

Research Paper



Investigating the Effectiveness of Cognitive Enhancement on Quality of Life in the Elderly With Mild Cognitive Impairment

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ABSTRACT

Objective: Cognitive enhancement is a noninvasive brain treatment that has the potential to improve cognitive deficits in patients with symptoms of cognitive impairment, such as mild cognitive impairment. Studies have not investigated the effectiveness of this method on people's quality of life; therefore, this study aims to investigate the effectiveness of cognitive enhancement on the quality of life (QoL) of the elderly with mild cognitive impairment.

Methods: As a quasi-experimental study, the authors utilized the pre-test-post-test design with follow-up. The statistical population of the study was elderly with mild cognitive impairment. A total of 40 senior patients with cognitive abnormalities who were referred to the Rehabilitation Clinic of the Payambaran Hospital in Tehran City, Iran, were picked at random and assigned into an experimental and a control group. The experimental group underwent 12 sessions of cognitive enhancement. To measure the variables, the LEIPAD QoLquestionnaire was employed. The data were analyzed using the two-way repeated measures analysis of variance via the SPSS software, version 25.

Results: In terms of the post-test quality of life, the results revealed a significant difference between the experimental and control groups. The QoLof the elderly with mild cognitive impairment was impacted by cognitive improvement. The follow-up studies also demonstrated that the observed disparities between the groups were persistent over time ($P<0.05$).

Conclusion: In addition to affecting the cognitive abilities of the brain, cognitive enhancement can affect the QoLof the elderly with mild cognitive impairment.

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Highlights

- The possibility of cognitive problems in the elderly is high.
- Mild cognitive impairment is one of the disorders associated with the elderly.
- Mild cognitive impairment in the elderly is associated with a decline in quality of life (QoL).
- Cognitive enhancement improves the quality of life in the elderly with mild cognitive impairment.

Plain Language Summary

Population aging has increased worldwide and has many social, economic and health implications. Aging is associated with a decline in cognitive function. Mild cognitive impairment (MCI) is an intermediate stage between cognitive decline expected in natural aging and early stages of Alzheimer's disease. The effects of MCI go beyond cognition and negatively affect the QoL of the elderly. Therefore, it is very important to pay attention to the improvement of this problem. The main approach in cognitive therapies is the cognitive enhancement approach. Cognitive rehabilitation is a treatment method whose main goal is to improve the patient's cognitive function and defects such as memory, executive function, social understanding, concentration and attention. Cognitive rehabilitation is effective in improving cognitive symptoms and improving the QoL of the elderly with mild cognitive impairment.

1. Introduction

Based on the demographic information and improvement in the quality of health services, the percentage of the elderly population has increased significantly in recent years (Prince et al., 2015). The rate of population aging has increased dramatically worldwide. This has many social, economic, and health consequences (Rao et al., 2018). Aging is associated with a decline in cognitive functions (Crimmins et al., 2016). One of the assumptions considered today to explain the decline in cognitive performance in the elderly is the reduction of stimulation and challenging activities in the environment (Calero, 2019). The growing number of elderly people leads to an increase in the incidence of aging-related disorders, such as mild cognitive impairment (MCI) (Klimova & Maresova, 2017). Alzheimer disease and MCI are major challenges in geriatric healthcare in the 21st century (Livingston et al., 2020).

Age-related cognitive decline is a widespread phenomenon (Hu et al., 2017). MCI is an intermediate stage between the cognitive decline expected in the natural aging period and the early stages of Alzheimer, dementia, or mental decline, causing problems related to memory, language, thinking, and judgment. Deficits of cognitive functions are more than normal age-related changes (Lima et al., 2017). Currently, there is a consensus that successful aging is related to having healthy genes and access to health resources. Additionally, successful ag-

ing depends on how people actively regulate life and their behaviors (Pachana & Laidlaw, 2014).

Quality of life (QoL) is a key concept for understanding the effects of cognitive impairment on the lives of MCI patients (Hussenoeder et al., 2020). It seems that people who are aware of their diagnosis of MCI experience a lower quality of life, regardless of the severity of the disorder (Stites et al., 2017). The effects of MCI exceed beyond cognition and they negatively affect the QoL of the elderly (Hussenoeder et al., 2020).

