

Original Article



Home-Visiting Cognitive Intervention for the Community-Dwelling Elderly Living Alone

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Conflict of Interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: Lee AY; Data curation: Lee J; Formal analysis: Lee J; Methodology: Lee AY, Lee J; Validation: Lee J; Writing - original draft: Lee J; Writing - review & editing: Lee AY.

ABSTRACT

Background and Purpose: The elderly living alone feel lonelier and more isolated than do those live with others, and they are at higher risk for cognitive decline and depression. This study aimed to assess whether a home-visiting cognitive intervention (HCI) can have positive effects on cognitive improvement for the elderly who living alone.

Methods: HCI was conducted from April 2016 to November 2019. Every elder who lived alone and 2 matched partners met for 8 weeks once a week. The partners visited participants' home and did the HCI which composed of cognitive training and cognitive stimulation activities. The Mini-Mental State Examination-dementia screening (MMSE), Geriatric Depression Scale (GDS), the Korean version of instrumental activities of daily living (K-IADL), and the Social Support Scale (SSS) were evaluated before and after HCI to compare the effect of HCI.

Results: A total of 258 participants showed significant improvements in MMSE, GDS, K-IADL, and SSS. The MMSE and GDS scores were significantly improved after HCI in both the normal cognition (NC, $n=210$) and cognitive impairment (CI, $n=48$) groups. The cognitive effect of HCI for CI was higher than for NC. Among the NC, the magnitude of cognitive improvement was greater in the higher educated group (above 7 years) than in the other groups.

Conclusions: Active cognitive interventions could provide possible benefits to improve cognition, emotion, and functional abilities. Regular cognitive-care services like HCI are necessary to reduce dementia risk for the elderly who live alone in the community.

Keywords: Intervention Study; Cognition Therapy; Community Dwelling; Elderly

INTRODUCTION

The elderly over 65 number more than 0.68 million, and the number of them who live alone is 0.14 million, accounting for 20% of all elderly households in Korea. It is estimated that the number of elderly who live alone will increase steadily and will more than double by 2035.¹ Elderly people living alone are more vulnerable to socioeconomic and physical/mental problems than are elderly people living with family or other people.^{2,3} They are known to have more depression or loneliness than do the elderly living with family.^{3,4} According to other domestic studies, 33.3% of elderly persons living alone reported loneliness, which was associated with cognitive decline.⁵ Depression also more than doubles the risk of dementia.⁶

Therefore, the elderly living alone should be categorized as being at high-risk for dementia and need a variety of cognitive and social activities to prevent or delay dementia.

Non-pharmacological treatment is important for the elderly with dementia or at high-risk for dementia. It includes cognitive intervention, nutrition, and exercise. Exercise and cognitive intervention are recommended as effective ways to prevent dementia in patients with mild cognitive impairment (MCI).⁷ In several studies, elders in the community showed improvement in cognitive function and quality of life after a cognitive intervention program.⁸ This study investigates the cognitive and emotional effects of the home-visiting cognitive intervention (HCI) on the elderly who are living alone.

METHODS

Participants

The participants were enrolled in this study from April 2016 to November 2019. Subjects were recruited in the local community through public administration, such as metropolitan and 5 local dementia centers in Daejeon. Anyone who lived alone, was over 65, and wanted to participate in this study was enrolled. The participants were informed of the HCI, voluntarily decided to participate, and signed a consent form.

We recruited twice as many partners as there were enrolled elderly; these were volunteers, ranging from teenagers to adults, in the local community. They were matched to each participant in teams of 2. The partners received preliminary training on HCI guidelines, including cognitive evaluation tools, cognitive training, and cognitive stimulation activities. They visited a participant's house once a week for a total of 8 weeks. At each visit, a pre-produced cognitive training paper and a cognitive stimulation activity were used according to the program schedule (**Fig. 1**).

