Dement Neurocogn Disord. 2020 Dec;19(4):140-151
https://doi.org/10.12779/dnd.2020.19.4.140
pISSN 1738-1495·eISSN 2384-0757

DND Dementia and Neurocognitive Disorder

Original Article

Check for updates

The Effect of Seoul Dementia Healing Design Project on Cognition and Social Engagement

Min Young Chun[1,*] **Jihye Hwang**[2,*] **Ji Young Yun**[3] **Geum Yun Sim**[4] **Gyoung-sil Choi**[5] **Geon Ha Kim**[1] **Jee Hyang Jeong**[3,6]

[1]Department of Neurology, Ewha Womans University Mokdong Hospital, Ewha Womans University College of Medicine, Seoul, Korea
[2]Department of Neurology, Keimyung University Daegu Dongsan Hospital, Keimyung University School of Medicine, Daegu, Korea
[3]Department of Neurology, Ewha Womans University Seoul Hospital, Ewha Womans University College of Medicine, Seoul, Korea
[4]Ewha Womans University College of Medicine, Seoul, Korea
[5]Department of Color Design, Ewha Womans University School of Medicine, Seoul, Korea
[6]Gangseo-gu Center for Dementia, Seoul, Korea

Received: Jun 25, 2020
Revised: Aug 19, 2020
Accepted: Oct 11, 2020

Correspondence to
Jee Hyang Jeong
Department of Neurology, Ewha Womans University Seoul Hospital, Ewha Womans University College of Medicine, 260 Gonghang-daero, Gangseo-gu, Seoul 07804, Korea.
E-mail: jjeong@ewha.ac.kr

*These authors are equally contributed to this work.

ORCID iDs
Min Young Chun
https://orcid.org/0000-0003-3731-6132
Jihye Hwang
https://orcid.org/0000-0002-8736-6309
Ji Young Yun
https://orcid.org/0000-0001-9648-9450
Geum Yun Sim
https://orcid.org/0000-0001-5630-4976
Geon Ha Kim
https://orcid.org/0000-0001-5395-1924
Jee Hyang Jeong
https://orcid.org/0000-0001-7945-6956

ABSTRACT

Background and Purpose: Rapid population aging and an increase in the demented elderly became major social concerns in South Korea. Environmental design is increasingly recognized as an important aid for long-term care of patients with dementia as well as pharmacotherapy. We did a pilot study to investigate the effect of the Seoul Dementia Healing Design Project In-House Design (S-DHDP-IHD) in improving the quality of life of the cognitively impaired patients and of the S-DHDP Environmental Design (S-DHDP-ED) in increasing daily outdoor activities for cognitively impaired individuals and not cognitively impaired (NCI) elderly residents.
Methods: We applied the S-DHDP-IHD to 2 households of patients with mild cognitive impairment (MCI) and early-stage vascular dementia (VD). We assessed the effectiveness of intervention by surveys and video recordings of daily tasks. Additionally, we applied the S-DHDP-ED to 5 community facilities and randomly selected 287 residents over 65 years old (32 dementia caregivers and 255 NCI elderly) to participate in surveys.
Results: S-DHDP-IHD intervention showed improved instrumental activities in MCI patient and early-stage VD patient. Also, the satisfaction with an intervened home environment was increased. Following S-DHDP-ED intervention, non-demented residents engaged in more outdoor and social activities. They were also satisfied with the function and design of the installed facilities.
Conclusions: S-DHDP encompassing both home and environmental improvements was effective in readapting cognitively impaired individuals and could achieve a customized, holistic approach to dementia caregiving by means of the improved design.

Keywords: Mild Cognitive Impairment; Vascular Dementia; Prevention & Control; Environment Design

Funding

This research was supported by a grant of the Department of Design Policy of the Cultural Headquarters of the Seoul Metropolitan Government.

This research was also supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HI18C0460, HI18C0479) and supported by the Original Technology Research Program for Brain Science through the National Research Foundation of Korea (NRF) funded by the Ministry of Science and ICT (NRF-2018M3C7A1057137).

Conflict of Interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: Chun MY, Hwang J; Data curation: Chun MY, Hwang J, Jeong JH; Formal analysis: Yun JY, Kim GH; Investigation: Yun JY, Jeong JH; Methodology: Yun JY, Choi GS; Software: Kim GH; Validation: Sim GY; Writing - original draft: Chun MY, Hwang J; Writing - review & editing: Kim GH, Jeong JH.

INTRODUCTION

Demographic changes in South Korea over the years highlight the importance of a paradigm shift in the national health-care policy. The rapid growth of the elderly population in South Korea has brought population aging and socioeconomic problems related to caregiving for dementia patients. According to the Korean Dementia Observatory 2019 on the outlook of the dementia population, the prevalence of dementia in people 65 or older is 9.8%, with a projected 2 fold increase every 20 years, so that the dementia population of 788,035 in 2019 is expected to rise to 3,200,000 by 2060.[1] Consensus on the need for a change in the current health-care policy to adequately address the severity of the socioeconomic burden is spreading.

