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Original Article

A 3-month multicomponent home-based rehabilitation program for older people with restricted life-space mobility: a pilot study

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Abstract. [Purpose] The purpose of this study was to verify the effects of a 3-month multicomponent home-based rehabilitation program developed on the basis of the reevaluation of older people with restricted life-space mobility. [Participants and Methods] The participants were residents in Japan aged ≥65 years who had Life-Space Assessment scores ≤52.3. Multicomponent home-based rehabilitation was conducted by physical and occupational therapists. Each visit included 40–60 min of combined exercise, practicing activities of daily living, improving the home environment, and caregiver support. The programs were developed in accordance with a flow diagram. The primary outcome was life-space mobility evaluated using the Life-Space Assessment score. [Results] Overall, 30 participants completed the intervention. The mean age of the participants was 82.4 ± 7.5 years. Three months after the intervention initiation, the Life-Space Assessment scores significantly improved from 12.0 to 30.5. The proportion of participants at maximal life-space level 5 (unlimited mobility) doubled from 16.7% at baseline to 33.3%. The functional independent measure score, fall efficacy scale score, and lower limb strength associated with standing up also significantly improved. We found no significant changes in the geriatric depression scale 5 and self-rated good health scores. [Conclusion] Multicomponent home-based rehabilitation can improve life-space mobility in older people with restricted life-space mobility.

Key words: Home-based rehabilitation, Life-Space mobility, Older people

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INTRODUCTION

Restricted life-space mobility is associated with various risk factors among older people, declining cognitive function[1)] and quality of life[2)], hospital readmission[3)], nursing home admission[4)], and mortality[5)]. Baker et al. reported that life-space mobility can be evaluated using the Life-Space Assessment (LSA) tool[6)]. Older people with an LSA score of ≤56 points and Timed Up & Go (TUG) test score of ≥12 s were predicted to have instrumental activities of daily living (ADL) declined after 1 year[7)]. As per another study, a baseline LSA score of ≤52.3 points and decline in LSA score by >11.7 points indicated that the older people would be unable to perform ADL in the next 2 years[8)]. Thus, expanding life-space mobility is necessary for older people with a low LSA score.

For older people, active social participation is associated with an increased level of life-space mobility[9)]. The LSA measures life-space mobility based on the movement distance a person reports during the 4 weeks preceding the assessment. In older people, it is important to evaluate not only independence in mobility but also the range of life-space mobility.

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Accordingly, when the person moves long distances and performs high-frequency movements, even if assistance is required, the LSA score is higher than that for moving only at home without assistance.

Home-based rehabilitation is an intervention for older people with restricted life-space mobility. In a previous study, multicomponent home-based rehabilitations were mainly focused on clinical populations after hip fracture[10] or hospital discharge[11] or people with chronic obstructive pulmonary disease[12], chronic conditions[13], or frailty[14, 15]. Multicomponent home-based rehabilitation included exercise, practicing ADL, and improving home environment (such as removing environmental hazards and home modification). These interventions were effective in improving upper extremity strength[10], and self-efficacy[13], reducing functional difficulty[13] and environmental hazards[13], and preventing ADL decline[14]. Some studies have evaluated life-space mobility as an indicator of social participation. One study targeting community-dwelling frail older people recently discharge from an aged care and rehabilitation service reported that multifactorial interdisciplinary home-based intervention improved LSA score by 6.57 points after three-months[15]. Multicomponent home-based rehabilitation for older people who had a stroke or an injury within the past 1 year were reported to show improvement in LSA score by 5.0 points after 6 months[16]. However, a change of 10≥ points in the LSA score was required for the results to be considered clinically meaningful[6, 17, 18]. The intervention in a previous study included exercise, practicing ADL, improving home environment, and caregiver support; however, the study was unclear in terms of planning and checking of rehabilitation programs. Therefore, this study aimed to verify the effects of three-months multicomponent home-based rehabilitation program developed based on the revaluation of older people with restricted life-space mobility. As a pilot study of multicenter research, this study was conducted a single-center.