QoL is an important health outcome for the older population with MCI because it is multidimensional in nature. Accordingly, it is necessary to enable healthcare providers to comprehensively measure the disease and treatment effects (Song et al., 2019). Few effective treatments are available to prevent the progression of dementia and MCI. Only a small number of studies have tested the effectiveness of neuromodulation techniques for the treatment of dementia-related defects or MCI (Orinstein & Stevens, 2014). Non-pharmacological interventions for the treatment of MCI have attracted much attention. One of the main nonpharmacological approaches is the cognitive enhancement approach. Cognitive rehabilitation is a treatment method whose main goal is to improve the patient's cognitive function, such as memory, executive function, social understanding, concentration, and attention. This method is based on the principles of the neuroplasticity of the brain (Bergo et al., 2016).

Research background supports computerized cognitive rehabilitation interventions to improve MCI. In a recent study, Bahar-Fuchs et al. (Bahar-Fuchs et al., 2017) investigated the effects of computer-based cognitive rehabilitation on cognitive performance in the elderly with MCI. The findings of the research showed that the participants in the condition of computerized cognitive training had more improvement in the measurements of memory, learning, and cognitive ability. Ge et al. (2018) found in a meta-analysis that cognitive enhancement was effective in improving the symptoms of the elderly with MCI and some cognitive enhancement interventions improved non-cognitive symptoms, such as anxiety and depression. Keeping the brain stimulated may be a key aspect of reducing some aspects of age-related cognitive decline or deficits associated with MCI (Coffman, Trumbo & Clark, 2012; Satorres et al., 2022).

Since MCI is considered a critical period during which cognitive and neurological reconstruction, such as compensation still occurs, rehabilitation can have a beneficial effect on reducing the probability of progression in the MCI period (Kirova et al., 2015). Cognitive rehabilitation can improve MCI in the elderly (Cosmo et al., 2015). Biundo et al. (2015) combined cognitive training with transcranial direct-current stimulation and reported a significant improvement in memory in the elderly with MCI. Mirzaei et al. (2021) investigated the effectiveness of the combined treatment of computerized cognitive rehabilitation and direct electrical stimulation of the brain on the cognitive performance of the elderly and concluded that this method can improve the cognitive abilities of the elderly. Park et al. (2013) investigated the effect of cognitive computer training on stroke patients and concluded that the application of such a protocol can have a significant effect on improving patients' performance when compared to the control group. According to the conducted studies, investigating the effectiveness of cognitive enhancement training on the QoL and mental health of the elderly has received less attention. Investigating whether improving cognitive abilities in the elderly with MCI can improve their QoL is the focus of this study.

Considering that the elderly, as the most vulnerable group, are subject to a decrease in their functional abilities as well as some changes in their physical conditions, such as cognitive, social, and psychological functioning (Kotradyová, 2016), and because, nowadays, the rapid diagnosis of the Alzheimer disease from MCI is the most important step in preventing the progression (Syaifullah et al., 2021) and also given that MCI is a risk factor for dementia (Mirza et al., 2017), the need for more studies in this field is evident. Various treatment methods

have investigated the effect of cognitive enhancement on the cognitive problems of patients with MCI; however, so far, no research has been conducted regarding this type of treatment and its effectiveness in the QoL of this group of people. The application of this method has mostly been used to improve cognitive abilities but its effectiveness on psychological issues and QoL has not been investigated. Hence, this study aims to investigate the effectiveness of cognitive enhancement on the QoL of the elderly with MCI.

2. Materials and Methods

This was quasi-experimental research and used a pre-test-post-test design with a control group and follow-up. The target population in this study included all the elderly with MCI living in Tehran City, Iran. Using the convenience sampling method and the Cochran formula, 40 people who visited Tehran Payambaran Hospital for evaluation in 2020-2021 and were diagnosed with MCI by a neurologist were randomly selected and divided into an experimental and a control group (20 subjects in each group). Written consent was obtained from both groups of participants and they were informed that they can leave the research whenever they wished. The experimental group received cognitive enhancement individually, and the intervention was not implemented for the control group. The participants were assessed before the intervention process, after the intervention, and 1 month after the treatment by questionnaires on the QoL of the elderly. The obtained data were analyzed via the two-way repeated measures analysis of variance (ANOVA) in the SPSS software, version 25.