One area warranting policy consideration is creating a dementia-friendly environment for both therapeutic and preventive purposes. Sixty percent of dementia caregivers are family members, and related social issues such as murder-suicide involving caregivers have been increasingly reported in the media.[2,3] Thus, given that it is difficult to manage the rapidly increasing dementia patients collectively and that most patients receive care at home, there is an absolute need for a "dementia-friendly" environmental design that meets the specific needs of dementia patients at home. These efforts to create a dementia-friendly residential environment will ensure the safety of dementia patients receiving in-home care and reduce the burden of family caregivers.

The importance of environmental design in the care of patients with dementia has long been emphasized.[4] Many previous studies have been done on dementia-care design guidance to reduce potential risks to demented elderly.[5-7] These results showed that proper environmental modification could improve functional daily activity and independence in dementia patients. However, these recommendations were proposed for high-income countries and could not be applied directly to Korean society and cultural elements; so their effect is unclear.

The Seoul Dementia Healing Design Project (S-DHDP) was conducted by the Department of Design Policy of the Cultural Division of the Seoul Metropolitan Government to develop a dementia-friendly design that can be applied to Korean society in cooperation with the Yangcheon-gu Dementia Center. Our pilot study investigated the effect of S-DHDP In-House design (S-DHDP-IHD) on mild cognitive impairment (MCI) and early-stage vascular dementia (VD) households by investigating residential patterns and satisfaction levels and S-DHDP Environmental Design (S-DHDP-ED) on dementia caregivers and non-demented older adults by using survey research.

METHODS

The S-DHDP by the Department of Design Policy of the Cultural Headquarters of the Seoul Metropolitan Government was conducted between November 2014 and March 2016. It was designed to obtain safety for dementia patients and alleviate the burden on the family members, as the need for the development of a dementia-friendly environment has increased in Korean society. The project consisted of 2 parts: 1) S-DHDP-IHD to improve the vulnerable indoor environments of dementia families and improve the quality of life (QoL) of patients with cognitive impairment and their family members, as well as to increase cognitive activity in MCI by modifying the indoor environment based on analyses of the residential patterns of the dementia family; and 2) S-DHDP-ED to promote outdoor activities not only of dementia

patients and caregivers, but also of healthy community elderly. A comprehensive flowchart of the study is shown in **Supplementary Fig. 1**.

We selected Yangcheon-gu, Sinwol 1-dong for the study site because of the high rate of aged population and the high ratio of residents with dementia compared to that in other districts. We did pre-test/post-test surveys to evaluate the effectiveness of S-DHDP.

S-DHDP-IHD

Subjects of S-DHDP-IHD

To assess effect of S-DHDP-IHD, we recruited 10 households of residents who were 70 or older living in Sinwol 1-dong and had cognitive impairments from Yangcheon-gu Dementia Center. We selected 2 household settings after site visits and evaluations conducted between November 2014 and March 2015, using the following criteria: 1) ability to understand the project and cooperate, 2) home conditions in need of improved services, 3) family arrangements with residents either living alone or living with one caregiver.

We chose 2 households among 10 candidates to undergo renovation for S-DHDP-IHD. Since this study was about the environmental effects of preventing dementia, an MCI patient without daily activity problems and an early-stage dementia patient who had mild difficulties in daily life were selected. The first of the 2 households consisted of a 70-year-old MCI woman living alone and engaging in social activities 2 or 3 times a week. She complained of mild anxiety, depression, and fatigue but was otherwise generally healthy for her age. The other household consisted of a 77-year-old early-stage VD patient and his 78-year-old spouse, who was the main caregiver. The patient had almost no outdoor activities because of deteriorating physical health, and the caregiver had limited social life, lacking empathizing friends and other family members.

Intervention of S-DHDP-IHD

For S-DHDP-IHD, the intervention consisted of renovations of various home areas. In the MCI household (**Fig. 1**), there were replacements of a storage closet, toilet seat covers, storage shelves, wall-socket safety covers in the bathroom, a shoe shelf at the entrance, window shades in the bedroom, and sink bowls in the kitchen and dining area. Two storage closets and a clothes rack were set for a second room. In the early-stage VD household (**Fig. 2**), there were replacements of sidesteps and application of handrails, tissue holders, non-slip tapes in the bathroom, replacements of sink bowls in the kitchen and dining area, curtains in the bedroom, and application of handrails and a storage closet in the living room. Also, handrails were applied to the porch stairs. Three storage closets and a clothes rack were set for a second room. In both households, light switch, wallpaper, and door handles were replaced, and name tags on storage closets and labels for cold/hot water were applied in common living areas.