PARTICIPANTS AND METHODS

This was an interventional, single-center study that was performed at a home-based rehabilitation service facility in Osaka, Japan. This facility includes approximately 300 users, 50% of whom have orthopedic diseases, 30% have cerebrovascular diseases, and 10% have intractable diseases. This study was conducted with the approval of the Research Ethics Committee of Osaka Prefecture University (2013-123). All participants provided written informed consent to participate in the study.

The study was conducted between April 2014 and March 2016. The family doctors and care managers of all participants judged that they needed home-based rehabilitation. The inclusion criteria included the following: age 65 years or older; LSA score of ≤52.3; first experience of home-based rehabilitation; and ability to communicate with the study personnel. We considered older people with an LSA score of ≤52.3 to have restricted life-space mobility[8]. Older people who were under terminal care, those with an incurable disease, and those with severe cognitive impairment were excluded. The flow diagram for participants recruited in this study is shown in Fig. 1.

Multicomponent home-based rehabilitation program was conducted by the physical and occupational therapists at least once or twice a week for three-months. Each 40–60-min visit included measuring the vital signs and confirming the condition of the participants. Additionally, the programs combined exercise, practicing ADL, improving home environment, and caregiver support based on evaluation. Exercises included stretching, improving range of motion, muscle strengthening, balance and weight shifting, and posture strengthening. Practicing ADL included bed mobility, transfer, gait, stair climbing, fall-recovery techniques, training with assistive devices, ADL techniques (such as eating, toileting, grooming, dressing, and bathing), and instrumental ADL techniques (such as meal preparation, dish washing, laundry, housekeeping, and shopping). Improving home environment included removing environmental hazards, providing assistive devices, and modifying the home. Caregiver support included guidance in terms of safer techniques for assisting participant ADL, fall-recovery techniques, using assistive devices, and removing environmental hazards. The intervention programs were conducted according to the instructions from the family doctor and planning for care management. The programs were developed according the flow diagram (Fig. 2), and increased load and frequency about exercise, advanced practicing ADL and instrumental ADL, an additional improving home environment, and suggested care manager to add some support services. For example, a participant have repeated falls because of caregiver cannot maintain the home environment safety, we suggested to visit home care worker.

The participants were evaluated at baseline and after three-months of intervention. We investigated the medical records of participants in terms of age, gender, disease, living status, hospitalization history, and fall history.

The primary outcome was life-space mobility evaluated using the LSA score (range: 0–120), with a higher score indicating increased life-space[6]. Life-space was categorized into five levels. Level 1 was characterized by mobility in the bedroom and inside the home; level 2, mobility outside home; level 3, mobility in the neighborhood; level 4, mobility within the town; level 5, unlimited mobility. In addition, we used the Swedish version of the Life-space Assessment Questionnaire[19]. There were three additional measures of life-space levels: the independent, assistive, and maximal life-space levels. The independent life-space level indicates the highest level obtained without any assistance. The assistive life-space level is the highest level reached with help from an equipment but not another person. The maximal life-space level indicates the greatest distance travelled irrespective of assistance from equipment and/or another person.

Secondary outcomes included ADL and psychological and physical functions. ADL was evaluated based on the Functional Independent Measure (FIM) scores (range: 18–126), with a higher score indicating better ADL. Psychological function was evaluated with the Falls Efficacy Scale (FES), Geriatric Depression Scale 5 (GDS5), and self-rated health scores. FES

