

Research Paper

Investigating the Effect of Cognitive Rehabilitation on the Memory Improvement of Patients With Alzheimer



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ABSTRACT

Objectives: Alzheimer is the most prevalent cognitive disturbance with a high spread rate among the elderly. The current research aims to investigate the impact of cognitive rehabilitation on the memory improvement of Alzheimer disease patients.

Methods: This was a semi-experimental design with pre-test and post-test designs. The statistical population in Baghdad City, Iraq, in 2021 included 60 patients with Alzheimer and was divided into an experimental (n=30) and a control group (n=30). The patient's cognitive abilities were assessed before the intervention (pre-test), promptly after the intervention (post-test), and 2 months later (follow-up). The experimental group had twenty-eight 45-min sessions of training based on the Montessori method (2 sessions per week). The data were analyzed via the SPSS software, version 19, using the independent t-test and repeated measures analysis of variance. The results had a P<0.05.

Results: The findings of the independent t-test demonstrated no significant difference between the scores of both groups during the pre-test stage (P>0.05); however, the difference was significant during the post-test and follow-up stages (P<0.001). In addition, the findings of the repeated measure analysis of variance indicated a significant difference between both groups' mean scores in the post-test and follow-up (P<0.001).

Discussion: Cognitive rehabilitation can help patients with memory disorders and positively affect their memory performance.

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Highlights

- Cognitive rehabilitation can positively affect memory performance.
- Cognitive rehabilitation interventions effectively reduce cognitive deficits in the elderly.
- Using cognitive rehabilitation intervention reduces Alzheimer-related disorders in the elderly.

Plain Language Summary

The planning of dementia treatment is based on the Montessori method which stimulates brain nerve cells and strengthens synaptic connections to improve cognitive status, establish the interaction of emotions, arouse positive emotions, reduce anxiety and restlessness, alleviate depression, lessen behavioral problems, and boost self-confidence. The findings of the current study can be explained using the cognitive empowerment theory. These exercises are based on the hypothesis that stimulating the flexibility of a modular system can improve cognitive abilities. As a result, by facilitating the phenomenon of plasticity and using repeated exercises, improvements in attention and memory are obtained.

Introduction

Alzheimer is a brain disturbance that often has a chronic and progressive course. This disease alters a person's mental abilities, personality, and behavior [1]. Memory and daily activities are frequently impaired in Alzheimer patients [2]. Patients frequently forget recent events, frequently ask questions, have communication and social interaction problems, lose awareness of place and time, and suffer from decreased motivation, depression, and anxiety [3]. Alzheimer patients cannot live alone, make individual decisions, or carry out daily tasks [4].

Alzheimer disease is the most prevalent and well-known kind of dementia, specified by the unjustified destruction of neurons and cerebral cortex atrophy [5]. Following these changes, there is a progressive loss of recent memory, cognitive disturbance, and mood changes [6]. After heart disease, cancer, chronic respiratory diseases, and stroke, Alzheimer is the fifth leading cause of death in the elderly [7, 8].

Alzheimer has two neuropathological characteristics, one of which is the accumulation of beta-amyloid peptide plaques on the exterior of neurons, produced by the degradation of the amyloid precursor protein [9]. The formation of neurofibrillary tangles within neurons, caused by hyperphosphorylation of the tau protein and observed in the hippocampus and other cortical regions, is another characteristic of Alzheimer disease [10]. Beta-amyloid is regarded as a potent poison for mitochondria,

which leads to functional disorders in mitochondria, the production of free radicals, and the eventual destruction of neurons [11]. Slowly, the disorder in the brain's cognitive functions manifests with the onset of the disease. Two cognitive functions exist in the human brain, namely executive functions which regulate and control a person's thinking and performance, and non-law functions [12].

As the disease progresses, the subjects gradually lose their sense of independence, fail to achieve their goals, and have severe social interaction problems [13]. Depression, anxiety, aggression, a decrease in self-confidence, a lack of satisfaction, and a sense of inadequacy are all symptoms of these issues [14]. As a result, the patient's quality of life reduces. The quality of life comprises a state of well-being defined by a multidimensional concept of health in physical, mental, spiritual, social, and economic aspects [15]. Despite these damages and problems, the human brain has complex and dynamic functional characteristics and aims to control the severity of the disease's destruction as much as possible [16]. Educational interventions play an essential role in the improvements mentioned above. Researchers have provided non-pharmacological methods, such as cognitive-based rehabilitation, to help Alzheimer patients in addition to drug treatments by examining the positive impact of external stimuli on neurons [17]. This specific treatment program consists of targeted and planned activities for cognitive stimulation in patients with mild to moderately advanced dementia [18].