Measurement of S-DHDP-IHD

We carried out pre- and post-intervention studies by surveys, used video monitoring to measure task performance improvement, and completed a comprehensive neuropsychological battery. We defined the effectiveness of the S-DHDP-IHD as being evidenced by improvements in facility satisfaction with the home environment and in functioning of everyday activities.

First of all, we evaluated the study subjects' cognition, mood, and neuropsychological symptoms using the following clinical tools before and after the project.

https://doi.org/10.12779/dnd.2020.19.4.140

Fig. 1. Pre- and post-intervention in renovations of various home areas in the mild cognitive impairment household (top: before; bottom: after). (A) Replacement of storage closet, toilet seat covers, storage shelves, and wall-socket safety cover. (B) Replacement of shoe shelf at entrance. (C) Replacement of sink bowl at kitchen and dining area. (D) Appliance of 2 storage closets and clothes rack in second room.

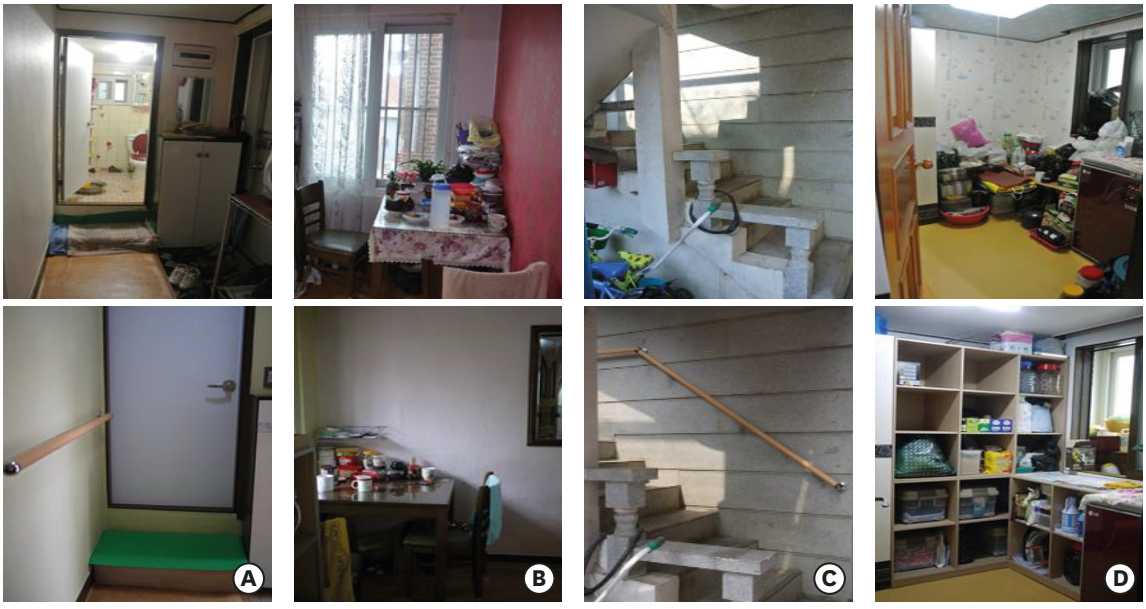

Fig. 2. Pre- and post-intervention in renovations of various home areas in the early-stage vascular dementia household (top: before; bottom: after). (A) Replacement of sidesteps and appliance handrail, tissue holder, non-slip tapes in bathroom. (B) Replacement of sink bowl in kitchen and dining area. (C) Appliance handrail at porch stairs. (D) Appliance of 3 storage closets and clothes rack in second room.

- Korean Mini-Mental State Examination (K-MMSE), Clinical Dementia Rating (CDR), CDR-Sum of Boxes
- Seoul Neuropsychological Screening Battery[8] to assess cognitive impairments in memory, executive functioning, visuospatial function, language, and attention
- Short Geriatric Depression Scale (SGDS)[9] to assess depression in the elderly
- Barthel Activities of Daily Living scale (ADL)[10] to measure degree of independence in

https://doi.org/10.12779/dnd.2020.19.4.140

everyday activities, and the Seoul-Instrumental Activities of Daily Living scale[11] to assess complex functional tasks of the elderly in daily living
- Caregiver-Administered Neuropsychiatric Inventory[12] to assess neuropsychiatric symptoms
- Zarit Burden Interview (ZBI)[13,14] to measure subjective caregiver burden
- Positive and Negative Affect Schedule (PANAS)[15] to assess mood and emotion

Second, we evaluated the indoor facility satisfaction levels by surveys conducted between April 14 and April 30, 2015, before intervention and between July 14, 2015, and August 28, 2015, after intervention. We used a Five Evaluation Framework (Supportiveness, Safety, Accessibility, Efficiency in Perception, Amenity) and the 10 Point Scale Bar.