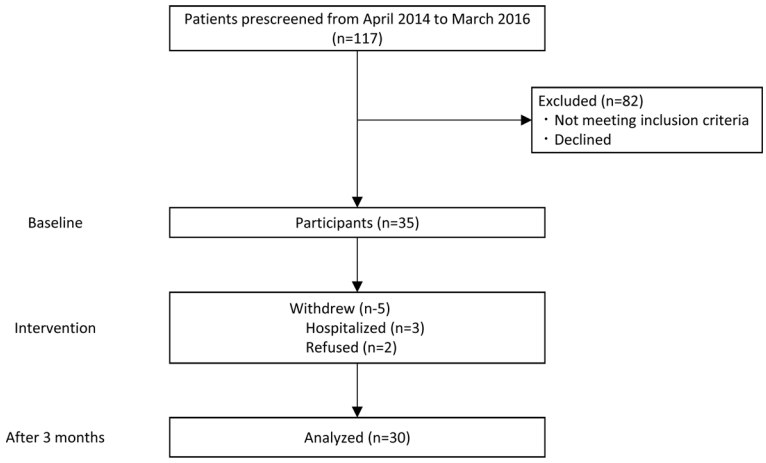

Fig. 1. Flow diagram of the participants who were recruited in this study.

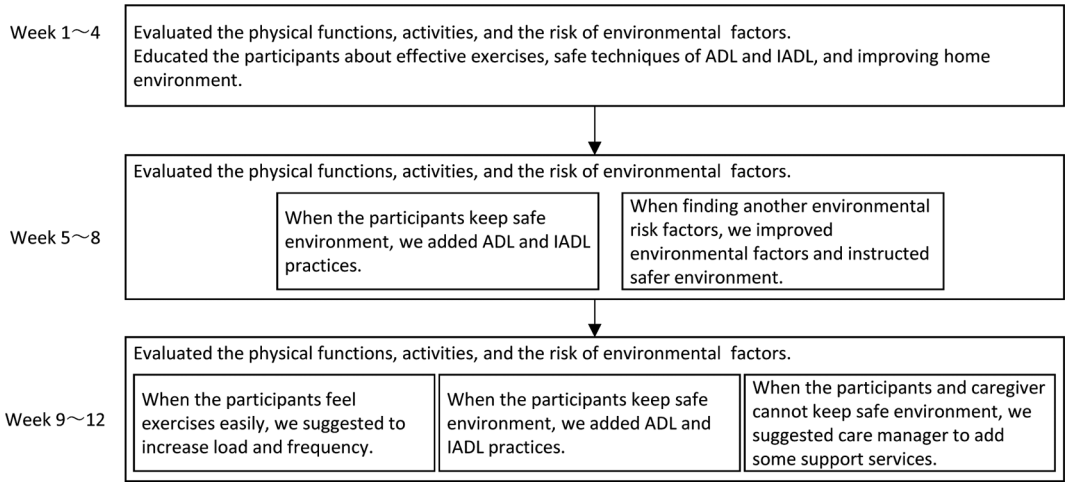

Fig. 2. Flow diagram for developing the intervention programs, including new exercises, advanced practicing activities, and improved environmental risk factors.

(range: 10–40) evaluated fall-related self-efficacy, with a higher score indicating better efficacy. GDS5 (range: 0–5) evaluated depression, with over 2 points indicating a depression tendency. Self-rated health was divided into four categories: very good, good, fair, or poor. Physical function was evaluated based on the participant's ability to stand. No participant could perform the Sit-to-Stand test five times. Therefore, we evaluated the participant's ability to stand based on whether they were able to stand up from a 40-cm chair without assistance.

Wilcoxon signed rank test and McNemar test were used for intragroup comparisons. All statistical analyses were conducted using SPSS statistics, version 26 (IBM Corp., Armonk, NY, USA). P-values <0.05 were considered statistically significant.

RESULTS

Of a total of 117 people participating in the study, 82 were excluded. Accordingly, 35 people matched the inclusion criteria; of these, five participants (including two who were hospitalized and three who refused to participate) were withdrawn. Thus, 30 participants completed the intervention (Fig. 1).

The average age of the participants was 82.4 ± 7.5 years. Orthopedic disorders were the most common disease in participants, and the other conditions included respiratory diseases and frailty. Further, 30% participants had a hospitalization history and fall history (Table 1).