The subjects' brains are malleable, changing in response to learning, practice, and environmental stimuli [19]. When brain damage occurs or when parts of the cells are lost as a result of Alzheimer, the human brain can maintain its optimum level of function by changing the neural structure and forming new connections in the remaining parts [20]. In addition, following an injury, the human brain can respond to external stimuli (cognitive rehabilitation programs, sports, music, etc.). Stimulation of the brain aids in maintaining the nervous system's functioning by forcing the brain to respond to stimuli, thus maintaining its neural connections [21]. The impacts of these stimuli on the brain structure increase in synapses, new neuronal sprouting, an increase in the parameters involved in brain nerve tissue growth, and a decrease in cell death [22].

Considering the increase in the population of the elderly with Alzheimer, it is necessary to investigate methods for treating and preventing this disease. Also, drug treatments could be more effective or insufficient in some stages; in the long run, when the disease develops resistance, they lose their effectiveness. Drugs are associated with side effects and impose high costs on patients due to the disruption of the hormonal balance. Consequently, cognitive rehabilitation protocols are important. The current study aims to investigate the effect of cognitive rehabilitation on the memory improvement of Alzheimer patients.

Materials and Methods

This research used a semi-experimental design with a pre-test and post-test design. The statistical population in Baghdad City, Iraq in 2021 included 60 patients with Alzheimer, divided into an experimental ($n=30$) and a control group ($n=30$). The patient's cognitive abilities were assessed before the intervention (pre-test), immediately after the intervention (post-test), and 2 months after the intervention (follow-up). The experimental group had twenty-eight 45-min sessions of training based on the Montessori method (2 sessions per week) [23].

The inclusion criteria were confirming the presence of Alzheimer in the participants, memory and attention disorders diagnosed by the neurologist, having a Glasgow coma table state of consciousness of 13 to 15 (patients who were conscious and awake or at least in the phase of confusion), not receiving similar therapeutic interventions, and having minimal literacy [24]. The exclusion criteria were mental retardation, major depression, and other severe psychiatric disorders, the presence of a brain white matter lesion, brain atrophy (despite the absence of previous symptoms), alcohol and drug addic-

tion, hearing loss, a lack of speech, a disturbance in the state of consciousness, sensory and motor disorders, and a lack of cognitive impairment other than Alzheimer. Before beginning the research, the objectives and general process were presented to all participants. Then, with the cooperation of the patient's families, a written consent letter to participate in the research was obtained. After the follow-up stage, the desired educational intervention was presented to the control group of patients.

The everyday memory questionnaire [20] was used to collect data in the present study. This tool is one of the most commonly used memory rehabilitation questionnaires. The EMQ comprises 28 statements that assess repetition inadequacy and memory weaknesses in faces, places, actions, speech, reading, writing, and learning new tasks. Answers are scored based on a 9-point Likert scale ranging from 1 (never in the last six months) to 9 (more than once daily). Higher scores indicate a worsening of everyday memory function. Scores between 28 and 58 indicate good memory, scores between 59 and 116 indicate medium memory and scores greater than 116 indicate poor memory status. The reliability and validity of the EMQ have been confirmed in several research. In the current study, the reliability and validity were 0.84 and 0.78, respectively. In this study, reliability was checked using the Cronbach α method, and content validity was checked using the opinions of professors of the University of Baghdad's College of Medicine.

The intervention sessions for the experimental group consisted of twenty-eight 45-min sessions of training based on the Montessori method (2 sessions per week). Table 1 shows the educational content of the sessions. A pre-test stage was held using EMQ in both groups before the start of the first session in the experimental group. The post-test stage was held after the completion of all sessions, and a follow-up stage was held two months later.