The Five Evaluation Framework Questionnaire was derived from the concepts of Universal Design. According to this theory, supportiveness provides convenience to the user by reducing physical effort, such as by handrails and door handles. Safety is a characteristic that prevents accidents and minimizes obstacles, such as by using anti-slip tapes, handrails, and gas insulator or hot-water labels. Accessibility offers easy access regardless of the user's activities; examples include removal of pulleys and appropriateness of the height and size of sinks. Efficiency in perception heightens awareness and necessary information for switches. outlets, and storage labels. Last, amenity promotes comfort and emotional welfare by adequate environmental stimulations; examples include satisfaction with lighting, wallpaper, curtains, and storage.

The 10 Point Scale Bar assigns 0 to 10 points to images to measure satisfaction level. Five points is the baseline score, which is the satisfaction level before intervention. Increase in the satisfaction level is reflected by a shift of the score to the right, whereas a decrease in the satisfaction level is reflected by a shift to the left.

Third, we evaluated daily activity by means of video recordings and observations of task performances. Security cameras were placed in selected residential spaces from April 14, 2015, to May 9, 2015, for pre-intervention assessment and from July 7 to July 22, 2015, for post-intervention assessment. We compared video recordings of daily living before and after intervention. The monitored task performances in a specific home space were cleaning and washing clothes in the bathroom, finding lotion or favorite pants in the bedroom, and making bean sprout or seaweed soup in the kitchen. We measured the time spent in daily life, such as in taking a bath, finding winter hats and coats, and cooking, and evaluated each subject's ADL scales.

S-DHDP-ED

Subjects of S-DHDP-ED

For S-DHDP-ED, we recruited 255 residents of Sinwol 1-dong who are 40 or older and without dementia ('non-demented residents') by random selection to participate in pre- and post-intervention studies. We initially recruited 32 residents who were high-risk or early-stage dementia ('demented elderly') to participate in the first pre-intervention studies in June 2015. Only 30 of the demented elderly participated in the second pre-intervention studies, because 2 subjects dropped out, but subsequently, one additional demented elderly was recruited, and a total of 31 subjects completed the post-intervention study. We conducted pre-intervention studies between May and June 2015; neighborhood renovations were done between June and July 2015; post-intervention studies were done from October 12 to December 20, 2015; and a reassessment study was done until December 29, 2015.

https://doi.org/10.12779/dnd.2020.19.4.140

Fig. 3. Seoul Dementia Healing Design Project-Environmental Design facilities. (A) Pre- and post-installation of helpful service facilities named Gil Ban Jang (top: before; bottom: after). (B) Pre- and post-intervention in Cognitive Health Walking Course with 100-m trail marks on the road (left: before; right: after). (C) Pre- and post-intervention in one of the 7 rest areas (left: before; right: after). (D) 100-m trail bulletin board and exercise picture board along the Cognitive Health Walking Course.

Intervention of S-DHDP-ED

For S-DHDP-ED, the intervention consisted of renovations of various areas in the town, such as safe passage named helpful service facilities named Gil Ban Jang, exercise picture board, 7 rest areas, the 100-m trail bulletin board, and intersection marks along the Cognitive Health Walking Course (**Fig. 3**).

Measurement of S-DHDP-ED

To measure the effectiveness of the S-DHDP-ED, we conducted pre- and post-intervention surveys to: 1) evaluate the changes in the outdoor and social activity patterns of residents and 2) evaluate the satisfaction of residents in the project itself. To investigate changes in outdoor activities, we measured the number of outdoor activities per week, daily practice of taking a walk, and the number of social activities per week. These were surveyed in both pre- and post-intervention studies. Awareness of and experience with the renovated facilities of S-DHDP-ED, as well as satisfaction with their function and design, were surveyed in the post-intervention studies to evaluate the effect of the project itself.

RESULTS

Effectiveness of S-DHDP-IHD

The results of the neuropsychological test assessment before and after the interventions are summarized in **Table 1**. K-MMSE score increased in the MCI subject after the intervention, showing mildly improved cognition, but the change was not significant. Bayer ADL score decreased significantly in the MCI subject, indicating improved capacity for instrumental activities post-intervention. Although the SGDS score remained unchanged, PGCMS score improved in the MCI subject.

On the other hand, the K-MMSE score increased significantly in the early-stage VD subject, with a marked improvement in time and place orientation and memory recall. The Bayer ADL score decreased slightly in the early-stage VD subject, but the change was not significant. The PANAS score of the caregiver of the early-stage VD subject was maintained at a mildly depressive state after the intervention. The ZBI score of the caregiver of the early-stage VD subject significantly decreased, suggesting a decrease in the burden of care, and that satisfaction as a caregiver after the intervention was increased.

https://doi.org/10.12779/dnd.2020.19.4.140

Table 1. Neuropsychological test results, neurobehavioral symptoms, and caregiver burden score of an MCI patient and an early-stage VD patient between pre- and post-intervention