Three-months after the interventions were initiated, significant improvements were observed in the LSA score, from 12.0 to 30.5 (Table 2). The FIM score also improved from 108 to 115. Further, the FES score improved from 23.5 to 26.0.

Table 1. Participant characteristics at baseline (n=30)

Characteristic			
Age (years)		mean ± SD	82.4 ± 7.5
Female		n (%)	24 (80.0)
Disease	Orthopedic disorder	n (%)	19 (63.3)
	Stroke		6 (20.0)
	Other		5 (16.7)
Living status	Alone	n (%)	6 (20.0)
Hospitalization history		n (%)	15 (30.0)
Fall history		n (%)	15 (30.0)
Visiting frequency	1 time/week	n (%)	23 (38.3)

Multicomponent home-based rehabilitation was conducted at least once or twice a week for three months.

Table 2. Intervention scores between baseline and after three-months (n=30)

	Baseline			After three-months			p-value
	Median	IQR	Range	Median	IQR	Range	
LSA	12.0	16.8	4–44	30.5	15.3	6–54	0.000[a]
FIM	108.0	17.0	66–122	115.0	17.3	75–124	0.001[a]
FES	23.5	11.3	14–40	26.0	9.3	13–39	0.004[a]
GDS5	2.0	2.0	0–5	2.0	1.0	0–5	0.257[a]
Self-rated good health, n (%)	18	(60.0)		19	(63.3)		1.000[b]
Able to stand without assistance, n (%)	7	(23.3)		17	(56.7)		0.010[b]

IQR: interquartile range; LSA: Life Space Assessment; FIM: Functional Independent Measure; GDS5: Geriatric Depression Scale 5; FES: Falls Efficacy Scale.
[a]Wilcoxon signed-rank test, [b]χ^2 test, Fisher's exact test.

Table 3. Independent, assisted, and maximal life-space levels between baseline and after three-months (n=30)

	Independent life-space		Assisted life-space		Independent life-space	
	Baseline	After 3 months	Baseline	After 3 months	Baseline	After 3 months
Not able	24 (80.0%)	23 (76.7%)	7 (23.3%)	4 (13.3%)	0	0
Level 1	5 (16.7%)	5 (16.7%)	12 (40.0%)	11 (36.7%)	11 (36.7%)	1 (3.3%)
Level 2	1 (3.3%)	1 (3.3%)	5 (16.7%)	6 (20.0%)	3 (10.0%)	3 (10.0%)
Level 3	0	1 (3.3%)	4 (13.3%)	7 (23.3%)	5 (16.7%)	2 (6.7%)
Level 4	0	0	2 (6.7%)	1 (3.3)	6 (20.0%)	14 (46.7%)
Level 5	0	0	0	1 (3.3)	5 (16.7%)	10 (33.3%)

Furthermore, 23% of participants could stand without assistance at baseline, and this proportion increased to 56.7% after three-months. There were no significant changes in the GDS5 and Self-rated good health scores.

Table 3 shows the independent, assisted, and maximal life-space levels between baseline and after three-months. Eighty percent of participants were not able to independently move within the bedroom at baseline, and this proportion was only reduced to 77% participants after three-months. With regard to assisted life-space, 40.0% and 36.7% participants were at level 1 at baseline and after three-months, respectively. One participant reached assisted life-space level 5 after three-months. Further, 37% of participants were at level 1 with regard to maximal life-space at baseline; however, only 1 participant (3.3%) stayed at level 1 after three-months. The proportion of participants at maximal life-space level 5 doubled from 16.7% at baseline to 33.3% after three-months.

DISCUSSION

Our multicomponent home-based rehabilitation program significantly improved the LSA score (by 18.5 points) of older people with restricted life-space mobility after three-months. As shown in a prior study, a change of ≥10 points in LSA score can be considered clinically meaningful[6, 17, 18]. The strength of our study was that our intervention resulted in the expansion

of life-space mobility within a short period.

