighting the prolonged recovery of a survivor, with a focus on mental health and social participation.
Case Presentation and Progress: A man in his 50s with diabetes required prolonged hospitalization and mechanical ventilation for severe COVID-19. OT started early and continued for 9 months. The overall rehabilitation team's goals were to restore independent activities of daily living (ADL) and facilitate social participation. OT progressed from basic to complex tasks, including strength training, cognitive rehabilitation, ADL training, and work simulations. At the initial evaluation, the patient demonstrated severe muscle weakness, cognitive impairment, delirium, and elevated anxiety and depression, significantly reducing quality of life (QOL). Following rehabilitation, muscle strength and cognitive function improved and delirium resolved. QOL gradually improved, reaching pre-hospital levels at 7 months. The patient was able to return to work after 8 months. Mental health also improved, corresponding with enhanced social participation, as indicated by the community integration questionnaire.
Conclusion: This case highlights the importance of early and sustained OT in addressing recovery challenges of severe COVID-19 survivors. OT, including vocational assessment and individualized support, facilitated social participation and improved QOL. Although generalizability is limited, this report underscores the potential of OT in optimizing long-term outcomes for severe COVID-19 survivors.

Keywords: social participation, COVID-19, occupational therapy

(*Asian J Occup Ther* **21**: 125−128, 2025)

Introduction

Severe COVID-19 survivors often experience lasting mental health and social reintegration issues significantly impacting quality of life (QOL). While physical and cognitive impairments in COVID-19 survivors are well-documented [1, 2], the mental and social outcomes are less explored. This report aims to elucidate the potential of occupational therapy (OT) for patients with severe COVID-19 by highlighting the prolonged recovery process of mental health and social participation.

Case presentation

A man in his 50s with diabetes was diagnosed with severe COVID-19 requiring ICU admission and 16 days of intubation. His peak acute physiology and chronic health evaluation II score was 29, complicated by sepsis and hyperglycemia. He was independent and employed in manufacturing before hospitalization.

Initial evaluation

On admission, the patient had good physical function [Medical Research Council Scale Sum Score (MRC-SS): 60; Barthel Index (BI): 100]. Four days later, respiratory decline required mechanical ventilation, leading

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to reduced muscle strength (MRC-SS: 30) and independence (BI: 20). Cognitive evaluation showed impaired global cognition [Mini-Mental State Examination-Japanese version (MMSE-J): 20], attention and executive function [Trail Making Test-Japanese version (TMT-J): A: 61 s, B: 97 s, average standard deviation A: 33.7 ± 6.2 s, B: 60.4 ± 14.0 s [3]]. Delirium was positive on the Confusion Assessment Method for the Intensive Care Unit. Mental health assessments revealed moderate depression [Hospital Anxiety and Depression Scale (HADS): 11] and anxiety (HADS: 15), with severely compromised QOL [EuroQol 5 Dimensions 5 Levels (EQ-5D-5L): 0.17].

Overall treatment strategy by the rehabilitation team

The rehabilitation team aimed to restore independent ADL and facilitate social participation. OT and physical therapy (PT) began on day 4 post-onset, continuing for 9 months with inpatient sessions (5 days/week, 20–40 min) and monthly outpatient care. PT targeted strength, balance, and gait to improve physical capacity for ADL and return to work.

OT intervention strategy

OT targeted social participation recovery across three phases.

Phase 1: Inpatient isolation period (admission to 34 days)

OT prioritized basic ADL and cognitive orientation, including active range of motion exercises, resistance training (upper extremities), sitting and standing exercises, cognitive tasks (orientation, calculation, and word fluency), and ADL training (eating, grooming).

Phase 2: Inpatient period after isolation (35 days to 4.5 months)

OT focused on complex cognitive and work-simulated tasks to enhance independence and facilitate return to work. Pre-hospital HADS, EQ-5D-5L, and community integration questionnaire (CIQ) were retrospectively obtained once the MMSE-J reached 26. A vocational assessment, combining interviews and tests, identified return-to-work barriers. Specific goals were set, including performing high-dexterity manufacturing tasks and transporting products. Training encompassed fine motor, physical (aerobic/resistance), and advanced cognitive exercises (word fluency/visual cancellation) to improve work capacity.

Phase 3: Outpatient period following discharge (4.5–9 months)

OT focused on facilitating social participation. Based on pre-hospital CIQ, goals were set: shopping at least 5 times monthly, and performing high-dexterity manufacturing tasks and product transport at pre-hospital speeds. The patient continued guided home exercises (resistance, aerobic, work simulation) for 9 months.

Progress and re-evaluation

Patient recovery varied across physical and cognitive functions, mental health, QOL, and social participation (Fig. 1).

Phase 1: Inpatient isolation period (admission to 34 days)

Muscle strength increased (MRC-SS: 36), but ADL remained dependent (BI: 50). Delirium improved and MMSE-J increased to 24 upon isolation discharge, with normalized attention and executive function (TMT-J: A: 36 s, B: 61 s). Both mental health and QOL remained low (HADS depression: 9; anxiety: 12; EQ-5D-5L: 0.17).

Phase 2: Inpatient period after isolation (35 days to 4.5 months)

Muscle strength increased (MRC-SS: 60), and BI reached 100 at discharge. MMSE-J reached 28, attention and executive function improved (TMT-J: A: 26 s, B: 41 s). HADS (depression: 7; anxiety: 6) and QOL improved (EQ-5D-5L: 0.70). Vocational assessment revealed that upper limbs tremors and products transport difficulty as barriers to returning to work.

Phase 3: Outpatient period following discharge (4.5 to 9 months)

Physical function remained stable (MRC-SS: 60; 6-minute walk distance: 360 m). Cognitive function normalized (MMSE-J: 30) by 6 months. QOL returned to pre-hospital levels by 7 months. The patient successfully returned to work at 8 months. Mental health improved, with HADS normalizing by 9 months, though anxiety briefly worsened post-discharge. Social participation increased significantly (CIQ: 9 and 23 at 6 and 9 months, respectively), associated with increased activity engagement.

Discussion

This study investigated prolonged OT for a patient with severe COVID-19 who experienced persistent mental health issues and reduced social participation.

Severe muscle weakness likely stemmed from ICU-

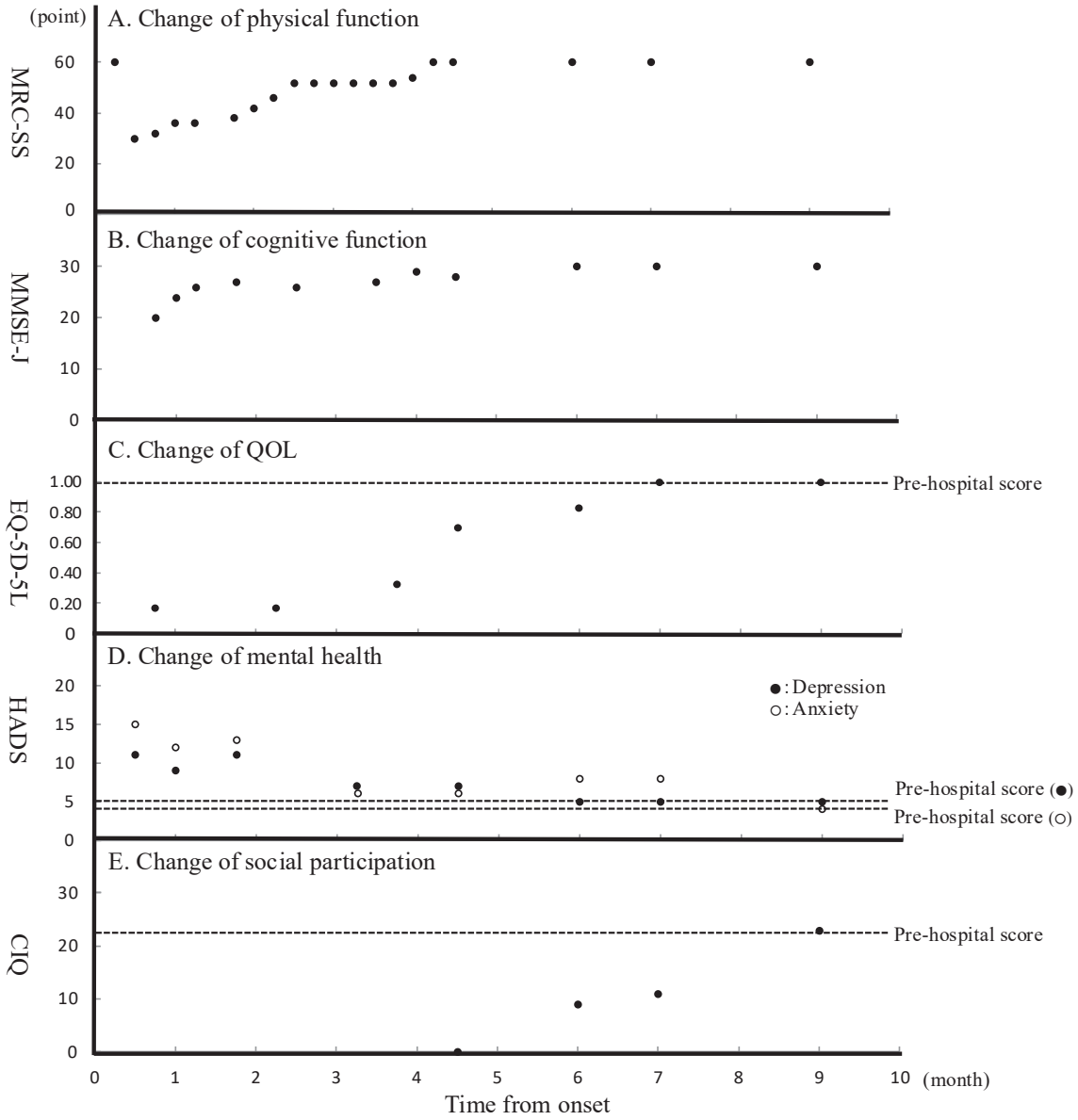

Fig. 1. Longitudinal changes in physical and cognitive function, mental status, and social participation.
Change in MRC-SS (A.), MMSE-J (B.), HADS (C.), EQ5D5L (D.), and CIQ (E.). The line shows the pre-hospital score.
MRC-SS: Medical Research Council Scale Sum Score, MMSE-J: Mini-Mental State Examination-Japanese version, HADS: Hospital Anxiety and Depression Scale, EQ-5D-5L: EuroQol 5 Dimensions 5 Levels, CIQ: community integration questionnaire

acquired weakness (ICU-AW) [4]. Prolonged intubation, sepsis, and hyperglycemia are ICU-AW risk factors [5, 6], contributing to this patient's condition along with restricted activity during isolation. Improved MRC-SS suggests upper limb-focused OT during isolation may contribute to this improvement.

Cognitive recovery took 6 months. Preventing acute-phase functional decline is crucial to minimize long-term cognitive issues.

Persistent anxiety and depression were observed, consistent with previous studies [7]. While the 6-month post-COVID-19 return-to-work rate is 73% [8], this patient returned after 8 months. Notably, QOL and anxiety improved as social re-engagement progressed, suggesting the importance of social reintegration in enhancing mental health and QOL for patients with COVID-19.

OT roles include clinical assessments, interventions, and work preparation in COVID-19 return-to-work initiatives [9]. Effective OT for return to work involves vocational assessment, goal setting, and self-management, with early intervention support being key [10]. Consistent with previous research, early vocational assessment and goal setting in this case facilitated return to work, underscoring the potential of early and sustained OT in optimizing long-term outcomes for severe COVID-19 survivors.

This report has limitations, including potential for recall bias from retrospective data collection (HADS, EQ-5D-5L, and CIQ) after MMSE-J recovery, healthcare provider-led goal setting, and a lack of self-management strategies. Larger studies and tailored OT are needed to investigate the long-term effectiveness of OT for severe COVID-19.

Ethical statement

Written informed consent was obtained. All procedures followed the ethical standards of the institutional research committee and the Declaration of Helsinki.

Conflict of Interest

The authors declare no conflicts of interest.

Funding Statement

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References

[1] Belli S, Balbi B, Prince I, Cattaneo D, Masocco F, Zaccaria S, et al. Low physical functioning and impaired performance of activities of daily life in COVID-19 patients who survived hospitalisation. Eur Respir J. 2020; 56(4): 2002096.

[2] Becker JH, Lin JJ, Doernberg M, Stone K, Navis A, Festa JR, et al. Assessment of cognitive function in patients after COVID-19 infection. JAMA Netw Open. 2021; 4(10): e2130645.

[3] Brain Function Test Committee, Japan Society for Higher Brain Dysfunction. Trail Making Test, Japanese edition (TMT-J). Tokyo: Shinkoh-Igaku Shuppan Co., Ltd.; 2019.

[4] Rahiminezhad E, Zakeri MA, Dehghan M. Muscle strength/intensive care unit acquired weakness in COVID-19 and non-COVID-19 patients. Nurs Crit Care. 2023; 28(6): 1012–21.

[5] Hermans G, Van den Berghe G. Clinical review: intensive care unit acquired weakness. Crit Care. 2015; 19(1): 274.

[6] Yang T, Li Z, Jiang L, Wang Y, Xi X. Risk factors for intensive care unit-acquired weakness: a systematic review and meta-analysis. Acta Neurol Scand. 2018; 138(2): 104–14.

[7] Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, et al. The prevalence of depression, anxiety, and sleep disturbances in COVID-19 patients: a meta-analysis. Ann N Y Acad Sci. 2021; 1486(1): 90–111.

[8] Carenzo L, Dalla Corte F, Haines RW, Palandri C, Milani A, Aghemo A, et al. Return to work after coronavirus disease 2019 acute respiratory distress syndrome and intensive care admission: prospective, case series at 6 months from hospital discharge. Crit Care Med. 2021; 49(11): e1157–62.

[9] Sy MP, Frey S, Baldissera A, Pineda RC, Toribio FNRB. The role of occupational therapists in return-to-work practice for people with post-COVID condition: a scoping review. Work. 2025; 80(2): 498–513.

[10] De Dios Perez B, McQueen J, Craven K, Radford K, Blake H, Smith B, et al. The effectiveness of occupational therapy supporting return to work for people who sustain serious injuries or develop long-term (physical or mental) health conditions: a systematic review. Br J Occup Ther. 2023; 86(7): 467–81.

■ORIGINAL ARTICLE

Effect of the Timing of Occupational Therapy Initiation During the Acute Phase of Stroke on Recovery: A Retrospective Study with Propensity Score Matching

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Abstract: Objective: This study investigated the effect of the timing of occupational therapy initiation during the acute phase of stroke on patient recovery.
Methods: This retrospective study with a 2-week observation period included 216 patients who experienced stroke and underwent rehabilitation during hospitalization at our institution. Patients were classified as the early group (began occupational therapy 1 day after stroke onset) or the late group (began therapy 2 days or later after stroke onset). This classification was based on the limited number of occupational therapists at our institution, where therapy is initiated 1 day after stroke onset if that day is a weekday (Monday through Friday); however, therapy for new patients is suspended on weekends (Saturday and Sunday) and holidays. As a result, the classification of patients into early and late groups was influenced by the patients' admission dates, resulting in some degree of randomization. Baseline characteristics were balanced using propensity score matching, and outcomes were compared at 2 weeks using the Mann-Whitney U test. The primary outcome was the change in the activities of daily living (ADLs) performance. The secondary outcome was the ADLs performance at 2 weeks.
Results: The early group exhibited a significantly greater change in the ADLs performance compared to that of the late group ($p = 0.036$). Additionally, compared to the late group, the early group exhibited significantly better ADLs performance at 2 weeks ($p = 0.049$).
Conclusion: Earlier initiation of occupational therapy during the acute phase of stroke may positively influence patient recovery.

Keywords: activities of daily living, acute phase, occupational therapy, stroke, timing

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Introduction

Stroke is the second leading cause of death worldwide; furthermore, according to the disability-adjusted life years, which include both the degree and duration of disability, stroke is the third leading cause of disability globally [1]. Many stroke treatment guidelines recommend initiating active rehabilitation for patients who have experienced acute stroke as early as possible after stroke onset [2–4]. However, the AVERT study phase 3 trial suggested that starting rehabilitation within 24 hours (early mobilization) rather than within 48 hours was associated with worse modified Rankin scale outcomes [5]. As a result, rehabilitation is recommended to begin within 24 to 48 hours after stroke onset.

Among rehabilitation therapies, occupational therapy aims to help individuals perform activities of daily living (ADLs) [6], whereas physical therapy focuses on developing, maintaining, and restoring maximum movement and functional capacity [7]. Because occupational therapy and physical therapy are associated with different objectives and services, their effects may differ depending on the timing of their initiation; therefore, it is important to separately investigate the effects of timing on each type of therapy.

Previous studies of physical therapy during the acute phase of stroke have compared the effects of

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interventions on one group of patients who began mobilization within 24 hours and another group of patients who began mobilization later and found that mobilization within 24 hours was associated with poor outcomes [8], thus suggesting that early mobilization may have adverse effects. In contrast, studies that have examined early occupational therapy have suggested its usefulness when initiated in the acute phase of stroke. One study reported that patients who received intensive upper limb training within one week of cerebral infarction onset showed greater activation in the anterior cingulate cortex and the ipsilateral supplementary motor area compared with those who received standard rehabilitation [9]. Another study found that a 3-week course of modified constraint-induced movement therapy initiated within 14 days after stroke onset resulted in better upper limb functional recovery than usual care [10].

However, in those studies, the experimental and control groups started occupational therapy simultaneously, and no study has directly compared specific timeframes for the initiation of occupational therapy to determine the most effective timing.

Clarifying the ideal timing of occupational therapy initiation during the acute phase of stroke is essential not only for improving clinical decision-making but also for ensuring that rehabilitation interventions are delivered at the most therapeutically beneficial period. Determining the optimal window for initiating occupational therapy may help clinicians balance the risks and benefits of early mobilization, tailor interventions to individual patient conditions, and allocate rehabilitation resources more efficiently. Ultimately, such insights can contribute to maximizing functional recovery, shortening hospital stays, and improving long-term outcomes in patients with acute stroke.

In Japan, cerebral infarction comprises 72% of all stroke cases [11]. Because of the relatively relaxed blood pressure management criteria for stroke [12] compared with the criteria for cerebral hemorrhage and subarachnoid hemorrhage, it is easier to implement rehabilitation during the acute phase of stroke. Therefore, this study focused on patients who experienced cerebral infarction and examined the effects of the timing of occupational therapy during the acute phase.

Methods

Study Design and Ethical Considerations

This retrospective cohort study included an observation period of 14 days (2 weeks) that started 1 day after stroke onset. The average length of stay at our hospital was considered when determining this observation period. Informed consent was obtained using an opt-out method. This study was approved by the Ethics Committee of our hospital (approval number: 202412-2; approval date: June 28, 2024). All procedures were conducted in accordance with the ethical standards of the Declaration of Helsinki.

Participants

Patients who experienced cerebral infarction, were hospitalized, and underwent rehabilitation at our hospital were included in this study. The exclusion criteria were as follows: patients who were discharged before the completion of the 2-week observation period; patients who could not begin rehabilitation as planned because of worsening symptoms; and patients who were unable to undergo magnetic resonance imaging examinations.

Survey Items

Baseline characteristics, rehabilitation status, and outcomes were collected from the medical records. The following baseline characteristics were investigated: age, sex, the presence of bilateral lesions, right-sided lesions, left-sided lesions, and thrombectomy, volume of the responsible lesion at admission, medical history, and comorbidities. The volume of the responsible lesion at admission was measured using Ziostation 2 (Amin Inc., Tokyo). Ziostation 2 is a workstation capable of processing images obtained with computed tomography and magnetic resonance imaging in three dimensions, extracting lesion areas from the images, and calculating the volume of the extracted areas.

The medical history included the presence of stroke and dementia, and comorbidities included the presence of cerebral edema and delirium until the day after stroke onset. Occupational therapists assessed the presence of delirium during hospitalization using the Japanese version of the Intensive Care Delirium Screening Checklist [13], which is a tool that allows the retrospective evaluation of recorded data. The Intensive Care Delirium Screening Checklist is a widely used international scale used to assess delirium and evaluate eight symptoms commonly associated with delirium, such as changes in the consciousness level and attention deficits. Each symptom received a score of 1 point, and the total score ranged from 0 to 8 points. A score of 4 or more points was considered indicative of delirium.

The rehabilitation status was assessed in terms of time to rehabilitation initiation, duration of rehabilitation, and rehabilitation content. Time to rehabilitation initiation was measured as the time from hospital admission to the start of occupational therapy and physical therapy. Rehabilitation duration was separately measured as the daily time (in minutes) performing occupational therapy and the daily time (in minutes) performing

physical therapy. The rehabilitation content included the presence or absence of functional training, basic movement exercises, ADLs training, and instrumental ADLs training during both occupational therapy and physical therapy. The number of days between stroke onset and the initiation of these therapies was also considered. We also collected data regarding the presence or absence of speech-language therapy, the time from hospital admission to the start of speech-language therapy, and the daily duration (in minutes) of speech-language therapy for patients. Although it was difficult to retrospectively collect detailed information regarding the specific content of functional training, basic movement training, and ADLs training in occupational and physical therapy, general trends in our hospital suggest that occupational therapy primarily focuses on upper limb functional training, bed mobility training within basic movements, and ADLs training excluding walking. In contrast, physical therapy tends to focus on lower limb functional training, standing and sit-to-stand training within basic movements, and walking training as part of ADLs.

The primary outcome was the change in the performance of ADLs from the start of rehabilitation to 2 weeks later. Secondary outcomes included changes in stroke severity, changes in the level of consciousness, ability to perform ADLs, stroke severity, level of consciousness at 2 weeks, destination after discharge from the acute care hospital, and any worsening events during the 2-week observation period. Worsening events, such as infarct expansion or hemorrhagic infarction, were also assessed during the observation period. The performance of ADLs at the start of rehabilitation and that at 2 weeks were assessed by occupational therapists or physical therapists using the Barthel Index (BI) [14]. To ensure consistency in the timing of assessments between the two groups, the BI score at the start of rehabilitation was determined based on evaluations conducted by occupational or physical therapists on the day following stroke onset in the early group, and on the same day of therapy initiation (also the day following stroke onset) by physical therapists in the late group. Occupational therapists assessed stroke severity using the National Institutes of Health Stroke Scale [15]. Occupational or physical therapists assessed the level of consciousness using the Japan Coma Scale [16].

Group Classification and Statistical Analysis

To examine the effect of the timing of occupational therapy, we first classified the participants into the following two groups based on the time from stroke onset to the start of occupational therapy: the early group comprised patients who started therapy 1 day after stroke onset and the late group comprised patients who started therapy 2 days or later after stroke onset. This classification was influenced by the limited number of physical therapists, occupational therapists, and speech therapists at our institution. Physical therapy was initiated 1 day after stroke onset, regardless of whether it was a weekday, weekend, or holiday, and speech therapy was initiated as needed. Occupational therapy was initiated 1 day after stroke onset if that day was a weekday (Monday through Friday); however, if that day was a weekend (Saturday or Sunday) or holiday, then occupation therapy was delayed for new patients because of staffing issues at our institution. For example, if a patient experienced stroke on Friday or Saturday and was admitted to our hospital, then physical therapy was started on the following Saturday or Sunday, respectively, but occupational therapy was started on the following Monday. As a result, we classified the patients into the early and late groups, resulting in some degree of randomization. Consecutive data of both groups were collected, and care and treatment in the wards were the same for both groups.

A statistical analysis was performed to compare the two groups before and after propensity score matching to adjust for baseline characteristics and create patient groups similar to those of a randomized controlled trial. The propensity score was calculated using a logistic regression analysis, in which all collected baseline characteristics—selected in advance based on their presumed relevance to the outcomes or timing of occupational therapy initiation—were included as independent variables, and the two groups based on the timing of occupational therapy initiation were used as the dependent variable. Receiver-operating characteristic curves were used to evaluate the discriminative power of the logistic regression model, and C-statistics were calculated. To adjust for covariates and estimate causal effects, we performed one-to-one matching using the nearest-neighbor matching method with nonreplacement sampling. The caliper was set at 0.2, and the balance between groups was evaluated using standardized scores.

Baseline characteristics and outcomes were compared between groups before and after matching. For categorical variables, the chi-square test or Fisher's exact test was performed; however, for continuous variables, the Shapiro-Wilk test was performed to confirm normality before applying the t test or Mann-Whitney U test. EZR version 1.61 was used for these tests [17], and the significance level was set at 5%.

The sample size was determined using G-Power [18, 19]. Because the initiation of rehabilitation for the early group was only 1 to 2 days earlier than that for the late group, and because the effect was expected to be small, we assumed an effect size of $r = 0.2$ and calcu-

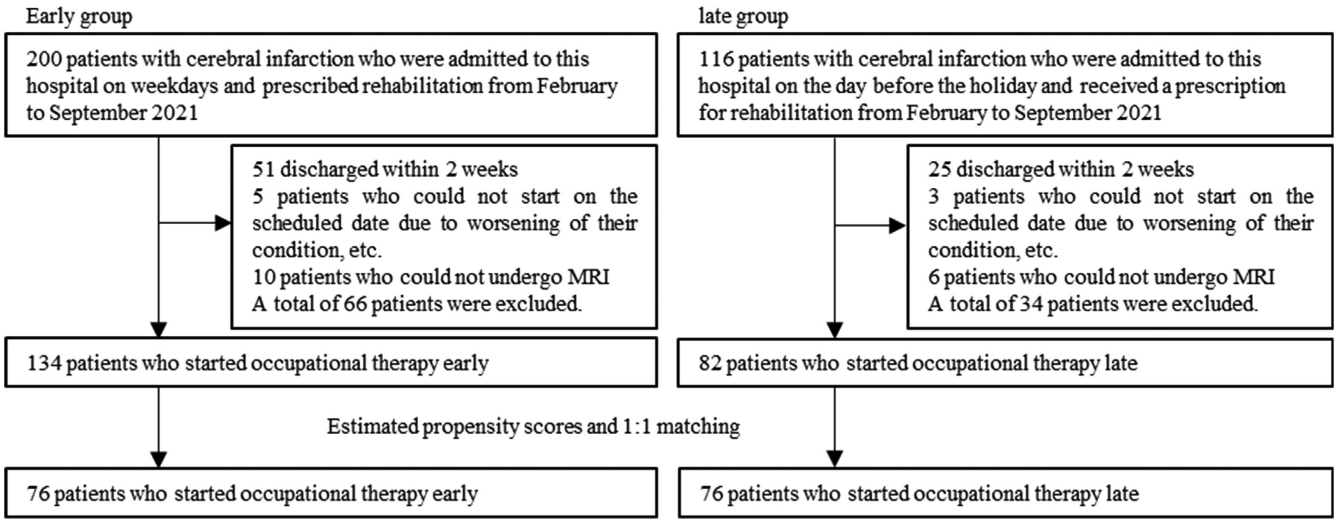

Fig. 1. Patient Inclusion Flowchart
This flowchart depicts the patient inclusion process. A total of 316 patients were initially screened for eligibility. After applying inclusion/exclusion criteria, 134 patients were allocated to the early group and 82 patients to the late group. 76 patients from each group were selected after propensity score matching for the final analysis.
Abbreviations: MRI, Magnetic Resonance

lated the sample size using an α error of 0.05 and power of $1 - \beta = 0.8$. As a result, 82 participants in each group were needed. Although the sample size after matching was uncertain because of propensity score matching, the sample size of the late group was expected to be approximately one-third that of the early group because of the number of weekends and holidays. Therefore, we decided to include at least 82 participants in the late group.

Results

Eligible patients

Figure 1 shows the patient inclusion flowchart. Of the 316 consecutive patients who were admitted to the hospital and underwent rehabilitation between February and September 2021, 134 in the early group and 82 in the late group met the inclusion criteria. Subsequently, 76 patients from each group were selected using propensity score matching.

The C-statistic calculated based on the receiver-operating characteristic analysis was 0.608 (95% confidence interval: 0.529–0.686), indicating that it was within an appropriate range.

Table 1 shows the baseline characteristics of the early and late groups before and after propensity score matching. In propensity score matching, the balance of baseline characteristics in each group is typically assessed using standardized differences, which are independent of the sample size, rather than p-values, which are dependent on the sample size. After matching, the standardized differences of most items were less than 0.1, confirming that balance was achieved.

Table 2 shows the rehabilitation status of the early group and that of the late group before and after propensity score matching. After matching, compared to the late group, the early group started occupational therapy earlier ($p < 0.001$), started functional training earlier ($p < 0.001$), and started basic movement exercises earlier ($p < 0.001$). Additionally, after matching, no significant differences in the time to initiation, duration, and content of physical therapy were observed between the early and late groups. Similarly, no significant differences in terms of the presence or absence of speech-language therapy, time to therapy initiation, and duration of therapy after matching were observed between the early and late groups.

Table 3 compares the outcomes of the early and late groups before and after propensity score matching. After matching, the early group had a greater change in the BI than that of the late group ($p = 0.036$). Additionally, the early group had a better BI at 2 weeks than that of the late group ($p = 0.049$). No significant differences in other outcomes were observed between the early and late groups after matching.

Discussion

This study is, to our knowledge, the first to directly compare the effects of different initiation timeframes of occupational therapy during the acute phase of stroke, focusing on specific, narrowly defined time windows.

