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ARTIGO ORIGINAL

Cognitive training with virtual reality at older people long-term residences: a series of cases

Treinamento cognitivo com realidade virtual em residenciais de longa permanência para idosos: uma série de casos

Entrenamiento cognitivo con realidad virtual en residencias de larga duración para ancianos: una serie de casos

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Abstract

Purpose: to describe a series of cases of older people with a clinical diagnosis of mild cognitive impairment or dementia at elderly long-term residences using virtual reality as cognitive rehabilitation.

Methods: this study is a series of cases. Older adults diagnosed with mild cognitive impairment or dementia were included. Elderly people with visual and/or hearing problems that made it impossible to carry out the training were excluded. The same tests were used after intervention and at follow up after 15 days.

Results: final sample consisted of 13 women and the mean age was 81.77 years (± 6.94). Patients were divided into 2 groups: mild cognitive impairment group and the dementia group. According to the therapeutic objectives aimed at improving fluency, among the results, the improvement in the scores to the group mild cognitive impairment stands out for the phonemic verbal fluency tests 23.63 (± 12.72) pre-test and 29.50 (± 11.14) post-test. There was an improvement in mild cognitive impairment group scores for the phonemic verbal fluency tests 23.63 (± 12.72) pretest and 29.50 (± 11.14) post-test. In the dementia group, test scores were 10 (± 5, 47) pretest and 12.80 (± 5.72) post-test. On the semantic verbal fluency test, the mild cognitive impairment group showed improvement 11.00 (± 3.62) pretest and 13.88 (± 6.03) post-test, while the dementia group test scores were 7.60 (± 4.56) pretest and 8.20 (± 5.12) post-test.

Conclusion: regarding phonemic verbal fluency, virtual reality may be a good resource for improving the performance of older adults with mild cognitive impairment. Results were not maintained in the medium term, showing the importance of continual training.

Keywords: virtual reality, neurological rehabilitation, cognitive impairment, dementia, institutionalized elderly health.

Resumo

Objetivo: descrever uma série de casos de idosos com diagnóstico clínico de comprometimento cognitivo leve ou demência em reabilitação cognitiva por realidade virtual.

Métodos: este estudo é uma série de casos. Pacientes idosos com diagnóstico de comprometimento cognitivo leve ou demência foram incluídos. Foram excluídos idosos com problemas visuais e/ou auditivos que impossibilitasse a

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realização do treino. Os mesmos testes foram usados após a intervenção e o acompanhamento após 15 dias.

Resultados: a amostra final foi composta por 13 idosas e a média de idade foi de 81,77 anos (± 6,94). Os pacientes foram divididos em dois grupos: grupo com comprometimento cognitivo leve e grupo com demência. Conforme os objetivos terapêuticos que visavam à melhora da fluência, destaca-se, entre os resultados, a melhora nas pontuações do grupo com comprometimento cognitivo leve para os testes de fluência verbal fonêmica 23,63 (± 12,72) pré-teste e 29,50 (± 11,14) pós-teste. No grupo com demência, os resultados dos testes foram 10 (± 5, 47) pré-teste e 12,80 (± 5,72) pós-teste. No teste de fluência verbal semântica, o grupo com comprometimento cognitivo leve apresentou melhora 11,00 (± 3,62) pré-teste e 13,88 (± 6,03) pós-teste, enquanto os escores do grupo demência foram 7,60 (± 4,56) pré-teste e 8,20 (± 5,12) pós-teste.

Conclusão: em relação à fluência verbal fonêmica, a realidade virtual mostrou-se um bom recurso para melhorar o desempenho de idosos com déficit cognitivo leve, porém os resultados não se mantiveram em médio prazo, demonstrando a importância do treinamento contínuo.

Palavras-chave: realidade virtual, reabilitação neurológica, comprometimento cognitivo, demência, saúde do idoso institucionalizado.

Resumen

Objetivo: describir una serie de casos de ancianos con diagnóstico clínico de deterioro cognitivo leve o demencia en rehabilitación cognitiva mediante realidad virtual.