The effects of multicomponent home-based rehabilitation have been reported in a few studies. Fairhall et al. performed multifactorial interdisciplinary home-based intervention and significantly improved LSA scores to 4.68 points after 12 months[14]. The participants were aged 83.3 ± 5.9 years and mobility-related disability in frail older people. Kamioka et al. reported a significant improvement of 5.0 points in LSA score after 6 months of multicomponent home-based rehabilitation in older people who had suffered a stroke or an injury in the past 1 year[16].

These studies focused on exercises, ADL, environmental factors, and other factors, unclear in terms of planning and checking of rehabilitation programs. In this study, we conducted three-months multicomponent home-based rehabilitation program according a flow diagram. Particularly, environmental barriers were associated with restricted life-space mobility and less participation[20, 21]. When we found the risk of environmental factors, we took measures such as removing environmental hazards, providing assistive devices, and modifying the home; in addition, we instructed the participants and caregivers to maintain a safe environment during interventions. If the participants and caregivers could not maintain safety environment, we suggested the care manager to add some support services such as a home care worker. As a result, an improvement of over 10 points was observed in the LSA score after three-months, despite the average age of people being 82.4 ± 7.5 years. On comparing assisted life-space and maximal life-space, improvement in LSA score was caused by expanding the life-space mobility via assistance from another person. Assistance was more effective for expanding maximal life-space mobility as the older people received not only home-based rehabilitation but also caregiver support.

According to past systematic reviews, home-based rehabilitation for community-dwelling older people had no clear evidence for improving ADL[22]. People with an LSA score of ≤52.3 points at baseline and a decline in the LSA score by >11.7 points were predicted to be unable to perform ADL during the 2 years of follow-up in a study[8]. The participants in this study had an LSA score of <52.3 at baseline, which indicated that they were all high-risk people with ADL decline. Despite having risk factors, the FIM score significantly improved from 108 to 115 points after intervention. Further, Kamioka et al. reported significant improvements in the FIM score from 94.4 to 97.9 points after three-months of multicomponent home-based rehabilitation in older people[16]. The participants in our study showed an improved of FIM score by 7.0 points after three-months of intervention, despite having high scores at baseline. Home environmental interventions and assistive technology devices were reported to suppress the decline of FIM score, which decreased from 108.8 to 104.8 in 18 months; in contrast, the control group showed a decline in the score from 109.4 to 97.9[20]. Our three-months multicomponent home-based rehabilitation program included improving home environment, which was considered to more effectively improve ADL.

Fear of falling is associated with life-space mobility of older people[23]. In the present study, the FES score was significantly improved, and 56.7% participants could stand without assistance after three-months. Sit-to-stand test has often been used as an indicator for lower limb strength in older people[24]. Declining muscle mass, strength, power, and physical performance have been reported to be independently associated with an increased fear of falling[25]. Therefore, the result of increasing FES score was considered to be associated with improving lower limb strength. Furthermore, home-based rehabilitation for the assessment and modification of environmental hazards has been reported to prevent falls among older people[26]. Multicomponent home-based rehabilitation includes the improvement of environmental factors prevent falls which are considered to associated with declining life-space mobility[27].

This study had several limitations. First, the number of participants was small. Many participants did not match the inclusion criteria; there were only 35 participants including various clinical conditions. Second, there was a difficulty in visiting participants by others because of the limited number of therapists; further, we could not blind the evaluator. Finally, as the study was conducted at a single facility, we could not compare with the control group. We aim to conduct future studies at multiple facilities and increase the number of participants; thus, our study is a pilot study conducted at a single facility. Nonetheless, targeting older people with restricted life-space mobility was clinically meaningful.

In conclusion, a three-months multicomponent home-based rehabilitation program can improve life-space mobility in older people with restricted life-space mobility. Expanding life-space mobility with home-based rehabilitation may also facilitate the social participation of older people. In the future, the effects life-space mobility on multicomponent home-based rehabilitation need to clearly.

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Conflict of interest

None.

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