Table 1 Comparison of baseline characteristics between the early and late groups before and after propensity score matching

before matching			Early group (n = 134)	late group (n = 82)	p value	SMD
Background						
	Age (year)[a]		80 [74–87]	82 [74–87]	0.622	0.061
	Sex[b]	Male : Female	75 (56.0) : 59 (44.0)	39 (47.6) : 43 (52.4)	0.262	0.169
	Bilateral lesion[b]	Yes : No	19 (14.2) : 115 (85.8)	16 (19.5) : 66 (80.5)	0.343	0.143
	Right-sided lesion[b]	Yes : No	55 (41.0) : 79 (59.0)	32 (39.0) : 50 (61.0)	0.777	0.041
	Left-sided lesion[b]	Yes : No	60 (44.8) : 74 (55.2)	34 (41.5) : 48 (58.5)	0.673	0.067
	Volume of responsible lesion (ml)[a]		5.6 [1.9–25.6]	5.7 [2–30.1]	0.636	0.076
	Thrombectomy[b]	Yes : No	15 (11.2) : 119 (88.8)	13 (15.9) : 69 (84.1)	0.404	0.137
Medical history						
	Stroke[b]	Yes : No	43 (32.1) : 91 (67.9)	23 (28.0) : 59 (72.0)	0.547	0.088
	Dementia[b]	Yes : No	20 (14.9) : 114 (85.1)	9 (11.0) : 73 (89.0)	0.538	0.118
Complication						
	Delirium[a]	Yes : No	15 (11.2) : 119 (88.8)	11 (13.4) : 71 (86.6)	0.669	0.068
	Cerebral edema[b]	Yes : No	33 (24.6) : 101 (75.4)	24 (29.3) : 58 (70.7)	0.525	0.105
Evaluate Results						
	BI at the start of rehabilitation[a]		10 [0–50]	5 [0–50]	0.888	0.021
	NIHSS at the start of rehabilitation[a]		6 [3–16.8]	7.5 [3–18]	0.553	0.087
	JCS at the start of rehabilitation[a]		2 [1–4]	2 [1–4]	0.779	0.077
after matching			(n = 76)	(n = 76)		
Background						
	Age (year)[a]		80 [74–86]	82 [73.8–87]	0.536	0.071
	Sex[b]	Male : Female	37 (48.7) : 39 (51.3)	36 (47.4) : 40 (52.6)	1	0.026
	Bilateral lesion[b]	Yes : No	13 (17.1) : 63 (82.9)	14 (18.4) : 62 (81.6)	1	0.034
	Right-sided lesion[b]	Yes : No	31 (40.8) : 45 (59.2)	30 (39.5) : 46 (60.5)	1	0.027
	Left-sided lesion[b]	Yes : No	32 (42.1) : 44 (57.9)	32 (42.1) : 44 (57.9)	1	< 0.001
	Volume of responsible lesion (ml)[a]		5.0 [1.9–25.5]	5.7 [2–30.0]	0.525	0.083
	Thrombectomy[b]	Yes : No	11 (14.5) : 65 (85.5)	11 (14.5) : 65 (85.5)	1	< 0.001
Medical history						
	Stroke[b]	Yes : No	25 (32.9) : 51 (67.1)	22 (28.9) : 54 (71.1)	0.726	0.085
	Dementia[b]	Yes : No	7 (9.2) : 69 (90.8)	9 (11.8) : 67 (88.2)	0.792	0.086
Complication						
	Delirium[a]	Yes : No	11 (14.5) : 65 (85.5)	10 (13.2) : 66 (86.8)	1	0.038
	Cerebral edema[b]	Yes : No	20 (26.3) : 56 (73.7)	22 (28.9) : 54 (71.1)	0.856	0.059
Evaluate Results						
	BI at the start of rehabilitation[a]		25 [0–51.3]	12.5 [0–50]	0.519	0.097
	NIHSS at the start of rehabilitation[a]		6 [3–14.3]	7 [3–18]	0.331	0.181
	JCS at the start of rehabilitation[a]		2 [1–4]	2 [1–4]	0.879	0.087

This table shows the comparison of baseline characteristics between the early and late groups before and after propensity score matching. The upper section shows the results before matching, and the lower section shows the results after matching.
a: Median [Interquartile Range], b: Number (%), c: Mean (Standard Deviation).
Abbreviations: BI, Barthel Index; NIHSS, National Institutes of Health Stroke Scale; JCS, Japan Coma Scale.

Although previous studies have explored the general benefits of early rehabilitation, none have specifically examined the comparative impact of initiating occupational therapy on the day following stroke onset versus later initiation. By addressing this gap, the present study provides a novel and clinically relevant perspective on a topic that has remained underexplored despite its practical importance in acute stroke care. Given the increasing emphasis on optimizing early-phase interventions to improve recovery trajectories, our findings offer valuable evidence to support the time-sensitive implementation of occupational therapy in the acute setting.

In this study, patients were divided into two groups based on whether occupational therapy was initiated on the day after stroke onset (early group) or on or after the second day (late group), and their outcomes were compared over a 2-week period. The early group demonstrated significantly greater improvements in Barthel Index (BI) scores, both in terms of change and absolute values at two weeks, indicating the potential advantages of prompt occupational therapy initiation. These results highlight the critical role that the timing of intervention

Table 2 Comparison of rehabilitation status between the early and late groups before and after propensity score matching

before matching		Early group (n = 134)	late group (n = 82)	p value	SMD
OT implementation status					
Time to start OT (hours)[a]		23 [19.5–27]	67.1 [47–74.8]	< 0.001	3.032
OT time per day (minutes)[c]		30.1 (8.8)	31.8 (12.2)	0.283	0.160
Functional training[b]	Yes : No	132 (98.5) : 2 (1.5)	81 (98.8) : 1 (1.2)	1	0.024
Days until the start of functional training (days)[a]		2 [2–2]	4 [3–4]	< 0.001	1.382
Basic movement exercises[b]	Yes : No	110 (82.1) : 24 (17.9)	58 (70.7) : 24 (29.3)	0.064	0.270
Days until the start of basic movement exercises (days)[a]		2 [2–3]	4 [3–5]	< 0.001	0.658
ADL practice[b]	Yes : No	61 (45.5) : 73 (54.5)	37 (45.1) : 45 (54.9)	1	0.008
Days until the start of ADL practice (days)[a]		5 [3–7]	5 [4–7.3]	0.314	0.213
IADL practice[b]	Yes : No	9 (6.7) : 125 (99.3)	11 (13.4) : 71 (86.6)	0.145	0.224
Days until the start of IADL practice (days)[a]		9 [8–11]	10 [6.3–10.8]	0.934	0.215
PT implementation status					
Time to start PT (hours)[a]		24 [20.6–27.7]	23 [19.1–27.5]	0.313	0.112
PT time per day (minutes)[c]		26.8 (6.9)	27.1 (8.6)	0.820	0.034
Functional training[b]	Yes : No	133 (99.3) : 1 (0.7)	81 (100) : 0 (0)	1	0.123
Days until the start of functional training (days)[a]		2 [1–2]	2 [1–2]	0.570	0.108
Basic movement exercises[b]	Yes : No	105 (78.4) : 29 (21.6)	65 (79.3) : 17 (20.7)	1	0.022
Days until the start of basic movement exercises (days)[a]		2 [2–3.3]	2 [2–4]	0.945	0.041
ADL practice[b]	Yes : No	44 (32.8) : 90 (67.2)	23 (28.0) : 59 (72.0)	0.545	0.104
Days until the start of ADL practice (days)[a]		6.5 [3.8–8.3]	5.5 [3.0–10.8]	0.799	0.093
IADL practice[b]	Yes : No	0 (0) : 134 (100)	0 (0) : 82 (100)		< 0.001
ST implementation status					
ST implementation	Yes : No	79 (59) : 55 (41)	50 (61.0) : 32 (39.0)	0.777	0.041
Time to start ST (hours)[a]		72 [48.1–144]	96 [71–120.2]	0.157	0.157
ST time per day (minutes)[c]		24.4 (29.1)	25.5 (26.9)	0.793	0.037
after matching		(n = 76)	(n = 76)		
OT implementation status					
Time to start OT (hours)[a]		23.9 [19.9–27.5]	67.1 [47.3–74.6]	< 0.001	2.946
OT time per day (minutes)[c]		31.8 (8.9)	32.1 (12.2)	0.853	0.030
Functional practice[b]	Yes : No	75 (98.7) : 1 (1.3)	75 (98.7) : 1 (1.3)	1	< 0.001
Days until the start of functional practice (days)[a]		2 [2–2]	4 [3–4]	< 0.001	1.558
Basic movement exercises[b]	Yes : No	61 (80.3) : 15 (19.7)	52 (68.4) : 24 (31.6)	0.137	0.274
Days until the start of basic movement exercises (days)[a]		2 [2–3]	4 [3–5.3]	< 0.001	0.735
ADL practice[b]	Yes : No	42 (55.3) : 34 (44.7)	35 (46.1) : 41 (53.9)	0.330	0.185
Days until the start of ADL practice (days)[a]		5 [3–7.5]	5 [4–7.3]	0.431	0.219
IADL practice[b]	Yes : No	5 (6.6) : 71 (93.4)	10 (13.2) : 66 (86.8)	0.276	0.222
Days until the start of IADL practice (days)[a]		9 [9–11]	10 [6.3–10.8]	0.536	0.734
PT implementation status					
Time to start PT (hours)[a]		24 [21–28]	23 [19.1–27.4]	0.213	0.266
PT time per day (minutes)[c]		26.8 (6.9)	27.1 (8.6)	0.820	0.034
Functional training[b]	Yes : No	75 (98.7) : 1 (1.3)	76 (100) : 0 (0)	1	0.163
Days until the start of functional training (days)[a]		2 [1.5–2]	2 [1–2]	0.434	0.069
Basic movement exercises[b]	Yes : No	58 (76.3) : 18 (23.7)	61 (80.3) : 15 (19.7)	0.694	0.096
Days until the start of basic movement exercises (days)[a]		2 [2–3]	2 [2–4]	0.915	0.020
ADL practice[b]	Yes : No	27 (35.5) : 49 (64.5)	22 (28.9) : 54 (71.1)	0.488	0.141
Days until the start of ADL practice (days)[a]		6.5 [3.8–8.3]	5.5 [3.0–10.8]	0.799	0.093
IADL practice[b]	Yes : No	0 (0) : 76 (100)	0 (0) : 76 (100)		< 0.001
ST implementation status					
ST implementation	Yes : No	43 (56.6) : 33 (43.4)	46 (60.5) : 30 (39.5)	0.742	0.080
Time to start ST (hours)[a]		72 [48–144]	95 [72–120.1]	0.396	0.056
ST time per day (minutes)[c]		25 (32.5)	25.4 (27.2)	0.933	0.014

This table shows the comparison of rehabilitation status between the early and late groups before and after propensity score matching. The upper section shows the results before matching, and the lower section shows the results after matching.
Abbreviations: OT, Occupational Therapy; PT, Physical Therapy; ST, Speech-Language Therapy; ADL, Activities of Daily Living; IADL, Instrumental Activities of Daily Living.

Table 3 Comparison of outcomes between the early and late groups before and after propensity score matching

before matching		Early group (n = 134)	Delayed group (n = 82)	p-values	effect size
BI change[a]		20 [1–40]	15 [0–35]	0.222	r = 0.087
NIHSS change[a]		−1 [−3–0]	−1 [−3–0]	0.227	r = 0.107
JCS improvement[a]	Yes : No	74 (55.2) : 60 (44.8)	46 (56.1) : 36 (43.9)	0.900	φ = 0.009
BI after 2 weeks		55 [1.3–83.8]	52.5 [0–80]	0.345	r = 0.053
NIHSS after 2 weeks		5 [2–11.8]	5.5 [2–17.0]	0.214	r = 0.095
JCS after 2 weeks		2 [1–3]	2 [1–4]	0.583	r = 0.049
Destination of discharge[b]	Home : Other than home	36 (26.9) : 98 (73.1)	21 (25.6) : 61 (74.4)	0.839	φ = 0.014
Worsening events[b]	Yes : No	22 (16.4) : 112 (83.6)	19 (23.2) : 63 (76.8)	0.219	φ = 0.084
after matching		(n = 76)	(n = 76)		
BI change[a]		30 [10–46.3]	15 [0–35]	0.036	r = 0.167
NIHSS change[a]		−1.5 [−3.3–0]	−1 [−3–0]	0.127	r = 0.149
JCS improvement[a]	Yes : No	43 (56.6) : 33 (43.4)	42 (55.3) : 34 (44.7)	0.870	φ = 0.013
BI after 2 weeks		65 [38.8–91.3]	55 [0–80]	0.049	r = 0.160
NIHSS after 2 weeks		3 [1–9]	5 [2–16.3]	0.055	r = 0.157
JCS after 2 weeks		1 [0.8–3]	2 [0.8–4]	0.278	r = 0.106
Destination of discharge[b]	Home : Other than home	23 (30.3) : 53 (69.7)	19 (25.0) : 57 (75.0)	0.468	φ = 0.059
Worsening events[b]	Yes : No	12 (15.8) : 64 (84.2)	18 (23.7) : 58 (76.3)	0.221	φ = 0.099

This table shows the comparison of outcomes between the early and late groups before and after propensity score matching. The upper section shows the results before matching, and the lower section shows the results after matching.
a: Median [Interquartile Range], b: Number (%)
Abbreviations: BI, Barthel Index; NIHSS, National Institutes of Health Stroke Scale; JCS, Japan Coma Scale.

plays in maximizing functional gains during the acute phase of stroke recovery.

This effect may be attributable to the earlier initiation of occupational therapy for the early group, which allowed for the earlier initiation of functional and basic movement exercises. Consequently, additional training could be performed. In particular, exercises that target the upper limb function, which comprise a large portion of functional exercises that are performed during occupational therapy, and early basic movement exercises, such as sitting on the edge of the bed, likely contributed to faster recovery. Previous studies have also suggested the effectiveness of upper limb function exercises during the acute phase of stroke and the usefulness of early mobilization [2–4, 20, 21]. The favorable outcomes of the early group in our study were consistent with these findings.

On the other hand, although a significant difference was observed between the two groups in terms of the number of days until the initiation of functional and basic movement exercises, no significant difference was found in the number of days until the initiation of ADLs training. This may be because the timing of ADLs training was determined not by the progress of occupational therapy but rather by standardized medical decisions. Specifically, it is assumed that ADLs training, such as feeding or toileting, was initiated at the time when physicians judged that oral intake or removal of the urinary catheter was permitted. Although the timing of occupational therapy initiation differed between the groups, the timing of such medical decisions may have been similar, which could explain the lack of difference in the timing of ADLs training initiation.

The short observation period of 2 weeks may have contributed to the better outcomes of the early group. Although a difference of 1 or 2 days during the intervention period has a significant effect in the short term, this difference is expected to diminish over time. Therefore, additional studies should be performed to examine the long-term effects.

The limitations of this study include the unexplored long-term effects, limited generalizability attributable to its single-center design, and the possibility that the covariates used for the propensity score calculation may have been inadequately selected. Additionally, the possibility that complete covariate balance was not achieved should be noted, as indicated by a slightly elevated standardized difference of 0.181 in NIHSS at the start of rehabilitation after propensity score matching. Because of the retrospective nature of this study, the collection of detailed information regarding the content and quality of training was difficult, which may have resulted in insufficient examination of these effects. Future studies involving multiple centers and randomized controlled trials should be performed to allow more detailed analyses that account for differences in the content and quali-

ty of training and to investigate long-term outcomes.

Conclusion

The results of a 2-week follow-up period and comparisons of outcomes of patients who experienced stroke and underwent rehabilitation showed that the early group exhibited a greater change in the Barthel Index (BI) than that of the late group, and that the BI of the early group at 2 weeks was better than that of the late group. These findings suggest that earlier initiation of occupational therapy during the acute phase of stroke may have a positive impact on patient recovery. Starting occupational therapy earlier may enable patients to engage in upper limb functional training and basic mobility exercises, such as sitting on the edge of the bed, at an earlier stage. This, in turn, may contribute to accelerated functional improvement. Our findings highlight that even a 1- to 2-day difference in the timing of rehabilitation initiation can influence outcomes, emphasizing the importance of optimizing the timing of occupational therapy during the acute phase of stroke.

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Conflict of Interest

The authors have no conflicts of interest to declare for this article.

References

[1] Feigin VL, Brainin M, Norrving B, Martins S, Sacco RL, Hacke W, et al. World stroke organization (WSO): Global stroke fact sheet 2022. Int J Stroke. 2022; 17(1): 18–29, doi:10.1177/17474930211065917.

[2] The Japan Stroke Society. Japanese guidelines for the management of stroke. Tokyo: The Japan Stroke Society; 2021.

[3] Intercollegiate Stroke Working Party. National clinical guidelines for stroke for the United Kingdom and Ireland. 2023 ed. Available from: https://strokeguideline.org/National-Clinical-Guideline-for-Stroke-2023.pdf.

[4] Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, et al. Guidelines for the early management of patients with acute ischemic stroke: 2019 update to the 2018 guidelines for the early management of acute ischemic stroke: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2019; 50(12): e344–418, doi:10.1161/STR.0000000000000211.

[5] AVERT Trial Collaboration group. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): A randomised controlled trial. Lancet. 2015; 386(9988): 46–55, doi:10.1016/S0140-6736(15)60690-0.

[6] World Federation of Occupational Therapists. About occupational therapy. Available from: https://wfot.org/about/about-occupational-therapy.

[7] World physiotherapy. Description of physical therapy [Policy statement]. Available from: https://world.physio/sites/default/files/2020-04/PS-2019-Description-of-physical-therapy.pdf.

[8] Bernhardt J, Churilov L, Ellery F, Collier J, Chamberlain J, Langhorne P, et al. AVERT Collaboration Group. Prespecified dose-response analysis for A Very Early Rehabilitation Trial (AVERT). Neurology. 2016; 86(23): 2138–45, doi:10.1212/WNL.0000000000002459.

[9] Hubbard IJ, Carey LM, Budd TW, Levi C, McElduff P, Hudson S, et al. A randomized controlled trial of the effect of early upper-limb training on stroke recovery and brain activation. Neurorehabil Neural Repair. 2015; 29(8): 703–13, doi:10.1177/1545968314562647.

[10] Kwakkel G, Winters C, van Wegen EEH, Nijland RHM, van Kuijk AAA, Visser-Meily A, et al. Effects of unilateral upper limb training in two distinct prognostic groups early after stroke: The EXPLICIT-Stroke Randomized Clinical Trial. Neurorehabil Neural Repair. 2016; 30(9): 804–16, doi:10.1177/1545968315624784.

[11] Japan Stroke Data Bank: Report on the Current Status of Stroke Care in Japan Using the Stroke Registry (in Japanese). Available from: https://strokedatabank.ncvc.go.jp/f12kQnRl/wp-content/uploads/日本脳卒中データバンク報告書 2024 年.pdf.

[12] Takami A Risk management in physiotherapy for cerebrovascular diseases (in Japanese). Phys Ther Jpn. 2012; 39(2): 135–40, doi:10.15063/rigaku.KJ00008046850.

[13] Koga Y, Murata H, Yamase H. Validity and reliability of the Japanese version of intensive care delirium screening checklist (ICDSC). Yamaguchiigaku. 2014; 63(2): 103–11. Available from: https://www.jstage.jst.go.jp/article/ymj/63/2/63_103/_pdf.

[14] Mahoney FI, Barthel DW. Functional evaluation: The Barthel index: A simple index of independence useful in scoring improvement in the rehabilitation of the chronically ill. Md State Med J. 1965; 14: 56–61.

[15] Brott T, Adams HP Jr, Olinger CP, Marler JR, Barsan WG, Biller J, et al. Measurements of acute cerebral infarction: A clinical examination scale. Stroke. 1989; 20(7): 864–70, doi:10.1161/01.str.20.7.864.

[16] Ohta T, Waga S, Handa W, Saito I, Takeuchi K. New grading of level of disordered consciousness (author's transl). No Shinkei Geka. 1974; 2(9): 623–7.
[17] Kanda Y. Investigation of the freely available easy-to-use software 'EZR' for medical statistics. Bone Marrow Transplant. 2013; 48(3): 452–8, doi:10.1038/bmt.2012.244.
[18] Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007; 39(2): 175–91, doi:10.3758/bf03193146.
[19] Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. Behav Res Methods. 2009; 41(4): 1149–60, doi:10.3758/BRM.41.4.1149.
[20] El-Helow MR, Zamzam ML, Fathalla MM, El-Badawy MA, El Nahhas N, El-Nabil LM, et al. Efficacy of modified constraint-induced movement therapy in acute stroke. Eur J Phys Rehabil Med. 2015; 51(4): 371–9.
[21] Dehem S, Gilliaux M, Stoquart G, Detrembleur C, Jacquemin G, Palumbo S, et al. Effectiveness of upper-limb robotic-assisted therapy in the early rehabilitation phase after stroke: A single-blind, randomized, controlled trial. Ann Phys Rehabil Med. 2019; 62(5): 313–20.

■CASE REPORTS

Examination of Effects of Illness Management and Recovery Combining Occupational Dysfunction-Focused Interviewing for an Inpatient with Avoidant Personality Disorder

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Abstract: Introduction: Illness Management and Recovery (IMR) is expected to be an effective strategy to support the recovery of clients with personality disorders, but its effective implementation for clients with avoidant personality disorder (AvPD) is unknown. In this study, we outlined the IMR modules combined with interviews focused on occupational dysfunction to facilitate recovery.
Methods: The study consisted of two courses of IMR with a client with AvPD who was reluctant to participate in treatment. The recovery process was assessed using the Recovery Assessment Scale (RAS), and interviews were conducted to share difficulties in daily life using the Classification and Assessment of Occupational Dysfunction (CAOD). In this study, only two IMR modules were performed on the following themes: "Recovery Strategies" and "Coping with Stress."
Results: RAS scores increased throughout the study, indicating his recovery process was facilitated. The CAOD scores increased during the interview before the overnight stay. However, they improved at the end of the occupational therapy intervention, when the patient was anxious but hopeful toward discharge and maintained a recovery orientation.
Conclusion: The IMR modules combined with interviews focused on occupational dysfunction for the client with AvPD led to increased recovery orientation and hope for life after discharge. The IMR module support for this client provided basic information for considering support strategies for recovery and improving occupational dysfunction in clients with AvPD.

Keywords: Illness Management and Recovery, occupational dysfunction, recovery, psychiatric occupational therapy, avoidant personality disorder

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1. Introduction

Examining the efficacy of Illness Management and Recovery (IMR) is an essential challenge in recovery-oriented practice studies in avoidant personality disorder (AvPD). The IMR program provides information and skills to self-manage symptoms toward life goals and facilitate one's recovery [1, 2]. Despite the expected effectiveness of IMR for the recovery of clients with personality disorders [3], a practical introduction strategy for IMR remains unclear for the recovery of clients with AvPD.

AvPD is characterized by fear of rejection and a sense of personal inadequacy to the point of extreme avoidance of social interactions and treatment, making recovery challenging [4]. Therefore, individuals with AvPD may have occupational dysfunction defined as negative experiences in engaging in daily activities (i.e., marginalization, alienation, etc.) in Occupation-Based

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Practice 2.0 (OBP 2.0) [5]. Watanabe et al. suggested the importance of an occupational dysfunction-focused approach when facilitating client recovery [6]. Moreover, the usefulness of interviews focused on occupational dysfunction to promote recovery and proactive participation in treatment has been examined in several case reports on schizophrenia [7, 8]. However, although examining the effectiveness of interview practices focused on occupational dysfunction in AvPD is valuable for new therapeutic strategies, it remains unreported.

This case study of an inpatient with AvPD aimed to outline the IMR modules combined with occupational dysfunction-focused interviewing as the occupational therapy (OT) intervention. By conducting interviews focusing on occupational dysfunction in advance, the patient might have expressed his difficulties in daily life, learned to make practical coping behaviors in the IMR modules, and incorporated them into his daily life. This study followed the ethical standards of the Declaration of Helsinki, and the client obtained signed informed consent.

2. Case and Methods

2.1 Case

A man in his 50s with AvPD got a job after graduating from high school, but he quit after about three years and lived as a recluse with his parents for about 30 years. In year X, he developed anxiety and depression, requested to be voluntarily hospitalized, and said, “I want to live separately because it would bother my family.” His condition did not improve after three months, so he was transferred to an open ward where OT was started. He participated in individual hobby activities and group programs while remaining self-negative and rejecting. Although he was unsure whether he could leave the hospital when asked about discharge, he hesitantly accepted the staff’s suggestion to participate in IMR programs.

2.2 Measurements

The Japanese version of the Recovery Assessment Scale (RAS) is a self-reported scale of the recovery process of people with mental illness that consists of 24 items, with scores ranging from 24 to 120 and higher scores indicating more progress in recovery [9].

The Classification and Assessment of Occupational Dysfunction (CAOD) scale consists of 16 items. It measures occupational dysfunction in four domains, with scores ranging from 16 to 112 and higher scores indicating more severe occupational dysfunction [5].

2.3 Therapy Intervention and Assessment Procedures

IMR combined with interviewing based on CAOD assessments were initiated while conventional OT was conducted (Fig. 1-(a)). Conventional OT programs included reading comics, typing, sports, and aerobic activities while interacting with others in group programs. The IMR was conducted by occupational therapists and nurses in two terms (Term 1 and 2), each containing two modules (session theme 1: Recovery Strategies; session theme 7: Coping with Stress), according to the hopes and needs of four participants in the ward. The structure and contents of the IMR conducted in this study are shown in Table 1.

Interviews with CAOD assessments as an introduction strategy for IMR participation were conducted before each IMR term in the ward or OT room to prompt his expression of his daily life difficulties and to think together about what could be further improved. RAS assessment was conducted at the beginning and end of each IMR term to assess the effect of the intervention. These two assessments were performed as a follow-up before the overnight stay at his home and at the end of the therapy intervention (before discharge) (Fig. 2).

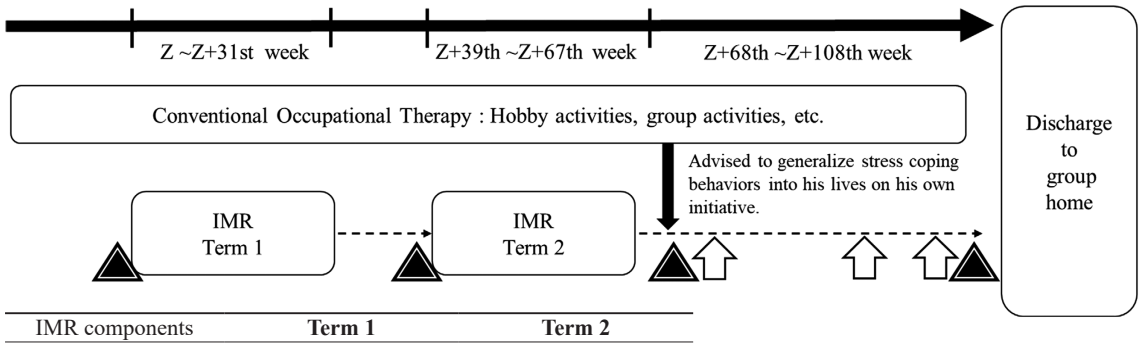
3. Results

The RAS and CAOD assessments were shared in each interview. Figure 2 shows the time course of RAS and CAOD scores and changes in the interview narratives. Although the RAS scores declined after the completion of IMR, the scores increased throughout the study period. CAOD scores increased at the interview before the overnight stay but improved at the OT intervention’s end. As a result, this intervention was not implemented until other modules of the IMR due to implementation limitations caused by group membership and nosocomial infections. He only noticed signs of stress in IMR Term 1, but in Term 2, he listed specific coping behaviors (Fig. 1-(b)). From the 68th week onward, he began to think of coping behaviors on his initiative and incorporate them into his daily life while consulting with the staff, and was discharged to a group home after the therapeutic intervention at the 108th week (Fig. 2).

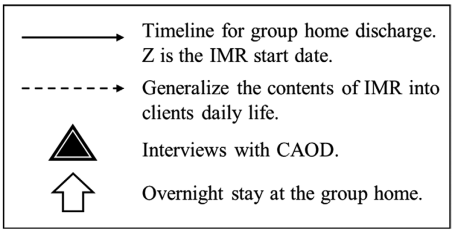
4. Discussion

This case study examined the effects of IMR combined with occupational dysfunction-focused interviewing for an inpatient with AvPD. IMR was not immediately effective, but the treatment intervention improved the subsequent recovery process and occupational dysfunction. Moreover, his remarks suggested that his thoughts had become more positive through the period

(a)



IMR components	Term 1	Term 2
IMR modules	• Recovery Strategies • Coping with Stress	• Recovery Strategies • Coping with Stress
Period	7 months	7 months
Frequency	2–3 times per a month	2–3 times per a month
Number of times	15 times	13 times
Session time	30 to 60 min	30 to 60 min
Number of members	4 participants 1 OTR 2 Nurses	4 participants 2 OTR 3 Nurses



(b)

	Term 1 (Z ~ Z+31st week)	Term 2 (Z+39th ~ Z+67th week)
Recovery Strategies		
Recovery Target	• Tell my doctor that I want to start self-administering my medications in preparation for discharge. • Finish reading the comics in the OT room.	• Daily walks to improve physical fitness for the goal of discharge from hospital to the group home.*
Target Behavior	• Prepare my mind. • Consult with the members to determine the best language to use. • Due to the timing of the change of primary doctor, I want to see what kind of doctor he is. • I'll start by asking for advice on how to take an abortive medication.	• If I decide on a specific time, I will not be able to respond when my schedule changes, so decide on once a day so that I can work on it flexibly.* • If I am not feeling well, take it easy and rest.
Narratives	"I'm not very good at public speaking." "I never thought of this before (studying recovery)." "I thought I was incapable of recovery, but maybe I already have a little bit of it." "I want to live a life where I can do what I want."	"I want to have an enjoyable life in a group home, so I want this workshop to be useful." "I've learned a lot from your input."
Coping with Stress		
Stressful Situations	• Previously, there was no appetite for activity at all. • Maybe it was the stress of not doing anything.*	• I used to have a hard time in situations where I had to talk to people. • Now the situation of not being able to sleep is stressful.
Stress signs	• I won't be able to sleep.* • I won't be able to change my mind.* • My body feels ruffled.*	• (He describes the same information as in the first term, and says) "Not recently."
How to Reduce Stress	• My relaxation time is in the OT program. • Watching videos on the computer in the OT room. • Participation in radio calisthenics was initiated. • I started listening to the radio.	• Balance my life.* • Currently done.
How to Cope with Stress	• I'm going to start keeping a journal. • I want to be positive. • But I don't know how to be positive.	• Participating in exercise programs.* • Walking.* • Watching videos.* • Reading comic.*
Narrative	"There may be stress in my life that I'm not even aware of." "I guess we all have our problems." "When I imagine a better future for myself, I'm sure it won't work out."	"I went into this meeting thinking back to the last time I was here, but I feel less stressed than before."*

Fig. 1. Overview of treatment and IMR implementation
(a) Overview of therapeutic progress and components of the IMR programs, (b) The client's records on the IMR worksheets.
IMR: Illness Management and Recovery, OTR: Occupational Therapist Registered, OT: Occupational Therapy.
* indicates the client's records where were related to the CAOD interview.