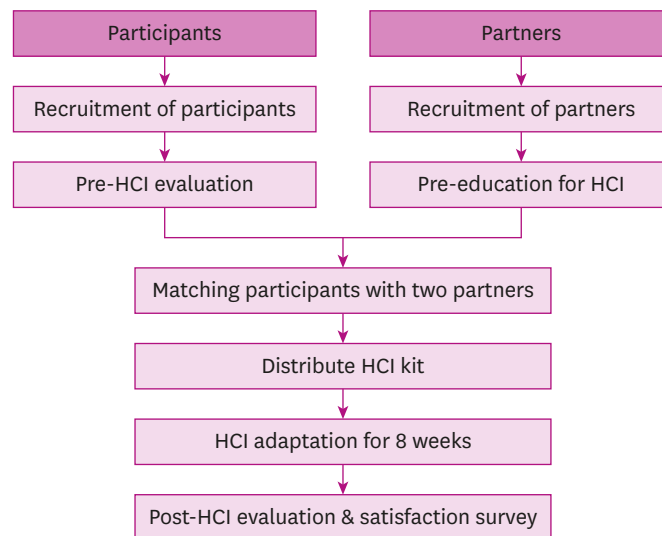


Fig. 1. Flow diagram of the study.
HCI: home-visiting cognitive intervention.

Table 1. Detailed contents of the home-visiting cognitive intervention program

Schedule	Cognitive training	Cognitive stimulation activities
1st wk*	Every session of cognitive training had different combinations of multiple cognitive domains such as:	Plant planting (tomato, lettuce, etc.)
2nd wk	- Orientation, attention	Dementia prevention exercise
3rd wk	- Language	Puzzle
4th wk	- Memory	Coloring
5th wk	- Calculation	Simple creating activities (clay activities, papercraft, etc.)
6th wk	- Visuospatial function	Finding hidden pictures
7th wk	- Program solving ability	Decorating frame, fan, or bag
8th wk*		Sharing feeling during the program

Participants had a different cognitive training and cognitive stimulation activity in every week.

*Pre- and post-evaluations were conducted on 1st and 8th week, respectively.

HCI program

Each session of HCI took 1 hour, including the cognitive training paper developed by the Daejeon Metropolitan Dementia Center and one cognitive stimulation activity. Every session had different contents. Each cognitive training contained combinations of several cognitive domains, such as orientation, concentration, memory, language, calculation, visuospatial perceptual ability, and problem-solving ability. The contents of the cognitive training were selected at an appropriate level for the elderly with a slight cognitive decline. Cognitive stimulation activities were dementia preventive exercises, coloring, puzzles, planting, finding hidden pictures, and simple creative activities that could stimulate participants' physical, emotional, and cognitive state (Table 1).

Evaluation tools

All participants were tested before and after HCI with Mini-Mental State Examination-dementia screening (MMSE-DS),⁹ Geriatric Depression Scale (GDS),¹⁰ the Korean version of instrumental activities of daily living (K-IADL),¹¹ and the Social Support Scale (SSS).¹² MMSE-DS is a dementia screening tool that is easy to learn, easy to apply, and used generally in the local community. GDS measures the severity of depression in the elderly, and K-IADL assesses the ability to carry out daily living activities. The SSS consists of 25 questions; its total score is 125, and a higher score means that the subjects consider themselves to have better social support. These evaluation tools can be easily used by people in general.

After the program, participants were divided into 2 groups by the level of cognition for the analyses. Participants who had under a 1.5 standard deviation of the MMSE-DS standard score according to age, education, and sex were allocated to a cognitive impairment (CI) group, and the other participants were in a normal cognition (NC) group. Participants also were divided into 3 groups in terms of educational levels: the uneducated group, the lower educated group (<7 years), and the higher educated group (≥7 years).

Statistics

We used nonparametric methods because the data did not satisfy the normal distribution. The demographic and baseline characteristics between CI and NC were compared by means of the Mann-Whitney *U*-test and Fisher's exact test. The pre and post HCI outcome measures were compared using the Wilcoxon signed-rank test in the NC and CI groups. The score differences in pre and post outcome measures between the NC and CI groups were compared by the Mann-Whitney *U*-test. Score differences between pre- and post-evaluations were compared between the 3 educational level groups using the analysis of covariates adjusted with MMSE-DS score and age. Bonferroni's methods were used for *post hoc* analysis. All

analyses were done using SPSS® version 21 (IBM Corp., Armonk, NY, USA) for Windows®. Values of $p < 0.05$ were considered to be statistically significant.