Characteristics	MCI		Early-stage VD	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
K-BNT	12/15 (51.47)	12/15 (58.20)	14/60 (<0.01)	20/60 (0.01)
RCFT copy score	32 (48.62)	26 (8.06)	28.5 (13.86)	22 (0.13)
SVLT delayed recall	8 (77.80)	7 (70.82)	0 (0.60)	1 (1.89)
RCFT delayed recall	5.5 (7.13)	4.5 (7.23)	7.5 (14.12)	6 (9.16)
COWAT animal	12 (21.19)	10 (11.68)	6 (1.18)	6 (1.18)
COWAT phonemic	24 (53.56)	24 (59.52)	5 (1.00)	6 (1.37)
K-MMSE	25 (5.22)	26 (20.45)	20 (<0.01)	25 (4.42)
CDR	0.5	0.5	1.0	1.0
CDR-SOB	-	1.5	-	8.0
GDepS-S	7	8	10	10
Barthel index	20	20	20	18
Bayer ADL	3.40	2.25	8.55	8.48
SIADL	2/45	3/45	8/45	20/45
PGCMS	53	40	43*	37*
CGA-NPI	0/144	7/144	0/144	13/144
ZBI*			48	18
PANAS positive effect*			11	10
PANAS negative effect*			15	15

Values are presented as raw score (%ile score).
MCI: mild cognitive impairment, VD: vascular dementia, K-BNT: Korean version of the Boston Naming Test, RCFT: Rey-Osterrieth Complex Figure Test, SVLT: Seoul Verbal Learning Test, COWAT: Controlled Oral Word Association Test, K-MMSE: Korean version-Mini-Mental State Examination, CDR: Clinical Dementia Rating scale, CDR-SOB: Clinical Dementia Rating scale-Sum of Boxes, GDepS-S: Geriatric Depression Scale-Short version, ADL: Activities of Daily Living scale, SIADL: Seoul Instrumental Activities of Daily Living scale, PGCMS: Philadelphia Geriatric Center for Moral Scale, CGA-NPI: Caregiver-Administered Neuropsychiatric Inventory, ZBI: Zarit Burden Interview, PANAS: Positive and Negative Affect Schedule.
*Tests done by main caregiver.

Second, we examined the percentage of positive responses to the 5 factors of home environment before and after the S-DHDP-IHD using the Five Evaluation Framework Questionnaire regarding satisfaction (**Table 2**). In general, the proportion of the percentage of positive satisfactory responses exceeding 50% in both MCI and early-stage VD households increased after the intervention. For the bathroom, home environment evaluation factors with increased rates of positive response were safety (58.33%), efficiency in perception (60.00%), and accessibility (69.23%) in the MCI household, and safety (66.67%), accessibility (76.92%), efficiency in perception (80.00%), and supportiveness (84.21%) in the

Table 2. Comparison of satisfaction survey by living space before and after the intervention

Spaces	Safety		Accessibility		Efficiency in Perception		Supportiveness		Amenity	
	Pre (%)	Post (%)	Pre (%)	Post (%)	Pre (%)	Post (%)	Pre (%)	Post (%)	Pre (%)	Post (%)
All										
MCI	**33.33**	**43.33**	**44.44**	**57.78**	**67.00**	**75.51**	**44.90**	**50.00**	**35.71**	**52.38**
VD	**45.71**	**51.43**	**54.72**	**60.38**	**52.83**	**64.15**	**61.11**	**68.52**	**45.65**	**67.39**
Bathroom										
MCI	**33.33**	**58.33**	**61.54**	**69.23**	**50.00**	**60.00**	42.11	42.11	28.57	28.57
VD	**50.00**	**66.67**	**61.54**	**76.92**	**60.00**	**80.00**	**68.42**	**84.21**	85.71	85.71
Bedroom										
MCI	33.33	33.33	**77.78**	**88.89**	**66.67**	**86.96**	**58.33**	**69.23**	**33.33**	**66.67**
VD	50.00	50.00	58.33	58.33	**54.17**	**62.50**	61.54	61.54	**40.00**	**60.00**
Kitchen										
MCI	50.00	50.00	**40.00**	**50.00**	**75.00**	**87.50**	55.56	55.56	**37.50**	**50.00**
VD	33.33	33.33	**50.00**	**60.00**	**75.00**	**87.50**	77.78	77.78	**37.50**	**68.75**
Entrance										
MCI	25.00	25.00	**0.00**	**75.00**	66.67	66.67	**28.57**	**42.86**	100.00	100.00
VD	50.00	50.00	75.00	75.00	**16.67**	**33.33**	28.57	28.57	**0.00**	**100.00**

The values in bold represent the main factors with positive changes.
MCI: mild cognitive impairment, VD: vascular dementia.

https://doi.org/10.12779/dnd.2020.19.4.140

early-stage VD household. For the bedroom, factors with increased rates of positive response were amenity (66.67%), supportiveness (69.23%), efficiency in perception (86.96%), and accessibility (88.89%) in the MCI household, and amenity (60.00%) and efficiency in perception (62.50%) in the early-stage VD household. In the kitchen and dining area, the factors with increased positive responses were amenity (50.00%), accessibility (50.00%), and efficiency in perception (87.50%) in the MCI household, and accessibility (60.00%), amenity (68.75%), and efficiency in perception (87.50%) in the early-stage VD household. In the entrance area, factors with increased rates of positive response were supportiveness (42.86%) and accessibility (75.00%) in the MCI household, and efficiency in perception (33.33%) and amenity (100.00%) in the early-stage VD household.