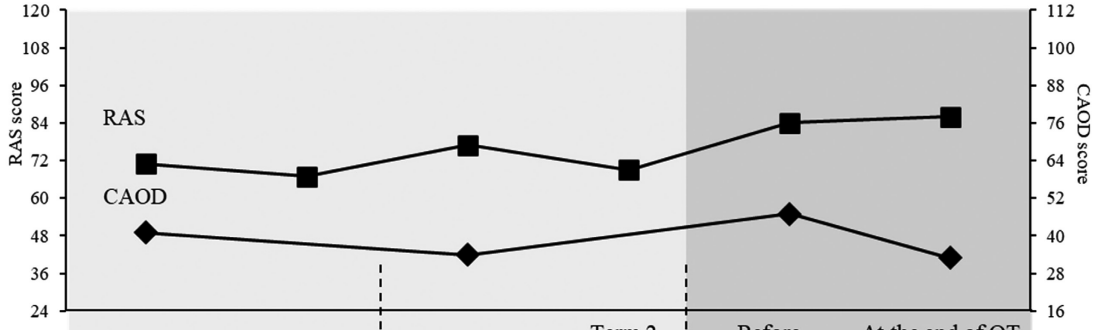
Table 1 Structure and Contents of the Illness Management and Recovery (IMR)

Overviews of the Illness Management and Recovery (IMR)	
• Standardized program of recovery-oriented rehabilitation approaches for people with severe mental illness [10]. • Five empirically supported strategies have been identified [1]. (Including psychoeducation about mental illness and its treatment, cognitive-behavioral approaches to medication adherence, developing a relapse prevention plan, strengthening social support by social skills training, and coping skills training for the management of persistent symptoms [2].) • Recovery strategies (session theme 1) are implemented at the beginning of each term.	
Session theme	Contents [2]
1*, Recovery strategies	• Engage clients in group • Increase awareness of recovery • Set personal recovery goals • Develop plans for achieving goals
2, Practical facts about mental illness	• Identify symptoms associated with Schizophrenia • Dispel myths about schizophrenia • Address stigma • Help clients become aware of people with schizophrenia who lead productive lives
3, The stress-vulnerability model and treatment strategies	• Explain that stress and biological vulnerability cause symptoms of schizophrenia • Discuss strategies for reducing stress and biological vulnerability • Inform clients about treatment options
4, Building social support	• Discuss how building social support can facilitate recovery • Teach strategies for increasing support, such as finding places to meet people, conversation skills, and getting closer to people
5, Using medication effectively	• Teach clients about benefits and side effects of medications • Increase skills for discussing medication issues with physician • Help clients weigh pros and cons of taking medications • Teach behavioral tailoring to facilitate medication adherence
6, Reducing relapses	• Teach clients that relapses are predictable and preventable • Develop an individual relapse prevention plan
7*, Coping with stress	• Inform clients they can reduce stress and improve their ability to cope with it effectively • Identify and practice strategies to prevent and to cope with stress
8, Coping with problems and symptoms	• Teach problem-solving model • Help clients identify common problems and symptoms that cause distress • Practice coping strategies for persistent symptoms
9, Getting your need met in the mental health system	• Review different mental health services • Identify insurance benefits clients are entitled to • Help clients identify strategies to advocate for self in mental health system

[1], [2], [10]: ref.
*: In this study, the participants (including the client) requested Coping with stress (session theme 7). Thus, these two modules (session theme 1 and 7) were conducted in the first term of the IMR program. The same combination of IMR modules was conducted in the second term of the IMR program.

of what he learned in the IMR modules incorporated into his daily life (after 68 weeks) and that his trajectory was finally following the process of recovery and mastery through the present interventions. Similarly to the treatment experience in a previous AvPD study [4], the client may have been aware of the connection with others and may progress through the process of promoting self-understanding and toward the goal while struggling with anxiety through participating in the IMR programs and interviews. Interviews and assessments using the CAOD provide an opportunity to discuss one's issues [8] and have the advantage of encouraging the subjects to verbalize and quantify their subjective experience of daily activities, thus allowing them to be objectively captured [7]. The IMR combined with occupational dysfunction-focused interviewing may contribute to forming an appropriate therapeutic relationship based on an alliance of agreement on tasks, goals, and the therapeutic implications of OT for clients with AvPD, as the previous study suggests [4].

Despite limitations due to a single case study, it provided basic information about IMR combined with



	Term 1 Start Z week	Term 1 Finish Z+31week	Term 2 Start Z+39week	Term 2 Finish Z+67week	Before overnight stay Z+94week	At the end of OT intervention Z+108week
RAS score	71	67	77	69	84	86
CAOD score	41	—	34	—	47	33
Occupational imbalance	12	—	6	—	10	4
Occupational deprivation	11	—	5	—	10	9
Occupational alienation	12	—	11	—	12	14
Occupational marginalization	6	—	12	—	15	6
Interview Narrative	"Sometimes I can't sleep." "Sometimes I get a stomach ache. " (Is that due to stress?) "Is that so...hmmm (I don't know)."	—	"My favorite is to use the computer in the OT room. I wish I could find something else." "I'm not doing OT or laundry for approval, I'm doing it for me." "I don't feel a sense of accomplishment because I don't set goals for myself every day. That's why I feel bored."	—	"I feel like it's finally coming..." "I don't have OT when I'm out there, and I don't know what I'm going to do with my time." "I don't know what I'm going to do for dinner or how my day goes ..."	"I feel more positive than when I did this (RAS) for the first time." "I've stayed out a lot, and they've already decided to discharge me here (GH), so now I just have to wait and see." "New I don't know how it will turn out, but for the time being, I'm fine."

Fig. 2. Joint display of the time course of RAS and CAOD scores and changes in the interview narratives. RAS: Recovery Assessment Scale, CAOD: Classification and Assessment of Occupational Dysfunction, OT: occupational therapy, GH: group home.

Occupational imbalance (4 items, 4–28 points), imbalance in daily activities of daily living; Occupational deprivation (3 items, 3–21 points), a condition in which activities of daily living are restricted by external factors; Occupational alienation (3 items, 3–21 points), a state of not finding meaning in daily activities; and Occupational marginalization (6 items, 6–42 points), a state of not being recognized by the surroundings for meaningful life activities. Each interview lasted 15–30 minutes. [ref.5]

interviews using CAOD assessment. Further studies are required to assess the impact of the present intervention and develop appropriate strategies addressing challenges in AvPD.

5. Conclusions

Combining IMR with interviews focused on occupational dysfunction may be an effective support strategy for clients with AvPD to express their difficulties and improve their recovery process.

Acknowledgments

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Declaration of interest

The authors have no conflicts of interest relevant to this article.

References

[1] Mueser KT, Corrigan PW, Hilton DW, Tanzman B, Schaub A, Gingerich S, et al. Illness Management and Recovery: a review of the research. Psychiatr Serv. 2002; 53(10): 1272–84.

[2] Mueser KT, Meyer PS, Penn DL, Clancy R, Clancy DM, Salyers MP. The Illness Management and Recovery program: rationale, development, and preliminary findings. Schizophr Bull. 2006; 32(1): S32–43.

[3] Goh YSS, Ow Yong JQY, Li AZ. Effectiveness of Illness Management and Recovery program on people with severe mental illnesses: a systematic review and meta-analysis. Front Psychiatry. 2023; 14: 1162288.

[4] Sørensen KD, Wilberg T, Berthelsen E, Råbu M. Lived experience of treatment for avoidant personality disorder. Searching for courage to be. Front Psychol. 2019; 10, 2879.

[5] Teraoka M, Kyougoku M. Development of the final version of the Classification and Assessment of Occupational Dysfunction Scale. PLoS One. 2015; 10(8): e0134695.

[6] Watanabe A, Kawaguchi T, Sakimoto M, Oikawa Y, Furuya K, Matsuoka T. Occupational dysfunction as a mediator between recovery process and difficulties in daily life in severe and persistent mental illness: a Bayesian structural equation modeling approach. Occup Ther Int. 2022; 2022: 2661585.

[7] Sakimoto M, Kawaguchi T, Matsuoka T, Oiwaka Y, Watanabe A. Assessment and interventions focused on classification of occupational dysfunction for a client with schizophrenia undergoing long-term hospitalization (in Japanese). Japanese Occupational Therapy Research (Sagyouryouhou). 2017; 36(3): 334–41.

[8] Kuzuoka S, Matsuoka T, Kawaguchi T. A case of schizophrenia in which an intervention focused on occupational dysfunction made a positive change in recovery (in Japanese). Japanese Occupational Therapy Research (Sagyouryouhou). 2022; 41(3): 340–7.

[9] Chiba R, Miyamoto Y, Kawakami N. Reliability and validity of the Japanese version of the Recovery Assessment Scale (RAS) for people with chronic mental illness: Scale development. Int J Nurs Stud. 2010; 47(3): 314–22.

[10] Dalum HS, Korsbek L, Mikkelsen JH, Thomsen K, Kistrup K, Olander M, et al. Illness management and recovery (IMR) in Danish community mental health centres. Trials. 2011; 12: 1–9.

■Rapid Communications

Generative AI in Occupational Therapy Journal Guidelines: A Comparative Review of Japan and International Journals with Accessible Policies

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Abstract: Background: As generative artificial intelligence (AI) becomes increasingly integrated into academic writing and research, journals across disciplines are developing editorial guidelines to regulate its use. However, the extent and nature of such guidelines vary, and little is known about their status in the field of occupational therapy.
Objective: This study aimed to examine and compare the generative AI-related submission guidelines of occupational therapy journals in Japan and internationally, and to identify differences in policy presence, content, and underlying editorial approaches.
Methods: Submission guidelines were reviewed from occupational therapy journals published by national associations in Japan and selected international counterparts, based on the availability of publicly accessible editorial policies. The presence of AI-related statements, their content, and policy details were analyzed.
Results: None of the 23 Japanese journals analyzed had explicit AI-related guidelines, whereas several international journals, including the American Journal of Occupational Therapy (AJOT) and those published by SAGE, had developed clear policies. These included rules on authorship, disclosure, ethical risks, and enforcement mechanisms.
Conclusions: The absence of AI policies in Japanese journals may reflect institutional, cultural, and operational factors. Developing explicit, context-sensitive AI editorial policies may help Japanese journals align with international practices and promote research integrity.

Keywords: generative AI, occupational therapy, submission guidelines, academic publishing, research ethics

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Introduction

Recent advances in generative artificial intelligence (AI) have expanded its use in academic writing, peer review, and research support [1]. This trend raises ethical and academic concerns [2], prompting journals and academic bodies to establish AI guidelines. Key principles include rejecting AI authorship, requiring disclosure, ensuring accuracy, and protecting data confidentiality [3].

AI cannot be listed as an author due to its lack of intellectual responsibility [4]; human researchers remain accountable for the work. Disclosure of AI use in writing or analysis is essential for transparency [5]. While AI can synthesize information, it may generate errors, requiring human verification [6]. Additionally, when handling personal or sensitive data, strong safeguards are needed, as ethical concerns increase for models trained on human data [7].

While general rules are emerging, their implementation varies across fields. A BMJ study found that only 24% of the top 100 global publishers had explicit AI policies, compared to 87% of top journals [8]. Nearly all rejected AI authorship. Some policies prohibit AI-generated content entirely, while others permit it with disclosure. In medicine, strict policies have been adopted [9]. Journals such as *NEJM* and *JAMA* reject AI authorship and tightly regulate AI-assisted writing. *The Lancet* allows AI only for language editing—not substantive content.

Caution is needed when using AI in clinical decision-making and diagnostics, as it may affect patient care and

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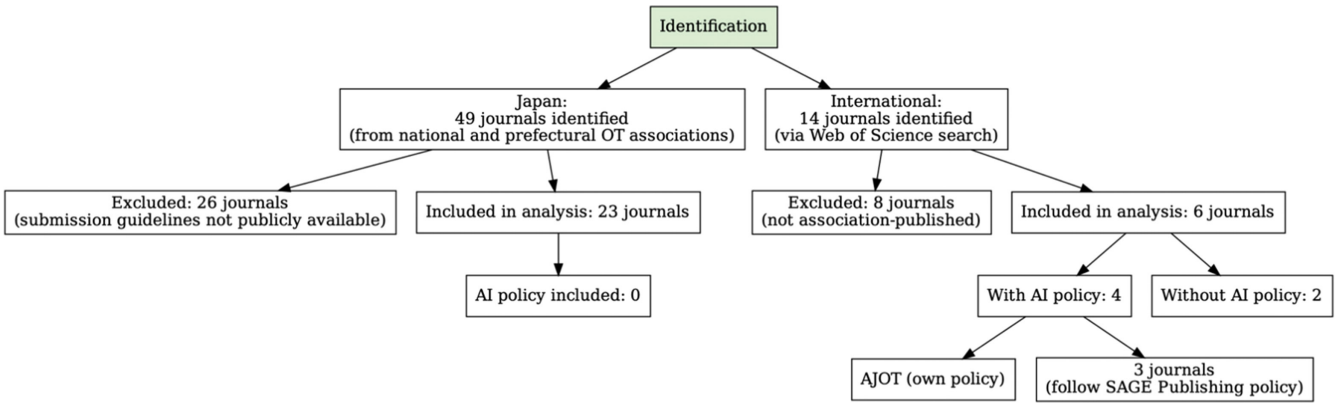

Fig. 1. Flow diagram of journal identification and selection.
This figure summarizes the number of journals identified, excluded, and included in the final analysis for both Japanese and international sources, along with the presence or absence of AI-related editorial policies.

thus requires thorough validation [10]. Transparency is critical in AI-driven data analysis; researchers should describe algorithms used and address training data biases [11]. Due to the sensitivity of medical data, ethical oversight and strict data protocols are vital. Some journals also limit AI in peer review over concerns about scientific judgment [12].

In Japan, the adoption of AI-related editorial policies remains limited. Both healthcare professionals and the public express strong concerns about AI, particularly regarding accountability, transparency, and data protection [13], which may explain the slower uptake of guidelines. Following trends in medicine, international rehabilitation and occupational therapy journals are beginning to develop editorial policies—especially regarding bias and ethical risks in AI-assisted analysis [14]. As AI becomes embedded in rehabilitation, its impact on research and practice requires careful evaluation [15].

This study aimed to compare generative AI-related editorial policies in occupational therapy journals in Japan and internationally, based on journals whose submission guidelines were publicly available. This study is the first to examine AI-related editorial policies in occupational therapy journals, which include client-centered reports and ethically sensitive narratives. These formats raise unique considerations for AI use. Thus, discipline-specific guidance is crucial to ensure responsible AI use aligned with occupational therapy's ethical values.

Methods

This study examined the submission guidelines of occupational therapy journals in Japan and internationally to assess whether they included statements on the use of generative AI.

In Japan, the targets were *The Japanese Journal of Occupational Therapy, Asian Journal of Occupational Therapy* (both from the Japanese Association of Occupational Therapists), and journals issued by occupational therapy associations in Japan's 47 prefectures. Only journals with publicly accessible guidelines were included in the analysis. As a result, 23 Japanese journals met these criteria.

For international journals, this study focused on those published by occupational therapy associations affiliated with the World Federation of Occupational Therapists (WFOT), again limiting the analysis to journals with submission guidelines available on their official websites as of February 2025. To identify core international occupational therapy journals, we used the Rehabilitation category of Web of Science JCR. Based on impact factor and relevance, we selected journals and verified WFOT affiliation and public submission guidelines. Six met inclusion criteria. This ensured relevance and transparency but may have excluded journals with limited access or non-WFOT affiliations.

The collected data included the following:

1. Latest update date of submission guidelines.
2. Whether the guidelines included explicit statements on generative AI.

Submission guidelines were reviewed from February 17 to February 20, 2025, via official journal websites. To identify AI-related content, full-text searches were conducted using the keywords "AI," "artificial intelligence," "generative AI," "ChatGPT," and "large language model (LLM)." The presence or absence of AI-related statements was manually confirmed by reading the relevant sections of the guidelines.

Table 1 Japanese Occupational Therapy Journals with Accessible Submission Guidelines

Prefecture	Journal Title	Last Updated	Statement on AI Usage
–	*Occupational Therapy* (Japanese Association of Occupational Therapists)	2024.6.15	None
–	*Asian Journal of Occupational Therapy* (Japanese Association of Occupational Therapists)	Unknown	None
Hokkaido	*Practice and Science of Occupational Therapy*	2024.4.1	None
Aomori	*Bulletin of Aomori occupational therapy*	Unknown	None
Fukushima	*Fukushimaken Journal of Occupational Therapy*	2022.8.1	None
Gunma	*The Journal of Gunma Association of Occupational Therapists*	Unknown	None
Saitama	*Bulletin of Occupational Therapy as Art and Science*	2024.10.15	None
Tokyo	*Tokyo Occupational Therapy Research*	2024.2.14	None
Kanagawa	*The Journal of Kanagawa Occupational Therapy Research*	2024.2.20	None
Nagano	*The Journal of Nagano Association of Occupational Therapists*	2024.3.1	None
Niigata	*Journal of Niigata Occupational Therapy*	2018.11.3	None
Ishikawa	*Ishikawa Occupational Therapy Journal*	2019.1.16	None
Aichi	*The Journal of Aichi OT*	2024.3.1	None
Shiga	*Shiga Occupational Therapy Journal*	2023.5.1	None
Ehime	*Ehime Occupational Therapy Association Journal*	Unknown	None
Kochi	*The Kochi Journal of Occupational Therapy*	2021.5.25	None
Fukuoka	*The Journal of Fukuoka Association of Occupational Therapy*	2024.5.23	None
Saga	*The Saga Journal of Occupational Therapy*	2023.2.1	None
Nagasaki	*Nagasaki Occupational Therapy Research*	Unknown	None
Miyazaki	*The Himuka Journal of Occupational Therapy*	2022.3.31	None
Kagoshima	*Kagoshima Journal of Occupational Therapy*	Unknown	None
Okinawa	*The Okinawa Journal of Occupational Therapy*	Unknown	None

Notes: 1. *Unknown* indicates that the journal does not provide information on the most recent update date.
2. None of the listed journals included explicit statements on the use of generative AI in their submission guidelines.
This table includes only journals for which submission guidelines were publicly available and accessible at the time of the review.

Table 2 AI-Related Submission Guidelines in International Occupational Therapy Journals

Journal Title	Last Updated	Statement on AI Usage
American Journal of Occupational Therapy (AJOT)	2025.1.28	Present
Canadian Journal of Occupational Therapy (CJOT)	2022.9.28	Present[1]
British Journal of Occupational Therapy (BJOT)	Unknown	Present[1]
Australian Occupational Therapy Journal	Unknown	None
Scandinavian Journal of Occupational Therapy	Unknown	None
Hong Kong Journal of Occupational Therapy	Unknown	Present[1]

Notes: 1. *Present*[1] indicates that the AI usage statement follows SAGE Publishing's standard policy, which permits the use of generative AI as a writing tool. Disclosure is recommended but not mandatory, and no specific penalties are outlined for non-disclosure.
2. *Unknown* means the journal does not provide information on the most recent update date.
3. *Not Available* indicates that submission guidelines were not accessible at the time of review.
This table presents the status of submission guidelines regarding generative AI in selected international occupational therapy journals.

Results

The journal selection process is shown in Fig. 1. A total of 23 Japanese journals were analyzed, including The Japanese Journal of Occupational Therapy, Asian Journal of Occupational Therapy, and 21 prefectural journals. Six had no update dates; the rest ranged from March 2017 to October 2024. None included explicit statements on generative AI use (Table 1). Six international journals were reviewed. Four lacked update dates; the others were revised between September 2022 and January 2025. Of these, four had AI-related policies: AJOT had its own, while three followed SAGE Publishing's guidelines. These allow AI for writing, recommend disclosure, and impose no sanctions for non-compliance (Table 2).

Notable differences were found between AJOT and SAGE. AJOT prohibits AI in data analysis, interpretation, and conclusions, SAGE places no such restrictions. Ethically, AJOT aligns with GDPR and warns against

discriminatory AI use, while SAGE notes risks but lacks mitigation steps. Disclosure requirements also differ: AJOT mandates detailed disclosure in both cover letter and manuscript, while SAGE merely suggests it. Enforcement varies, with AJOT specifying penalties (e.g., rejection, retraction), while SAGE provides none.

Discussion

This study examined submission guidelines from Japanese and international occupational therapy journals regarding generative AI. None of the Japanese journals included explicit AI-related statements, while several international journals, such as AJOT and those from SAGE, had clear policies. To our knowledge, this is the first focused analysis of AI guidelines in occupational therapy journals, especially in Japan. The comparison between AJOT and SAGE revealed differences in acceptable AI use, disclosure requirements, ethical concerns (e.g., bias, data integrity), and enforcement practices.

These differences reflect varying editorial priorities and perspectives on transparency and accountability in academic publishing. One of the most significant findings was the absence of AI-related submission guidelines in Japanese occupational therapy journals. Although AI technology is advancing in the medical and rehabilitation fields, the establishment of regulatory and ethical frameworks in Japan is still in progress. The lack of AI-related statements in the submission guidelines suggests that discussions on how generative AI should be incorporated into academic research and publishing may still be insufficient in Japanese occupational therapy academia. This study contributes to AI-related publishing research by focusing on occupational therapy—a field involving clinical studies, case reports, and client-centered narratives that require ethical sensitivity. These formats pose unique challenges for generative AI. Therefore, field-specific editorial policies are essential to ensure responsible AI use aligned with occupational therapy's ethical standards.

Several contextual factors may explain this absence. Japanese academic and professional institutions often take a cautious approach to emerging technologies, especially when ethical responsibilities and regulations are unclear. Studies have shown that both healthcare professionals and the public express strong concerns about accountability, data governance, and AI transparency in Japan [13]. Limited administrative capacity and infrequent policy updates may delay adoption of new standards. Structural features of Japan's academic and corporate sectors—such as hierarchical decision-making and limited collaboration—also slow the uptake of innovations like AI [16]. These factors may contribute to the lack of AI-specific editorial policies in Japanese occupational therapy journals.

Japanese journals generally update submission policies less frequently than international counterparts, limiting their ability to address emerging technologies like AI. While current guidelines lack AI-specific provisions, the growing use of AI in research highlights the need for clear editorial policies to ensure research integrity. This study also revealed notable differences between AJOT and SAGE policies. Both treat AI as a writing tool, not an author, but AJOT adopts stricter rules—prohibiting AI in data analysis and interpretation—reflecting its emphasis on research ethics. In contrast, SAGE allows AI use in manuscript preparation with minimal restrictions.

The two also differ in handling ethical risks. AJOT adheres to GDPR principles, requiring authors to avoid bias or discrimination in AI-generated content. These differences reflect varying editorial priorities. AJOT, as the flagship journal of a professional association, emphasizes ethical safeguards and mandates strict disclosure and verification. It also enforces penalties for non-compliance, such as rejection or retraction. In contrast, SAGE, a commercial publisher of numerous journals, adopts more flexible policies that prioritize general transparency over field-specific constraints. Disclosure is recommended but not required, and no sanctions are specified, indicating a more lenient approach.

Given the growing role of AI in academic publishing, the absence of AI regulations in Japanese occupational therapy journals indicates a gap that must be addressed. As observed in medical journals, strict guidelines for the use of AI are necessary to maintain research credibility and prevent ethical issues. It may be beneficial for Japanese journals to develop AI policies by referencing established international frameworks, such as those from AJOT or SAGE Publishing, to promote transparency and maintain research integrity.

Future research should examine a more regionally diverse set of journals, including those from Europe and non-English-speaking countries, to achieve a more balanced international comparison. Beyond editorial policies, it is also important to assess how generative AI is used in practice, including its effects on peer review, research quality, and ethical standards. These efforts will contribute to developing standardized yet context-sensitive guidelines that support both scientific rigor and responsible AI integration in occupational therapy publishing.

Such progress requires clearly defined roles among key stakeholders. Editorial boards should regularly update submission policies in response to emerging ethical and technological challenges. National occupational

therapy associations can lead the development of comprehensive AI guidelines through consensus-building and best practice sharing. Academic institutions should offer structured training and clear policies on AI use. These coordinated efforts will enhance transparency, uphold research integrity, and promote global alignment while accommodating local contexts.

This study has several limitations. First, the imbalance in journal numbers between Japan and other countries may affect generalizability. Second, only WFOT-affiliated journals with publicly available guidelines were included, potentially omitting influential but less accessible publications and introducing sampling bias. Third, as a cross-sectional survey conducted in February 2025, it does not capture future policy updates. Lastly, differences in disclosure styles between Japanese and English-language journals were not fully accounted for, possibly limiting the completeness of the international comparison.

Conclusion

This study reviewed submission guidelines of occupational therapy journals in Japan and abroad to assess generative AI regulations. No Japanese journals included explicit AI-related statements, while several international journals—such as AJOT and SAGE-published titles—had established clear policies. This gap suggests a slower institutional response in Japan. As AI use grows, Japanese journals should adopt transparent editorial policies, drawing on existing models to uphold research integrity. Collaborative efforts by editors, associations, and institutions are essential to address ethical challenges and promote responsible AI use. Further research should explore AI's impact on peer review, research quality, and accessibility in occupational therapy publishing.

Conflict of interest

The authors declare no conflict of interest.

References

[1] Guo H, Zaini SH. Artificial Intelligence in Academic Writing: A Literature Review. Asian Pendidikan. 2024; 4(2): 46–55.

[2] Ros T, Samuel A. Navigating the AI Frontier: A guide for ethical academic writing. eLearn. 2024; 2024(10).

[3] World Association of Medical Editors [Internet]. Recommendations on Chatbots and Generative Artificial Intelligence (AI) in Relation to Scholarly Publication [updated 2023 May; cited 2025 Feb 24]. Available from: https://wame.org/page2.php?id=106.

[4] Committee on Publication Ethics [Internet]. Authorship and AI tools [updated 2023 Feb 13; cited 2025 Feb 24]. Available from: https://publicationethics.org/guidance/cope-position/authorship-and-ai-tools.

[5] Flanagin A, Bibbins-Domingo K, Berkwits M, Christiansen SL. Nonhuman "authors" and implications for the integrity of scientific publication and medical knowledge. JAMA. 2023; 329(8): 637–9.

[6] Tang A, Li KK, Kwok KO, Cao L, Luong S, Tam W. The importance of transparency: Declaring the use of generative artificial intelligence (AI) in academic writing. Journal of Nursing Scholarship. 2024; 56(2): 314–8.

[7] Villegas-Ch W, García-Ortiz J. Toward a comprehensive framework for ensuring security and privacy in artificial intelligence. Electronics. 2023; 12(18): 3786.

[8] Ganjavi C, Eppler MB, Pekcan A, Biedermann B, Abreu A, Collins GS, Cacciamani GE. Publishers' and journals' instructions to authors on use of generative artificial intelligence in academic and scientific publishing: bibliometric analysis. BMJ. 2024; 384.

[9] Yoo JH. Defining the boundaries of AI use in scientific writing: A comparative review of editorial policies. J Korean Med Sci. 2025; 40(23): e272.

[10] Keskinbora KH. Medical ethics considerations on artificial intelligence. Journal of Clinical Neuroscience. 2019; 64: 277–82.

[11] Wehkamp K, Krawczak M, Schreiber S. The quality and utility of artificial intelligence in patient care. Deutsches Ärzteblatt International. 2023; 120(27–28): 463–69.

[12] Daneshjou R, Smith MP, Sun MD, Rotemberg V, Zou J. Lack of transparency and potential bias in artificial intelligence data sets and algorithms: a scoping review. JAMA Dermatology. 2021; 157(11): 1362–9.

[13] Tamori H, Yamashina H, Mukai M, Morii Y, Suzuki T, Ogasawara K. Acceptance of the use of artificial intelligence in medicine among Japan's doctors and the public: a questionnaire survey. JMIR Human Factors. 2022; 9(1): e24680.

[14] Lanotte F, O'Brien MK, Jayaraman A. AI in rehabilitation medicine: opportunities and challenges. Annals of Rehabilitation Medicine. 2023; 47(6): 444–58.

[15] Sumner J, Lim HW, Chong LS, Bundele A, Mukhopadhyay A, Kayambu G. Artificial intelligence in physical rehabilitation: A systematic review. Artificial Intelligence in Medicine. 2023; 146: 102693.

[16] Kostyukova KS. Digital transformation policy in Japan: the case of artificial intelligence. MIR (Modernization. Innovation. Research). 2019; 10(4): 516–29.

■ORIGINAL ARTICLE

Cognitive Processes of Occupational Therapists in Psychiatric Occupational Therapy: A Text Analysis of Case Study Reports

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Abstract: Objective: Occupational therapy plays a crucial role in the promotion of social participation and functional recovery. Although case studies provide valuable insights into intervention processes, their findings are often fragmented and lack systematic analyses. This study aimed to elucidate the clinical reasoning processes of occupational therapists in psychiatric settings by analyzing the discussion sections of case study reports.
Methods: A total of 159 case study reports registered in the Japanese Association of Occupational Therapists' Case Report Registration System between 2014 and 2023 were analyzed using Latent Dirichlet Allocation (LDA). Text preprocessing was performed to standardize the terminology and the optimal number of topics was determined using perplexity scores and the ldatuning package in R.
Results: The analysis identified 19 topics, with prominent themes including "patient," "occupation," "intervention," and "support." Occupational therapists frequently describe patients' conditions, intervention strategies, and the role of occupational activities. These concepts align with the International Classification of Functioning, Disability, and Health's "Activities and Participation" framework, indicating that therapists integrate clinical and contextual perspectives in intervention planning.
Conclusion: This study provides empirical insights into therapists' decision-making processes and contributes to a deeper understanding of psychiatric occupational therapy. Future research should incorporate patient perspectives and intervention outcomes to enhance the clinical reasoning from a more comprehensive perspective.

Keywords: psychiatric occupational therapy, case study, text mining, topic modeling, LDA

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1 Introduction

Psychiatric occupational therapy plays a crucial role in promoting social participation and supporting functional recovery in individuals with mental disorders [1, 2]. Case studies are widely used to systematically document individual intervention processes and their outcomes [3]. These case studies serve as valuable resources that enable occupational therapists to share clinical insights and enhance the quality of practice [4].