RESULTS

Characteristics of the participants

A total of 280 elders was recruited for this study. There were 22 participants who dropped out because of illness, moving, changing in living situation, or refusing the evaluation; So, 258 participants completed this program, finally. Their mean age was 80.0 years old, and the number of females was 225 (87.2%). There were 92 uneducated (0 years, 35.7%), 126 lower educated (between 1–6 years, 48.8%), and 40 higher educated (above 7 years, 15.5%) elders among the participants, and 48 of them (18.6%) were classified as CI. The mean age of the CI was 82.8 years, which was older than that of the NC (79.4 years). The mean MMSE-DS score was significantly different between CI and NC (16.8 vs. 25.0). The CI showed higher scores of the K-IADL, but the GDS and SSS were not different between the 2 groups (**Table 2**).

Effects of HCI

Participants showed better scores after HCI in the MMSE-DS, GDS, K-IADL, and SSS. All of the items evaluated, including cognition, were significantly improved in all participants, and the NC had same results. In the CI, the scores of MMSE-DS and GDS were significantly improved, but the scores of K-IADL and SSS were improved without significance (**Table 3**).

Table 2. Comparisons of demographics and baseline characteristics between NC and CI

Variables	Total	NC	CI	p-value
No.	258	210 (81.4)	48 (18.6)	-
Age	80.0±5.7	79.4±5.5	82.8±6.2	<0.01
Female (sex)	225 (87.2)	184 (87.6)	41 (85.4)	0.33
Educational levels	3.7±4.0	3.4±3.9	4.7±4.4	0.01
Uneducated (0 yr)	92 (35.7)	77 (36.7)	15 (31.3)	-
Lower educated (1–6 yr)	126 (48.8)	107 (51.0)	19 (39.6)	-
Higher educated (>7 yr)	40 (15.5)	26 (12.4)	14 (29.2)	-
HTN (n=236)	120 (50.8)	104 (53.9)	16 (37.2)	0.01
DM (n=236)	56 (23.7)	51 (26.4)	5 (11.6)	<0.01
Dyslipidemia (n=236)	42 (17.8)	38 (19.7)	4 (9.3)	0.03
Depression (n=236)	22 (9.3)	19 (9.8)	3 (7.0)	0.54
MMSE-DS	23.4±4.7	25.0±3.2	16.8±4.4	<0.01
GDS (n=255)	13.3±6.7	13.2±6.5	13.7±7.5	0.47
K-IADL (n=214)	0.41±0.51	0.30±0.36	0.93±0.72	<0.01
SSS (n=171)	87.4±23.6	87.7±22.2	85.8±31.1	0.47

Data are shown as mean±standard deviation or number (%).

NC: normal cognition, CI: cognitive impairment, HTN: hypertension, DM: diabetes mellitus, MMSE-DS: Mini-Mental State Examination-dementia screening, GDS: Geriatric Depression Scale, K-IADL: the Korean version of instrumental activities of daily living, SSS: the Social Support Scale.

Table 3. Comparisons of pre and post home-visiting cognitive intervention outcome measures within the NC and CI groups

Variables	Total (n=258)			NC (n=210)			CI (n=48)		
	Pre	Post	p-value	Pre	Post	p-value	Pre	Post	p-value
MMSE-DS	23.4±4.7	24.5±4.6	<0.01	25.0±3.2	25.8±3.2	<0.01	16.8±4.4	18.6±5.4	<0.01
GDS	13.3±6.7	11.7±6.5	<0.01	13.2±6.5	11.6±6.3	<0.01	13.7±7.5	12.2±7.0	0.01
K-IADL	0.41±0.51	0.37±0.57	<0.01	0.30±0.36	0.25±0.44	<0.01	0.93±0.72	0.89±0.78	0.27
SSS	87.4±23.6	93.2±20.5	<0.01	87.7±22.2	93.8±20.1	<0.01	85.8±31.1	89.6±23.1	0.34

Data are shown as mean±standard deviation.

NC: normal cognition, CI: cognitive impairment, MMSE-DS: Mini-Mental State Examination-dementia screening, GDS: Geriatric Depression Scale, K-IADL: the Korean version of instrumental activities of daily living, SSS: the Social Support Scale.