After data collection, the descriptive level of analysis was performed on the research data (frequency, mean, etc.). The data were analyzed via the SPSS software, version 19, utilizing the independent t-test and repeated measures analysis of variance (ANOVA). The Kolmogorov-Smirnov test was utilized to evaluate the research hypothesis, and the Bonferroni post hoc test was employed to compare the data over time. The results have a significance level of <0.05 .

Results

The findings of the demographic characteristics of the patients are provided in Table 2.

Table 1. Description of the educational intervention sessions of the experimental group based on the montessori method

Activity	Session	Description
Eyesight	1	Image classification by categorizing images based on a determined pattern (for example, color or black and white)
	2	The sequence of images by correctly positioning the images and utilizing the sequence pattern (for example, childhood, adolescence, youth, middle age, and old age)
	3	Creating a memory book by selecting and pasting photographs of family members or previous jobs into a notebook
	4	Creating a puzzle by slicing an image into three pieces, mixing the pieces, and rearranging them
	5	Matching equipment and accessories by determining which accessories are more compatible in color and shape (for example, which shoes go better with which handbag)
Hearing	6	Enjoying music by selecting one's favorite music, listening to it, and describing why it was chosen
	7	Sensing musical performance or rhythm by synchronizing with a musical rhythm (e.g. singing along, clapping, and playing on the table)
	8	Performing rhythmic movements as a simple dance, moving forward, backward, swaying, and turning slowly
	9	Examining a musical instrument, becoming familiar with its various components, and learning how to play it
	10	Reading books and magazines (reading a portion of a book, newspaper, or magazine with appropriate font size)
Touch	11	Touching fabrics made of distinct materials
	12	Touching different textures and structures (woods, metals, glass, or stones)
	13	Caressing and massaging hands and forearms
	14	Familiarizing with fishing equipment and touching its components
	15	Touching the exterior of a cloth bag to determine the contents
	16	Classification of clothing (the distinction between women's and men's clothes)
Olfactory	17	Creating coffee by grinding coffee beans, inhaling its aroma, adding boiling water or milk and sugar, and then drinking it with biscuits or a small diet cake
	18	Flower arrangement by choosing flowers, smelling their aroma, trimming the stem, and placing them in a decorative vase
	19	Working with fragrant plants (extracting the smell of leaves such as mint, coriander, and rosemary)
	20	Wearing gloves, placing soil and fertilizer in a container, planting seeds, and watering constitute gardening
	21	Aromatherapy places the individual in a calm, peaceful environment while seated in a comfortable chair and diffusing pure essential oils (such as lavender, chamomile, jasmine, and rose)
Taste	22	Drinking natural orange juice
	23	Tasting fruits with different colors and flavors, chopping them into smaller pieces, placing them in separate containers, picking up quantities of chopped fruits with plastic forks, tasting and humming them, and placing them in separate containers
	24	Tasting different types of tea
	25	Choosing favorite food with a cookbook, compiling a list of items and ingredients needed to prepare food, following step-by-step cooking instructions, preparing food, and consuming it
	26	Cutting the meat into smaller pieces, thread them onto skewers, place them on a grill, and cook before eating
	27	Placing different types of fruits in a large bowl and then separating like fruits into smaller bowls
	28	Preparation of different pasta types and separation into separate boxes based on shape, size, and color

Table 2. Demographic variables of the both groups of participants

Variables	No. (%)		P	
	Experimental	Control		
Gender	Male	12(40)	14(46.7)	0.43
	Female	18(60)	16(53.3)	
Age	<75	10(33.3)	13(43.3)	0.14
	>75	20(66.7)	17(56.7)	
Education	Secondary	25(83.3)	27(90)	0.36
	College	5(16.7)	3(10)	
Marital status	Single	17(56.7)	12(40)	0.19
	Married	13(43.3)	18(60)	

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According to Table 2, 26(43.3%) were male and 34(56.7%) were female. In the experimental group, the mean age was 81.76 ± 8.54 years and the mean age was 79.62 ± 7.83 years in the control group. Most participants were >75 years (61.7%) and had secondary education (86.7%). Also, the marital status of the participants was almost the same. In addition, the independent t-test showed no statistically significant difference for both groups' demographic characteristics ($P > 0.05$). The comparison of the two groups' pre-test, post-test, and follow-up mean EMQ values are provided in Table 3.