Evaluating the effectiveness of occupational therapy from the perspective of Activities and Participation within the International Classification of Functioning, Disability, and Health (ICF) is essential. However, case study reports often accumulate independently as individual cases, and attempts to systematically organize and extract common findings remain limited [5, 6]. To effectively accumulate and advance practical knowledge in psychiatric occupational therapy, it is necessary to comprehensively analyze the content of case studies and elucidate how occupational therapists make clinical judgments and interpret intervention outcomes.

Previous case studies have highlighted the impor-

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tance of occupational therapy [5, 6]. The discussion sections of the case reports provide valuable insights into the clinical reasoning and intervention strategies used by occupational therapists. These sections articulate the background of the intervention, the process of patient change, and the therapists' perspectives on the significance and effectiveness of the treatment, thereby linking practice with theory [5, 7]. In other medical and psychological disciplines, systematic analyses of case studies have been conducted to extract shared clinical knowledge [8, 9]. Text mining and topic modeling approaches have been demonstrated as effective methods for uncovering latent themes and trends in case reports [10, 11]. However, few studies have analyzed the discussion sections of case reports pertaining to psychiatric occupational therapy.

A systematic analysis of the qualitative information contained in the discussion sections of psychiatric occupational therapy case studies is essential for identifying common concepts and therapeutic approaches in clinical practice. Previous studies have primarily focused on verifying the effectiveness of specific interventions. However, few have examined how occupational therapists interpret their clinical experiences or evaluate the impact of their interventions [1, 2]. Analyzing the linguistic expressions and conceptual structures in the discussion sections can clarify how occupational therapists perceive patient changes and articulate the significance of treatment. Moreover, this analysis could contribute to the development of generalized clinical knowledge beyond individual case studies.

This study aimed to systematically analyze the discussion sections of psychiatric occupational therapy case studies to elucidate the characteristics of clinical reasoning and decision-making by occupational therapists. This study examined how therapists perceived patient changes and explained the significance of interventions. By focusing on the discussion sections, we analyzed how occupational therapists evaluate the success factors and challenges of interventions, and how their judgments reflect underlying theories and experiences. Furthermore, by organizing the unique perspectives and practices of psychiatric occupational therapy in Japan and comparing them with international occupational therapy frameworks, this study aimed to identify the commonalities and differences in therapists' cognitive processes.

To achieve this objective, we used text mining techniques to systematically analyze the linguistic expressions and conceptual structures embedded in the discussion sections of the case studies.

2 Materials and Subjects

2.1 Study Design

We conducted a retrospective analysis using text mining of the discussion sections of case study reports registered in the Case Report Registration System operated by the Japanese Association of Occupational Therapists (JAOT). The analysis used Latent Dirichlet Allocation (LDA) topic modeling to elucidate the characteristics of clinical reasoning in psychiatric occupational therapy. We examined how occupational therapists described the significance of the interventions and how environmental factors influenced their decisions from the perspective of Activities and Participation in the ICF.

2.2 Data Collection and Participants

Data were obtained from case study reports registered in the JAOT Case Report Registration System between 2014 and 2023. The system was designed to allow occupational therapists to share clinical insights and improve their occupational therapy practice [7]. The inclusion criteria for this study were case study reports that were registered under the "psychiatric disorder" category at the time of submission, resulting in a total of 159 reports for analysis. Occupational therapists assigned the category classifications.

All registered case study reports were peer-reviewed by at least two reviewers and modifications were required if necessary. In case of resubmission, only one primary reviewer evaluated the report. Therefore, the reports included in this analysis met qualitative standards. In this study, we included only case reports that were registered under the "psychiatric disorders" category in the JAOT Case Report Registration System. During submission, the system requires authors to specify both the clinical field (e.g., physical disability, psychiatric disorder) and the diagnostic code (e.g., schizophrenia, bipolar disorder) based on a standardized classification system. These entries are mandatory and are typically based on clinical diagnoses. Combined with JAOT's standardized reporting format and peer review process, these mechanisms ensure a high degree of reliability and consistency in classification.

3 Methods

3.1 Target Text for Analysis and Preprocessing

The case study reports in this study consisted of ten sections: title, purpose of the report, case description, occupational therapy assessment, basic intervention policy, occupational therapy implementation plan, intervention process, results, discussion, and references. Among these

sections, the discussion section, which best reflects the clinical reasoning of occupational therapists, was extracted as the target text for analysis. We selected the discussion sections as the analysis targets because they are consistently structured across JAOT case reports and provide rich textual data for topic modeling. This section also describes how the therapists perceived the patients and explains the significance of the interventions.

Before analysis, preprocessing was conducted to standardize the abbreviations and variations in word usage to prevent spelling inconsistencies. Specifically, we standardized vocabulary by unifying frequently occurring synonyms and abbreviations. For example, "OTR" was converted to "occupational therapist." These preprocessing steps were implemented using the default morphological analysis and tokenization functions of KH Coder (Version 3.02c). Subsequently, KH Coder was used for topic modeling analysis.

3.2 Statistical Analysis

To elucidate the clinical characteristics of occupational therapists, we applied LDA topic modeling to extract latent topics from the discussion sections of the reports [12–15]. LDA is a probabilistic topic modeling method that assumes that each document is composed of a mixture of latent topics, each of which is represented as a distribution over words. This approach allows the discovery of hidden thematic structures within large text corpora. In this study, we used KH Coder, which internally incorporates R-based libraries such as topic models, to perform LDA analysis. Although our previous study [5] applied a similar method to the "purpose of report" sections of stroke rehabilitation case reports, the present study focuses specifically on the "discussion" sections of psychiatric occupational therapy case reports, with an aim to explore clinical reasoning processes.

The number of topics was selected based on the perplexity and coherence metrics provided by KH Coder using its built-in topic modeling function. All hyperparameters were set to default values optimized for short-text documents. The optimal number of topics was determined using the perplexity scores and ldatuning package in R. Further details on the LDA method are available from Suzuki et al. [5]. All topic modeling analyses were conducted on the original Japanese texts. After analysis, the results, including keywords and topic summaries, were translated into English using machine translation software. The translated content was then reviewed and refined by members of the research team to ensure conceptual accuracy and consistency with the original Japanese meanings.

Additionally, the frequency of each topic was calculated to analyze the clinical reasoning patterns discussed in the discussion sections. We examined how occupational therapists evaluated interventions and support from the perspective of ICF Activities and Participation, and how environmental factors were incorporated into their reasoning.

3.3 Ethical Considerations

All case study reports analyzed in this study were originally registered in the JAOT Case Report Registration System after obtaining written informed consent from the individuals concerned or their family members, following sufficient explanation by the submitting occupational therapists. Appropriate privacy protection and ethical considerations have been ensured. This study utilized only secondarily analyzed data that had already been made available to JAOT members, and did not involve the collection of any new personal information. Therefore, we determined that an additional review by an institutional ethics committee was not required. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2013 revision).

4 Results

The application of LDA topic modeling to the discussion sections of the case study reports identified 19 topics as the optimal number. This decision was supported by the perplexity and coherence scores calculated using the ldatuning package, with the perplexity curve showing a clear elbow point and coherence peaking at approximately 19 topics (Figs. 1 and 2). The frequency and primary keywords of each topic were analyzed, revealing distinct themes associated with each topic (Table 1).

A comparison of the contribution rates among the topics indicated that six topics, topics #10, #8, #14, #1, #5, and #7, made relatively high contributions in descending order (Fig. 3). Topic #10, which had the highest contribution rate, was characterized by keywords such as "target" (referring to the individual receiving intervention, typically the patient), "treatment," "engagement," and "hope." Topic #8, the second most prominent topic, was centered around "case," "outcome," "goal," and "environment." Topic #14 featured keywords such as "intervention," "support," "hope," and "potential." Topic #1 included terms related to patient improvement, such as "recovery," "function," "cognition," and "disability." Topic #5 emphasized "self," "growth," "ability," and "motivation," indicating a focus on self-recognition and motivation. Topic #7 contained words such as "occupation," "environment," "continuation," and "engagement," highlighting the importance of occupational activities and their sustainability.

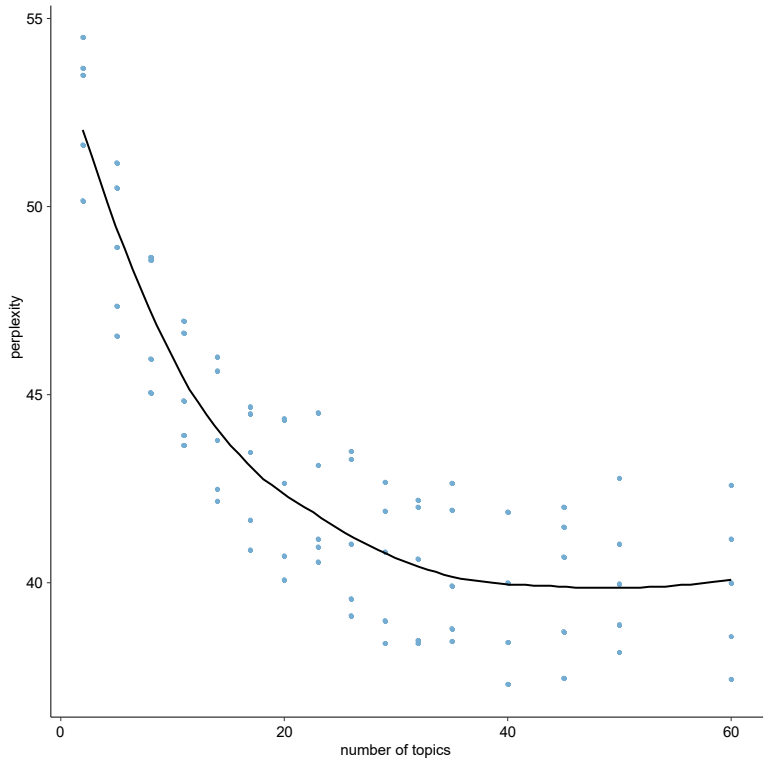

Fig. 1. Searching for the number of topics (Perplexity)

Perplexity curve for determining the optimal number of topics in Latent Dirichlet Allocation (LDA). The curve shows a clear elbow point around 19 topics, indicating the most appropriate solution for analyzing the discussion sections of psychiatric occupational therapy case reports.

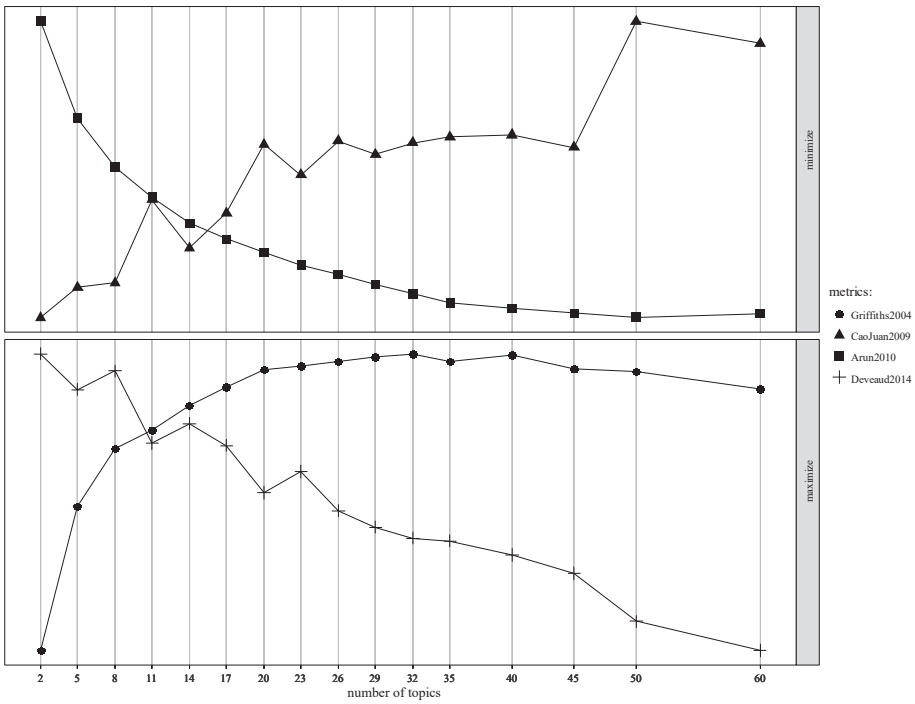

Fig. 2. Searching for the number of topics (ldatuning)

Results of the ldatuning analysis for selecting the optimal number of topics in LDA. The coherence score peaked at approximately 19 topics, supporting the choice of 19 as the most suitable number for topic modeling of the case report discussions.

Table 1 Results of topic estimation

#1		#2		#3		#4		#5	
Word	CR	Word	CR	Word	CR	Word	CR	Word	CR
Improvement	0.281	Discharge	0.325	Change	0.253	Activity	0.502	Self	0.305
Function	0.226	Family	0.198	Daycare	0.231	Time	0.156	Improvement	0.244
Cognition	0.198	Self	0.193	Utilization	0.149	Goal	0.109	Ability	0.156
Disability	0.137	Hospitalization	0.169	Place	0.133	Implementation	0.084	Evaluation	0.112
Implementation	0.073	Condition	0.042	Obtain	0.059	Continuation	0.04	Case	0.039
Issue	0.024	Reassurance	0.018	Outcome	0.045	Patient	0.022	Motivation	0.027
Outcome	0.024	Intervention	0.013	Environment	0.032	Support	0.01	Self	0.025
Experience	0.007	Myself	0.011	Employment	0.014	Understanding	0.01	Change	0.022
Challenge	0.005	Occupational Therapy	0.005	Continuation	0.011	Environment	0.008	Improvement	0.012
Change	0.005	Symptoms	0.003	Possibility	0.011	Possibility	0.008	Self	0.01

#6		#7		#8		#9		#10	
Word	CR	Word	CR	Word	CR	Word	CR	Word	CR
Anxiety	0.361	Work	0.513	Case	0.729	Connection	0.264	Target	0.462
Behavior	0.344	Environment	0.146	Goal	0.072	Possibility	0.204	Treatment	0.263
Reassurance	0.079	Have	0.082	Outcome	0.048	Role	0.144	Engagement	0.071
Experience	0.059	Myself	0.037	Have	0.036	Environment	0.072	Hope	0.03
Have	0.028	Continuation	0.037	Profession	0.029	Goal	0.066	Direct	0.03
Experience	0.025	Connection	0.025	Activity	0.027	Reassurance	0.04	Understanding	0.028
Hospitalization	0.025	Obtain	0.025	Obtain	0.01	Hope	0.032	Profession	0.024
Family	0.009	Case	0.023	Environment	0.007	Challenge	0.029	Importance	0.022
Patient	0.009	Reassurance	0.023	Understanding	0.007	Experience	0.02	Life	0.013
Intervention	0.009	Engagement	0.015	Family	0.005	Sharing	0.02	Work	0.009

#11		#12		#13		#14		#15	
Word	CR	Word	CR	Word	CR	Word	CR	Word	CR
Participation	0.245	Case	0.679	Challenge	0.214	Intervention	0.503	Support	0.533
Experience	0.194	Direct	0.142	Future	0.191	Sharing	0.1	Employment	0.156
Others	0.152	Experience	0.046	Continuation	0.11	Self	0.091	Opportunity	0.107
Outcome	0.114	Motivation	0.043	Condition	0.095	Life	0.081	Continuation	0.059
Self	0.101	Improvement	0.023	Opportunity	0.066	Case	0.071	Profession	0.027
Engagement	0.078	Importance	0.02	Profession	0.064	Evaluation	0.039	Self	0.024
Obtain	0.046	Sharing	0.017	Engagement	0.054	Hope	0.025	Role	0.019
Relationship	0.015	Reassurance	0.006	Life	0.049	Effectiveness	0.017	Change	0.011
Improvement	0.008	Participation	0.003	Hope	0.038	Outcome	0.012	Possibility	0.008
Family	0.005	Hospitalization	0.003	Experience	0.031	Possibility	0.01	Future	0.008

#16		#17		#18		#19	
Word	CR	Word	CR	Word	CR	Word	CR
Case	0.183	Occupational Therapist	0.417	Occupational Therapy	0.373	Life	0.646
Myself	0.177	Relationship	0.361	Symptoms	0.173	Community	0.229
Importance	0.166	Case	0.051	Patient	0.15	Future	0.057
Understanding	0.15	Issue	0.041	Effectiveness	0.132	Intervention	0.023
Life	0.115	Goal	0.022	Participation	0.066	Challenge	0.01
Issue	0.104	Motivation	0.022	Motivation	0.038	Connection	0.01
Hope	0.022	Sharing	0.016	Behavior	0.018	Goal	0.003
Motivation	0.019	Others	0.011	Work	0.015	Disability	0.003
Condition	0.014	Outcome	0.011	Condition	0.005	Employment	0.003
Change	0.014	Hope	0.008	Understanding	0.005	Daycare	0.003

CR: Contribution Rate, which represents the probability that the word belongs to a specific topic.
Nineteen topics identified through LDA topic modeling of the discussion sections of psychiatric occupational therapy case reports. Each topic is characterized by its frequency and primary keywords, reflecting concepts aligned with the ICF framework of Activities and Participation.

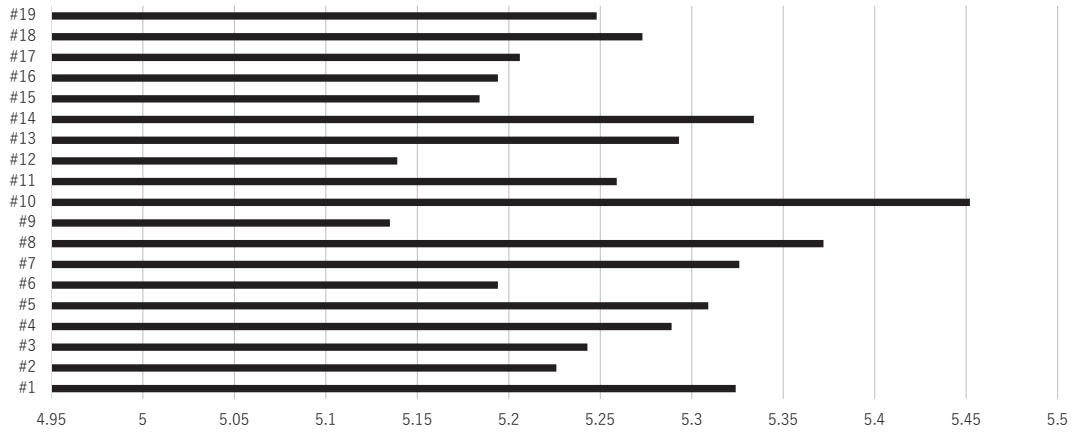

Fig. 3. Contribution Ratios of the 19 Topics Identified through LDA.
Contribution ratios of the 19 topics identified through LDA. Six topics (#10, #8, #14, #1, #5, and #7) showed relatively higher contributions, reflecting key themes such as patient engagement, intervention, recovery, and the role of occupational activities in psychiatric occupational therapy.

In contrast, several topics had relatively low contribution rates, including topics #13, #4, #11, #3, #17, #6, #16 and #9. Topic #3 contained terms such as "change," "daycare," and "utilization," though their frequency was low. Topic #4 was characterized by "activity," "goal," and "implementation," but its overall contribution was limited. Topic #6 included "anxiety," "behavior," and "safety." Topic #9 featured "connection," "environment," and "goal." Topic #11 included "participation," "experience," and "outcome." Topic #13 was composed of "challenges," "future," and "continuation." Topic #16 featured "case," "life," and "change." Topic #17 contained "occupational therapist," "relationship," and "importance."

Across all topics, the words "patient," "case," "intervention," "occupation," and "improvement" appeared frequently across multiple topics. The word "environment" was repeatedly mentioned in multiple topics, such as topics 7 and 8, indicating that environmental factors play a significant role in psychiatric occupational therapy. Additionally, the frequent appearance of "support," "hope," and "potential" suggests that these concepts are central to occupational therapists' reflections in case studies. The distribution of these key terms across topics suggests that the thematic structure of the discussion sections aligns with ICF's Activities and Participation framework (Table 1).

5 Discussion

This study analyzed the discussion sections of 159 psychiatric occupational therapy case study reports registered in the JAOT case report registration system. Using LDA topic modeling, we identified the characteristics of clinical reasoning among occupational therapists. Therapists emphasized key concepts such as "patient," "occupation," "intervention," and "support." Among these, "patient" (Topic #10) had the highest contribution, while "occupation" (Topic #7) and "intervention" (Topic #5) were also prominent. This topic modeling approach directly addresses the fragmented nature of knowledge derived from individual case reports highlighted in the Introduction. By extracting 19 latent and recurring themes across 159 reports, the present analysis provides a systematic conceptual map of psychiatric occupational therapy. For example, the repeated appearance of "environment," "support," and "occupation" across multiple topics demonstrates that these concepts function as core, generalizable domains of practice rather than isolated observations. This integrative framework complements and extends individual case findings and facilitates cumulative knowledge building.

These findings suggest that occupational therapists should focus on understanding patients' needs, implementing suitable interventions, and supporting engagement in meaningful occupations. Discussion sections provide a space to reflect on outcomes, progress, and therapeutic reasoning, offering a direct view of therapists' cognitive processes and aligning with clinical reasoning literature. The lower contribution of topics related to "challenges" and "anxiety" suggests that therapists tend to emphasize the positive aspects of interventions rather than highlighting difficulties. This tendency may reflect a strength-based approach to psychiatric occupational therapy, in which therapists focus on patients' potential and growth rather than their limitations.

Large-scale analyses of psychiatric occupational

therapy remain limited, and this study represents a novel nationwide analysis. This study represents a novel attempt to systematically analyze nationwide psychiatric occupational therapy case studies. A previous study by Suzuki et al. [5] analyzed case reports in stroke rehabilitation but focused on the "purpose of the report" section rather than the discussion section, making its perspective different from this study.

Tsuchisawa et al. [16] noted that psychiatric occupational therapy in Japan is shifting from hospital-centered to community-based care. Our findings align with this trend, highlighting the importance of engagement in meaningful activities and social participation. Evidence on social reintegration of individuals with schizophrenia [17, 18] similarly indicates that occupational therapy, supported employment, and cognitive behavioral therapy (CBT) foster shorter hospital stays and better participation. The current study's results, which show a strong emphasis on "intervention" and "support," are consistent with these findings. Prior systematic reviews and studies likewise report that occupational interventions improve employment and sustain social participation [19, 20].

Additionally, the extracted key concepts such as "patient," "occupation," "intervention," and "support" correspond with the "Activities and Participation" framework in the ICF [21]. Townsend and Polatajko [22] emphasize that integrative interventions, including environmental adjustments, are crucial for achieving health and well-being. These findings suggest that occupational therapists should apply clinical reasoning beyond single-case outcomes by considering holistic interventions that support patients' functional recovery and social participation.

These concepts also align with the Model of Human Occupation (MOHO) [23], which underscores restoring roles, modifying environments, and enhancing performance. MOHO focuses on internal factors such as motivation, habits, and performance capacity, whereas ICF evaluates patients' functioning based on "Activities" and "Participation," incorporating environmental factors [24]. According to Townsend and Polatajko [22], modifying environmental factors plays a vital role in maximizing an individual's potential and facilitating social integration. Studies show that clinical reasoning is shaped by sociocultural and organizational contexts and that therapists make flexible, experience-based decisions [25, 26].

Beyond the Japanese context, our findings resonate with international research on clinical reasoning in psychiatric occupational therapy. Studies from North America and Europe similarly emphasize the integration of client-centered goals, environmental adaptation, and participation-focused interventions [27, 28]. By demonstrating that such elements emerge naturally from topic modeling of Japanese case reports, our study suggests that these reasoning processes represent a cross-cultural foundation of occupational therapy practice.

The policy shift in Japan toward community-based psychiatric care, as promoted by the Ministry of Health, Labor, and Welfare, emphasizes the integration of medical, welfare, and social support systems [29, 30]. Our findings, particularly the importance of "environment" and "support," mirror this policy direction. Recent meta-analyses also show that CBT-based interventions facilitate return to work and reduce sick leave [31]. Other studies underscore that clinical reasoning is shaped by sociocultural factors, organizational structures, and therapists' experiences [26, 32, 33].

To enhance the interpretability, we examined how the extracted topics aligned with the ICF framework. For instance, Topic #1, characterized by keywords such as "Improvement," "Function," and "Cognition," reflects elements of Body Functions and Activities. Topic #5 includes "Self," "Growth," and "Ability," suggesting a focus on Personal Factors and Participation. Additionally, Topic #7, with keywords like "Occupation," "Environment," and "Continuation," corresponds closely to the domain of Activities and Participation, particularly in the context of sustaining meaningful engagement. These associations show how therapists frame client progress beyond functional outcomes to include participation and environmental fit.

Practically, the identified themes—patient, occupation, intervention, and support—offer a structured checklist for daily clinical decision-making. For instance, therapists may (1) assess patient motivation and cognitive function (patient), (2) ensure engagement in meaningful and sustainable activities (occupation), (3) select and adapt evidence-based treatment strategies (intervention), and (4) coordinate social and environmental resources to maintain participation (support). Integrating these checkpoints into routine case conferences or interdisciplinary meetings could enhance the consistency and comprehensiveness of psychiatric occupational therapy services.

5.1 Limitations

This study has certain limitations. First, because the original reports were written in Japanese, nuances may have been lost in translation. The LDA model was based on word co-occurrence without considering context, so extracted topics may not fully capture therapists' cognitive processes and intentions. Findings rely on self-reported case studies that may reflect subjective interpretations or institutional practices and lack direct observational or patient-reported outcomes.

Furthermore, this study focused exclusively on discussion sections without considering patients' perspectives or actual intervention outcomes. While rich in reflective content and directly related to clinical reasoning, other sections may also contain important decision-making information. Future research should incorporate patient feedback, outcome data, and multiple report sections to provide a more comprehensive understanding of clinical reasoning. Exploring therapists' reflections with qualitative methodologies and comparing Japanese with international practices remain important future tasks.

6 Summary

Overall, this study shows that psychiatric occupational therapy extends beyond symptom management to holistic interventions promoting engagement in meaningful activities and social participation. Therapists should focus on individualized interventions, recognize unique needs, and address environmental factors to optimize outcomes. By analyzing nationwide case reports, this study provides empirical evidence supporting clinical reasoning in psychiatric occupational therapy and its alignment with international frameworks. These findings underscore the need for structured, evidence-based intervention strategies to guide practice.

7 Conclusions

This study systematically analyzed the discussion sections of psychiatric occupational therapy case study reports to elucidate clinical reasoning characteristics. The text mining results indicated that occupational therapists emphasize "patient," "occupation," "intervention," and "support," demonstrating reasoning that prioritizes comprehensive support and social participation. Frequent mention of "patient" and "occupation" highlights the importance of assessing conditions and using occupational activities as key interventions, while "intervention" and "support" indicate aims to enhance quality of life and social engagement.

This study provides objective insights into psychiatric occupational therapy and offers valuable implications for practice and education. Future research should integrate patient perspectives and intervention outcomes for a more comprehensive understanding.

Conflict of Interest

The authors have no conflict of interest to declare.

References

[1] Gibson RW, D'Amico M, Jaffe L, Arbesman M. Occupational therapy interventions for recovery in the areas of community integration and normative life roles for adults with serious mental illness: A systematic review. Am J Occup Ther. 2011; 65(3): 247–56, doi:10.5014/ajot.2011.001297.

[2] Gutman SA. Special issue: Effectiveness of occupational therapy services in mental health practice. Am J Occup Ther. 2011; 65(3): 235–7, doi:10.5014/ajot.2011.001339.

[3] Legault E, Rebeiro KL. Occupation as means to mental health: A single-case study. Am J Occup Ther. 2001; 55(1): 90–6, doi:10.5014/ajot.55.1.90.

[4] Roberts PS, Robinson MR. Health policy perspectives—Occupational therapy's role in preventing acute readmissions. Am J Occup Ther. 2014; 68(3): 254–9, doi:10.5014/ajot.2014.683001.

[5] Suzuki M, Tamura T, Tanimura A, Kobayashi N, Naito Y. Analysis of published case reports in the case report registration system using a topic model. Asian J Occup Ther. 2024; 20(1): 70–6, doi:10.11596/asiajot.20.70.

[6] McQuaid L, Thomson K, Bannigan K. Exploring the contribution of case study research to the evidence base for occupational therapy: A scoping review. Syst Rev. 2023; 12: 132, doi:10.1186/s13643-023-02292-4.

[7] Guidelines for case report writing (Ver. 9.0) – General cases (in Japanese) [Internet]. Tokyo: Japanese Association of Occupational Therapists [cited 2025 February 18]. Available from: https://www.jaot.or.jp/files/page/wp-content/uploads/2010/08/tebiki-Ver9.0.pdf.

[8] Hagg LJ, Merkouris SS, O'Dea GA, Francis LM, Greenwood CJ, Fuller-Tyszkiewicz M, et al. Examining analytic practices in latent Dirichlet allocation within psychological science: Scoping review. J Med Internet Res. 2022; 24(11): e33166, doi:10.2196/33166.

[9] Ramon-Gonen R, Dori A, Shelly S. Towards a practical use of text mining approaches in electrodiagnostic data. Sci Rep. 2023; 13(1): 19483, doi:10.1038/s41598-023-45758-0.

[10] Inoue M, Fukahori H, Matsubara M, Yoshinaga N, Tohira H. Latent Dirichlet allocation topic modeling of free-text responses exploring the negative impact of the early COVID-19 pandemic on research in nursing. Jpn J Nurs Sci. 2023; 20(2): e12520, doi:10.1111/jjns.12520.

[11] Danler M, Hackl WO, Neururer SB, Huber L, Pfeifer B. Visualizing nursing narratives: An evaluation of latent Dirichlet allocation topic modeling for care reports. Stud Health Technol Inform. 2024; 316: 1709–13, doi:10.3233/SHTI240752.

[12] Carballo-Costa L, Quintela-Del-Río A, Vivas-Costa J, Costas R. Mapping the field of physical therapy and identification of the leading active producers: A bibliometric analysis of the period 2000–2018. Physiother Theory Pract. 2023; 39(11): 2407–19, doi:10.1080/09593985.2022.2073927.

[13] Karami A, Ghasemi M, Sen S, Moraes MF, Shah V. Ex-

ploring diseases and syndromes in neurology case reports from 1955 to 2017 with text mining. Comput Biol Med. 2019; 109: 322–32, doi:10.1016/j.compbiomed.2019.04.008.