Table 4. Effects of home-visiting cognitive intervention by the educational levels within the normal cognition subgroup

Variables	Uneducated (0 yr)	Lower educated (1-6 yr)	Higher educated (>7 yr)	p-value
No.	77 (36.8)	106 (50.7)	26 (12.4)	-
Age	80.0±5.4	79.4±5.6	77.4±4.9	0.11
Education	0.0±0.0	4.1±2.2	11.2±2.4	<0.01
Δ MMSE-DS	0.3±0.2	1.1±0.2	1.4±0.4	0.02*
Δ GDS	1.7±0.6	1.7±0.5	1.0±1.0	0.82
Δ K-IADL	-0.01±0.06	0.07±0.05	0.15±0.10	0.38
Δ SSS	4.3±2.3	7.4±1.6	4.7±4.1	0.51

Data are shown as mean±standard deviation or number (%).

Δ: differences between pre- and post-evaluations, MMSE-DS: Mini-Mental State Examination-dementia screening, GDS: Geriatric Depression Scale, K-IADL: the Korean version of instrumental activities of daily living, SSS: the Social Support Scale.

*p=0.01 (between uneducated and lower educated groups).

Among the outcome measures, the CI group showed better cognitive improvement than did the NC (1.94 points improvement of MMSE-DS in CI, and 0.83 points in NC, $p<0.01$, **Fig. 2**). There was no difference in change of outcome measures between educational levels in all participants, and the CI group had same results. However, the higher educational group had more participants with CI than did the other groups. In the comparisons within the NC, the magnitude of cognitive improvement was greater in the higher educated group than in the other groups (**Table 4**).

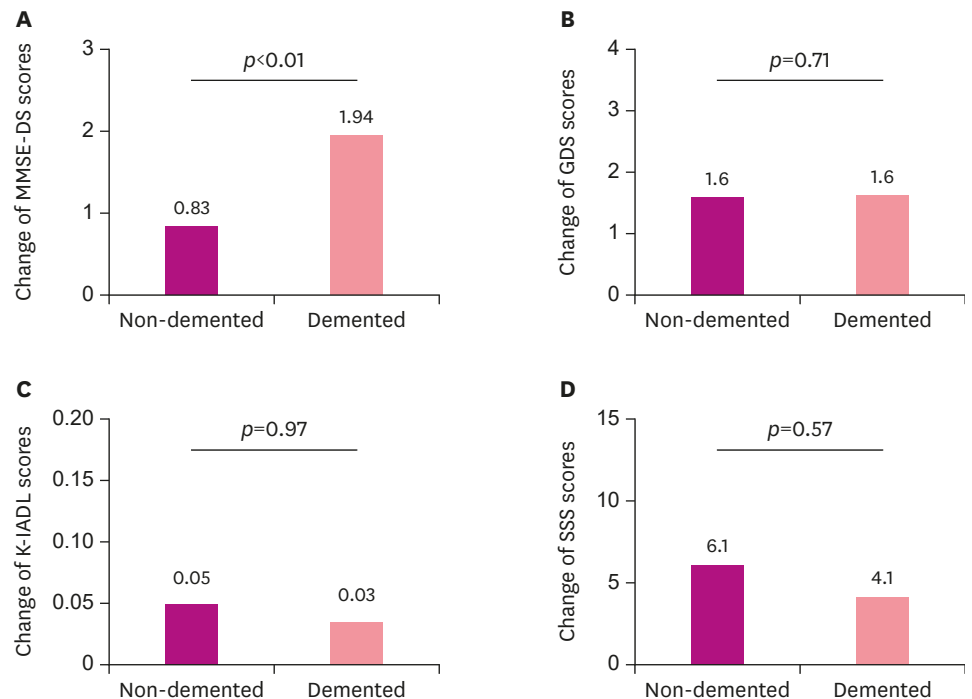


Fig. 2. Comparisons of score differences in pre and post outcome measures between the normal cognition and cognitive impairment groups adjusted by age and education. MMSE-DS: Mini-Mental State Examination-dementia screening, GDS: Geriatric Depression Scale, K-IADL: the Korean version of instrumental activities of daily living, SSS: the Social Support Scale.

DISCUSSION

In this study, the HCI for 8 weeks showed positive effects in the elderly who were living alone, in the aspects of cognition, mood, daily living activities, and social support. The cognitive and emotional benefit of HCI also showed for not only the NC but also the CI.