Satisfaction level surveyed using the 10 Point Scale Bar also showed an increase in good responses in both the MCI and early-stage VD households. Three points increased for improvements in the living room and second room, 2 points for the bathroom, and one point for the kitchen and entrance in the MCI household. Five points increased for the bathroom, second room, and outdoor porch stairs, 4 points for the kitchen and entrance, and 3 points for the living room in the early-stage VD household.

Finally, we analyzed the daily activities of the subjects. The analysis of the change in time of task performance using video monitoring showed a positive change in 3 out of 5 areas for both the MCI and early-stage VD patients (**Supplementary Table 1**). The time for a cognitive task was decreased for the bedroom, entrance, and bathroom for both subjects, which showed positive changes. However, the time for a cooking task in the kitchen was increased for both subjects and the duration of a strolling task was decreased.

Monitoring of ADL showed a positive change of 36.36% in the MCI subject (4 among eleven components of ADL), and a positive change of 77.78% in the early-stage VD patient (7 among 9 components of ADL). Details of the ADL changes in the MCI and early-stage VD patients are described in the **Supplementary Table 2**.

Effectiveness of S-DHDP-ED

To investigate the effect of the project on the outdoor activity patterns of the residents, we compared changes in the number of outdoor activities per week, daily practice of taking a stroll, and the number of social activities per week before and after the intervention, as summarized in **Table 3**. In the dementia population, the weighted number of outdoor activities and social activities could not be evaluated because we lacked available data.

We examined awareness of and experience with the Cognitive Health Walking Course among S-DHDP-ED facilities, and found that 225 of the 254 (87.8%) non-demented population were aware of the walking course, whereas only 4 of the 31 (12.9%) demented population were aware of it. Among those who reported awareness of the new facilities, 187 of 225 (82.7%) non-demented population had experience with the walking course, whereas 1 of 4 (25.0%) of the population had experienced the walking course.

We investigated the function and design satisfaction of Gil Ban Jang, exercise picture board, 100-m trail bulletin board, and 7 rest areas installed along the Cognitive Health Walking Course (**Table 4**). Overall, most of the survey respondents experienced satisfaction with the function and design of the facilities. Of the 255 non-demented residents, 205 had experience with the Gil Ban Jang and exercise picture board. Most reported satisfaction with the function

https://doi.org/10.12779/dnd.2020.19.4.140

Table 3. Changes in the number of outdoor activity patterns of the residents after the Seoul Dementia Healing Design Project-Environmental Design

Characteristics	Frequency (%)	Pre-intervention	Post-intervention	Rate of increase and decrease (%)
Outdoor activities per week	Never	4.71	5.88	24.84
	Once a month	5.88	3.53	−39.97
	Two, three times a month	7.84	2.35	−70.03
	Once a week	5.10	8.24	61.57
	Two, three times a week	25.10	30.20	20.32
	More than four times a week	51.37	49.80	−3.06
Daily practice of taking a walk		65.49	80.00	22.16
Social activities per week	Never	15.69	9.80	−5.89
	Once a month	8.24	3.14	−5.10
	Two, three times a month	16.08	5.49	−10.59
	Once a week	9.41	16.86	7.45
	Two, three times a week	23.53	36.86	13.33
	More than four times a week	27.06	27.84	0.78

Table 4. Function and design satisfaction rates after experiencing the Seoul Dementia Healing Design Project-Environmental Design facilities in the non-demented population

Items	Gil Ban Jang	Exercise Picture board	100-m trail bulletin board	7 rest areas
Number	205	205	181	202
Satisfied with function (%)	80.00	83.42	87.17	86.14
Satisfied with design (%)	88.30	86.10	87.17	86.00

and design of Gil Ban Jang (80.00% and 88.30%, respectively) and exercise picture board (83.42% and 86.10%, respectively); 181 non-demented residents had experience with the 100-m trail information bulletin, and were satisfied positively with function (87.17%) and design (87.17%); 202 non-demented residents had experience with the 7 rest areas along the Cognitive Health Walking Course, and most were satisfied with the function (86.14%) and design (86.00%). Interestingly, those in their 40s and 50s of the non-demented population showed less satisfaction than did those in their 70s and 80s. Of the 31 demented elderly residents, only 1 had experience with the facilities of the Cognitive Health Walking Course, except for Gil Ban Jang, and reported satisfaction with the function and design of each facility.