[14] Higuchi K. A two-step approach to quantitative content analysis: KH Coder tutorial using Anne of Green Gables (Part I). Ritsumeikan Soc Sci Rev. 2016; 52(3): 77–91.

[15] Higuchi K. A two-step approach to quantitative content analysis: KH Coder tutorial using Anne of Green Gables (Part II). Ritsumeikan Soc Sci Rev. 2017; 53(1): 137–47.

[16] Tsuchisawa K, Ono K, Kanda T, Kelly G. Japanese occupational therapy in community mental health and telehealth. J Telemed Telecare. 2000; 6(Suppl 2): S79–80, doi:10.1258/1357633001935699.

[17] Oka M, Otsuka K, Yokoyama N, Saito S. An evaluation of a hybrid occupational therapy and supported employment program in Japan for persons with schizophrenia. Am J Occup Ther. 2004; 58(4): 466–75, doi:10.5014/ajot.58.4.466.

[18] Naidu VV, Giblin E, Burke KM, Madan I. Delivery of cognitive behavioural therapy to workers: A systematic review. Occup Med. 2016; 66(2): 112–7, doi:10.1093/occmed/kqv141.

[19] Arbesman M, Logsdon DW. Occupational therapy interventions for employment and education for adults with serious mental illness: A systematic review. Am J Occup Ther. 2011; 65(3): 238–46, doi:10.5014/ajot.2011.001289.

[20] D'Amico ML, Jaffe LE, Gardner JA. Evidence for interventions to improve and maintain occupational performance and participation for people with serious mental illness: A systematic review. Am J Occup Ther. 2018; 72(5): 7205190020p1–9, doi:10.5014/ajot.2018.033332.

[21] International Classification of Functioning, Disability and Health (ICF) [Internet]. Geneva: World Health Organization; 2001.

[22] Townsend E, Polatajko H. Enabling Occupation II: Advancing an Occupational Therapy Vision for Health, Well-being, & Justice through Occupation. Ottawa: CAOT Publications; 2013.

[23] Kielhofner G. Model of human occupation: Theory and application. 4th ed. Lippincott Williams & Wilkins; 2008.

[24] Üstün T, Chatterji S, Bickenbach J, Kostanjsek N, Schneider M. The International Classification of Functioning, Disability and Health: a new tool for understanding disability and health. Disabil Rehabil. 2003; 25(10–11): 565–71, doi:10.1080/0963828031000137063.

[25] Vermeulen P, Lavoie P, Moreau E, Rochette A. Intuition in occupational therapists' clinical reasoning: A scoping review. OTJR (Thorofare N J). 2024: 15394492241300604, doi:10.1177/15394492241300604.

[26] Vermeulen P, Dyer JO, Rochette A. The place of intuition in the clinical reasoning of occupational therapists: A multiple-case study. Health Soc Care Community. 2024: 8385716, doi:10.1155/2024/8385716.

[27] McCannon R, Robertson D, Caldwell J, Juwah C, Elfessi A. Comparison of clinical reasoning skills in occupational therapy students in the USA and Scotland. Occupational Therapy International. 2004; 11(3): 160–176, doi:10.1002/oti.204.

[28] Márquez-Álvarez L-J, Calvo-Arenillas J-I, Talavera-Valverde M-Á, Moruno-Millares P. Professional reasoning in occupational therapy: A scoping review. Occupational Therapy International. 2019; 6238245, doi:10.1155/2019/6238245.

[29] Tamiya N, Noguchi H, Nishi A, Reich MR, Ikegami N, Hashimoto H, et al. Population ageing and wellbeing: lessons from Japan's long-term care insurance policy. Lancet. 2011; 378(9797): 1183–92, doi:10.1016/S0140-6736(11)61176-8.

[30] Tsutsui T, Muramatsu N. Care-needs certification in the long-term care insurance system of Japan. J Am Geriatr Soc. 2005; 53(3): 522–7, doi:10.1111/j.1532-5415.2005.53175.x.

[31] Xu H, Cai J, Sawhney R, Jiang S, Buys N, Sun J. The effectiveness of cognitive-behavioral therapy in helping people on sick leave to return to work: A systematic review and meta-analysis. J Occup Rehabil. 2024; 34(1): 4–36, doi:10.1007/s10926-023-10116-4.

[32] Shafaroodi N, Kamali M, Parvizy S, Hassani Mehraban A, O'Toole G. Factors affecting clinical reasoning of occupational therapists: A qualitative study. Med J Islam Repub Iran. 2014; 28: 8.

[33] Matthews LK, Mulry CM, Richard L. Matthews model of clinical reasoning: A systematic approach to conceptualize evaluation and intervention. Occup Ther Ment Health. 2017; 33(4): 360–73, doi:10.1080/0164212X.2017.1303658.

■ORIGINAL ARTICLE

Concept Analysis of Evidence-Based Practice in Occupational Therapy

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Abstract: Objective: This study aimed to clarify how the concept of evidence-based practice (EBP) has been developed and characterized within the field of occupational therapy.
Methods: This study employed Rodgers' evolutionary method of concept analysis to examine the concept of EBP in occupational therapy. A literature search was conducted using the PubMed, MEDLINE, OTseeker, and Scopus databases to identify relevant peer-reviewed articles. The selected publications were reviewed in detail, and data pertaining to the attributes, antecedents, and consequences of EBP within the context of occupational therapy were extracted and analyzed.
Results: A total of 40 articles were included. The "antecedents" of the concept were categorized as "Social needs" and "Conflict with the medical model," "attributes" as "Essence of occupational therapy" and "Skills for using evidence," and "consequences" as "Professional development." While experiencing conflict with the medical model, the concept of EBP in occupational therapy was developed independently based on "occupation-centered" and "client-centered" occupational therapy.
Conclusions: EBP in occupational therapy integrates diverse evidence-based on the "occupation-centered" and "client-centered" essence of occupational therapy. The definition of EBP can guide the development of occupational therapists' practices, education, and scholarship.

Keywords: advanced practice, client-centered, knowledge translation, evidence-based health care, clinical reasoning

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Introduction

Evidence-based practice (EBP) is an approach to delivering the most current and effective care to clients [1]. EBP emerged from societal needs for high-quality practices, and with the advancement of the internet, it has rapidly evolved [2]. Although EBP originated in the fields of medical treatment and diagnosis, it has extended to various health professions over time [3]. EBP is regarded as an essential concept in today's information-rich society.

In the field of occupational therapy, EBP is also highly valued. It is defined as "client-centered enablement of occupation based on client information and a critical review of relevant research, expert consensus and past experience" [4]. Implementing EBP is expected to promote client support effectiveness, improve cost-efficiency, and contribute to the professional identity of occupational therapists [4].

The concept of EBP in the field of occupational therapy has evolved. It was first introduced to the field in a 1997 article published in the British Journal of Occupational Therapy [5]. In 1998, Egan highlighted the compatibility of client-centered occupational therapy and EBP in the Canadian Journal of Occupational Therapy [6]. EBP was believed to be an ethically essential component of occupational therapy practice by 2000 [7]. Since then, specialized EBP frameworks tailored to the profession have been created, but a general EBP framework that applies to all healthcare professionals has become widely used [3].

However, many occupational therapists experience

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tension between the medical model of EBP, primarily focused on treatment and diagnosis, and the holistic view of occupational therapy [6, 8–10]. Occupational therapy has historically faced challenges that concern its professional identity due to the dominance of the medical model [10, 11]. This background suggests that when practicing EBP, occupational therapists must recognize their unique professional identity [12, 13]. Although many occupational therapists understand the importance of EBP, it is difficult for them to integrate it into their specialized occupational therapy practices [9, 12, 14].

The purpose of this study is to elucidate how the concept of EBP in occupational therapy emerged and developed over time. Understanding these conceptual shifts can guide occupational therapists in practicing EBP alongside other healthcare professionals while maintaining their professional identity. Moreover, it offers a conceptual foundation based on occupational therapy expertise for incorporating various forms of evidence into practice through interdisciplinary collaboration.

Methods

This was a concept analysis study. Concept analysis was performed by using the Rodgers' method. According to the philosophical foundation that supports this method, concepts are viewed as dynamically changing with blurred boundaries, context-dependent, and having some practical utility or purpose rather than an inherent truth [15]. The concept of EBP in the field of occupational therapy has evolved over time [9, 16], and its conceptual boundaries show considerable overlap with client-centered and other occupational therapy theories [6, 12]. Given these characteristics, Rodgers' methodology was chosen for this study.

Procedure and analysis

By using a systematic five-step approach, identified articles on the attributes, antecedents, and consequences of EBP in occupational therapy were collected and analyzed.

Identifying the concept of interest

The concept of interest was defined as "EBP in occupational therapy."

Select relevant documents

The data collection area was set in the field of occupational therapy. Peer-reviewed journals and review articles were the types of data included. In order to ensure comprehensive coverage, no restrictions were placed on the publication period. A literature search was conducted using multiple databases, including PubMed, MEDLINE, Scopus, and OTseeker. To enhance reproducibility, the Boolean search string used in PubMed is presented as an example: ("occupational therapy" OR "evidence-based occupational therapy") AND ("evidence-based practice" OR "evidence-based medicine"). The search terms and operators were adjusted as appropriate for each database.

Study the selection

Studies were included if they focused on occupational therapy and addressed the concept of EBP, including its attributes, antecedents, or consequences. Exclusion criteria comprised studies unrelated to EBP in occupational therapy and empirical studies (e.g., interventional or observational) that lacked a conceptual discussion. The study selection process is presented in Fig. 1. A total of 2,082 records were identified through database searches. After removing 864 duplicates, 1,218 records remained for title and abstract screening, of which 1,142 were excluded. The full texts of 76 studies were then assessed for eligibility. Among these, 4 were excluded due to difficulties in obtaining the full text. Of the remaining 72 studies, 32 were excluded because they did not address the concept of EBP. Consequently, 40 studies were included in the final analysis (Fig. 1). The screening process was conducted independently by the first author and coauthors, with any disagreements resolved through discussion.

Gathering data on the attributes, antecedents, and consequences of the concept

The articles were carefully read, and data on the antecedents, attributes, and consequences of the concept of EBP in occupational therapy were collected. Events or circumstances preceding the occurrence of a concept are referred to as the antecedents, the characteristics and definitions of a concept are called the attributes, and events occurring after the occurrence of a concept are known as consequences [15].

Analyze the data

As recommended by Rodgers' method, data analysis was conducted by using thematic analysis [15]. Thematic analysis was carried out in six phases: familiarizing yourself with the data; coding; generating initial themes; developing and reviewing themes; refining, defining, and naming themes; and writing up [17]. The coding process was guided by three key questions: (1) What are the characteristics of the concept? (2) What are the antecedents of the concept? (3) What are the essential consequences of the concept? The first author primarily conducted the initial coding and thematic devel-

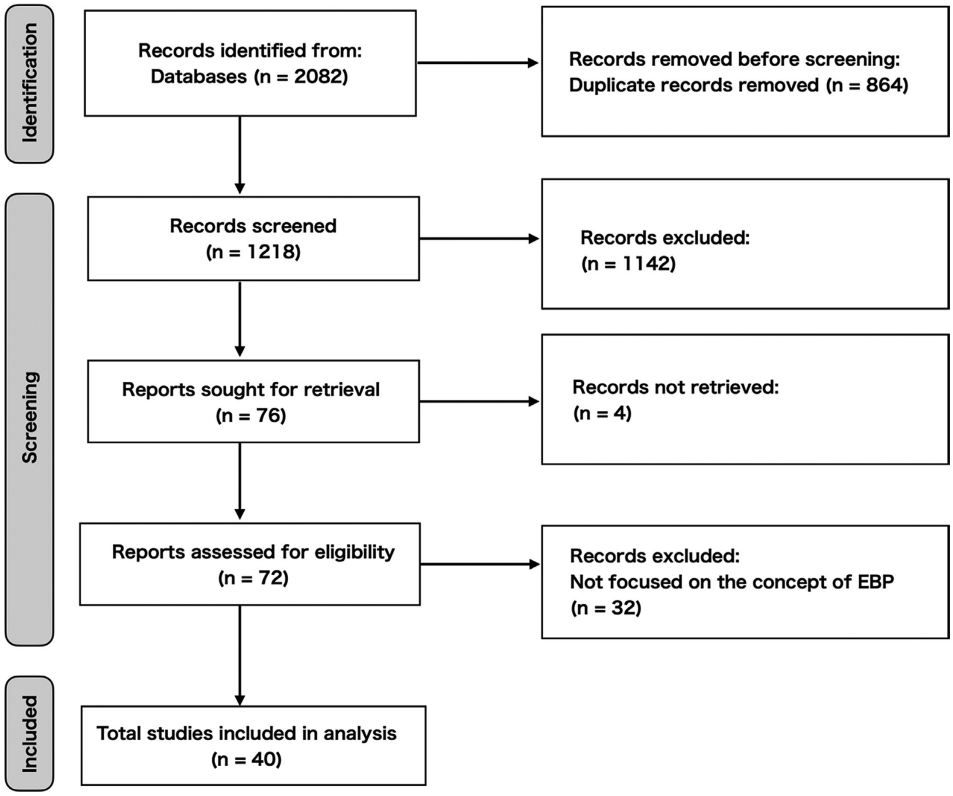

Fig. 1. Flowchart of the literature search and selection process.

opment. All coauthors, who have expertise in qualitative and theoretical research, participated in reviewing and refining the analysis process. Through this collaborative involvement, the analytical rigor and trustworthiness of the findings were ensured.

Results

The analysis included a total of 40 documents (Table 1), published between 1997 and 2020. Of these, 23 were review articles, most of which (n = 16) were published before 2005.

The concept analysis identified several key components. The antecedents included "social needs" and "conflict with the medical model," the attributes consisted of the "essence of occupational therapy" and "skills for using evidence," and the consequence was identified as "professional development" (Fig. 2). The application of the concept was observed in three main contexts that include clinical practice, education, and policy. EBP was primarily applied to support clinical reasoning in clinical practice, particularly in stroke rehabilitation [18]. In educational settings, the concept was utilized to investigate differences in perceptions between clinicians and students and to guide curriculum development for EBP education [19–21]. Within the policy context, EBP was studied in relation to measures and challenges surrounding its dissemination in occupational therapy [7, 13, 22–27].

Antecedents

Social needs

Society demanded that medicine and occupational therapy meet "expectations of best practice," even before the development of EBP in occupational therapy. Moreover, the increasing recognition of the value of "client involvement in healthcare" had a significant impact.

Expectations of the best practice. Clients expect occupational therapists to deliver practices that align with their needs and demonstrate professional competence [19, 28–30]. These expectations emphasize the important role of occupational therapists in ensuring effectiveness, safety, and value, rather than relying solely on experience or subjective opinions [9, 29, 31, 32]. In addition, societies prioritizing cost-effectiveness increasingly demand EBP [4].

Client involvement in healthcare. The importance of client participation in decision-making has been recognized in healthcare [4, 27]. Growing accountability in healthcare has increased client interest in being actively

Table 1 Summary of Analyzed Literature (40 Articles)

Authors	Year	Title	Journal Name
Lloyd-Smith W*	1997	Evidence-Based Practice and Occupational Therapy	British Journal of Occupational Therapy
Taylor MC*	1997	What is Evidence-Based Practice?	British Journal of Occupational Therapy
Egan M et al.*	1998	The Client-Centred Evidence-Based Practice of Occupational Therapy	Canadian Journal of Occupational Therapy
Law M et al.*	1998	Evidence-Based Occupational Therapy	Canadian Journal of Occupational Therapy
Brown GT et al.*	1999	Research utilization models: frameworks for implementing evidence-based occupational therapy practice	Occupational Therapy International
Dubouloz, CJ et al.	1999	Occupational Therapists' Perceptions of Evidence-Based Practice	American Journal of Occupational Therapy
Tickle-Degnen L*	1999	Organizing, Evaluating, and Using Evidence in Occupational Therapy Practice	American Journal of Occupational Therapy
von Zweck C*	1999	The Promotion of Evidence-Based Occupational Therapy Practice in Canada	Canadian Journal of Occupational Therapy
Bennett S et al.*	2000	The process of evidence-based practice in occupational therapy: Informing clinical decisions	Australian Occupational Therapy Journal
Holm MB*	2000	Our Mandate for the New Millennium: Evidence-Based Practice	American Journal of Occupational Therapy
Christiansen C et al.*	2001	Ethical Considerations Related to Evidence-Based Practice	American Journal of Occupational Therapy
Cusick A*	2001	OZ OT EBP 21C: Australian occupational therapy, evidence-based practice and the 21st century	Australian Occupational Therapy Journal
Hammell KW*	2001	Using Qualitative Research to Inform the Client-Centred Evidence-Based Practice of Occupational Therapy	British Journal of Occupational Therapy
Ottenbacher KJ et al.*	2002	Therapists Awake! The Challenge of Evidence-Based Occupational Therapy	American Journal of Occupational Therapy
Bennett S et al.	2003	Perceptions of evidence-based practice: A survey of Australian occupational therapists	Australian Occupational Therapy Journal
Rappolt S*	2003	The Role of Professional Expertise in Evidence-Based Occupational Therapy	American Journal of Occupational Therapy
Tse S et al.*	2004	Evidence-based practice and rehabilitation: occupational therapy in Australia and New Zealand experiences	International Journal of Rehabilitation Research
Cameron KAV et al.	2005	Utilization of evidence-based practice by registered occupational therapists	Occupational Therapy International
Sudsawad P*	2005	A Conceptual Framework to Increase Usability of Outcome Research for Evidence-Based Practice	American Journal of Occupational Therapy
Stube JE et al.	2007	The Acquisition and Integration of Evidence-Based Practice Concepts by Occupational Therapy Students	American Journal of Occupational Therapy
Lopez A et al.	2008	Intervention Planning Facets—Four Facets of Occupational Therapy Intervention Planning: Economics, Ethics, Professional Judgment, and Evidence-Based Practice	American Journal of Occupational Therapy
Dirette D et al.*	2009	Is There Enough Evidence for Evidence-Based Practice in Occupational Therapy?	American Journal of Occupational Therapy
Lin SH et al.*	2010	Facilitating Evidence-Based Practice: Process, Strategies, and Resources	American Journal of Occupational Therapy
Kristensen HK et al.	2011	Aspects affecting occupational therapists' reasoning when implementing research-based evidence in stroke rehabilitation	Scandinavian Journal of Occupational Therapy
Tomlin G et al.*	2011	Research Pyramid: A New Evidence-Based Practice Model for Occupational Therapy	American Journal of Occupational Therapy
DeAngelis TM et al.	2013	Evidence-Based Practice in Occupational Therapy Curricula	Occupational Therapy In Health Care
Hinojosa J*	2013	The Evidence-Based Paradox	American Journal of Occupational Therapy
Thomas A et al.	2013	Research Utilization and Evidence-Based Practice in Occupational Therapy: A Scoping Study	American Journal of Occupational Therapy
Arbesman M et al.*	2014	Using Evidence to Promote the Distinct Value of Occupational Therapy	American Journal of Occupational Therapy
Gustafsson L et al.*	2014	Contemporary occupational therapy practice: the challenges of being evidence based and philosophically congruent	Australian Occupational Therapy Journal
Hamilton AL et al.	2014	Development of an information management knowledge transfer framework for evidence-based occupational therapy	VINE
Mulligan S et al.	2014	An examination of occupation-based, client-centered, evidence-based occupational therapy practices in New Hampshire	Occupational Therapy Journal of Research
Sirkka M et al.	2014	A process for developing sustainable evidence-based occupational therapy practice	Scandinavian Journal of Occupational Therapy
Thomas A et al.	2014	Evidence-based practice supports among Canadian occupational therapists	Canadian Journal of Occupational Therapy
Upton D et al.	2014	Occupational Therapists' Attitudes, Knowledge, and Implementation of Evidence-Based Practice: A Systematic Review of Published Research	British Journal of Occupational Therapy
Samuelsson K et al.	2015	Turning evidence into practice: Barriers to research use among occupational therapists	British Journal of Occupational Therapy
Marr D*	2017	Fostering Full Implementation of Evidence-Based Practice	American Journal of Occupational Therapy
Myers CT et al.	2017	Practitioner Training for Use of Evidence-Based Practice in Occupational Therapy	Occupational Therapy In Health Care
Lindström AC et al.	2018	Evidence-Based Practice in Primary Care Occupational Therapy: A Cross-Sectional Survey in Sweden	Occupational Therapy International
Krueger RB et al.	2020	Occupational Therapists' Implementation of Evidence-Based Practice: A Cross Sectional Survey	Occupational Therapy In Health Care

Articles marked with * are review articles.

Fig. 2. The antecedents, attributes, and related consequences of EBP in occupational therapy.

involved in these decisions [27]. Occupational therapists are encouraged to consider the intentions of clients as a foundational step toward adopting EBP in the field of occupational therapy [7]. Client-centered thinking has long been an integral part of occupational therapy, emphasizing the importance of incorporating it within the context of EBP [6].

Conflict with the medical model

The concept of EBP in occupational therapy originated from the conflict between the medical model and occupational therapy. EBP has its origins in the medical model, which is grounded in a mechanistic paradigm focused on the disease structure rather than the client occupation. On the contrary, the occupational paradigm highlights client-centered and occupation-based practices, which fundamentally oppose the mechanistic paradigm. Historically, the mechanistic paradigm has undermined and brought crises to the occupational paradigm [22, 25, 33, 34]. This divergence in paradigms is a key antecedent of the concept of EBP in the field of occupational therapy.

Different Paradigm. The concept of EBP originated in medicine and was shaped by the scientific revolution [35]. It emerged within a society that embraced the mechanistic paradigm [6]. This paradigm is based on the idea that an individual's ability to engage in occupations is directly influenced by their physical and mental abilities.

Occupational therapy adopts an occupational paradigm rooted in its unique expertise, which reflects fundamental differences from the medical model [25]. According to the occupational paradigm, which adopts a holistic view of the human being, engagement in the occupation supports physical and mental recovery. Consequently, many occupational therapists were hesitant to apply evidence derived solely from quantitative research to their clients [26].

Evidence-based decision-making in occupational therapy was shown to differ significantly from the approaches used for diagnosis, treatment, and prognosis in the medical model [22]. Consequently, occupational therapists often expressed skepticism about adopting EBP derived from the medical model [25, 36].

Importance of capturing meaningful occupation. The importance of capturing the individuality of the client's occupation was considered a precedent for EBP in occupational therapy [26, 36] Occupational therapists highlight supporting the individuality of the client's meaningful occupation [9, 26]. This was also important to distinguish it from the positivist-centered medical model [6]. Moreover, qualitative research was considered a way to understand the complexity of the client's occupation [5, 23].

Attributes

Essence of occupational therapy

EBP in occupational therapy has been recognized as a practice that embodies the essence of the profession, characterized by being "occupation-centered" and "client-centered."

Occupation-centered. EBP in the context of occupational therapy begins with the acquisition of occupation-centered knowledge and skills [19, 21]. It includes the use of occupation-related assessments, interventions, theories, and evidence throughout the practice process [13, 22, 37]. Formulation of problem in EBP should extend beyond physical or mental functioning or disease, which focuses instead on issues that emerge during the observation of occupational performance and interaction with clients [26]. Practitioners can offer support that reflects the unique expertise of occupational therapy, by incorporating occupational therapy theory when addressing problems and utilizing evidence [19, 26]. Occupation-centered EBP is considered as the most effective approach to integrating theory with practice while demonstrating the benefits and effectiveness of occupational therapy [5].

Client-centered. The use of client-centered theory plays a crucial role in EBP in the concept of occupational therapy [38, 39]. EBP in this field emphasizes client-centered occupational therapy to distinguish it from the medical model [10, 25, 34]. While the concept of client-centered occupational therapy is widely accepted, there remains room for discussion regarding its integration within the EBP framework [6]. This is partly because collaboration with clients has become a key component of EBP in the medical field [21]. The evidence used by occupational therapists must align with a client-centered philosophy [21, 36, 40].

Skills for using evidence

EBP in occupational therapy involves the skill of effectively using evidence to facilitate "decision-making for best practices." Occupational therapists are also encouraged to "integrate diverse evidence," which encompasses not only evidence specific to occupational therapy but also insights from other fields.

Decision-making for best practice. To support effective decision-making, occupational therapists need to develop EBP knowledge and skills, which include problem formulation, information gathering, and critical literature review [29, 32, 38, 40–44].

Moreover, they are expected to make informed decisions that not only safeguard the profession but also contribute to reducing healthcare costs [22, 45].

Integrating diverse evidence. Diverse evidence in occupational therapy includes insights from other fields [26, 40, 46]. This means that occupational therapy must adaptably incorporate evidence from fields such as medicine and epidemiology [6]. Knowledge gained through client interaction is regarded as significant evidence for decision-making [7, 24, 47]. Rappolt referred to this as client evidence and proposed a practice framework to integrate it [37]. Since the early days of EBP in the field of occupational therapy, qualitative research has been recommended as a valuable approach [36]. It provides a means to address clients' individuality and analyze the complexity and diversity of occupations [23, 25]. Furthermore, Tomlin and Borgetto proposed an evidence pyramid to incorporate qualitative research into EBP [34]. EBP in occupational therapy should incorporate evidence from different sources, which include the subjectivity of clients [40].

Consequences

Professional development

The concept of EBP in occupational therapy supports the "realization of best practices" across practice, education, and policy. In addition, it fosters "academic development through the accumulation of evidence," further advancing the field.

Realization of best practice. The implementation of EBP in occupational therapy ensures the delivery of the latest and best practices [20, 38, 48]. Occupational therapists can improve client outcomes, enhance cost-effectiveness, and demonstrate the effectiveness of occupational therapy, by practicing EBP [10, 36]. Moreover, it contributes to accumulating clinical experience and developing decision-making skills [19, 24]. Additionally, EBP upholds occupation-centered and client-centered values and philosophies [49], which have significant implications for individual clinical practice, curriculum development in education, and policymaking [20, 24]. EBP in occupational therapy should evolve continually to adapt to the changing needs and expectations of society [29, 36, 41].

Development through the accumulation of evidence. Through insights gained from EBP in the field, the knowledge base specific to occupational therapy can be significantly expanded [38]. EBP promotes advanced scholarly development by necessitating reflection, planning, and action within practice [18, 20, 50]. The growth of EBP in occupational therapy has contributed to a growing body of evidence and a rise in the publication of scientific papers [33]. These developments have not only produced new evidence within the field but have also generated occupation-related research questions [24].

Discussion

To the best of our knowledge, this is the first study to explore EBP in the context of occupational therapy through conceptual analysis. The purpose of this study was to examine how the concept of EBP has evolved within the field of occupational therapy. The innovation of this study lies in demonstrating that EBP in occupational therapy is based on the essence of the profession, including occupation-centered and client-centered practices. In addition, it emphasized that the concept of EBP developed because of a conflict with the medical model. Promoting EBP in occupational therapy not only supports the accumulation of evidence but also fosters the academic development of the discipline. These conceptual developments highlight the crucial role of occupational therapists in advancing EBP by drawing on their unique expertise.

To gain a comprehensive knowledge of the concept of occupational therapy, this study did not restrict the selection of literature by year of publication. Consequently, the concept analysis included literature published over a 26-year period, from 1997 to 2020. Interestingly, most of the literature on the concept of occupational

therapy consists of review articles, the majority of which were published before 2005. This trend reflects the lively debates in the late 1990s and early 2000s surrounding the integration of EBP and occupational therapy expertise after the introduction of EBP into the field [5–7, 11, 24]. Since then, there seems to be a limited number of publications that explicitly address the conceptual development of EBP in occupational therapy. This is likely due to fact that the field of occupational therapy has gradually come to adopt an EBP concept like those used in other specialized disciplines [3].

Importance of occupation-centered and client-centered practices in EBP

This study demonstrated that EBP in occupational therapy is based on the essence of the profession, which is both occupation-centered and client-centered. The implications of this finding are twofold.

First, it helps safeguard occupational therapy expertise, which prevent EBP from leaning toward reductionism. A lack of a clear definition of EBP in occupational therapy has been linked to a potential loss of professional expertise because the concept of EBP is strongly associated with the medical model [8, 25]. The findings of this study align with previous research [7, 11, 25, 38], which emphasized that EBP in occupational therapy must be rooted in the profession's expertise. These insights are essential for avoiding potential crises in occupational therapy expertise that could occur during the implementation of EBP.

Second, the findings provide practical insights for occupational therapists on how to integrate diverse evidence. Although EBP in occupational therapy promotes the inclusion of evidence from different sources [14, 39], this method can sometimes pose difficulties in applying occupational therapy expertise [8, 13, 16]. According to Louise et al. integrating evidence from other fields requires a strong foundation in occupational therapy expertise [33]. This study emphasizes that EBP in occupational therapy incorporates core principles, which include being occupation-centered and client-centered, while utilizing a broad range of evidence [33]. These findings help occupational therapists maintain their professional expertise while practicing EBP effectively.

Suggestions from the background of the development of EBP in occupational therapy

The developmental trajectory of the concept demonstrates compatibility with the medical model paradigm while emphasizing the distinctiveness of EBP in occupational therapy. EBP in this field has evolved despite paradigm differences and conflicts with the medical model. Historically, the influence of the medical model has led to crises of expertise in the academic field of occupational therapy [11, 25]. The findings of this study suggest that EBP in the concept of occupational therapy is rooted in the essence of the profession and incorporates diverse forms of evidence. This idea supports the core practices of occupational therapy while allowing the flexible integration of evidence, including that derived from the medical model.

The concept presented in this study emphasizes the importance of collaboration with clients [6, 26]. Client-centered practice has long been a fundamental component of occupational therapy, prior to the introduction of EBP. Throughout the history of occupational therapy, client-centered approaches have been valued for promoting meaningful collaboration with clients [12]. Similarly, collaboration with clients has been considered as a critical component of EBP in medicine [3, 51]. The alignment of these concepts highlights the significance of practicing EBP through the lens of client-centered occupational therapy.

Promoting EBP in occupational therapy to enhance expertise

The findings of this study have the potential to advance EBP practices, education, and scholarship in occupational therapy. As highlighted in previous research, a lack of consensus on the expertise specific to occupational therapy has impeded the implementation of EBP in the field [12, 38]. This study identified a concept of EBP that aligns with and reflects occupational therapy expertise. Moreover, it showed how occupational therapists can influence the development of educational curricula and inform policy decisions by promoting EBP [14, 20]. EBP grounded in occupational therapy expertise has also been linked to the realization of best practices. These findings highlight the value of the concept of this study as a shared framework for EBP practice and education.