There have been many studies proving the benefits of cognitive intervention. Several studies that applied cognitive interventions to subjects with dementia,^{13,15} MCI,¹⁶ or even NC^{17,18} reported improvements of cognition, depression, and quality of life. The reasons for the cognitive effects were thought of as strengthening cognitive reserve¹⁹ which could resist greater neuropathological damage, and reducing the risk of further cognitive decline by increasing the ability to recruit alternative brain networks.²⁰ Neuronal plasticity, defined as the ability to adapt structural organization in response to changes in the environment, may be evidence for the usefulness of cognitive intervention.²¹

In a previous study, 1,251 NC elders got cognitive training and cognitive stimulation activities twice a week for 12 weeks, and they showed improvement in cognition, mood, and quality of life after the intervention. The sub-group analysis showed that the elderly who lived alone had better effects following the intervention program.²² The present study was focused on the elderly living alone with or without cognitive decline, and the results were in line with the sub-analysis results of the previous study. HCI has several strengths to improve cognition and mood, daily function, and social support.

At first, this program consisted of multiple interventions, such as cognitive training for multiple domains, and various cognitive stimulation activities including exercise. This is known to be more effective for cognitive function, depression, and quality of life than is simple cognitive training or cognitive stimulation activity alone.²³ A functional magnetic resonance imaging study with MCI patients showed that the activities of the hippocampus were increased by the cognitive program for 2 months.²⁴ The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability study, which was a large randomized controlled trial of 1,200 patients at risk for cognitive decline, showed effects on the general cognitive function and executive function from the complex cognitive intervention with cognitive training, nutrition, exercise, and social activities.²⁵

The effects of the HCI for the elderly who lived alone may have resulted because the regular visits and social interchanges with the partners had a positive influence on the social and psychological factors of the subjects who had been isolated from society. In this study, the participants recognized better social support after the program. It is well known that the elderly living alone feel more depression or loneliness than do the elderly living with family,^{26,27} and the more loneliness there is, the more the cognitive deterioration becomes worse.⁵ The elderly living alone explain that they are separated from social networks, such as family, friends, and neighbors, and they feel isolated and lonely because of the loss of social roles. However, one study suggested that just living alone was not associated with poor cognitive function, but social isolation may be more associated with poor cognitive function.³ In these cases, regularly visiting with community care services to prevent social isolation, including health care, bathing, and being a companion, could improve the subjects' physical status, social relationship, depression, and self-esteem.²⁸

In the present study, both CI and NC showed improvement in cognitive state and depressive mood. Also, the CI showed more improvement of the MMSE-DS score than did the NC.

Another study conducted on individuals with MCI and Alzheimer's disease also showed better cognitive effects in the Alzheimer's disease group than in the MCI group after cognitive intervention.¹⁶ The NC had less improvement in the score of MMSE-DS than did the CI correspondingly, which could be interpreted as the ceiling effect, which is the limitation of the MMSE-DS. Nonetheless, participants showed statistically significant improvement in cognitive effects in both groups after the program.

In the comparisons of cognitive effect based on the educational levels within the NC, the higher educated group showed the most improvement of MMSE-DS scores after HCI. This result implies the importance of cognitive intervention for preventing cognitive decline, especially for the more educated elderly in the community. Higher education is a factor of high cognitive reserve,²⁹ which refers to the high flexibility of neuronal plasticity against the environment.²¹ The HCI had one level of difficulty for cognitive training, which was commensurate with the elderly for having a slight cognitive decline. As the cognitive training paper could not satisfy all subjects, we suggest that a revised HCI program needs another level of difficulty for the uneducated group is needed.

This study has some limitations. First, the intervention duration was relatively short, being 8 weeks. Second, this study was designed with only an active group. Third, cognition was evaluated with the MMSE-DS only, which tool has the ceiling effect in a NC group and a learning effect of a retest within a short interval. Nonetheless, this study was conducted with a large number of participants and had positive effects on cognition, depressive mood, and activities of daily living after the HCI. Through this study, we constructed an effective HCI and could suggest a sustainable and practical program that is helpful to the elderly living alone who were very vulnerable to dementia and depression in the community.

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