After the facility construction, the average satisfaction rate of the neighborhood increased by 34.4% in the non-demented population and 31.5% in the demented population.

DISCUSSION

Our study was done to assess the effectiveness of the S-DHDP conducted by the Department of Design Policy of the Cultural Headquarters of the Seoul Metropolitan Government between November 2014 and March 2016. This pilot study investigated the effect of S-DHDP-IHD on MCI and early-stage VD households based on analyses of the residential patterns and satisfaction level and S-DHDP-ED on dementia caregivers and non-demented community older adults based on survey research. We found some positive changes of S-DHDP-IHD on detailed neuropsychological tests, satisfaction-level surveys, and video analysis for monitoring of time to task and ADL. Also, we identified positive effects of S-DHDP-ED on the frequency of outdoor activity and social activity.

The S-DHDP was conducted to develop a dementia-friendly design that is directly applicable to Korean society. It was designed to consider the cognitively impaired patients and their

https://doi.org/10.12779/dnd.2020.19.4.140

caregivers in order to reduce the burden of dementia care, to promote external activities and cognitive activities of dementia patients, family members, and healthy community elderly. As a result, we expect to reduce the socio-economic burden of the dementia population and aging in Korean society, which is moving toward being a super-aging society.

S-DHDP-IHD increased the satisfaction level using the Five Evaluation Framework Questionnaire and 10 Point Scale Bar in both MCI and early-stage VD patients. They were satisfied with all components of safety, accessibility, efficiency in perception, supportiveness, and amenity, which are the main 5 elements of universal design.

Comparison of some task times closely linked to everyday life and daily activity of the subjects before and after intervention showed a substantial improvement in both MCI and early-stage VD patients. In practice, we found the decrease in time for dressing, finding clothes and shoes, and washing dishes in both MCI and early-stage VD patients after renovation of S-DHDP-IHD. These findings suggest that the S-DHDP-IHD achieved the accessibility, efficiency in perception, and supportiveness as well as subjective satisfaction. Also, we observed the decrease in time despite the increase in number of uses of the cabinets by the MCI patient (**Supplementary Table 2**). This finding suggests that both patients used cabinets more efficiently with easier accessibility. A more important finding was that the amount of strolling increased and the time watching TV and lying down decreased in both patients. It suggests that the S-DHDP-IHD, which was developed as a dementia-friendly design, increases outdoor activity and leads to improvement of ADL and QoL in patients with dementia and their caregivers.

Many previous studies showed that a proper design for patients with dementia is good for their therapeutic perspective.[6,7] Some studies reported that patients' agitation and physical restraint use were reduced after environmental intervention,[16] and the patients who received dementia-friendly design experienced fewer declines in ADL, more sustained interest in the environment, and less negative affect.[17] Adequate design for patients with dementia led to their spending more time in the improved environments and showing increased pleasure in another study.[18]

In neuropsychological analysis and other investigation using some scales, cognition, affect, and instrumental ADL after the intervention either improved or did not change in either household. In addition, there was no change in disease status or functional ADL in either household. However, general satisfaction with life and the burden on caregivers improved slightly. Since dementia-friendly design does not relieve or reverse the underlying pathology, there is a limit to the improvement of cognitive function, and the short-term change arising from dementia-friendly design could not lead to improvement of objective cognitive function. However, ADL improvement and a decrease of the care burden would improve the QoL of patients and caregivers.

For the S-DHDP-ED, comparison of the frequency of use and satisfaction with project facilities by Sinwol 1-dong residents demonstrated positive changes. In particular, higher awareness, frequency of use, and satisfaction level with facilities were correlated with increasing age. After the S-DHDP-ED, the average satisfaction levels with the neighborhood showed an overall increase. Most of the non-demented residents who participated in the survey had decreased navigation time, better establishment of major hubs, a decrease in crossroad confusions, and an increase in use and awareness of facilities. Also, a notable point is that higher satisfaction was measured in older adults. This finding suggests that our

https://doi.org/10.12779/dnd.2020.19.4.140

design project is more suitable for older adults. Also, we could predict that these community changes of the project are an adequate plan for an aged society and aging people with slight aging-related cognitive impairment.

However, only a few residents living with dementia patients participated in pre- and post-intervention surveys, showed very low awareness of S-DHDP-ED, and had extremely limited outdoor activities, perhaps because of seasonal effects, since pre-intervention surveys were conducted around June and post-intervention surveys were conducted around October and December. The meager amount of outdoor activity may have been affected by the season in which the post-intervention studies were conducted, which is November. Furthermore, promotional efforts for the S-DHDP may have been heavily geared toward the non-demented population.

This study is meaningful in that it had a more positive effect on patients with milder stages of dementia and their caregivers than on conventional nursing-home-based dementia patients.