EBP in occupational therapy plays a critical role in generating evidence specific to the field's expertise. The long-standing shortage of evidence supporting occupational therapy has been widely acknowledged [19]. This study demonstrated that EBP can improve the knowledge and skills of occupational therapists while clarifying the role and effectiveness of occupational therapy. These contributions support academic growth and the accumulation of evidence, reinforcing the foundation of the profession.

Limitations

Several conceptual analysis methods are available, and the use of different methods could have yielded

alternative results.

Summary and conclusions

EBP in occupational therapy is an occupation-centered and client-centered practice that integrates diverse forms of evidence. Its development was driven by "social needs" and "conflict with the medical model," which ultimately leads to "professional development." These conceptual shifts emphasize that the significance of EBP in the field of occupational therapy is rooted in the profession's unique expertise.

Disclosure statement

The authors report no potential conflicts of interest.

Declaration of Interest

No funding was received.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

References

[1] Sackett DL, Rosenberg WMC, Gray JAM, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. BMJ. 1996; 312(7023): 71–2.
[2] Djulbegovic B, Guyatt GH. Progress in evidence-based medicine: a quarter century on. Lancet. 2017; 390(10092): 415–23.
[3] Hoffmann T, Bennett S, Del Mar C. Evidence-based practice across the health professions. 3rd ed. Amsterdam: Elsevier; 2017.
[4] Lopez A, Vanner EA, Cowan AM, Samuel AP, Shepherd DL. Intervention planning facets—Four facets of occupational therapy intervention planning: economics, ethics, professional judgment, and evidence-based practice. Am J Occup Ther. 2008; 62(1): 87–96.
[5] Taylor MC. What is evidence-based practice? Br J Occup Ther. 1997; 60(11): 470–4.
[6] Egan M, Dubouloz C-J, Zweck CV, Vallerand J. The client-centred evidence-based practice of occupational therapy. Can J Occup Ther. 1998; 65(3): 136–43.
[7] Holm MB. Our mandate for the new millennium: evidence-based practice. Am J Occup Ther. 2000; 54(6): 575–85.
[8] Greber C, Isbel S. The use of practice evidence by Australian occupational therapists: perspectives and actions. Aust Occup Ther J. 2024, doi:10.1111/1440-1630.12941.
[9] Marr D. Fostering full implementation of evidence-based practice. Am J Occup Ther. 2017; 71(1): 7101100050p1.
[10] Ottenbacher KJ, Tickle-Degnen L, Hasselkus BR. Therapists awake! The challenge of evidence-based occupational therapy. Am J Occup Ther. 2002; 56(3): 247–9.
[11] Murray A, Di Tommaso A, Molineux M, Young A, Power P. Contemporary occupational therapy philosophy and practice in hospital settings. Scand J Occup Ther. 2021; 28(3): 1–12.
[12] Thomas A, Amari F, Mylopoulos M, Vachon B, Menon A, Rochette A. Being and becoming an evidence-based practitioner: Occupational therapists' journey toward expertise. Am J Occup Ther. 2023; 77(5), doi:10.5014/ajot.2023.050193
[13] Gustafsson L, Molineux M, Bennett S. Contemporary occupational therapy practice: the challenges of being evidence based and philosophically congruent. Aust Occup Ther J. 2014; 61(2): 121–3.
[14] Garcia J, Copley J, Turpin M, Bennett S, McBryde C, McCosker JL. Evidence-based practice and clinical reasoning in occupational therapy: a cross-sectional survey in Chile. Aust Occup Ther J. 2020; 68(2), doi:10.1111/1440-1630.12713
[15] Rodgers BL, Knafl KA. Concept development in nursing: foundations, techniques, and applications. Philadelphia: Saunders; 2000.
[16] Canadian Association of Occupational Therapist. Joint position statement on evidence-based occupational therapy (1999 reviewed for currency 2009). https://caot.ca/document/3697/J%20-%20Joint%20Position%20Statement%20on%20Evidence%20based%20OT.pdf
[17] Braun V, Clarke V. Thematic analysis: a practical guide. London: SAGE; 2022.
[18] Kristensen HK, Borg T, Hounsgaard L. Aspects affecting occupational therapists' reasoning when implementing research-based evidence in stroke rehabilitation. Scand J Occup Ther. 2011; 19(2): 118–31.
[19] Myers CT, Lotz J. Practitioner training for use of evidence-based practice in occupational therapy. Occup Ther Health Care. 2017; 31(3): 214–37.
[20] DeAngelis TM, DiMarco TG, Toth-Cohen S. Evidence-based practice in occupational therapy curricula. Occup Ther Health Care. 2013; 27(4): 323–32.
[21] Stube JE, Jedlicka JS. The acquisition and integration of evidence-based practice concepts by occupational therapy students. Am J Occup Ther. 2007; 61(1): 53–61.
[22] Dubouloz C-J, Egan M, Vallerand J, von Zweck C. Occupational therapists' perceptions of evidence-based practice. Am J Occup Ther. 1999; 53(5): 445–53.
[23] Arbesman M, Lieberman D, Metzler CA. Using evidence to promote the distinct value of occupational therapy. Am J Occup Ther. 2014; 68(4): 381.
[24] Bennett S, Bennett JW. The process of evidence-based practice in occupational therapy: informing clinical decisions. Aust Occup Ther J. 2000; 47(4): 171–80.
[25] Hinojosa J. The evidence-based paradox. Am J Occup Ther. 2013; 67(2): e18–e23.
[26] von Zweck C. The promotion of evidence-based occupational therapy practice in Canada. Can J Occup Ther. 1999; 66(5): 208–13.

[27] Dirette D, Rozich A, Viau S. Is there enough evidence for evidence-based practice in occupational therapy? Am J Occup Ther. 2009; 63(6): 782–6.
[28] Tse S, Lloyd C, Penman M, King R, Bassett H. Evidence-based practice and rehabilitation: occupational therapy in Australia and New Zealand experiences. Int J Rehabil Res. 2004; 27(4): 269–74.
[29] Law M, Baum C. Evidence-based occupational therapy. Can J Occup Ther. 1998; 65(3): 131–5.
[30] Lloyd-Smith W. Evidence-based practice and occupational therapy. Br J Occup Ther. 1997; 60(11): 474–8.
[31] Cameron KAV, Ballantyne S, Kulbitsky A, Margolis-Gal M, Daugherty T, Ludwig F. Utilization of evidence-based practice by registered occupational therapists. Occup Ther Int. 2005; 12(3): 123–36.
[32] Brown GT, Rodger S. Research utilization models: frameworks for implementing evidence-based occupational therapy practice. Occup Ther Int. 1999; 6(1): 1–23.
[33] Hamilton AL, Coldwell-Neilson J, Craig A. Development of an information management knowledge transfer framework for evidence-based occupational therapy. VINE J Inf Knowl Manag Syst. 2014; 44(1): 59–93.
[34] Tomlin G, Borgetto B. Research pyramid: a new evidence-based practice model for occupational therapy. Am J Occup Ther. 2011; 65(2): 189–96.
[35] Christiansen C, Lou JQ. Ethical considerations related to evidence-based practice. Am J Occup Ther. 2001; 55(3): 345–9.
[36] Hammell KW. Using qualitative research to inform the client-centred evidence-based practice of occupational therapy. Br J Occup Ther. 2001; 64(5): 228–34.
[37] Rappolt S. The role of professional expertise in evidence-based occupational therapy. Am J Occup Ther. 2003; 57(5): 589–93.
[38] Thomas A, Law M. Research utilization and evidence-based practice in occupational therapy: a scoping study. Am J Occup Ther. 2013; 67(4): e55–e65.
[39] Thomas A, Law MC. Evidence-based practice supports among Canadian occupational therapists. Can J Occup Ther. 2014; 81(2): 79–92.
[40] Samuelsson K, Wressle E. Turning evidence into practice: barriers to research use among occupational therapists. Br J Occup Ther. 2015; 78(3): 175–81.
[41] Lindström A-C, Bernhardsson S. Evidence-based practice in primary care occupational therapy: a cross-sectional survey in Sweden. Occup Ther Int. 2018; 2018(5376764): 1–9.
[42] Bennett S, Tooth L, McKenna K, Rodger S, Strong J, Ziviani J, Mickan S, Gibson L. Perceptions of evidence-based practice: a survey of Australian occupational therapists. Aust Occup Ther J. 2003; 50(1): 13–22.
[43] Sudsawad P. A conceptual framework to increase usability of outcome research for evidence-based practice. Am J Occup Ther. 2005; 59(3): 351–5.
[44] Cusick A. OZ OT EBP 21C: Australian occupational therapy, evidence-based practice and the 21st century. Aust Occup Ther J. 2001; 48(3): 102–17.
[45] Krueger RB, Sweetman MM, Martin M, Cappaert TA. Occupational therapists' implementation of evidence-based practice: a cross sectional survey. Occup Ther Health Care. 2020; 34(3): 1–24.
[46] Sirkka M, Zingmark K, Larsson-Lund M. A process for developing sustainable evidence-based occupational therapy practice. Scand J Occup Ther. 2014; 21(6): 429–37.
[47] Upton D, Stephens D, Williams B, Scurlock-Evans L. Occupational therapists' attitudes, knowledge, and implementation of evidence-based practice: a systematic review of published research. Br J Occup Ther. 2014; 77(1): 24–38.
[48] Mulligan S, White BP, Arthanat S. An examination of occupation-based, client-centered, evidence-based occupational therapy practices in New Hampshire. OTJR (Thorofare N J). 2014; 34(2): 106–16.
[49] Tickle-Degnen L. Organizing, evaluating, and using evidence in occupational therapy practice. Am J Occup Ther. 1999; 53(5): 537–9.
[50] Lin SH, Murphy SL, Robinson JC. Facilitating evidence-based practice: process, strategies, and resources. Am J Occup Ther. 2010; 64(1): 164–71.
[51] Haynes RB. Clinical expertise in the era of evidence-based medicine and patient choice. Evid Based Med. 2002; 7(2): 36–8.

■ORIGINAL ARTICLE

Association between Predicted and Actual Occupational Performance in Patients with Stroke: Analysis Using the Assessment of Client's Enablement at Discharge and the Canadian Occupational Performance Measure after Discharge

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Abstract: Objective: In the convalescent rehabilitation wards, the perceptions of clients and occupational therapists of post-discharge occupational performance are crucial. However, the association between predicted and actual occupational performance in patients with stroke remains unclear. This study aimed to examine the association between predicted and actual occupational performance in patients with stroke in a convalescent rehabilitation ward.
Methods: Twenty patients with stroke were included in the discharge survey, whereas 16 patients participated in the post-discharge survey. All participants, who exhibited no significant cognitive impairments, were scheduled for home discharge in a convalescent rehabilitation ward. The discharge survey collected data on basic demographics, physical and mental function, experience with application or social adjustment practices, occupational typology, Canadian Occupational Performance Measure (COPM) scores, and Assessment of Client's Enablement (ACE) results. In the post-discharge survey, COPM scores for the occupations identified at discharge and the utilization of long-term care insurance were assessed.
Results: A total of 93 and 74 occupations were recorded in the discharge and post-discharge surveys, respectively. ACE client scores were significantly correlated with post-discharge COPM performance ($r = 0.47$) and satisfaction scores ($r = 0.36$). Post-discharge COPM-P ($p < 0.001$) and COPM-S ($p = 0.047$) scores were significantly higher in occupations with practice experiences during their stay in the convalescent rehabilitation ward.
Conclusions: Clients' perception of "engaging in meaningful occupations after discharge" may facilitate the resumption and continuation of occupations. Furthermore, the provision of practice experiences during hospitalization is recommended to enhance post-discharge occupational performance.

Keywords: occupational performance, perception, convalescent rehabilitation wards, stroke, prediction

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1. Introduction

In the convalescent rehabilitation wards, clients (CLs) acquire the mental and physical functions and activities of daily living (ADL) skills necessary to live independently and lead meaningful lives in the community [1]. Consequently, occupational therapists (OTs) in these wards emphasize the importance of understanding, sharing, and supporting CLs' perceptions of their lives after discharge [1]. Occupational therapy, as a client-centered health profession, prioritizes CLs' perceptions of their occupational performance [2]. However, CLs may either overestimate or underestimate their abilities [3], and these perceptions influence the planning and implementation of occupational therapy interventions [4]. To practice client-centered occupational therapy, OTs should understand CLs' perceptions of occupational performance.

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However, OTs provide interventions based on their predictions of CLs' post-discharge occupational performance [5]. They may adjust these interventions according to their perception of CLs' ability to perform occupations [6]. Therefore, OTs' perception of CLs' occupational performance plays a critical role in the effectiveness of occupational therapy.

Furthermore, approximately 90% of patients with stroke demonstrate differences in occupational performance perceptions compared with OTs [7], and reducing the discrepancy between CLs' and OTs' perceptions may contribute to improvements in occupational performance [8]. Thus, understanding these differences is essential for delivering effective occupational therapy.

Based on these findings, the perceptions of CLs and OTs regarding post-discharge occupational performance are critical for effective occupational therapy. Among the tools available to evaluate such perceptions, the Assessment of Client's Enablement (ACE) enables the visualization of CLs' and OTs' perceptions of occupational performance. Using the ACE, perceptions extracted through interviews can be visualized and applied to occupational therapy practice through discussions between CLs and OTs [9]. Indeed, Goto [10] reported that when occupational therapy in a convalescent rehabilitation ward incorporated the ACE to reduce the perception gaps between CLs and OTs, patients maintained their Canadian Occupational Performance Measure (COPM) scores even after discharge. Furthermore, Sawada et al. [11] demonstrated that COPM scores obtained during hospitalization were correlated with perceptions on whether the occupations would be performed after discharge. However, no studies have examined whether the perceptions of predicted occupational performance at discharge are associated with actual occupational performance after discharge. Therefore, this study aimed to clarify the association between predicted and actual occupational performance in patients with stroke in a convalescent rehabilitation ward.

2. Methods

2.1 Participants

The participants for this study were recruited via posters or referrals from the facility staff. Patients with stroke who were scheduled for home discharge without significant cognitive impairments in the convalescent rehabilitation ward. In clinical practice, patients with various medical histories or cognitive impairments are often discharged home. To enhance the clinical applicability of this study and include a broader range of participants, strict inclusion or exclusion criteria based on medical history or cognitive assessments, such as the Mini-Mental State Examination, were not applied. However, to ensure the reliability and validity of interview-based evaluations, only individuals judged by their treating OT to have no significant cognitive impairments and to be capable of participating in data collection were included as participants.

Twenty patients with stroke were enrolled in the discharge survey, whereas 16 patients were enrolled in the post-discharge survey. All participants received written and verbal explanations of the study objectives and protocol and provided written informed consent in accordance with the Declaration of Helsinki. The study was approved by the research ethics review boards of Saiseikai Higashi-Kanagawa Rehabilitation Hospital (approval number: 23–14) and Tokyo Metropolitan University (approval number: 24006).

2.2 Outcome measure

2.2.1 COPM

The COPM [12] is a semi-structured interview in which CLs identify occupations they want, need, or expect to perform and rate the importance of each occupation on a 10-point scale. Subsequently, one to five occupations deemed most important were selected and rated on a 10-point scale for performance (COPM-P) and satisfaction (COPM-S).

2.2.2 ACE

The ACE evaluates the perceptions of CLs and OTs regarding each occupation identified through the COPM and other interviews, serving as a useful tool to facilitate collaboration between CLs and OTs [9]. For each occupation, both the CL and OT respond to the question, "To what extent do you perform this occupation in your daily life under your current physical and mental condition?". The CL response is recorded as the CL score (ACE-CL), and the OT response is recorded as the OT score (ACE-OT). The difference between these scores, referred to as the ACE-GAP, reflects the discrepancy in the perception of occupational performance between CL and OT. The ACE-CL score indicates "the extent to which CL perceive they would perform an occupation in their daily life" and ranges from −100 to +100. Similarly, the ACE-OT score indicates "the extent to which OT perceive that CL would perform the occupation in their daily life" and also ranges from −100 to +100. A score of −100 indicates that the occupation would not be performed, whereas a score of +100 indicates that the occupation would be performed. The ACE-GAP score ranges from −200 to +200, with 0 indicating no difference in the perception of occupational performance between CL and OT. Positive and negative values indicate the direction of discrepancy. However, as this study

focused on the magnitude rather than the direction of the difference in the perceptions of occupational performance between CLs and OTs, the absolute values of the ACE-GAP scores were used. Therefore, in this study, the ACE-GAP scores ranged from 0 to 200. Data were collected in accordance with the ACE implementation manual [12], and the ACE-OT scores were obtained from information provided by the treating OT of each participant.

2.3 Measurement procedure

2.3.1 Discharge survey

Baseline information, including age and sex, presence or absence of a roommate, level of long-term care/support needs, length of time before admission to the convalescent rehabilitation ward (length of pre-stay), and length of stay in the ward, was collected from medical records. In addition, data on physical function (assessed using the Fugl–Meyer Assessment (FMA) [13], Functional Balance Scale (FBS) [14], and Timed Up and Go Test (TUG) [15]), mental and cognitive function (assessed using the Mini-Mental State Examination-Japanese (MMSE-J) [16], Patient Health Questionnaire-9 (PHQ-9) [17], and General Self-Efficacy Scale (GSES) [18]), ADLs (assessed using the Functional Independence Measure (FIM)), and quality of life (assessed using the EuroQOL-5 dimensions-5 levels (EQ-5D-5L) [19]) were collected. In addition to medical record review, semi-structured interviews were conducted approximately 1 week before discharge to collect COPM scores, ACE results, experiences with application or social adjustment practices during the ward stay (practice experience), and occupational typology. For practice experience, the participants were asked, for each occupation identified in the COPM at discharge, whether it had been practiced during the ward stay in either a real-life or simulated setting. The distinction between real-life and simulated practice was determined by whether the occupation was addressed through the Application or Social Adjustment Program of the MTDLP [20]. Responses were recorded in a binary format (“yes” or “no”) for each occupation. For occupational typology, the participants were instructed to classify each occupation identified in the discharge COPM using a binary format (“yes” or “no”), indicating whether it was considered an obligatory occupation (something they had to do) or a desired occupation (something they wanted to do). If both categories applied, the occupation was classified as an “obligatory and desired occupation,” whereas if neither applied, it was categorized as a “non-obligatory and non-desired occupation” [21].

2.3.2 Post-discharge survey

Approximately 1 month after discharge, the COPM-P and COPM-S scores for each discharge occupation, the level of long-term care/support needs, and the use of long-term care insurance were collected.

2.4 Data analysis

Descriptive statistics were calculated for baseline demographic information, physical and mental function, COPM scores at and post-discharge, ACE results at discharge, occupation categories, practice experiences during the ward stay, and occupational typology. To examine the association between post-discharge COPM scores and discharge ACE results, correlations were assessed using Spearman’s rank correlation coefficient. Furthermore, occupations were classified according to the presence or absence of practice experience during the ward stay, and post-discharge COPM scores and discharge ACE results were compared between the two groups using the Mann–Whitney U test. Statistical analyses were performed using IBM SPSS Statistics version 29 (IBM Corp., Armonk, NY, USA), with the significance level set at 5%.

3. Results

3.1 Baseline characteristics of the study participants (Table 1)

In the discharge survey, the participants’ median age was 68 years (interquartile range [IQR], 62–78), with 16 men and 4 women. The median values were as follows: length of pre-stay, 29 days (15–36); length of stay, 87 days (52–150); FMA score, 95 (90–98); FBS score, 52 (47–56); TUG result, 11.2 s (7.9–15.3); MMSE-J score, 29 (26–29); PHQ-9 score, 3 (1–6); GSES score, 10 (8–12); FIM score, 122 (112–124); and EQ-5D-5L score, 0.84 (0.70–0.89).

In the post-discharge survey, the participants’ median age was 71 years (IQR, 60–78), and the sample included 12 men and 4 women. No changes were observed in the level of long-term care/support needs after discharge, and seven participants reported using long-term care insurance.

3.2 Occupational performance status at and after discharge and perceptions at discharge (Table 2)

In total, 93 occupations were analyzed in the discharge survey and 74 in the post-discharge survey. The median number of occupations per patient was 5 (IQR, 4–5) for both surveys.

In the discharge survey, the occupations were categorized as 27 (29%) self-care, 29 (31.2%) productive activities, and 37 (39.8%) leisure activities. In the post-

Table 1 Baseline characteristics of the study participants

	Median (interquartile range)
Age (year)	68 (62–78)
Sex (no. of individuals)	
Male	16
Female	4
Roommate (no. of individuals)	
Presence	16
Absence	4
Level of long-term care/support need (no. of individuals)	
Unused	7
Requiring support 1	0
Requiring support 2	5
Requiring long-term care 1	0
Requiring long-term care 2	2
Requiring long-term care 3	1
Requiring long-term care 4	4
Requiring long-term care 5	1
Length of pre-stay (day)	29 (15–36)
Length of stay (day)	87 (52–150)
Physical and mental function	
FMA (score)	95 (90–98)
FBS (score)	52 (47–56)
TUG (seconds)	11.2 (7.9–15.3)
MMSE-J (score)	29 (26–29)
PHQ-9 (score)	3 (1–6)
GSES (score)	10 (8–12)
FIM (score)	122 (112–124)
EQ-5D-5L (score)	0.84 (0.70–0.89)

FMA, Fugl–Meyer-Assessment; FBS, Functional Balance Scale; TUG, Timed Up and Go Test; MMSE-J, Mini-Mental State Examination-Japanese; PHQ-9, Patient Health Questionnaire-9; GSES, General Self-Efficacy Scale; FIM, Functional Independence Measure; EQ-5D-5L, EuroQOL-5 dimensions-5 levels

Table 2 Occupational performance status at and after discharge and perceptions at discharge

	Discharge survey		Post-discharge survey	
	Median (interquartile range)	%	Median (interquartile range)	%
Occupations per patient (no. of occupations)	5 (4–5)		5 (4–5)	
Occupation categories (no. of occupations)				
Self-care	27	29	20	27
Productive activities	29	31.2	26	35.1
Leisure activities	37	39.8	28	37.8
Practice experience (no. of occupations)[1]				
Yes	48	51.6	36	48.6
No	45	48.4	38	51.4
Occupational typology (no. of occupations)[1]				
Obligatory occupation	15	16.1	14	18.9
Desired occupation	30	32.2	19	25.7
Obligatory and desired occupation	46	49.5	40	54.1
Nonobligatory and non-desired occupation	2	2.2	1	1.3
Status of occupational performance				
COPM-P (score)[2]	8 (5–9)		7 (5–9)	
COPM-S (score)[2]	7 (5–9)		7 (5–10)	
ACE				
ACE-CL (score)[1]	85 (44–100)		—	
ACE-OT (score)[1]	59 (28–100)		—	
ACE-GAP (score)[1]	39 (12–69)		—	

COPM, Canadian Occupational Performance Measure; ACE, Assessment of Client's Enablement; COPM-P, Performance score of COPM; COPM-S, Satisfaction score of COPM; ACE-CL, CL score of ACE; ACE-OT, OT score of ACE; ACE-GAP, GAP score of ACE

[1] Data collection was only conducted at the time of discharge.

[2] In this study, COPM scores were analyzed by treating the scores for each occupation as independent measures.

Table 3 Association between post-discharge COPM scores and discharge ACE results

	Post-discharge COPM-P scores		Post-discharge COPM-S score	
	Correlation coefficient	*p*	Correlation coefficient	*p*
ACE-CL	0.47	< 0.001	0.36	0.002
ACE-OT	0.19	0.1	0.1	0.41
ACE-GAP	−0.17	0.14	−0.09	0.46

COPM, Canadian Occupational Performance Measure; ACE, Assessment of Client's Enablement; COPM-P, Performance score of COPM; COPM-S, Satisfaction score of COPM; ACE-CL, CL score of ACE; ACE-OT, OT score of ACE; ACE-GAP, GAP score of ACE
To examine the correlation between post-discharge COPM scores and ACE results, Spearman's rank correlation coefficient test was performed.

Table 4 Comparison of post-discharge COPM scores and discharge ACE results according to practice experience during the convalescent rehabilitation ward stay

	Occupations with practice experience	Occupations without practice experience	*p*
	Median (interquartile range)	Median (interquartile range)	
Post-discharge COPM-P[1]	8 (7–10)	6 (4–8)	< 0.001
Post-discharge COPM-S[1]	8 (6–10)	6 (4–9)	0.047
ACE-CL[2]	100 (62–100)	67 (19–10)	0.06
ACE-OT[2]	72 (31–100)	52 (28–83)	0.09
ACE-GAP[2]	34 (5–68)	41 (15–72)	0.34

COPM, Canadian Occupational Performance Measure; ACE, Assessment of Client's Enablement; COPM-P, Performance score of COPM; COPM-S, Satisfaction score of COPM; ACE-CL, CL score of ACE; ACE-OT, OT score of ACE; ACE-GAP, GAP score of ACE
The Mann–Whitney U test was performed to compare the post-discharge COPM scores and discharge ACE results according to practice experience during the convalescent rehabilitation ward stay.
[1] Analysis was performed on the 74 occupations reassessed on the post-discharge survey in this study.
[2] Analysis was performed on the 93 occupations identified from the discharge survey in this study.

discharge survey, the distribution was 20 (27%) self-care, 26 (35.1%) productive activities, and 28 (37.8%) leisure activities. Examples of occupations identified through the COPM included self-care (e.g., bathing, dressing, and toileting), productivity (e.g., cooking, laundry, and shopping), and leisure (e.g., walking, dining out with family, and caring for grandchildren). At discharge, 48 occupations (51.6%) had been practiced through application or social adjustment programs, whereas 45 (48.4%) had not. In the post-discharge survey, 36 occupations (48.6%) had been practiced during the ward stay, whereas 38 (51.4%) had not. With regard to occupational typology, the discharge survey identified 15 (16.1%) "obligatory occupations," 30 (32.2%) "desired occupations," 46 (49.5%) "obligatory and desired occupations," and 2 (2.2%) "non-obligatory and non-desired occupations." In the post-discharge survey, 14 (18.9%) were "obligatory occupations," 19 (25.7%) were "desired occupations," 40 (54.1%) were "obligatory and desired occupations," and 1 (1.3%) was a "non-obligatory and non-desired occupation."

3.3 Association between post-discharge COPM scores and discharge ACE results (Table 3)

A significant correlation was observed between post-discharge COPM-P scores and discharge ACE-CL scores ($r = 0.47$, $p < 0.001$), whereas no significant correlation was found between discharge ACE-OT scores ($r = 0.19$, $p = 0.1$) and ACE-GAP scores ($r = -0.17$, $p = 0.14$) (Table 3). Moreover, post-discharge COPM-S scores were significantly correlated with discharge ACE-CL scores ($r = 0.36$, $p = 0.002$), whereas no significant correlation was found between discharge ACE-OT scores ($r = 0.1$, $p = 0.41$) and ACE-GAP scores ($r = -0.09$, $p = 0.46$).

3.4 Comparison of post-discharge COPM scores and discharge ACE results according to practice experience during the convalescent rehabilitation ward stay (Table 4)

Post-discharge COPM-P ($p < 0.001$) and post-discharge COPM-S ($p = 0.047$) scores were significantly higher in occupations that had application or social adjustment practice experience during the ward stay. By contrast, no significant differences were observed in discharge ACE-CL ($p = 0.06$), ACE-OT ($p = 0.09$), and

ACE-GAP ($p = 0.34$) scores.

4. Discussion

4.1 Baseline characteristics of the participants and their perception of occupational performance at discharge

In this study, the median FMA score was > 80, indicating a mild level of paralysis [22]. The median FBS score exceeded the cutoff range of 46.5–50.5, suggesting a low risk of falls after stroke [23]; and the median TUG result was below the cutoff of 15–19 s, further indicating reduced fall risk [23]. The median MMSE-J score was above the cutoff of 24 [16], and the median PHQ-9 score was ≤ 4, reflecting the absence of depressive symptoms [17]. The median GSES score was within the "normal" range on the 5-point scale [18]. In addition, the median FIM score was 122, indicating a high level of independence in ADL, whereas the median EQ-5D-5L score was comparable to the mean score of 0.93 reported in individuals aged 60–69 years [24]. Taken together, these findings suggest that the study participants maintained relatively high physical and mental function and a high degree of independence in self-care. Because the study included only patients scheduled for home discharge, judged by their treating OT to have no cognitive impairments, and deemed capable of participating in data collection, the sample likely consisted of individuals with above-average function. This may explain why many of the occupations identified were related to productive and leisure activities other than self-care.

The median discharge ACE-CL, ACE-OT, and ACE-GAP scores were 85, 59, and 39, respectively. This indicates that although OTs perceived that CLs would perform occupations after discharge, CLs themselves anticipated performing occupations in daily life more positively than OTs perceived. This discrepancy may have contributed to differences in the perception of occupational performance between CLs and OTs. Furthermore, Schkade et al. [25] described the concept of "occupational challenge," referring to a CL's willingness to engage creatively in adapting to obligatory occupations expected by others and to desired occupations, even in the presence of difficulties. In this study, more than 90% of the occupations identified were classified as "obligatory" or "desired" occupations, suggesting that the participants were in a state of occupational challenge, characterized by a strong desire to perform occupations after discharge. Moreover, Moroboshi et al. [26] reported that being in a state of occupational challenge facilitated occupational participation even when physical function declined. This suggests that the participants in this study were in a state of occupational challenge, which may have contributed to their strong motivation for post-discharge occupational participation and to their positive perception of "performing the occupation in their daily life."

However, in this study, OTs perceived a lower likelihood of CLs performing occupations in daily life after discharge compared with CLs themselves. Kawakami et al. [27] reported that approximately 40% of patients with stroke who were able to walk independently at home experienced a fall within 6 months after discharge, indicating that even individuals with high self-care abilities remain at risk of falling in daily life. Based on such evidence and clinical experience, OTs may have considered the potential risks faced by CLs after discharge when rating the ACE, which could have resulted in lower ACE-OT scores compared with ACE-CL scores. Furthermore, most occupations identified in this study were instrumental ADL (IADL) related to productive and leisure activities, which are generally more challenging than self-care [28]. These findings suggest that OTs may have regarded certain desired occupations as difficult to perform in their daily life from a risk management perspective. This perception may have contributed to the tendency for discharge ACE-OT scores to be lower than discharge ACE-CL scores.