The research method followed the following procedure: after the approval of the proposal and the approval of the Ethics Committee of Shahid Beheshti University, and considering the ethical considerations in the neurology clinic department of Payambaran Hospital, 40 people who had been diagnosed with MCI were randomly selected to participate in the study and the information required to participate in the research was given to them; subsequently, cognitive enhancement sessions were held 3 times a week in the Neurotherapy Clinic of the hospital; meanwhile, the ethical considerations included privacy and confidentiality, informed consent to participate in the research, and the freedom to withdraw from the research at any time.

Inclusion and exclusion criteria

The inclusion criteria were 1) having a minimum age of 65 years and a maximum of 74 years, 2) having been diagnosed with MCI according to diagnostic tools, and 3) having a minimum education of a diploma. Meanwhile, the exclusion criteria were as follows:

1) abuse of alcohol and addictive substances, 2) suffering from acute and chronic psychological diseases, 3) severe cognitive impairment (similar to occurrences in dementia), 4) physical illnesses that may interfere with the response and cooperation of the participants, 5) participating in another treatment program at the same time, and 6) vision and hearing problems according to vision and hearing tests.

Study instruments

Elderly QoL questionnaire

The LEIPAD QoL questionnaire is used to measure the QoL of the elderly. This tool was designed in 1998 by De Leo et al. LEIPAD measures the QoL of the elderly in 7 dimensions, namely physical function, self-care, depression and anxiety, mental function, social function, sexual function, and life satisfaction. It includes 31 items and is scored based on a 4-point Likert scale. The total score ranges from 0 (minimum) to 93 (maximum) and higher scores indicate a better quality of life. The Cron-

bach α of this questionnaire was obtained at 0.83 (De Leo et al., 1998). The questionnaire has no cultural burden and has been translated and standardized in Iran. The first part of the questionnaire includes questions about age, gender, income, marital status, number of children, length of stay, and level of education. The second part has 31 questions. In the research by Sajjadi and Biglarian (2007), the reliability of the questionnaire was obtained at 0.87 via the Cronbach α method.

Intervention programs

In this study, the intervention protocol was designed by a researcher based on the neuroplasticity theories. The protocol included twelve 30-min sessions for each person. The summary of the sessions is provided in Table 1.

Results

Descriptive data, Mean \pm SD of scores of the QoL in the intervention and control groups are summarized in Table 2. Accordingly, in the intervention group, 14 people (70%) were men and 6 people (30%) were women. In the control group, 16 people (80%) were men and 4 people (20%) were women. The mean age of the intervention group was 71.5 while this mean was 68.4 for the control group.

Table 1. Sessions and content of cognitive enhancement program

| Session | Content |
|---------|---|
| | Summary of Cognitive Enhancement Sessions |
| 1 | In the 1 st session, after the pre-test and initial familiarization, the participants were informed about how to work with the software and what process should be followed during each session. Based on the Captain Log software, a basic test is taken from the person at the beginning and then based on the results, the desired exercises are performed. |
| 2-11 | These sessions included practice with suggested games as well as categories of games from Captain Log. During the 12 sessions of cognitive enhancement, the exercise process was similar and each session did not have separate instructions. |
| 12 | In the final session, after completing and reviewing the obtained graphs, the post-test was performed and the data was collected for analysis. |

Table 2. Descriptive information related to the variable of quality of life in pre-test and post-test

| Variables | Mean \pm SD | | | |
|-----------------|-------------------|------------------|-------------------|-------------------|
| | Experimental | | Control | |
| | Pre-test | Post-test | Pre-test | Post-test |
| Quality of life | 30.40 \pm 7.660 | 34.02 \pm 7.06 | 30.65 \pm 7.350 | 31.25 \pm 6.608 |

Table 3. The results of the multivariate within-subject effects test to compare the quality of life of the control and cognitive enhancement groups

| Effect | Value | F | Effect d _f | Error d _f | Sig. | Effect Size | |
|--------------|------------------|-------|-----------------------|----------------------|------|-------------|-------|
| Repeat | Pillai trace | 0.863 | 18.989 | 6 | 150 | 0.001 | 0.432 |
| | Wilk lambda | 0.170 | 35.241 | 6 | 148 | 0.001 | 0.588 |
| | Hotelling trace | 4.704 | 57.238 | 6 | 146 | 0.001 | 0.702 |
| | Roy largest root | 4.663 | 116.572 | 3 | 75 | 0.001 | 0.823 |
| Repeat×Group | Pillai trace | 0.755 | 15.153 | 6 | 150 | 0.001 | 0.377 |
| | Wilk lambda | 0.276 | 22.255 | 6 | 148 | 0.001 | 0.474 |
| | Hotelling trace | 2.506 | 30.488 | 6 | 146 | 0.001 | 0.556 |
| | Roy largest root | 2.460 | 61.502 | 6 | 150 | 0.001 | 0.711 |