According to Table 3, the experimental group's post-test and follow-up EMQ scores decreased significantly. In contrast, the results of all three stages in the control group remained nearly identical. In addition, the independent t-test examined the significance of the difference between the results of each stage for the two groups. The results demonstrated no significant difference in the scores of both groups during the pre-test stage ($P > 0.05$); however, the difference was significant during the post-test and follow-up phases ($P < 0.001$).

In the current study, the impact of cognitive rehabilitation on the memory improvement of Alzheimer disease patients was examined. Before testing the hypothesis, the Kolmogorov-smirnov test was utilized to examine the normality of the scores for EMQ variables. In this test, the goodness of fit was not statistically significant and the scores had a large difference from the normal distribution ($z = 0.143$ in the pre-test stage; $z = 0.161$ in the post-test phase; $z = 0.187$ in the follow-up stage). Therefore, the repeated measures ANOVA assumption is not violated. The findings of repeated measures ANOVA are shown in Table 4.

According to Table 4, the significance of the stage effect indicates a significant difference between the two groups mean values in the post-test and follow-up stages ($P < 0.001$). In addition, the significance of the phases and the experimental group indicates that the mean values of this group are significantly lower than the values of the control group during the post-test and follow-up stages ($P < 0.05$). Given the application of the independent variable (cognitive rehabilitation intervention), there was a

Table 3. Comparison of mean every memory questionnaire score in the pre-test, post-test, and follow-up stages in both groups

Stages	Mean \pm SD		P
	Experimental	Control	
Pre-test	123.19 \pm 14.84	119.67 \pm 14.35	0.64
Post-test	86.43 \pm 16.39	116.72 \pm 13.71	<0.001
Follow-up	89.51 \pm 16.87	117.68 \pm 13.94	<0.001

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Table 4. The findings of repeated measures analysis of variance for within-subjects vs between-subjects variables

Type of Effect	Source of Variation	SS	df	MS	F	P	Effect Size
Within-subjects	Pre-test	1673.14	2	836.57	40.05	<0.001	
	Pre-test×Group	1206.83	4	301.71	14.44	0.03	0.68
	Error	752.06	36	20.89			
Between-subjects	Group	8714.56	2	4357.28	7.31	0.004	0.40
	Error	10729.45	18	596.08			

Abbreviations: SS: Sum of squares; Df: Degree of freedom; MS: Mean squares.

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significant difference in the value of the dependent variable (everyday memory) between both groups.

Subsequently, the Bonferroni post hoc test was conducted to compare time, and the results indicated a significant difference in the values of the pre-test stage with the post-test and follow-up phases ($P < 0.001$). In contrast, no significant difference was observed between the post-test scores and with follow-up stages ($P > 0.05$).

Discussion

The current research aimed to evaluate the impact of cognitive rehabilitation on the memory improvement of Alzheimer patients. These results demonstrated the effect of cognitive rehabilitation on Alzheimer patients' everyday memory. Consequently, everyday memory has significantly increased compared to the control group. The current study's results are consistent with the findings of other studies [25-27].

In the current study, dementia treatment planning based on the Montessori method demonstrated significant positive impacts on the cognitive abilities of Alzheimer patients. The positive impact of the method is because of its general philosophy, which is based on the same ideas and principles and is designed and explained in the same way. Accordingly, every human being is treated with respect and emphasizes their choices, abilities, and strengths, and the subjects can find their place in society and develop self-efficacy and self-esteem [28]. This method focuses the content of the executive sessions on the 5 human senses and attempts to stimulate the desired sense and force an appropriate response. The effectiveness of this intervention is summarized by its content, method of execution, and participation of the appropriate individuals. Following the fundamental principles of the Montessori method, treatment planning for dementia includes activities that emphasize the senses. The activities are designed to be as appealing as possible to the individual. The individual is

invited to participate and has the freedom to choose, and their desires and interests are prioritized.