Métodos: este estudio es una serie de casos. Se incluyeron pacientes ancianos diagnosticados con deterioro cognitivo leve o demencia. Se excluyeron las personas con problemas visuales y / o auditivos que imposibilitaran la realización de la rehabilitación. Se utilizaron las mismas pruebas después de la intervención y en el seguimiento a los 15 días.

Resultados: la muestra final estuvo constituida por 13 mujeres ancianas y la edad media fue de 81,77 años (± 6,94). Los pacientes se dividieron en 2 grupos: grupo de deterioro cognitivo leve y grupo de demencia. Hubo una mejora en las puntuaciones del grupo de deterioro cognitivo leve para las pruebas de fluidez verbal fonémica (23,63 (± 12,72) preprueba y 29,50 (± 11,14) postprueba. En el grupo de demencia, las puntuaciones de la prueba fueron 10 (± 5, 47) preprueba y 12,80 (± 5,72) después de la prueba. En la prueba de fluidez verbal semántica, el grupo de deterioro cognitivo leve mostró una mejoría (11,00 (± 3,62) antes de la prueba y 13,88 (± 6,03) después de la prueba, mientras que las puntuaciones del grupo de demencia fueron 7,60 (± 4.56) pretest y 8.20 (± 5.12) postest.

Conclusión: en cuanto a la fluidez verbal fonémica, la realidad virtual demostró ser un buen recurso para mejorar el desempeño de los pacientes ancianos con deterioro cognitivo leve. Los resultados no se mantuvieron en el mediano plazo, mostrando la importancia de la formación continua.

Palabras clave: realidad virtual, rehabilitación neurológica, deterioro mental, demencia, salud del anciano institucionalizado.

Introduction

The increase in life expectancy has given rise to higher rates of mild cognitive impairment (MCI) and dementia among the older adults. MCI is defined as a syndrome characterized by cognitive decline with essentially preserved activities of daily living (ADLs)[1]. Annually, 10% -15% of patients with MCI are at risk for progressing to dementia[2,3]. Dementia is a condition in which one or more cognitive domains are significantly impaired, leading to a loss in autonomy in ADLs[4]. However, several studies have reported benefits following cognitive stimulation in these populations, with satisfactory results concerning the maintenance and improvement of cognitive processes, quality of life, and functional abilities[5,6].

With technological advances, new strategies have been tested for cognitive rehabilitation. One of them is virtual reality (VR), a technology used for several purposes that simulates real-life environments or activities[7,8]. This strategy provides an immersive, interactive, and three-dimensional virtual experience that stimulates the patient's active participation, even in cases of cognitive impairment. VR training offers activities within rich, safe, and challenging environments, promoting motor stimuli and increased neuroplasticity[9,10].

A growing body of studies[11-16] on cognitive training with VR has shown it to be an efficient resource for cognitive improvement in older people with MCI and dementia, for memory, dual-task, and visual attention tasks. Nevertheless, further research is necessary for its effectiveness on compromised functions, due to the methodological variety among studies. Therefore, the aim of this study is to describe a series of cases of older people with a clinical diagnosis of MCI or dementia sing virtual reality as cognitive rehabilitation.

Methods

This study is a series of cases. Training and data collections were carried out from July 2019 to February 2020 at elderly long-term residences, in the city of Porto Alegre/RS. Older residents with medical diagnosed clinical MCI or dementia were included, once permission was obtained from these patients or their legal guardians. Residents with uncorrected vision impairment or hearing loss that precluded VR training were excluded.

This research was approved by the institution's Ethics and Research Committee, under protocol number 10020919.7.00005347. The Free and Informed Consent Form (FICF) was signed by legal guardians since the participants had cognitive impairment.

Pre-and post-tests

Initially, sociodemographic and clinical data were collected from medical records (e.g., age, sex, education, length institution care and medical diagnoses). Then, a battery of cognitive tests was carried out before intervention, immediately after the intervention, and at the 15-day follow-up. The following tests were used.