The results of [Table 2](#) demonstrate that the scores of the experimental group in the variable of QoL have changed in the post-test when compared to the pre-test phase, and this change is not observed in the control group. The Levene test was used to check the homogeneity of variances between the control and experimental groups. The results for the QoL in the pre-test, post-test, and follow-up are as follows: $P < 0.05$, $F_{1,38} = 0.039$; $P < 0.05$, $F_{1,38} = 0.101$; $P < 0.05$, $F_{1,38} = 0.0216$. Accordingly, it was not significant and the assumption of homogeneity of variances is confirmed. The Mauchly sphericity test was also used for homoscedasticity of the variance of the differences between the groups and was not statistically significant for the QoL ($P < 0.05$). This establishes the assumption of sphericity. Because of the validity of the assumptions of repeated variance analysis, the use of this method is allowed.

Based on the information in [Table 3](#), the results show that all the multivariate tests are significant, which indicates the existence of the main effect related to the repetition factor (pre-test, post-test, and follow-up) as well as the interaction effect between groups and repetition (that is, the existence of differences between groups during the stages measurement). To more accurately examine the difference between groups, the single-variable within-subject effects should be used, as presented in [Table 4](#).

According to the results presented in [Table 4](#), the F values related to the interaction effects between groups and repetition (that is, the existence of differences between groups during the measurement steps) for all variables are significant at the α of 0.01 ($P < 0.01$). The significance of the interaction effects indicates the difference between the changes in QoL scores of the control and cognitive enhancement groups during the measurement stages. To compare the average scores

Table 4. The Results of the single-variable within-subject effects test to compare the quality of life of the control and cognitive enhancement groups

| Source | Variables | SS | d _f | MS | F | Sig. | Effect Size | |
|--------------|-----------------|--------------------|----------------|--------|--------|--------|-------------|-------|
| Repeat | Quality of life | Sphericity | 57.403 | 2 | 28.702 | 10.545 | 0.001 | 0.217 |
| | | Greenhouse Geisser | 57.403 | 1.478 | 38.826 | 10.545 | 0.001 | 0.217 |
| Repeat*Group | Quality of life | Sphericity | 24.648 | 2 | 12.324 | 4.528 | 0.014 | 0.106 |
| | | Greenhouse Geisser | 24.648 | 1.478 | 16.672 | 4.528 | 0.024 | 0.106 |
| Error | Quality of life | Sphericity | 206.862 | 76 | 2.722 | | | |
| | | Greenhouse Geisser | 206.862 | 56.182 | 3.682 | | | |

Table 5. Bonferroni post hoc test for pairwise comparison of quality of life post-test and follow-up

| Group | | Variables | | Mean±SE | Sig. |
|-----------------------|-----------------|-----------|-----------|--------------|-------|
| Control | Quality of life | Pre-test | Post-test | -0.600±0.337 | 0.250 |
| | | Post-test | Follow-up | -0.280±0.568 | 1 |
| | | Pre-test | Follow-up | 0.320±0.616 | 1 |
| Cognitive enhancement | Quality of life | Pre-test | Post-test | -2.750±0.337 | 0.001 |
| | | Post-test | Follow-up | -1.835±0.568 | 0.008 |
| | | Pre-test | Follow-up | 0.915±0.616 | 0.437 |

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during the measurement stages, the Bonferroni post hoc test was used and the results are presented in [Table 5](#).

According to [Table 5](#), pairwise comparisons are given to examine the difference between QoL scores during the treatment for each of the control and cognitive enhancement groups. Based on the results obtained in the cognitive enhancement group, the difference between the average scores of the pre-test, post-test, and follow-up is significant ($P<0.05$). The follow-up compared to the pre-test has increased significantly. The difference between the scores of the post-test and the scores of the follow-up is not significant ($P<0.05$), which indicates the stability of the treatment effects over time. In the control group, the difference between the scores of the pre-test, post-test, and follow-up, as well as the difference between the scores of the post-test and the follow-up scores is not significant ($P<0.05$).