4.2 Correlation between post-discharge COPM scores and discharge ACE results

This study showed that discharge ACE-CL score was significantly correlated with both post-discharge COPM-P and post-discharge COPM-S scores. Borell et al. [29] reported that individuals who maintained a positive interest and outlook on occupations tended to continue engaging in previously performed occupations even as their physical function declined. Similarly, Fukuda et al. [30] found that motivation and a sense of competence were important for patients with stroke in developing occupations after discharge and that positive predictions promoted engagement in new occupations. A high discharge ACE-CL score therefore reflects a state in which CLs anticipate performing the occupations after discharge and possess positive expectations, motivation, and a sense of competence toward them. These findings suggests that adjusting the level of occupational difficulty and selecting appropriate tools before discharge is essential. Such preparation may support patients in resuming and sustaining their occupation after discharge, while reinforcing positive expectations, motivation, and competence.

However, this study did not identify a significant correlation between discharge ACE-OT or ACE-GAP scores and post-discharge COPM scores. Anderson et al. [8] reported that smaller differences in the perceptions of occupational performance between CLs and OTs

were associated with better occupational outcomes, and the results of this study differed from those of previous studies. Engel et al. [3] noted that 28%–97% of patients with brain injury exhibited self-perception deficits, often overestimating or underestimating their own abilities. Such impairments in self-perception may also influence discrepancies between CL and OT perceptions in patients with stroke. However, the study participants generally demonstrated relatively high physical and mental function and a high degree of independence in self-care, suggesting that they may have had comparatively accurate self-perceptions. Furthermore, Ikeda et al. [31] reported that patients with stroke admitted to convalescent rehabilitation wards adapted through occupations, learning new ways to engage in meaningful activities that fit their post-stroke bodies and circumstances. This implies that CLs may adaptively perform occupations through trial and error in real-life contexts. Therefore, even if the CL is perceived by the OT as having difficulty performing occupations at the time of discharge, the CL may still be able to carry them out in real-life settings. However, hospitals may restrict opportunities for practicing occupations in real-life settings due to financial and other constraints. When such limitations exist, OTs may have difficulty understanding the occupational context of CLs, making it more difficult to predict whether CLs will perform occupations after discharge. Consequently, CLs are able to predict their post-discharge occupational performance based on their lived experiences, whereas OTs may rely on incomplete contextual understanding when making such predictions. The occupations examined in this study were diverse, which may have made it difficult for OTs to accurately predict whether "CLs would perform them after discharge" based solely on physical and mental status at the time of discharge. This limitation may explain why significant correlations were observed between discharge ACE-CL scores and post-discharge COPM scores but not between discharge ACE-OT or ACE-GAP scores and post-discharge COPM scores. These findings suggest that differences in the perceptions of occupational performance between CLs and OTs may not necessarily pose a problem, as their impact depends on the accuracy of CLs' self-perception and the nature of the occupations performed. Accordingly, careful consideration of CL and OT perspectives is warranted when evaluating occupational performance.

4.3 Comparison by practice experience during their stay in a convalescent rehabilitation ward

This study showed that post-discharge COPM-P and COPM-S scores were significantly higher in the group that engaged in application or social adjustment practice experiences during the convalescent rehabilitation ward stay. Nomura et al. [32] reported that the actual frequency of IADL performance after discharge was lower than the frequency predicted by patients with stroke admitted to a convalescent rehabilitation ward at discharge. Furthermore, Kimura et al. [33] found that COPM-P and COPM-S scores in patients with stroke admitted to a convalescent rehabilitation ward were significantly lower at 1 month after discharge than at the time of discharge. These findings suggest that occupational performance after discharge may be lower than that predicted by CLs at discharge from a convalescent rehabilitation ward. However, this study demonstrated that post-discharge COPM-P and post-discharge COPM-S scores were significantly higher for occupations that had been practiced before discharge. These results suggest that engaging in occupational performance practice during the convalescent rehabilitation ward stay may facilitate the resumption and continuation of occupational performance after discharge.

By contrast, although discharge ACE-CL and ACE-OT scores tended to be higher for occupations with greater practical experience, the differences were not significant. Aihara et al. [34] reported that patients with stroke developed an understanding of their physical and mental functions and life abilities through specific occupational performance practices during hospitalization, which enabled them to anticipate their self-adapted lives after discharge. However, Kaneno et al. [35] noted that IADL practice was not fully implemented in the convalescent rehabilitation wards due to environmental constraints and characteristics of the medical care system, with approximately 30% of OTs providing practice for each activity only once. In the present study, the most common occupations identified were leisure activities, many of which were difficult to perform in hospital settings. Therefore, even when patients had the opportunity to practice occupational performance in real-life settings, the limited amount of practice may have hindered CLs from accurately predicting their post-discharge lives and adapting to their condition. This may explain the absence of significant differences in discharge ACE results between occupations that were practiced and those that were not. Thus, OTs must provide CLs with sufficient opportunities for occupational performance in real-life or simulated settings during the convalescent rehabilitation ward stay to help CLs better anticipate their post-discharge lives.

5. Limitations and future studies

This study was conducted at a single facility and included participants with relatively high physical and mental function, all of whom were scheduled for home

discharge. This likely reflects the inclusion of only individuals deemed to have no significant cognitive impairments and to be capable of participating in the data collection by the treating OT. Therefore, the generalizability of the findings may be limited. Future studies should include participants from multiple facilities and include individuals with a broader range of physical and cognitive abilities. Furthermore, although a significant correlation was observed between post-discharge COPM scores and discharge ACE-CL scores, the causal relationship remains unclear and warrants further investigation. Future research should also account for factors such as the age and clinical experience of OTs.

6. Conclusion

This study examined the association between predicted and actual post-discharge occupational performance in patients with stroke. CLs' perception of "engaging in meaningful occupations after discharge" may support the resumption and continuation of occupational performance. Moreover, engaging in application or social adjustment practice during the convalescent rehabilitation ward stay are important for improving post-discharge occupational performance.

Conflict of interest

The authors have no conflict of interest to declare.

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References

[1] Japanese Association of Occupational Therapists [Internet]. Japan: Sagyorouhoushi tte donnna shigoto? [What is Occupational Therapist? (in Japanese)] [cited 2024 Dec 5]. Available from: https://www.jaot.or.jp/ot_job/.

[2] World Federation of Occupational Therapists [Internet]. Australia: About Occupational Therapy [cited 2024 Nove 13]. Available from: https://wfot.org/about/about-occupational-therapy.

[3] Engel L, Chui A, Goverover Y, Dawson DR. Optimizing activity and participation outcomes for people with self-awareness impairments related to acquired brain injury: an interventions systematic review. Neuropsychol Rehabil. 2019; 29(2): 163–98.

[4] Plant SE, Tyson SF, Kirk S, Parsons J. What are the barriers and facilitators to goal-setting during rehabilitation for stroke and other acquired brain injuries? A systematic review and meta-synthesis. Clin Rehabil. 2016; 30(9): 921–30.

[5] Lam Wai Shun P, Swaine B, Bottari C. Clinical reasoning underlying acute care occupational therapists' assessment of rehabilitation potential after stroke or brain injury: A constructivist grounded theory study. Aust Occup Ther J. 2022; 69(2): 177–89.

[6] Kaneno T, Aida T. Introduction criteria and issues in implementing instrumental activities of daily living (IADL) practice for occupational therapists in a rehabilitation ward for recovery phase (in Japanese). J Japan Acad Health Sci. 2024; 27(3): 138–47.

[7] Sansonetti D, Fleming J, Patterson F, De Lacy L, Lannin NA. Factors associated with self-awareness impairment in an inpatient brain injury rehabilitation cohort. Brain Inj. 2024; 38(9): 699–707.

[8] Anderson RL, Doble SE, Merritt BK, Kottorp A. Assessment of awareness of disability measures among persons with acquired brain injury. Can J Occup Ther. 2010; 77(1): 22–9.

[9] ACE [Internet]. Japan: ACE toha? [What is ACE? (in Japanese)]. [cited 2023 Nov 17]. Available from: https://aceprojects15.wixsite.com/aceproject.

[10] Goto N. Examination of the clinical usefulness of ACE for participation in occupation after discharge —an example of practice focusing on occupational gaps— (in Japanese). Jpn J Clin Occup Ther (nihon rinsyou sagyouryouhou kenkyu). 2020; 7: 89–94.

[11] Sawada T, Kitahashi T, Kose A, Ashby S, Karamatsu Y, Ohno K et al. Reliability and validity of the Assessment of Client's Enablement (ACE). Br J Occup Ther. 2018; 81(7): 369–75.

[12] Law M, Baptiste S, McColl M, Opzoomer A, Polatajko H, Pollock N. The Canadian occupational performance measure: an outcome measure for occupational therapy. Can J Occup Ther. 1990; 57(2): 82–7.

[13] Amano S, Umeji A, Uchita A, Hashimoto Y, Takebayashi T, Takahashi K, et al. Clinimetric properties of the Fugl-Meyer assessment with adapted guidelines for the assessment of arm function in hemiparetic patients after stroke. Top Stroke Rehabil. 2018; 25(7): 500–8.

[14] Berg K, Wood-Dauphinée S, Williams JI, Gayton D. Measuring balance in the elderly: Preliminary development of an instrument. Physiother Can. 1989; 41(6): 304–11.

[15] Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991; 39(2): 142–8.

[16] Sugishita M, Koshizuka Y, Sudou S, Sugishita K, Hemmi I, Karasawa H, et al. The validity and reliability of the Japanese version of the Mini-Mental State Examination (MMSE-J) with the original procedure of the attention and calculation task (2001) (in Japanese). Jpn J Cogn Neurosci (Ninchishinkeikagaku). 2018; 20(2): 91–110.

[17] Muramatsu K, Miyaoka H, Kamijima K, Muramatsu Y, Tanaka Y, Hosaka M, et al. Performance of the Japanese version of the Patient Health Questionnaire-9 (J-PHQ-9)

for depression in primary. Gen Hosp Psychiatry. 2018; 52: 64–9.
[18] Sakano Y, Tojo M, Fukui I, Komatsu C. GSES: General Self-Efficacy Scale Manual (in Japanese). Tokyo: Kokoro net Co., Ltd; 2006.
[19] Ikeda S, Shiroiwa T, Igarashi A, Noto S, Fukuda T, Saito S, et al. Developing a Japanese version of the EQ-5D-5L value set (in Japanese). J Natl Inst Public Health (hokeniryokagaku). 2015; 64(1): 47–55.
[20] Japanese Association of Occupational Therapists. Management tool for daily life performance, 2nd ed (in Japanese). Tokyo: Ishiyaku Publishers, Inc; 2020.
[21] Kobayashi N. A study on the meaning of occupations constituting daily life: analogizing daily life through obligatory and desired occupations (in Japanese). (Unpublished version; Doctoral thesis, Department of Health Sciences, Graduate School of Health Sciences, Hiroshima University). 2004.
[22] Duncan PW, Goldstein LB, Horner RD, Landsman PB, Samsa GP, Matchar DB. Similar motor recovery of upper and lower extremities after stroke. Stroke. 1994; 25(6): 1181–8.
[23] Matsumoto D, Fujita T, Kasahara R, Tsuchiya K, Iokawa K. Screening cutoff values to identify the risk of falls after stroke: a scoping review. J Rehabil Med. 2024; 56: jrm40560.
[24] Shiroiwa T, Noto S, Fukuda T. Japanese population norms of EQ-5D-5L and health utilities index mark 3: disutility catalog by disease and symptom in community settings. Value Health. 2021; 24(8): 1193–202.
[25] Schkade JK, Schultz S. Occupational adaptation: toward a holistic approach for contemporary practice, part 1. Am J Occup Ther. 1992; 46: 829–37.
[26] Morohoshi N, Kyougoku M. Analysis of structural relationships among occupational challenge, occupational participation, occupational dysfunction, depression, and health-related QOL in community dwelling elderly with physical disabilities (in Japanese). Jpn J Occup Ther (sagyouryouhou). 2019; 38(3): 294–303.
[27] Kawakami K, Wada Y, Tamura E, Ito M, Tanaka W, Terahashi T, et al. A study of fal1-prediction factors of patients with stroke after their discharge from recovery rehabilitation unit: for those patients with stroke whom can independently walk at home (in Japanese). J Jpn Phys Ther Assoc (rigakuryouhou). 2012; 39(2): 73–81.
[28] Fisher AG, Jones KB. Assessment of motor and process skills 7th edition, revised, vol. 1: development, standardization, and administration manual. Three Star Press, Fort Collins; 2012.
[29] Borell L, Lilja M, Svidén GA, Sadlo G. Occupations and signs of reduced hope: an explorative study of older adults with functional impairments. Am J Occup Ther. 2001; 55(3): 311–6.
[30] Fukuda H, Yoshikawa H. Developing post-stroke occupations and occupational performance (in Japanese). Jpn J Occup Ther (sagyouryouhou). 2013; 32(3): 221–32.
[31] Ikeda K, Sasada S. The influence of subjective experience of stroke hemiplegic patients on occupation in a recovery rehabilitation ward (in Japanese). Jpn J Occup Ther (sagyouryouhou). 2020; 39(4): 433–41.
[32] Nomura M, Yaeda J. Comparing of performed IADL of patients at hospital pre-admission and post-discharge with the predictive IADL upon discharge in recovery phase rehabilitation wards (in Japanese). Jpn J Occup Ther (sagyouryouhou). 2021; 40(1): 12–20.
[33] Kimura N, Yoshino M, Sawada T, Ogawa M. Occupational performances of community dwelling patients after discharge from a convalescent rehabilitation hospital using the Canadian Occupational Performance Measure (in Japanese). Jpn J Compr Rehabil. 2017; 18(2): 134–42.
[34] Aihara S, Tanimura A. Transformation of life cognition of stroke patients after discharge during admission to the convalescent ward: An analysis of the Trajectory Equifinality Approach (in Japanese). Jpn J Occup Ther (sagyouryouhou). 2022; 41(3): 285–93.
[35] Kaneno T, Aida T. A survey of training conditions for instrumental activities of daily living in a recovery rehabilitation unit (in Japanese). Jpn J Occup Ther (sagyouryouhou). 2024; 43(2): 203–12.

Malignant Giant Cell Tumor of the Wrist with Subsequent Flexor Pollicis Longus Rupture: A Case Report and Rehabilitation Outcomes

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Abstract: Background: Malignant giant cell tumor of bone (MGCTB) is a rare and challenging tumor characterized by malignant atypical cells within a benign giant cell tumor structure. Due to its scarcity and unique pathology, MGCTB lacks established treatment protocols, presenting difficulties in clinical management and postoperative care.
Case Presentation: A 59-year-old male presented with MGCTB in the wrist, for which he underwent wide tumor resection and allogeneic bone grafting. One year post-surgery, the patient experienced a rupture of the right flexor pollicis longus (FPL) tendon, presenting as an inability to flex his right thumb during daily activities. Following tendon grafting surgery, a modified Kleinert protocol was initiated on the first postoperative day, with active motion exercises starting on day 23. Despite extensive rehabilitation efforts, including the use of a wrist splint and range-of-motion exercises, bone fusion remained incomplete after one year. To improve functional outcomes, a specialized brace supporting wrist extension and joint rotation was introduced, complemented by graded splinting in occupational therapy (OT). Upon completing OT, the Musculoskeletal Tumor Society (MSTS) score improved from 16/30 (53%) to 24/30 (80%), and the Toronto Extremity Salvage Score (TESS) increased from 10.8/100 to 48.3/100. The patient regained adequate hand function for daily activities, allowing him to return to work post-OT.
Conclusion: Despite the absence of complete bone fusion, graded splinting and OT significantly improved hand function and facilitated a timely return to work in this rare MGCTB case. This report highlights the critical role of rehabilitation in managing MGCTB patients facing complex postoperative challenges.

Keywords: giant cell tumor of bone, tendon ruputure, cancer rehabilitaion

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Introduction

Giant cell tumor of bone (GCTB) is typically a benign, locally aggressive neoplas [1].However, its malignant counterpart (MGCTB) is rare and poses unique therapeutic challenges due to the presence of sarcomatous components within the conventional GCTB structure. Literature on MGCTB is limited, mostly consisting of small case series or individual reports [2–5]. In cases of benign giant cell tumor of bone (GCTB) in the forearm and wrist, which are more common, the standard procedure is to begin rehabilitation gradually after the removal of postoperative fixation, following extensive resection and autologous bone graft reconstruction. In cases of MGCTB occurred in long bones (femur, tibia) or the spine, extensive resection of the tumor and bone tissue is the basic approach. Following surgical resection, including the stump, many cases aim to preserve function using artificial bone heads or endoprostheses. However, in cases where GCTB occurs in the bones of the wrist, appropriate treatment methods are not clearly established due to the structural complexity of the area, including the presence of complex flexor and extensor muscles, and the course of nerves and arteries.

Here, we present an unprecedented case involving MGCTB of the wrist, managed through wide tumor resection and attempted osteogenesis. Complications

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Fig. 1. Preoperative and post operative distal radial ulner joint bone X-ray.
a: preoperative frontal plane b: preoperative sagittal plane
c: postoperative frontal plane d: postoprerative sagittal plane

included delayed bone union and a subsequent rupture of the FPL tendon. This case uniquely demonstrates tendonopathy in MGCTB and associated rehabilitation challenges, with OT contributing to the patient's functional recovery and occupational reintegration.

Case Report

The patient, a 59-year-old male with no notable medical or family history, was diagnosed with MGCTB at our facility in January, X. Treatment involved extensive tumor resection, allogeneic bone grafting, and internal fixation. One year postoperatively, he developed an FPL tendon rupture, presenting as difficulty flexing his right thumb, a movement required during daily activities. Following tendon grafting and osteoplasty, OT began on the first postoperative day.

Initial imaging revealed bone translucency, osteolysis, and a mass lesion (Fig. 1). Due to the lack of an available wrist-sized homologous bone, the femoral cortex was reshaped and inserted into the distal radius, sized from the radial styloid process, and fixed with a palmar locking plate. Intraoperatively, the distal radial joint and articular capsule were resutured without additional ligamentous repairs. Postoperative X-ray imaging showed advanced bone resorption in the grafted area, with a prominent bony protrusion on the palmar side.

The patient, employed as subway staff, was motivated to return to work. Post-surgery, he wore an upper arm-to-hand cast, leaving shoulder and elbow joints unrestricted but limiting forearm range of motion (ROM) to 20° pronation/supination and wrist dorsiflexion/palmar flexion at 15°/−10°. He managed most daily activities using his left hand, with limitations in dressing and bathing. His initial MSTS score was 16/30 (53%), and his TESS score was 10.8/100.

On postoperative day two, a static splint positioned his wrist at 10° dorsiflexion, the metacarpophalangeal (MP) joint at 0°, and the thumb in opposition. By day seven, The Modified Kleinert technique was selected with the primary objectives of preventing pain at the donor site and avoiding adhesion to the graft bone, while ensuring smooth tendon gliding. Modified Kleinert protocol was initiated, employing a rubber band to maintain 40° passive flexion and 0° active extension at the interphalangeal (IP) joint with the MP joint at 0° (Fig. 2a). Outpatient OT began weekly on day 15, The pain was reduced, so reviewing Kleinert contraindications and introducing Duran's method manually. By day 23, he achieved active flexion at the thumb IP joint, with blocking exercises added to enhance flexion while stabilizing the MP joint at 0°. As a result, the thumb's IP joint achieved 30 degrees of active flexion, enabling grasping.

Given the lack of bone union, a wrist splint was designed to support healing. The patient wore a forearm brace (Fig. 2b) to allow controlled ROM during routine tasks, with lifestyle modifications to avoid excessive strain. OT sessions continued until postoperative day 96, upon which his MSTS score improved to 24/30 (80%), and his TESS score to 48.3/100. This allowed him to resume work within a week post-OT, capable of daily activities such as operating doorknobs, eating, and writing (Table 1).

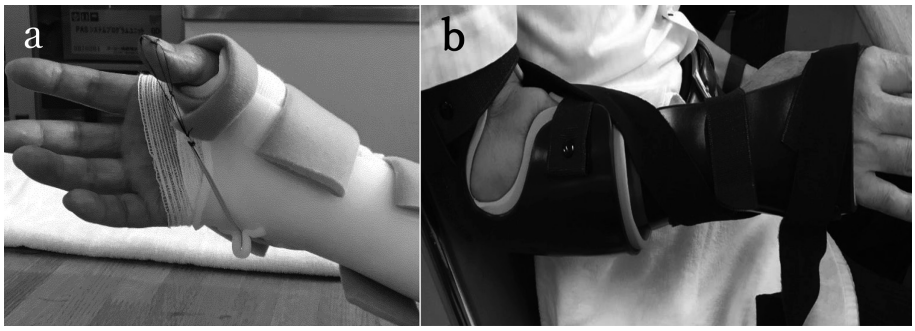

Fig. 2. Modified Kleinert method in thumb (a) and forearm brace (b).

Table 1 Upper limb function evaluation results before and after occupational therapy

Outcome	Pre-treatment	Post-treatment
MSTS	16 (53%)	24 (80%)
TESS	10.8	48.3
forearm pronation	20°	50°
supination	45°	45°
wrist dorsiflexion	15°	15°
palmerflexion	−10°	−10°
thumb IP flexion	0°	24°
extention	0°	0°
Grip (kg)	–	7.2

MSTS: Musculoskeletal tumor society score, TESS: Tront extremity salvage score.

Discussion

While GCTB is often benign, its aggressive nature can compromise bone integrity and joint function, particularly near critical joint regions. MGCTB, with its malignant features, presents further complications, as shown in this wrist case. Prognostic data is limited; however, studies such as those from Memorial Sloan Kettering Cancer Center (MSKCC) report a 5-year survival rate of 87% in primary MGCTB cases, underscoring the importance of post-treatment functional optimization [6–7]. In reports of nonunion, such as in this case, the incidence varies depending on the surgical technique. Nonunion or structural failure occurs in 10–30% of cases using non-pedicled autografts or allografts. While union rates are high with pedicled fibula grafts, nonunion at the docking site occurs in 0–33% of cases. Although there has been no report of FPL tendon rupture like this case, wrist instability may develop and potentially cause secondary re-rupture. Therefore, long-term follow-up is necessary.

Despite successful functional improvements, the patient's ROM remained restricted, particularly in forearm, wrist, and thumb IP joints. This highlights the inherent difficulties in addressing MGCTB around function-critical joints like the wrist. The risk of tendon rupture in MGCTB cases, attributed to non-union complications, suggests the need for early rehabilitative strategies that balance stability and function, as seen with early bracing and flexor tendon gliding exercises in this case.

Persistent ROM limitations due to delayed bone union underscore the value of individualized, function-centered rehabilitation. This case emphasizes OT's role in addressing complex postoperative needs and could inform future MGCTB management strategies for patients with high-demand anatomical sites.

Conclusion

MGCTB in the wrist presents a unique challenge due to the hand's complex functional demands, which complicate healing and elevate the risk of tendon rupture. Patients should be advised on activity modifications to mitigate these risks. In this case achieved meaningful functional recovery despite incomplete bone union. This study is a single case study, so the possibility of generalizing the results is low. Therefore, it will be necessary to accumulate MGCTB cases in the future and consider comparisons with benign GCTB cases and other MGCTB cases.

Declaration of patient consent

In accordance with the Helsinki Declaration, the authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal.

Conflicts of interest

There are no conflicts of interest.

References

[1] Tu J, Li W, Shu S, et al. Total spondylectomy of recurrent giant cell tumors in the cervical spine: two case reports and review of literature. Medicine (Baltimore). 2018; 97: e10799.
[2] Rock MG, Sim FH, Unni KK, et al. Secondary malignant giant-cell tumor of bone. Clinicopathological assessment of nineteen patients. J Bone Joint Surg Am. 1986; 68: 1073–9.
[3] Bertoni F, Bacchini P, Staals EL. Malignancy in giant cell tumor of bone. Cancer. 2003; 97: 2520–9.
[4] Dahlin DC, Cupps RE, Johnson EW Jr. Giant-cell tumor: a study of 195 cases. Cancer. 1970; 25: 1061–70.
[5] Hutter RVP, Worcester JN, Francis KC, et al. Benign and malignant giant cell tumors of bone. A clinicopathological analysis of the natural history of the disease. Cancer. 1962; 15: 653–90.
[6] Gong L, Liu W, Sun X, et al. Histological and clinical characteristics of malignant giant cell tumor of bone. Virchows Arch. 2012; 460(3): 327–34.
[7] Domovitov SV, Healey JH. Primary malignant giant-cell tumor of bone has high survival rate. Ann Surg Oncol. 2010; 17(3): 694–701.

■ORIGINAL ARTICLE

Exploring Caregiving Skills Required for Family Caregivers of Patients with Stroke Living at Home

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Abstract: Background: Caregiving skills for the family members of patients with stroke are considered important in rehabilitation wards. However, few studies have clarified the specific caregiving skills and instructional content required by family caregivers of patients with stroke.
Purpose: This study aimed to clarify the caregiving skills required by family caregivers of patients with stroke, as Study 1, and to examine the validity of the content, as Study 2.
Methods: In Study 1, six skilled therapists (occupational and physical therapists) practicing with patients with stroke and three family caregivers of homebound patients with stroke were interviewed. Data were analyzed using qualitative inductive analysis. In Study 2, a questionnaire was administered to the therapists and family caregivers using the Delphi method. These were administered twice. 65 family caregivers and therapists responded to the first questionnaire and 58 responded to the second.
Results: 20 skills were extracted and classified into 11 categories in Study 1. The classifications included: environmental adjustment, motivation, body stabilization, body positioning, risk prediction, activity promotion, procedures, ingenuity (trial and error), tool use, communication, and confirmation. Study 2 confirmed the content validity of all 20 caregiving skills.
Conclusions: These results indicate that it is important to provide care skills to family members of patients with stroke for them to live safely at home, not only from a physical aspect, but also from various viewpoints, such as cognitive, mental, and material environments.

Keywords: stroke, family support, advice in discharge, caregiving skills

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1. Introduction

The number of patients with cerebrovascular disease in Japan was approximately 1.84 million in 2023 [1]. Cerebrovascular disease (stroke) is the second most common cause of long-term care needs after dementia [2]. Clearly, the role of the therapist requires interventions that focus not only on the patients with stroke, but also on family caregivers. Against this background, the "Japanese Guidelines for the Management of Stroke 2015" [3] recommend the education of patients and families on rehabilitation content, caregiving methods, and home programs. However, there are reports [4, 5] that home modification and Activities of Daily Living (ADL) guidance by therapists for family caregivers during pre-discharge visits are not fully utilized after discharge. Rather than focusing on physical function and providing interventions, it is necessary to assess whether the family members providing care themselves have accepted the disability and are able to adapt, and to provide support for discharge from hospital, taking into account the family environment and family relationships [4]. In my experience, I feel that the content of the guidance that therapists give to family caregivers often focuses on imparting technical knowledge and teaching them

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how to perform certain actions. I wonder if therapists themselves are not aware of the importance of comprehensive assessments that take into account family relationships and family members' abilities, and guidance that includes communication that understands and grasps the situation of both the patient and the family. Therefore, by clarifying the caregiving skills required for family caregivers from the perspectives of both the therapists providing caregiver guidance and the family caregivers actually performing the care, we believe therapists' caregiver guidance can be implemented more effectively. We investigated previous studies on the development of caregiving skills and assessment tools necessary for family caregivers of patients with stroke to assist them with their daily life performance (The general conduct of life in which people live. [6]) for five years from 2015. Consequently, there is literature [7–9] on the development of tools and training programs to assess the practical skills of family caregivers of patients with stroke. Specific care skills related to ADL items, such as eating (e.g., placing food on the side of the plate that is easier for patients with stroke to eat), were identified [7]. However, no studies have identified the caregiving skills necessary to assist with daily life performance (e.g., Instrumental Activities of Daily Living (IADL), work, hobbies, and other activities that have purpose and value for the individual) other than ADLs. Therefore, we decided to conduct this study as the first step toward developing a tool that allows occupational and physical therapists (hereafter, therapists) to assess the caregiving skills required by family caregivers when assisting patients with stroke with various daily life performance by observing their daily life performance. In this study, we first interviewed several therapists and family caregivers to identify the high-level, directly observable, abstract caregiving skills required of family caregivers when assisting patients with stroke in their daily life performance. Then, in Study 2, we surveyed a larger number of therapists and family caregivers to comprehensively identify the skills required by family caregivers. In other words, we explored these skills in Study 1 and confirmed their validity in Study 2.

Generally speaking, the term "caregiving" refers to "looking after the daily lives of sick people, disabled people, bedridden elderly people, etc." [10]. In this study, "caregiving skills" were defined operationally as direct, observable skills that are necessary for providing assistance with daily life performance to help people who have become dependent on caregiving due to illness or injury to lead a life with peace of mind. In this study, the subjects were limited to people who had suffered a stroke. As we are aiming to develop an observational assessment tool for family caregivers in the future, we defined the skills to be observable in the context of rehabilitation. We omitted items related to time and daily life management (e.g., regular medication administration) and indirect assistance (e.g., family members going shopping alone). In addition, we did not include medical procedures (e.g., injections and bedsores) for which therapists do not provide family guidance.

2. Research design and ethical considerations

Study 1 was an interview survey using a semi-structured interview method, and Study 2 was a questionnaire survey using the Delphi method. This study was conducted after receiving approval from the ethical review committee of Mitsugi General Hospital (Approval No. 1231) and Prefectural University of Hiroshima (Approval No. 19 MH046-02) and was conducted following the principles of the Declaration of Helsinki.

3. Study 1

3.1 Methods

3.1.1 Study participants

The participants were therapists and family caregivers of patients with stroke (hereinafter, family caregivers).

It was necessary for the therapists to have a deep knowledge as experts. Schell et al. [11] states that it generally takes at least 10 years to become proficient in a field, but that sometimes it takes only 5 years to reach a level of proficiency. Therefore, with reference to these, the selection criteria for therapists are set out below, and those who meet all of the criteria are defined operationally as the subjects of the study.