In the intervention method used in the current study, the implementation of activities focuses on skills and abilities, the pace of activities is adjusted based on the individual's condition, and visual cues, signs, or patterns are employed. Although the individual is given small responsibilities, they begin with simple tasks, complex activities are broken down into smaller steps, and the individual's enjoyment of the activity is evaluated. This method emphasizes that there is no right or wrong, and only the Alzheimer patient's motivation and participation matter; therefore, the therapist can work on cognitive, social, and executive aspects through training, repetition, guidance, and the execution of activities to improve the cognitive performance of individuals with Alzheimer and achieve positive results [29]. The current study's findings can be explained using the theory of neuroplasticity, or neural flexibility of the brain. Recent research has shown that different brain areas can change significantly even in adulthood. Making structural changes over time; thus, changes in related functions is what flexibility entails. This process can be observed at different levels and scales, ranging from microscopic changes in neurons to more extensive scale changes, such as cortex routing and remapping in response to brain damage. On the other hand, cortical remapping occurs on a much larger scale early in brain development [30]. Additionally, behavior, environmental stimuli, thoughts, and emotions can cause neural flexibility via the activity-dependent flexibility process, which is critical and necessary in developing healthy people [31].

One limitation of the current research is that only Alzheimer patients in Baghdad participated. Consequently, the findings cannot be generalized to other regions and nations. In addition, patients' memory status has not been compared to their memory status before Alzheimer disease. To conduct future studies, it is suggested that

alternative methods and protocols be used to assess Alzheimer patients' everyday memory. It is also suggested that the current study's methodology be used to evaluate other brain diseases.

Conclusion

The present study demonstrated that cognitive rehabilitation interventions effectively reduce cognitive deficits in the elderly; therefore, by using it as an independent treatment method or in conjunction with existing treatments, it can be utilized to reduce Alzheimer-related disorders in the elderly, even in individuals who appear to lack the ability to learn, regular or irregular practice and repetition lead to learning, as demonstrated by the findings. Therefore, the necessity of cognitive rehabilitation for Alzheimer patients is emphasized more than ever before, and experts are instructed to implement it.

Ethical Considerations

Compliance with ethical guidelines

The study was approved by the Ethics Committee of the [University of Baghdad](#)'s College of Medicine.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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References

- [1] Marin A, DeCaro R, Schiloski K, Elshaar A, Dwyer B, Vives-Rodríguez A, et al. Home-based electronic cognitive therapy in patients with alzheimer disease: Feasibility randomized controlled trial. *JMIR Formative Research*. 2022; 6(9):e34450. [DOI:10.2196/34450] [PMID] [PMCID]