4. Discussion

This research aimed to investigate the effectiveness of cognitive enhancement treatment on the QoL of the elderly with MCI. According to the findings, cognitive enhancement has an effect on the QoL and mental health of the elderly with MCI. Also, based on the studies in the 1-month follow-up stage, the observed difference between the groups is stable over time.

The findings are in line with the results of the studies by Hyer et al. ([Hyer et al, 2016](#)) regarding the effect of the cognitive training program to improve working memory in the elderly with MCI, [Mirzaei et al. \(2021\)](#) regarding the effectiveness of the combined treatment of computerized cognitive rehabilitation and direct electrical stimulation of the brain on the cognitive function of the elderly, and [Zare et al. \(2019\)](#) regarding the effect of computerized cognitive rehabilitation on the improvement of MCI and working memory capacity of elderly women. Similar results have been ob-

tained in other studies as well. [San juan et al. \(2020\)](#), based on systematic reviews and meta-analysis, found that after the cognitive intervention, the elderly obtained positive results in the trained specific skills. These effects are seen in the specific skills learned and in mental health and quality of life. [Chandler et al. \(2016\)](#) found that cognitive interventions are effective in improving MCI patients, and [Case-miro et al. \(2016\)](#) found that cognitive enhancement plays a significant role in the anxiety and depression of the elderly.

Low QoL in the elderly is associated with concerns about memory ([Montejo et al., 2012](#) and [Trigg, 2011](#)) and cognitive impairment ([Mhaoláin et al, 2012](#)). Cognitive enhancement helps people to accept their conditions, emphasizes supporting factors and corrects a person’s knowledge and beliefs, and can change a person’s perspective on life experiences as well as strengthen their mental health ([Khashab et al., 2017](#)).

The results show that the effects of MCI exceed cognition and affect the QoL of people with MCI ([Hussenoeder et al, 2020](#)). By improving brain function and brain connections, and consequently, cognitive abilities, the psychological life of people are affected and improved. The inability to perform daily tasks and the type of lifestyle in which a person is dependent on others greatly reduce self-esteem and quality of life, therefore, improving brain function using nonpharmacological and noninvasive methods can improve mental health. Most studies of different rehabilitation methods to date have reported a positive effect on cognitive and mood variables in MCI ([Ferreira et al., 2020](#); [Fernandez et al., 2017](#)). Because of the close relationship between people’s QoL and their understanding of themselves, self-confidence, the ability to create positive emotions in themselves and resist negative emotions, positive views about themselves, the world, and the future, and the ability to cope with them, any improvement in these factors can reduce people’s anxiety and have a positive effect on their QoL ([Sharma et al., 2016](#)).

The findings of the present study show convincing evidence that nonpharmacological, noninvasive, and risk-free methods, such as cognitive training, are useful intervention options to help the mental health of the elderly. The neuroplasticity feature may be a key aspect of reducing some aspects of age-related cognitive decline or deficits associated with MCI. Considering that cognitive decline and MCI have important consequences for patients and their families, and given the need for clinicians to be skilled in identifying and managing this common disorder as the number of elderly people will increase in the coming decades (Langa & Levine, 2014), more research is suggested. Considering that the level of income and education also play a role in cognitive functions, considering these variables can also be investigated in future studies.

Study limitations

Not considering gender as a variable and the available sample is one of the limitations of this research, which is recommended to be considered in future research. Also, future studies can examine the individual characteristics of patients with MCI (such as IQ, diet, drug abuse, physical activity level, and so on) on the treatment results.

5. Conclusion

It can be stated that the cognitive enhancement method, which is one of the noninvasive neurological modification methods, can lead to changes in the psychological health of the elderly with MCI. Neurological correction and cognitive abilities, and consequently, more management and control over life, can affect the QoL and vitality in people with MCI.

Ethical Considerations

Compliance with ethical guidelines

The present study has been approved by the Ethics Committee of Shahid Beheshti University (Code: IR.SBU.REC.1400.261).

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Authors' contributions

All authors participated equally in different parts of the research.

Conflict of interest

The authors declared no conflict of interest.