In conclusion, our study illustrates the need to improve both home and neighborhood in order to prevent dementia and provide suitable care for dementia patients. We conclude that a customized design approach that takes both residential and outdoor environments into consideration is essential for holistic, family-oriented dementia care.

SUPPLEMENTARY MATERIALS

Supplementary Table 1

Change in task time of MCI patient and early-stage VD patient between pre- and post-intervention

Click here to view

Supplementary Table 2

Change in activities of daily living scale of MCI patient and early-stage VD patient between pre- and post-intervention

Click here to view

Supplementary Fig. 1

Flowchart for evaluation of the effectiveness of (S-DHDP). The project consists of 2 main components: 1) S-DHDP-In-House Design was designed to improve the vulnerable indoor environment of patients with cognitive impairment and their family members for the quality of life and encouraging cognitive activity. 2) S-DHDP-Environmental Design was made to promote outdoor activities of not only dementia patients and caregivers, but also healthy community elderly. Both pre- and post-interventions were evaluated in both designs.

Click here to view

REFERENCES

1. Central Dementia Center (KR). Korean Dementia Observatory 2019 [Internet]. Seoul: Central Dementia Center; 2020 [cited 2020 Jun 23]. Available from: https://www.nid.or.kr/info/dataroom_view.aspx?bid=209.

2. Ministry of Health & Welfare (KR). National dementia strategy 2013–2015 [Internet]. Seoul: Ministry of Health & Welfare; 2012 [cited 2020 Jun 23]. Available from: http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&CONT_SEQ=274723&page=1.
3. Kim WK. Analysis of newspaper articles on murder or suicide on family caregivers with dementia. Health Soc Welf Rev 2014;34:219-246.
CROSSREF
4. Brawley EC. Environmental design for Alzheimer's disease: a quality of life issue. Aging Ment Health 2001;5 Suppl 1:S79-S83.
PUBMED | CROSSREF
5. Calkins MP. The physical and social environment of the person with Alzheimer's disease. Aging Ment Health 2001;5 Suppl 1:S74-S78.
PUBMED | CROSSREF
6. Day K, Carreon D, Stump C. The therapeutic design of environments for people with dementia: a review of the empirical research. Gerontologist 2000;40:397-416.
PUBMED | CROSSREF
7. Fleming R, Purandare N. Long-term care for people with dementia: environmental design guidelines. Int Psychogeriatr 2010;22:1084-1096.
PUBMED | CROSSREF
8. Kang Y, Na D, Hahn S. Seoul Neuropsychological Screening Battery. Incheon: Human Brain Research & Consulting Co.; 2003.
9. Burke WJ, Roccaforte WH, Wengel SP. The short form of the Geriatric Depression Scale: a comparison with the 30-item form. J Geriatr Psychiatry Neurol 1991;4:173-178.
PUBMED | CROSSREF
10. Collin C, Wade DT, Davies S, Horne V. The Barthel ADL Index: a reliability study. Int Disabil Stud 1988;10:61-63.
PUBMED | CROSSREF
11. Gu HM, Kim JH, Gwon UJ, Kim SH, Lee HS, Go HJ, et al. A study on the reliability and validity of Seoul-Instrumental Activities of Daily Living (S-IADL). J Korean Neuropsychiatr Assoc 2004;43:189-199.
12. Kang SJ, Choi SH, Lee BH, Jeong Y, Hahm DS, Han IW, et al. Caregiver-administered neuropsychiatric inventory (CGA-NPI). J Geriatr Psychiatry Neurol 2004;17:32-35.
PUBMED | CROSSREF
13. Bédard M, Molloy DW, Squire L, Dubois S, Lever JA, O'Donnell M. The Zarit Burden Interview: a new short version and screening version. Gerontologist 2001;41:652-657.
PUBMED | CROSSREF
14. Seng BK, Luo N, Ng WY, Lim J, Chionh HL, Goh J, et al. Validity and reliability of the Zarit Burden Interview in assessing caregiving burden. Ann Acad Med Singapore 2010;39:758-763.
PUBMED
15. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. J Pers Soc Psychol 1988;54:1063-1070.
PUBMED | CROSSREF
16. Cleary TA, Clamon C, Price M, Shullaw G. A reduced stimulation unit: effects on patients with Alzheimer's disease and related disorders. Gerontologist 1988;28:511-514.
PUBMED | CROSSREF
17. Reimer MA, Slaughter S, Donaldson C, Currie G, Eliasziw M. Special care facility compared with traditional environments for dementia care: a longitudinal study of quality of life. J Am Geriatr Soc 2004;52:1085-1092.
PUBMED | CROSSREF
18. Cohen-Mansfield J, Werner P. The effects of an enhanced environment on nursing home residents who pace. Gerontologist 1998;38:199-208.
PUBMED | CROSSREF