- [2] Caggianese G, Chirico A, De Pietro G, Gallo L, Giordano A, Predazzi M, et al. Towards a virtual reality cognitive training system for mild cognitive impairment and Alzheimer's disease patients. Paper presented at: 2018 32nd International Conference on Advanced Information Networking and Applications Workshops (WAINA). 23 July 2018; Krakow, Poland. [DOI:10.1109/WAINA.2018.00164]
- [3] Mahboubinia M, Dalvandi A, Nourozi K, Mahmoudi N, Sadat Safavi S, Hosseinzadeh S. The effect of multi sensory stimulation (MSS) on cognitive disturbances and quality of Life of male patients with Alzheimer's disease. *Iranian Rehabilitation Journal*. 2012; 10(2):50-5. [Link]
- [4] Germain S, Wojtasik V, Lekeu F, Quittre A, Olivier C, Godichard V, et al. Efficacy of cognitive rehabilitation in alzheimer disease: A 1-year follow-up study. *Journal of Geriatric Psychiatry and Neurology*. 2019; 32(1):16-23. [DOI:10.1177/0891988718813724] [PMID]
- [5] Wang YY, Yang L, Zhang J, Zeng XT, Wang Y, Jin YH. The effect of cognitive intervention on cognitive function in older adults with alzheimer's disease: A systematic review and meta-analysis. *Neuropsychology Review*. 2022; 32(2):247-73. [DOI:10.1007/s11065-021-09486-4] [PMID]
- [6] Cotelli M, Manenti R, Brambilla M, Gobbi E, Ferrari C, Binetti G, et al. Cognitive telerehabilitation in mild cognitive impairment, Alzheimer's disease and frontotemporal dementia: A systematic review. *Journal of Telemedicine and Telecare*. 2019; 25(2):67-79. [DOI:10.1177/1357633X17740390] [PMID]
- [7] Sarlak Z, Dadkhah A, Kashi A, Sheikh M. The effect of a "selected exercise training" on reducing symptoms of dementia caused by alzheimer's disease in people with down syndrome. *Iranian Rehabilitation Journal*. 2013; 11(2):35-45. [Link]
- [8] Choi J, Twamley EW. Cognitive rehabilitation therapies for Alzheimer's disease: A review of methods to improve treatment engagement and self-efficacy. *Neuropsychology Review*. 2013; 23(1):48-62. [DOI:10.1007/s11065-013-9227-4] [PMID] [PMCID]
- [9] Amieva H, Robert PH, Grandoulier AS, Meillon C, De Rotrou J, Andrieu S, et al. Group and individual cognitive therapies in Alzheimer's disease: The ETNA3 randomized trial. *International Psychogeriatrics*. 2016; 28(5):707-17. [DOI:10.1017/S1041610215001830] [PMID]
- [10] Hwang JH, Cha HG, Cho YS, Kim TS, Cho HS. The effects of computer-assisted cognitive rehabilitation on Alzheimer's dementia patients memories. *Journal of Physical Therapy Science*. 2015; 27(9):2921-3. [DOI:10.1589/jpts.27.2921] [PMID] [PMCID]
- [11] Brueggen K, Kasper E, Ochmann S, Pfaff H, Webel S, Schneider W, et al. Cognitive rehabilitation in alzheimer's disease: A controlled intervention trial. *Journal of Alzheimer's Disease*. 2017; 57(4):1315-24. [DOI:10.3233/JAD-160771] [PMID]
- [12] Regan B, Wells Y, Farrow M, O'Halloran P, Workman B. MAXCOG-maximizing cognition: A randomized controlled trial of the efficacy of goal-oriented cognitive rehabilitation for people with mild cognitive impairment and early alzheimer disease. *The American Journal of Geriatric Psychiatry*. 2017; 25(3):258-69. [DOI:10.1016/j.jagp.2016.11.008] [PMID]