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References

- Bahar-Fuchs, A., Webb, S., Bartsch, L., Clare, L., Rebok, G., & Cherbuin, N., et al. (2017). Tailored and adaptive computerized cognitive training in older adults at risk for dementia: A randomized controlled trial. *Journal of Alzheimer's Disease*, 60(3), 889-911. [DOI:10.3233/JAD-170404] [PMID]
- Bergo, E., Lombardi, G., Pambuku, A., Della Puppa, A., Bellu, L., & D'Avella, D., et al. (2016). Cognitive rehabilitation in patients with gliomas and other brain tumors: State of the art. *BioMed Research International*, 2016, 3041824. [PMID] [PMCID]
- Biglarian, A. (2007). [Quality of life among elderly women in Kahrizak charity foundation, Tehran, Iran (Persian)]. *Payesh (Health Monitor)*, 6(2), 1-4. [Link]
- Biundo, R., Weis, L., Fiorenzato, E., Gentile, G., Giglio, M., & Schifano, R., et al. (2015). Double-blind randomized trial of t-DCS versus sham in Parkinson patients with mild cognitive impairment receiving cognitive training. *Brain Stimulation*, 8(6), 1223-1225. [DOI:10.1016/j.brs.2015.07.043] [PMID]
- Calero, M. (2019). Effects of environmental enrichment and training across life span in cognition. In R. Fernández-Ballesteros, A. Benetos, & J. Robine (Eds.), *The Cambridge Handbook of Successful Aging (Cambridge Handbooks in Psychology)* (pp. 321-354). Cambridge: Cambridge University Press. [DOI:10.1017/9781316677018.020]
- Casemiro, F. G., Rodrigues, I. A., Dias, J. C., Alves, L. C. D. S., Inouye, K., & Grato, A. C. M. (2016). Impact of cognitive stimulation on depression, anxiety, cognition and functional capacity among adults and elderly participants of an open university for senior citizens. *Revista Brasileira de Geriatria e Gerontologia*, 19, 683-694. [DOI:10.1590/1809-98232016019.150214]
- Chandler, M. J., Parks, A. C., Marsiske, M., Rotblatt, L. J., & Smith, G. E. (2016). Everyday impact of cognitive interventions in mild cognitive impairment: A systematic review and meta-analysis. *Neuropsychology Review*, 26(3), 225-251. [PMID] [PMCID]
- Coffman, B. A., Trumbo, M. C., & Clark, V. P. (2012). Enhancement of object detection with transcranial direct current stimulation is associated with increased attention. *BMC Neuroscience*, 13, 108. [DOI:10.1186/1471-2202-13-108] [PMID] [PMCID]
- Cosmo, C., Ferreira, C., Miranda, J. G., do Rosário, R. S., Baptista, A. F., & Montoya, P., et al. (2015). Spreading effect of tDCS in individuals with attention-deficit/hyperactivity disorder as shown by functional cortical networks: A randomized, double-blind, sham-controlled trial. *Frontiers in Psychiatry*, 6, 111. [DOI:10.3389/fpsyt.2015.00111] [PMID] [PMCID]