Therapists were those who were employed at Mitsugi General Hospital as of February 2020, or those with whom the authors could request to collaborate. The selection criteria were as follows: 1) clinical experience of at least 10 years; 2) clinical experience of at least five years with patients with stroke and at least 20 cases of family support; and 3) experience of lecturing at workshops, writing papers, or presenting at conferences. This study sought to gather opinions not only from therapists working in hospitals but also from home-visit rehabilitation therapists who are directly involved in the home life of patients with stroke and provide family guidance. Therefore, the selection criteria did not restrict therapists based on their place of employment.

Family caregivers were family members of patients with stroke who had been hospitalized in the convalescent rehabilitation ward of Mitsugi General Hospital and were living at home as of February 2020. The selection criteria were as follows: 1) the caregiver had received

Table 1 Interview content

Target	Interview content
Therapists	1. Please recall any the most memorable experiences of caregiving guidance so far, or any experiences where you think the guidance you provided was put to good use by the family caregiver, and talk about those cases. We also collect the following information: a. Information on patients with stroke (age, gender, degree of disability, higher brain dysfunction, etc.) b. Information on family caregivers (age, gender, attributes, etc.) c. Period during which caregiving guidance was provided 2. Specifically, for what purpose did you provide guidance on daily life performance? 3. Next, please tell us about a case where your caregiving guidance did not go well. Collect information on above a.b.c. 4. Specifically, for what purpose did you provide guidance on daily life performance?
Family caregiver	1. Please tell us about the specific caregiving guidance you received from the rehabilitation staff in the past. The following are items to be listened to while relating them to the content of the research collaborator's narrative. • When and to what extent are the contents of the caregiving guidance being put to use in daily life? • Framework for content of caregiving guidance (basic movements (turning over in bed, getting up, sitting, standing, etc.), mobility (walking, climbing stairs, operating a wheelchair, etc.), ADL (excretion, eating, dressing, grooming, bathing, etc.), IADL (shopping, washing, cleaning, managing medication, etc.), hobbies, etc.) 2. What kind of things do you do to make sure that your care goes well? 3. What kind of measures do you take when your care is not going well? 4. Is there any caregiving skills you would have liked to have been taught by the rehabilitation staff while you were in hospital?

some care guidance from a therapist before discharge from the hospital, and 2) the caregiver had at least three months of experience caring for a family member at home.

3.1.2 Data collection

The interview guide (Table 1) was created by three authors who have experience in qualitative research and family guidance, and a semi-structured interview of about 60 minutes was conducted based on this. The interviews were recorded with the consent of the participants using an IC recorder, and field notes were recorded.

3.1.3 Method of Analysis

A qualitative inductive analysis [12] was employed. First, the IC recorder data were converted into text data, and a verbatim transcript was created. From the verbatim transcripts, sentences related to the caregiving skills needed by family caregivers were extracted, and labels summarizing these sentences were created. Next, all labels were categorized into primary, secondary, and tertiary categories according to similarities in their semantic content. To ensure the validity of the categorization, the analysis was conducted in a consensual manner by three occupational therapists, including the author, who had experience in writing papers or presenting at conferences on qualitative research. Microsoft Excel was used for the analysis. In addition, in order to explore the research question of "exploring caregiving skills" from various angles (triangulation [13]), we decided that the skills would not only be those common to both therapists and family caregivers, but also those obtained from the narratives of either one of them. To collect broad and reliable data, we aimed to explore caregiving skills from multiple perspectives by utilizing the viewpoints of family caregivers who actually provide care and therapists who instruct caregiving (therapists work in various settings such as hospitals and home-visit rehabilitation).

3.2 Results

3.2.1 Basic attributes of the participants

The participants consisted of six therapists (five occupational therapists and one physical therapist) with an average age of 37 ± 2.8 years, an average of 15 ± 2.6 years of clinical experience, and an average of 14.4 ± 2.9 years of clinical experience with patients with stroke. The mean number of family support cases was 90 ± 54.5, and the most common affiliation was the hospital (four therapists), followed by home visits (two therapists). There were 3 family caregivers (two males and one female) with a mean age of 65.3 ± 3.9 years. Two were spouses and one was a child of the patient with stroke. The average duration of caregiving experience was 10.6 ± 6.2 months.

3.2.2 Pathological conditions of patients with stroke as described by the participants

Regarding the pathological conditions of the patients with stroke, the most common was moderate hemiplegia (five participants), followed by mild hemiplegia (two participants) and severe hemiplegia (three participants). All patients had higher brain dysfunctions, such as attention and memory impairment. One therapist, who had

more time to interview, talked about two patients with stroke; therefore, the total number of patients with stroke was ten.

3.2.3 Extracted skills

As a result of this analysis, 149 labels were created and categorized, as shown in Table 2. Twenty items were extracted from the secondary category, which corresponded to the caregiving skills needed by family caregivers of patients with stroke. These caregiving skills were further classified into 11 tertiary categories. In the following sections, [ ] indicates a tertiary category and 〈 〉 indicates caregiving skills (secondary category).

4. Study 2

4.1 Methods

4.1.1 Study participants

The participants were therapists practicing with patients with stroke and their families, and family members caring for patients with stroke.

4.1.1.1 Therapists

The selection criteria for therapists were as follows: 1) at least five years of clinical experience with patients with stroke, and 2) at least 20 cases of family support. Questionnaires were mailed to 36 member hospitals in Hiroshima Prefecture from the membership list (as of March 2021) of the "Kaifukuki Rehabilitation Ward Association," which is available free of charge online, to recruit therapists who met the selection criteria. In addition, we recruited five participants in Study 1 and 16 therapists who were introduced by the co-researcher.

4.1.1.2 Family caregivers

Family caregivers were the family members of patients with stroke undergoing rehabilitation at Mitsugi General Hospital. The selection criteria for family caregivers were as follows: 1) had received some care guidance from a therapist prior to discharge and 2) had at least three months of experience caring for an elderly patient at home. 77 family caregivers were selected from the hospital database using the following procedure. 1) discharged from a convalescent rehabilitation ward between April 2017 and September 2020; and 2) patients with stroke whose level of independence in daily living was more severe than level B1 (elderly people can transfer to a wheelchair without assistance and eat and use the toilet away from bed) [14].

4.1.2 Preparation of the Delphi method questionnaire and data collection

4.1.2.1 Questionnaire development and implementation of the first questionnaire

The authors, who have experience in qualitative research, discussed and created the questionnaire by adding explanations and examples to the skill items obtained in Study 1. The questions were designed to ask respondents to answer how necessary the caregiving skills are in general, based on their own experience of providing care. After that, we conducted a preliminary survey with two current occupational therapists who are acquaintances of our research collaborators and provide guidance to families, and two family caregivers who are currently providing care. The appropriateness of the expressions was reviewed based on the opinions obtained, and a web-based questionnaire for therapists and family caregivers was constructed based on the skill items.

The questionnaire was based on the participants' own caregiving experiences, and they were asked to indicate their degree of agreement (degree of need for caregiving skills) with each item on the 6-item method (1 = not at all necessary to 6 = very necessary). In addition, an open-ended column was provided in which respondents were asked to write the name of any skills other than those they thought were necessary, and why they were needed.

4.1.2.2 Implementation of the second questionnaire

Based on the results of the first questionnaire, the second questionnaire was revised to include the names of the skills, and the web system (creating graphs using Google forms) or documents (displayed as percentages) were revised or created to display the response distribution of the level of agreement for each caregiving skill for all research subjects, and the questionnaire was sent by email or post. The results are displayed as the combined response distribution for all study participants (therapists and family caregivers), rather than the response distribution for each individual study participant. Respondents were asked to rate their level of agreement on the 6-item method, referring to the distribution of responses. The second questionnaire did not include a free-response column.

4.1.2.3 Feedback

The results of the second questionnaire were tabulated. Regarding the skill items and their response distribution for which content validity could ultimately be confirmed, the survey was completed by sending an email to the therapist and mailing a document to the family caregiver.

Table 2 Caregiving skills needed by family caregivers of patients with stroke obtained from interviews

Tertiary category	Secondary category (technical skills)	Primary Category
Environmental adjustment	1. Clear away objects and sounds that interfere with activities※1	Adjusting the position of tools and making space for easy assistance. 6 others
	2. Prepare necessary tools and materials	Prepare tools to be used in the activity. 7 others
Motivating	3. Talk to them in a way that elicits spontaneous action	• Encourage the children to be aware of the activity. • Encourage the participants to perform the activity.
	4. Share activities with patients with stroke※1	Make a memo together about the activity. 2 others
	5. Have them do the activities or parts of the activities they can do, depending on their abilities	Cl helps with only the parts that are difficult for him to do by himself. 7 others
Body stabilization	6. Stabilize the body by supporting appropriate areas of the body and holding handrails	• Hold a handrail or adjust the height of the bed. • Supporting parts of Cl's body. 3 others
Body positioning	7. Position the caregiver's body in the right place	Position the caregiver's body near Cl's body. 3 others
	8. Position the patient with stroke's body in the right place	Turn your body in the direction of the transfer in advance. 4 others
Anticipating risk	9. Anticipate injuries and falls in patients with stroke and caregivers and take safe measures	Do not leave the paraplegic's side while performing activities that have a high risk of injury. 8 others
Activity promotion	10. Provide visual cues※1	• Write notes so that you know the steps of the activity. • Pointing out the location of tools. 4 others
	11. Provide linguistic cues※1	Communicate the order of activities by voice. 8 others
	12. Provide tactile cues	Guiding Cl. movements, not the caregiver's intention.
Procedures	13. Use efficient procedures※1	Perform activities in order considering the paralyzed side. 2 others
Devising (trial and error)	14. Finding a better method※1	Care in a way that is easy for the caregiver to perform. 2 others
	15. Adjusting the assistance method and activity time according to the patient with stroke's condition (physical condition, mood, and facial expressions).	Selecting and changing the method of care according to Cl's physical condition. 5 others
Using tools	16. Understand the characteristics of tools and use them appropriately	• Tilting tools (sliding boards and wheelchairs) • Adjusting the height of tools (beds) 4 others
Communication	17. Use of positive words※1	Encourage awareness rather than pointing out mistakes. 2 others
	18. Use clear and specific words※1	Avoid complicated instructions and give simple instructions. 2 others
	19. Regarding dignity※2	• Avoid embarrassment and awkwardness. • Choose words that Cl will not be uncomfortable with. 4 others
Checking	20. Confirm whether the results meet the objectives and assist, if necessary※1	At the end of the activity, correct if necessary.

Cl: Client. In this study, it represents a patient with stroke.
※1: Caregiving skills extracted from the therapist's narrative only.
※2: Caregiving skills extracted from family caregivers' narratives only.

Table 3 Basic Information on the Subjects of the Second Questionnaire from the First Questionnaire

Therapists (n = 43)		
Age (years)		38.3 ± 4.8
Gender (persons)	Male Female	36 7
Job title (persons)	Occupational therapist Physical therapist	22 21
Years of experience as a therapist (years)		14.9 ± 4.2
Years of clinical experience with patients with stroke (years)		14.3 ± 4.3
Family support experience (persons)		91.4 ± 78.2
Stage currently involved (persons)	Acute 10, Recovery 23, Life 8, Chronic 1, Education 1	
Family caregivers (n = 22)		
Age (years)		66.4 ± 9.8
Gender (persons)	Male Female	4 18
Relationship to patients with stroke (persons)	Spouse Child Child Spouse Sibling	9 8 3 2
Years of care (months)		62.1 ± 78.2
Living together (persons)	Yes No	19 3
Frequency of care (persons)	Daily 18, 3–6 days 2, Less than 2 days 1, In hospital 1	
Activities for patients with stroke involved (persons)	Basic activities excluding transfers 19, transfers 22, ADL 19, IADL 21, hobby activities 7, other (e.g., hospital visits) 8	

ADL: Activities of Daily Living
IADL: Instrumental Activities of Daily Living
Multiple responses were given regarding the patients with stroke's activities in which the family caregiver is involved.

4.1.3 Data Analysis

Referring to previous studies [15, 16], we determined the median value of each item answered by the 6-item method and combined the responses of the therapists and family caregivers. As a result, an item was defined as having achieved consensus if it met the following two conditions: 1) the median value was 4.0 or higher, and 2) 80% or more of the participants selected 4 (a little necessary), 5 (fairly necessary), or 6 (very necessary) in the 6-item method. In previous research [15], there was a study that considered consensus to be reached when the agreement rate was 51% or higher, but since this time the research is at the stage of creating an evaluation tool, we set it at 80% in order to extract the skills that are truly important and necessary. The three authors reviewed and revised the names of the skill items and the content of the questionnaire, referring to the degree of agreement rate and free comments in the first questionnaire.

4.2 Results

4.2.1 Questionnaire collection rate and basic information on the participants

Table 3 presents the basic information on the participants in the first and second questionnaires.

4.2.1.1 Therapists

In the first questionnaire, of the 45 respondents who responded to the web-based survey, 43 were valid responses after excluding two respondents who did not meet the participants' selection criteria. In the second survey, a web-based questionnaire was sent to 43 participants, 36 of whom provided valid responses. The participants consisted of 22 occupational therapists and 21

physical therapists, the mean age was 38.3 ± 4.8 years, the mean clinical experience as a therapist was 14.9 ± 4.2 years, and the mean clinical experience with patients with stroke was 14.3 ± 4.3 years.

4.2.1.2 Family caregivers

In the first questionnaire, 23 of the 77 respondents responded, and 22 valid responses were obtained after excluding one person who did not meet the participants' selection criteria. In the second questionnaire, the questionnaires were mailed to 22 participants, 22 of whom provided valid responses. The participants consisted of 4 males and 18 females with a mean age of 66.4 ± 9.8 years. Nine were spouses, while the others were children, spouses of children, or siblings.

4.2.2 Questionnaire survey results

The content validity of the caregiving skills required by family caregivers was examined using the Delphi method for therapists and family caregivers, and 20 skills were agreed upon. The results of the first and second questionnaires are presented in Table 4.

4.2.2.1 Degree of consensus

Sixty-five family caregivers and therapists responded to the first questionnaire and 58 responded to the second. In both the first and second questionnaires, the median score for family caregivers and therapists together was 4.0 or higher, and the total score of 4, 5, and 6 on the 6-item method exceeded 80% of the total, indicating a consensus on all 20 care skills. Therefore, the third questionnaire was not administered.

4.2.2.2 Correction of skill names

Many of the opinions obtained in the first free-response section were different from those already included in the skills generated in Study 1 or from the content of the current study. Based on the therapists' opinions, the skill ⟨16. Understand the characteristics of the tools and use them appropriately⟩ were modified to ⟨16. Understand the characteristics of tools and orthoses and use them appropriately⟩. The revised skills are shown in Table 4. After modifying the names of the skills and adding annotations to the questionnaire, a consensus was reached regarding all skills in the second questionnaire.

5. Discussion

The results of the analysis showed that 20 caregiving skills needed by family caregivers were extracted, all of which were confirmed to have content validity. In Studies 1 and 2, therapists and family caregivers were included. Therefore, we believe that we were able to extract more specific and practical caregiving skills specific to patients with stroke, that are necessary for living at home. The following sections discuss the characteristics and validity of the extracted items.

5.1 Characteristics of the skill items extracted

The care guidance and care experiences described by the participants in Study 1 were about cases with various pathological conditions, such as the degree of paralysis and the presence or absence of higher brain dysfunction. The skills extracted included not only physical and mental functions but also communication and tool use. Previous studies [7] have described caregiving skills applicable to specific daily life performances, such as eating, which is consistent with ⟨2. Preparing necessary tools and materials⟩ in this study. The caregiving skills identified in this study included items with a high level of abstraction. To the best of our knowledge, no other study has captured the caregiving skills necessary for patients with stroke using highly abstract expressions, which is novel in this respect. The highly abstract caregiving skill items can be applied to a variety of daily life performances rather than specific activities, and can be used in the future as items for assessing the caregiving skills of family caregivers of patients with stroke.

In addition, it is thought that the caregiver guidance provided by therapists tends to be biased towards technical content, such as movement guidance that focuses on physical functions. However, this study has revealed the need to emphasize not only such content, but also the [Devising (trial and error)] that family caregivers use in providing care, and [Communication] such as their attitudes and ways of relating to the patients with stroke. For example, this study showed the necessity of skills ⟨14. Finding a better method⟩ ⟨15. Adjusting the assistance method and activity time according to the patient with stroke's condition (physical condition, mood, and facial expressions)⟩ ⟨20. Confirm whether the results meet the objectives and assist, if necessary⟩ These skills are considered to be acquired by the caregivers themselves through their own experiences and reflections; however, they were not included in some past research reports [7–9]. However, Chow et al. [17] interviewed caregivers and patients with stroke who practiced positive care and reported that they prioritized their own well-being and dealt constructively with unexpected challenges. Condon et al. [18] also identified "developing problem-solving skills to cope with caregiving situations" as a key component of their intervention for family caregivers of patients with stroke. After returning home, patients with stroke may experience unexpected situations as they cope with the environmental changes during their hospital stay. Additionally, the support needs

Table 4 Results from the first questionnaire to the second questionnaire

No.	Caregiving skill	The first questionnaire						The second questionnaire					
		Therapists (n = 43)		Family caregivers (n = 22)		Therapists and family caregivers (n = 65)		Therapists (n = 36)		Family caregivers (n = 22)		Therapists and family caregivers (n = 58)	
		MED	%	MED	%	MED	%	MED	%	MED	%	MED	%
1	Clear away objects and sounds that interfere with activities	5	88.4	4	63.6	4	80	5	94.4	5	90.9	5	93.1
2	Preparing necessary tools and materials	5	97.7	5.5	95.5	5	96.9	5	97.2	6	100	5	98.3
3	Talk to them in a way that elicits spontaneous action	5	97.7	5.5	90.9	5	95.4	5	94.4	6	100	5	96.6
4	Share activities with patients with stroke	4	90.7	5	81.8	4	87.7	5	91.7	5.5	90.9	5	91.4
5	Have them do the activities or parts of the activities they can do, depending on their abilities	5	93	5	90.9	5	92.3	5.5	100	6	95.5	6	98.3
6	Stabilize the body by supporting appropriate areas of the body and holding handrails	5	95.3	6	95.5	5	95.4	5.5	100	6	100	6	100
7	Position the caregiver's body in the right place	6	97.7	5	90.9	6	95.4	6	100	6	100	6	100
8	Position the patient with stroke's body in the right place	5	88.4	5.5	86.4	5	87.7	5.5	100	6	86.4	6	94.8
9	Anticipate injuries and falls in patients with stroke and caregivers and take safe measures	6	100	6	100	6	100	6	100	6	100	6	100
10	Provide visual cues	5	93	5.5	86.4	5	90.8	5	100	5.5	95.5	5	98.3
11	Provide linguistic cues	4	93	5.5	90.9	5	92.3	5	97.2	5	95.5	5	96.6
12	Provide tactile cues	4	86	4	72.7	4	81.5	5	97.2	4.5	81.8	5	91.4
13	Use efficient procedures	5	100	5.5	90.9	5	96.9	6	100	6	95.5	6	98.3
14	Finding a better method	6	100	6	100	6	100	6	100	6	95.5	6	98.3
15	Adjusting the assistance method and activity time according to the patient with stroke's condition (physical condition, mood, and facial expressions).	5	97.7	5	90.9	5	95.4	6	100	6	90.9	6	96.6
16	Understand the characteristics of tools and use them appropriately → (modified)Understand the characteristics of tools and orthosis and use them appropriately	6	100	6	100	6	100	6	97.2	6	95.5	6	96.6
17	Use of positive words	5	100	5	100	5	100	5	97.2	5.5	100	5	98.3
18	Use clear and specific words	5	97.7	5	100	5	98.5	5	97.2	5.5	100	5	98.3
19	Regarding dignity	6	100	6	100	6	100	6	97.2	6	100	6	98.3
20	Confirm whether the results meet the objectives and assist, if necessary.	5	97.7	5	90.9	5	95.4	5	100	5	95.5	5	98.3

Skill items marked with "→ (modified)" indicate that they were modified in the second questionnaire after the completion of the first questionnaire.
MED: Represents the median
%: The sum of the grades 4, 5, and 6 of the six-point scale as a percentage of the total

of caregivers change over time as patients with stroke recover, and support that responds to the changing needs of caregivers is required [19]. As can be seen from the preceding research [17–19], it is stated abstractly that skills are needed to respond to changes in situations while providing care, but the specific skills are not clearly stated. The novelty of this study is that it has revealed specific skills (⟨14⟩ and ⟨15⟩) related to the [Devising (trial and error)] required by family caregivers of patients with stroke. If the therapist provides family caregivers with guidance on caring for their loved ones from the perspective of items ⟨14⟩ and ⟨15⟩, it is thought that the guidance will not simply be about "teaching" the family caregivers technical content, but will also change to content that "makes the family caregivers think" when certain situations arise. In order to achieve this kind of caregiver guidance, it will be necessary to get family caregivers involved with the patient with stroke as early as possible during their hospital stay, and to provide guidance that will encourage them to observe the patient's changing condition and think about how they should provide care. It is also desirable to provide guidance more than once, rather than just once or twice. In addition to therapists need to be able to predict as far as possible the changes and needs that may occur in the future, and to be able to provide guidance that allows them to respond appropriately to changes in the patient's condition. In other words, if therapists provide guidance from this perspective and the quality of caregiver guidance changes, it will prevent family caregivers from becoming exhausted even if the situation changes before and after a stroke, and it will help them to acquire the ability to respond to patients with stroke who are in different conditions each day, and to continue living at home for longer. In this way, it may be possible to prevent the situation where the content of the caregiver guidance provided by the therapist, as described in the Introduction, is not fully utilized after discharge from hospital. Therapists should understand the necessity of this skill, and this study has clarified the perspective of necessary caregiver guidance for therapists who are not adequately instructed in clinical practice.

5.2 Content validity of skill items

The results of Study 2 confirm the content validity of all 20 items. All items were considered to have high content validity, with a median score of 4.0 or higher for both the first and second questionnaires, and a total score of 4, 5, or 6 for the 6-item method of at least 80% of all items. In addition, we attempted to identify caregiving skills that could not be extracted in Study 1 by soliciting opinions in the free-response section; however, no new skill items were generated. It can be inferred that this was due to the fact that highly valid caregiving skills had already been extracted in Study 1.

Considering each skill item, an agreement rate of ⟨9. Anticipate injuries and falls in patients with stroke and caregivers and take safe measures⟩ was 100% for both therapists and family caregivers in the two questionnaires. This was judged to be the skill with the highest agreement rate among the 20 skills, indicating that it is important for therapists to instruct caregivers to pay attention to the injuries and falls of not only patients with stroke but also family caregivers.

For [Communication] skills, the agreement rate among family caregivers was 100% for both questionnaires. In the free comments, family caregivers wrote, "*I keenly feel that mental care for him is the most important.*" "*I value his feelings.*" "*Even if I get frustrated, I have to be careful with my words and try not to blame him.*" Many of the descriptions were related to their relationships with patients with stroke. After a stroke, in addition to personality changes, various emotions, such as suffering, embarrassment, and sadness, are induced in patients with stroke [20], and the quality of the relationship between patients with stroke and their family caregivers plays an important role in their well-being [21]. The results of this study support the necessity of communication, as has been shown in previous research. However, as this study has shown, despite being a skill that family caregivers need, it is not given much importance by therapists in the context of caregiver guidance, and this is a major issue. Therapists should actively incorporate communication-related content into their caregiver guidance. When therapists are teaching these skills in a clinical setting, it would be a good idea to set up a situation and practice communicating while using the skills in ⟨17⟩, ⟨18⟩ and ⟨19⟩. If family caregivers can learn how to communicate smoothly in this way, they will be able to build good family relationships even in the caregiver-care recipient relationship, and they will be able to continue living at home for longer with fewer problems at home.

Conclusion

Through Research 1 and Research 2, 20 items of caregiving skills needed by family caregivers of patients with stroke were extracted, and their content validity was demonstrated from the perspectives of therapists and family caregivers. The caregiving skills identified in this study could be used in family guidance situations for people with moderate to severe paralysis in a convalescent rehabilitation ward. In addition, it is thought that it can be used to provide guidance to family members who are not good at providing care or who lack confi-

dence in providing care during home-visit rehabilitation. Furthermore, if the newly identified caregiving skills are incorporated into the training ladder for new therapists, it is thought that this will have a positive impact on the quality of the therapists' caregiver guidance to families.

Limitations of the Study and Future Prospects

In Study 1, the degree of paralysis in the patients with stroke described by family caregivers was all moderate or higher, and there was also higher brain dysfunction. As a limitation of this study, it is possible that the family caregivers interviewed only recalled the patients with stroke in front of them, and so it may have been difficult for them to answer objectively by imagining patients with stroke of various severities. It is necessary to be careful when generalizing the results of this study to a representative group of the patients with stroke and caregivers in general. It is an issue to consider whether the skills revealed in this study can be applied to and utilized by patients with stroke who were not included in this study, such as patients with stroke with mild paralysis or patients with stroke without higher brain dysfunction.

In addition, in Study 2, the number of samples was not large when the therapists were divided into occupational therapists and physical therapists, and there was also a bias in the stage at which the therapists were involved. There may be new skill items that we were unable to extract in this study, and it is necessary to widely ask more therapists working in various fields about the necessary caregiving skills.

Furthermore, in order to create an evaluation tool from the caregiving skills clarified in this study in the future, it is necessary to examine the construct validity and reliability.

Conflict of Interest

There are no conflicts of interest in this study.

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References

[1] Ministry of Health, Labour and Welfare. Summary of the 2023 Patient Survey [online]. Ministry of Health, Labour and Welfare [cited 2025 February 7]. Available from: https://www.mhlw.go.jp/toukei/saikin/hw/kanja/23/index.html.

[2] Ministry of Health, Labour and Welfare. 2019 Summary of the National Survey of Basic Living Conditions: Status of Long-Term Care [online]. Ministry of Health, Labour and Welfare [cited 2021 December 6]. Available from: https://www.mhlw.go.jp/toukei/saikin/hw/k-tyosa/k-tyosa19/dl/05.pdf.

[3] The Japan Stroke Society Stroke Guidelines Committee. Japanese Guidelines for the Management of Stroke 2015 (in Japanese). Tokyo: Kyowa kikaku. 2015; 284–5.

[4] Ogaki M. Need for follow-up after pre-discharge visit guidance (in Japanese). The Japanese Journal of Physical Therapy. 2004; 38(7): 581–3.

[5] Kibayashi H, Nakamoto K, Tsuda H. Changes in FIM before and after discharge in Convalescent patients with stroke: What we learned from conducting post-discharge visits (in Japanese). Journal of Everyone's Physical Therapy. 2020; 32: 63–8.

[6] Sugita S, Fujimoto S, Komukai K, Kobayashi M. Physical therapists' and occupational therapists' perceptions regarding factors and their countermeasures related to the feeling of care burden in families having patients with stroke: Semi-structured interview (in Japanese). Japanese Journal of Geriatric Psychiatry. 2017; 28(11): 1255–66.

[7] Araújo O, Lage I, Cabrita J, Teixeira L. Development and psychometric properties of ECPICID-AVC to measure informal caregivers' skills when caring for older stroke survivors at home. Scand J Caring Sci. 2016; 30(4): 821–9.

[8] Day CB, Bierhals CCBK, Mocellin D, Predebon ML, Santos NO, Dal Pizzol FLF, et al. Nursing Home Care Intervention Post Stroke (SHARE) 1 year effect on the burden of family caregivers for older adults in Brazil: A randomized controlled trial. Health Soc Care Community. 2021; 29(1): 56–65.

[9] Forster A, Dickerson J, Young J, Patel A, Kalra L, Nixon J, et al. A cluster randomised controlled trial and economic evaluation of a structured training programme for caregivers of inpatients after stroke: the TRACS trial. Health Technol Assess. 2013; 17(46): 1–216.

[10] Hayashi S. Example-based New Japanese Dictionary, 9th ed (in Japanese). Tokyo: Sanseido; 2015.

[11] Schell BAB, Gillen G. Professional reasoning in practice. Willard and Spackman's Occupational Therapy 13th edition. Baltimore: Wolters Kluwer. 2009; 482–97.

[12] Stephen B. In: Kihara M, Kihara M, trans. Research methods in health : foundations for evidence-based practice (in Japanese). Tokyo: MEDSi; 2012.

[13] Kawaguchi T. Guide Map for Nursing Research (in Japanese). Tokyo: Igaku-Shoin; 2002; 137.

[14] Ministry of Health, Labour and Welfare. Level of independence in daily living (bedridden) of the elderly with disabilities [online]. Ministry of Health, Labour and Welfare [cited 2021 December 6]. Available from: https://www.mhlw.go.jp/file/06-Seisakujouhou-12300000-Roukenkyoku/0000077382.pdf.

[15] Yokoyama E, Karashima C. Development of a social participation questionnaire for families of children with developmental disorder (in Japanese). Japanese Occupational Therapy research (sagyouryouhou). 2018; 37(4): 410–20.
[16] Aida T, Yamada T. Review of risk management items in occupational therapy department - occupational therapy department risk management items considered by administrator (in Japanese). Japanese Occupational Therapy research (sagyouryouhou). 2007; 26(2): 131–43.
[17] Chow EOW, Wong YY, Fok DYH, Liao X, Li C. Positive life stories of Stroke-Survivor's spousal caregiving in Hong Kong: Lessons for policy and practice. Soc Sci Med. 2021; 291: 114476.
[18] Condon L, Benford P, Kontou E, Thomas S, Walker M. The use of carer perspectives and expert consensus to define key components of a biopsychosocial support intervention for stroke carers. Top Stroke Rehabil. 2019; 26(6): 440–7.
[19] Cameron JI, Naglie G, Silver FL, Gignac MA. Stroke family caregivers' support needs change across the care continuum: a qualitative study using the timing it right framework. Disabil Rehabil. 2013; 35(4): 315–24.
[20] Bucki B, Spitz E, Baumann M. Emotional and social repercussions of stroke on patient-family caregiver dyads: Analysis of diverging attitudes and profiles of the differing dyads. PLoS One. 2019; 14(4): e0215425.
[21] Kvigne K, Kirkevold M, Gjengedal E. Fighting backstruggling to continue life and preserve the self-following a stroke. Health Care Women Int. 2004; 25(4): 370–87.