- [13] Kurth S, Wojtasik V, Lekeu F, Quittre A, Olivier C, Godichard V, et al. Efficacy of cognitive rehabilitation versus usual treatment at home in patients with early stages of alzheimer disease. *Journal of Geriatric Psychiatry and Neurology*. 2021; 34(3):209-15. [DOI:10.1177/0891988720924721] [PMID]
- [14] Irazoki E, Contreras-Somoza LM, Toribio-Guzmán JM, Jenaro-Río C, van der Roest H, Franco-Martín MA. Technologies for cognitive training and cognitive rehabilitation for people with mild cognitive impairment and dementia. A systematic review. *Frontiers in Psychology*. 2020; 11:648. [DOI:10.3389/fpsyg.2020.00648] [PMID] [PMCID]
- [15] Mirzakhani N, Esmailian H, Jamebozorgi AA, Tabatabaee SM, Hejazi-Shirmard M. Effects of upper limb resistance training on cognition and daily living activities in older adults. *Iranian Rehabilitation Journal*. 2022; 20:47-54. [DOI:10.32598/irj.20.SpecialIssue.1436.1]
- [16] Kelly ME, Lawlor BA, Coen RF, Robertson IH, Brennan S. Cognitive rehabilitation for early stage Alzheimer's disease: A pilot study with an Irish population. *Irish Journal of Psychological Medicine*. 2019; 36(2):105-19. [DOI:10.1017/ipm.2017.23] [PMID]
- [17] Rajji TK, Bowie CR, Herrmann N, Pollock BG, Bikson M, Blumberger DM, et al. Design and rationale of the PACTMD randomized clinical trial: Prevention of alzheimer's dementia with cognitive remediation plus transcranial direct current stimulation in mild cognitive impairment and depression. *Journal of Alzheimer's Disease*. 2020; 76(2):733-51. [DOI:10.3233/JAD-200141] [PMID]
- [18] Kudlicka A, Martyr A, Bahar-Fuchs A, Woods B, Clare L. Cognitive rehabilitation for people with mild to moderate dementia. *The Cochrane Database of Systematic Reviews*. 2019; 2019(8):CD013388. [DOI:10.1002/14651858.CD013388] [PMCID]
- [19] Richard P, Foloppe D, Allain P. A virtual kitchen for cognitive rehabilitation of alzheimer patients. Paper presented at: Human Interface and the Management of Information Interaction, Visualization, and Analytics: 20th International Conference. 20 July 2018; Las Vegas, USA. [DOI:10.1007/978-3-319-92043-6_36]
- [20] Silva AR, Pinho MS, Macedo L, Moulin C, Caldeira S, Firmino H. It is not only memory: Effects of sensecam on improving well-being in patients with mild alzheimer disease. *International Psychogeriatrics*. 2017; 29(5):741-54. [DOI:10.1017/S104161021600243X] [PMID]
- [21] Cuc AV, Locke DEC, Duncan N, Fields JA, Snyder CH, Hanna S, et al. A pilot randomized trial of two cognitive rehabilitation interventions for mild cognitive impairment: Caregiver outcomes. *International Journal of Geriatric Psychiatry*. 2017; 32(12):e180-7. [DOI:10.1002/gps.4689] [PMID] [PMCID]
- [22] Sitzer DI, Twamley EW, Jeste DV. Cognitive training in Alzheimer's disease: a meta-analysis of the literature. *Acta Psychiatrica Scandinavica* 2006; 114(2):75-90. [DOI:10.1111/j.1600-0447.2006.00789.x] [PMID]
- [23] Dalili Z, Bayazi MH. The effectiveness of mindfulness-based cognitive therapy on the illness perception and psychological symptoms in patients with rheumatoid arthritis. *Complementary Therapies in Clinical Practice*. 2019; 34:139-44. [DOI:10.1016/j.ctcp.2018.11.012] [PMID]
- [24] Smits M, Dippel DW, Houston GC, Wielopolski PA, Koudstaal PJ, Hunink MG, et al. Postconcussion syndrome after minor head injury: Brain activation of working memory and attention. *Human Brain Mapping*. 2009; 30(9):2789-803. [DOI:10.1002/hbm.20709] [PMID] [PMCID]
- [25] Clare L, Woods RT. Cognitive training and cognitive rehabilitation for people with early-stage Alzheimer's disease: A review. *Neuropsychological Rehabilitation*. 2004; 14(4):385-401. [DOI:10.1080/09602010443000074]
- [26] Bahar-Fuchs A, Clare L, Woods B. Cognitive training and cognitive rehabilitation for mild to moderate Alzheimer's disease and vascular dementia. *The Cochrane Database of Systematic Reviews*. 2013; 2013(6):CD003260. [DOI:10.1002/14651858.CD003260.pub2] [PMID] [PMCID]
- [27] Viola LF, Nunes PV, Yassuda MS, Aprahamian I, Santos FS, Santos GD, et al. Effects of a multidisciplinary cognitive rehabilitation program for patients with mild Alzheimer's disease. *Clinics*. 2011; 66(8):1395-400. [DOI:10.1590/S1807-59322011000800015] [PMID] [PMCID]
- [28] Loewenstein DA, Acevedo A, Czaja SJ, Duara R. Cognitive rehabilitation of mildly impaired Alzheimer disease patients on cholinesterase inhibitors. *The American Journal of Geriatric Psychiatry*. 2004 ; 12(4):395-402. [DOI:10.1097/00019442-200407000-00007] [PMID]
- [29] Bottino CM, Carvalho IA, Alvarez AM, Avila R, Zukauskas PR, Bustamante SE, et al. Cognitive rehabilitation combined with drug treatment in Alzheimer's disease patients: A pilot study. *Clinical Rehabilitation*. 2005; 19(8):861-9. [DOI:10.1191/0269215505cr911oa] [PMID]
- [30] Cipriani G, Bianchetti A, Trabucchi M. Outcomes of a computer-based cognitive rehabilitation program on Alzheimer's disease patients compared with those on patients affected by mild cognitive impairment. *Archives of Gerontology and Geriatrics*. 2006; 43(3):327-35. [DOI:10.1016/j.archger.2005.12.003] [PMID]
- [31] Kim S. Cognitive rehabilitation for elderly people with early-stage Alzheimer's disease. *Journal of Physical Therapy Science*. 2015; 27(2):543-6. [DOI:10.1589/jpts.27.543] [PMID] [PMCID]