- Crimmins, E. M., Saito, Y., & Kim, J. K. (2016). Change in cognitively healthy and cognitively impaired life expectancy in the United States: 2000-2010. *SSM-Population Health*, 2, 793-797. [DOI:10.1016/j.ssmph.2016.10.007] [PMID] [PMCID]
- De Leo, D., Diekstra, R. F., Lonqvist, J., Trabucchi, M., Cleiren, M. H., & Frisoni, G. B., et al. (1998). LEIPAD, an internationally applicable instrument to assess quality of life in the elderly. *Behavioral Medicine*, 24(1), 17-27. [DOI:10.1080/08964289809596377] [PMID]
- Fernandez, E., Bergado Rosado, J. A., Rodriguez Perez, D., Salazar Santana, S., Torres Aguilar, M., & Bringas, M. L. (2017). Effectiveness of a computer-based training program of attention and memory in patients with acquired brain damage. *Behavioral Sciences*, 8(1), 4. [DOI:10.3390/bs8010004] [PMID] [PMCID]
- Ferreira, G., Silva-Filho, E., de Oliveira, A., de Lucena, C., Lopes, J., & Pegado, R. (2020). Transcranial direct current stimulation improves quality of life and physical fitness in diabetic polyneuropathy: A pilot double blind randomized controlled trial. *Journal of Diabetes & Metabolic Disorders*, 19(1), 327-335. [DOI:10.1007/s40200-020-00513-4] [PMID] [PMCID]
- Ge, S., Zhu, Z., Wu, B., & McConnell, E. S. (2018). Technology-based cognitive training and rehabilitation interventions for individuals with mild cognitive impairment: A systematic review. *BMC Geriatrics*, 18(1), 213. [DOI:10.1186/s12877-018-0893-1] [PMID] [PMCID]
- Hu, C., Yu, D., Sun, X., Zhang, M., Wang, L., & Qin, H. (2017). The prevalence and progression of mild cognitive impairment among clinic and community populations: A systematic review and meta-analysis. *International Psychogeriatrics*, 29(10), 1595-1608. [DOI:10.1017/S1041610217000473] [PMID]
- Hussenoeder, F. S., Conrad, I., Roehr, S., Fuchs, A., Pentzek, M., & Bickel, H., et al. (2020). Mild cognitive impairment and quality of life in the oldest old: A closer look. *Quality of Life Research*, 29(6), 1675-1683. [DOI:10.1007/s11136-020-02425-5] [PMID] [PMCID]
- Hyer, L., Scott, C., Atkinson, M. M., Mullen, C. M., Lee, A., & Johnson, A., et al. (2016). Cognitive training program to improve working memory in older adults with MCI. *Clinical Gerontologist*, 39(5), 410-427. [DOI:10.1080/07317115.2015.1120257] [PMID]
- Solaimani Khashab, A., Ghamari Kivi, H., & Fathi, D. (2017). Effectiveness of cognitive behavioral therapy on spiritual well-being and emotional intelligence of the elderly mourners. *Iranian Journal of Psychiatry*, 12(2), 93-99. [PMID]
- Kirova, A. M., Bays, R. B., & Lagalwar, S. (2015). Working memory and executive function decline across normal aging, mild cognitive impairment, and Alzheimer's disease. *BioMed Research International*, 2015, 748212. [DOI:10.1155/2015/748212] [PMID] [PMCID]
- Klimova, B., & Maresova, P. (2017). Computer-based training programs for older people with mild cognitive impairment and/or dementia. *Frontiers in Human Neuroscience*, 11, 262. [DOI:10.3389/fnhum.2017.00262] [PMID] [PMCID]
- Kotradyová, K. (2016). The psychosocial aspects of the genesis of depression in old age and the possibilities of using group psychotherapy. *Kontakt*, 18(3), e194-e202. [DOI:10.1016/j.kontakt.2016.07.002]
- Langa, K. M., & Levine, D. A. (2014). The diagnosis and management of mild cognitive impairment: A clinical review. *JAMA*, 312(23), 2551-2561. [DOI:10.1001/jama.2014.13806] [PMID] [PMCID]
- Lima, A. P. V., Castilhos, R., & Chaves, M. L. F. (2017). The use of the clinical dementia rating scale sum of boxes scores in detecting and staging cognitive impairment/dementia in Brazilian patients with low educational attainment. *Alzheimer Disease & Associated Disorders*, 31(4), 322-327. [DOI:10.1097/WAD.000000000000205] [PMID]
- Livingston, G., Huntley, J., Sommerlad, A., Ames, D., Ballard, C., & Banerjee, S., et al. (2020). Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *Lancet*, 396(10248), 413-446. [DOI:10.1016/S0140-6736(20)30367-6] [PMID]
- Mhaoláin, A. M., Gallagher, D., Crosby, L., Ryan, D., Lacey, L., & Coen, R. F., et al. (2012). Frailty and quality of life for people with Alzheimer's dementia and mild cognitive impairment. *American Journal of Alzheimer's Disease & Other Dementias*, 27(1), 48-54. [DOI:10.1177/1533317511435661] [PMID]
- Mirza, S. S., Ikram, M. A., Bos, D., Mihaescu, R., Hofman, A., & Tiemeier, H. (2017). Mild cognitive impairment and risk of depression and anxiety: A population-based study. *Alzheimer's & Dementia*, 13(2), 130-139. [DOI:10.1016/j.jalz.2016.06.2361] [PMID]
- Mirzaei, M., Hasani Abharian, P., Meschi, F., & Sabet, M. (2021). [Effectiveness of combination therapy of computerized cognitive rehabilitation and transcranial direct current stimulation on the cognitive function in elderlies (Persian)]. *EBNESINA*, 22(4), 47-59. [Link]
- Montejo, P., Montenegro, M., Fernandez, M. A., & Maestu, F. (2012). Memory complaints in the elderly: Quality of life and daily living activities. A population based study. *Archives of Gerontology and Geriatrics*, 54(2), 298-304. [DOI:10.1016/j.archger.2011.05.021] [PMID]
- Orinstein, A. J., & Stevens, M. C. (2014). Brain activity in predominantly-inattentive subtype attention-deficit/hyperactivity disorder during an auditory oddball attention task. *Psychiatry Research*, 223(2), 121-128. [DOI:10.1016/j.psychres.2014.05.012] [PMID] [PMCID]
- Pachana, N. A. (2014). Why we need an international clinical geropsychology. In N.A. Pachana, & K. Laidlaw (Eds), *The Oxford handbook of clinical geropsychology* (pp. 1064-1082), Oxford: Oxford Academic. [DOI:10.1093/oxfordhb/9780199663170.013.027]
- Park, S. H., Koh, E. J., Choi, H. Y., & Ko, M. H. (2013). A double-blind, sham-controlled, pilot study to assess the effects of the concomitant use of transcranial direct current stimulation with the computer assisted cognitive rehabilitation to the prefrontal cortex on cognitive functions in patients with stroke. *Journal of Korean Neurosurgical Society*, 54(6), 484-488. [DOI:10.3340/jkns.2013.54.6.484] [PMID] [PMCID]
- Prince, M. J., Wu, F., Guo, Y., Gutierrez Robledo, L. M., O'Donnell, M., & Sullivan, R., et al. (2015). The burden of disease in older people and implications for health policy and practice. *Lancet*, 385(9967), 549-562. [DOI:10.1016/S0140-6736(14)61347-7] [PMID]

- Rao, D., Luo, X., Tang, M., Shen, Y., Huang, R., & Yu, J., et al. (2018). Prevalence of mild cognitive impairment and its subtypes in community-dwelling residents aged 65 years or older in Guangzhou, China. *Archives of Gerontology and Geriatrics*, 75, 70-75. [DOI:10.1016/j.archger.2017.11.003] [PMID]
- Sanjuán, M., Navarro, E., & Calero, M. D. (2020). Effectiveness of cognitive interventions in older adults: A review. *European Journal of Investigation in Health, Psychology and Education*, 10(3), 876-898. [DOI:10.3390/ejihpe10030063] [PMID] [PMCID]
- Satorres, E., Meléndez, J. C., Pitarque, A., Real, E., Abella, M., & Escudero, J. (2022). Enhancing immediate memory, potential learning, and working memory with transcranial direct current stimulation in healthy older adults. *International Journal of Environmental Research and Public Health*, 19(19), 12716. [DOI:10.3390/ijerph191912716] [PMID] [PMCID]
- Sharma, R. K., Singh, B., & Sharma, S. (2016). Efficacy of cognitive behaviour therapy and quality of life in the amputees. *The International Journal of Indian Psychology*, 3(3), 151-66. [Link]
- Song, D., Yu, D. S., Li, P. W., He, G., & Sun, Q. (2019). Correlates of health-related quality of life among Chinese older adults with mild cognitive impairment. *Clinical Interventions in Aging*, 14, 2205-2212. [DOI:10.2147/CIA.S227767] [PMID] [PMCID]
- Stites, S. D., Karlawish, J., Harkins, K., Rubright, J. D., & Wolk, D. (2017). Awareness of mild cognitive impairment and mild Alzheimer's disease dementia diagnoses associated with lower self-ratings of quality of life in older adults. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 72(6), 974-985. [DOI:10.1093/geronb/gbx100] [PMID] [PMCID]
- Syaifulallah, A. H., Shiino, A., Kitahara, H., Ito, R., Ishida, M., & Tanigaki, K. (2021). Machine learning for diagnosis of AD and prediction of MCI progression from brain MRI using brain anatomical analysis using diffeomorphic deformation. *Frontiers in Neurology*, 11, 576029. [DOI:10.3389/fneur.2020.576029] [PMID]
- Trigg, R., Watts, S., Jones, R., & Tod, A. (2011). Predictors of quality of life ratings from persons with dementia: The role of insight. *International Journal of Geriatric Psychiatry*, 26(1), 83-91. [DOI:10.1002/gps.2494] [PMID]
- Zare, H., Sharifi, A. A., & Hashamdar, S. (2019). [Effect of computerized cognitive rehabilitation on improvement of mild cognitive impairment and working memory capacity (Persan)]. *Journal of Psychology*, 92(4), 371-387. [Link]

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