- The Mini-Mental State Examination (MMSE): this is a cognitive screening test, with cut-off points stratified according to years of formal education (8+ years = ≥ 28 points; 5 - 8 years = 26 points; 1 - 4 years = 25 points; illiteracy = 20 points[17].
- The Montreal Cognitive Assessment (MoCA): this test assesses cognitive functions such as visuospatial apraxia, naming, memory, attention, language, abstraction, and orientation. A score of 26 or higher is expected for individuals with preserved cognition[18].
- Phonologic verbal fluency test (PVF): with this task several aspects of cognition are evaluated, such as attention, the ability to inhibit the processing of other categories, and the ability to perform semantic search restrictions. The patient is asked to name words beginning with the letters F, A, and S. The score is influenced by age and education[19].
- Semantic verbal fluency (SVF): evaluates the ability to search and retrieve data established in long-term memory, within a given category. This is a very sensitive test for assessing access to and organization of semantic mental lexicon. The score is influenced by education[19].

Intervention

The cognitive training with VR consisted of the presentation of a video shown on a mobile telephone, coupled with *VR BOX* glasses (Virtual Reality Glasses). Images were projected through an immersive three-dimensional (3D) visualization system. Subsequently, a sequence of cognitive stimulation exercises was conducted, based on the VR presentation. A daily session was held over a period of five consecutive days. Each session lasted 30 minutes each. Three videos were presented with a maximum duration of 2 min 30 s each, featuring the themes of wild animals, marine animals, and food.

The cognitive training tasks aimed to work on naming, evocation, and categorization. Each training day included 7 tasks for a specific video. The training was carried out by a researcher blinded to the clinical diagnosis, as well as to the cognitive variables being investigated. **Table 1** describes the 5 sessions.

Table 1 – Description of consecutive sessions of VR training

Session	Cognitive training with VR per session
1st session	1. SVF task - naming as many animals as possible in 1 minute 2. Watching a VR video about wild animals (2 min 30 s). 3. Immediate memory task - recognition of images from the video, presented as 20 printed images (10 images from the video and 10 that were not). 4. Watching a VR video about wild animals (2 min 30 s). 5. Attention task - matching names with pictures, using the words LION, ZEBRA, BIRD, DEER, ELEPHANT. 6. Categorization task - presentation of images for categorization (e.g. domestic animal: wild animal). 7. Long-term memory task (at the end of each session) - presentation of 5 images from the video and verification of recognition.
2nd session	1. SVF task - naming as many animals as possible in 1 minute 2. Watching a VR video about marine animals (2 min 30 s). 3. Immediate memory task - recognition of images from the video, presented as 20 printed images (10 images from the video and 10 that were not). 4. Watching a VR video about marine animals (2 min 30 s). 5. Attention task - matching names with pictures, using the words FISH, DOLPHIN, TURTLE, CORAL, DIVER. 6. Categorization task - presentation of images for categorization, (e.g., domestic animal: wild animal). 7. Long-term memory task (at the end of each session) - presentation of 5 images from the video and verification of recognition.
3rd session	1. SVF task - naming as many types of food as possible in 1 minute 2. Watching a VR video about food (2 min 30 s). 3. Immediate memory task - recognition of images from the video, presented as 20 printed images (10 images from the video and 10 that were not). 4. Watching a VR video about food (2 min 30 s). 5. Attention task - matching names with pictures, using the words TOMATO, SHRIMP, APPLE, PEPPER, LEMON. 6. Categorization task - presentation of images for categorization (e.g., vegetable: fruit). 7. Long-term memory task (at the end of each session) - presentation of 5 images from the video and verification of recognition.
4th session	1. SVF task - - naming as many animals as possible in 1 minute. 2. Watching a VR video about wild animals (2 min 30 s). 3. Immediate memory task - recognition of images from the video, presented as 20 printed images (10 images from the video and 10 that were not). 4. Watching a VR video about wild animals (2 min 30 s). 5. Attention task - matching names with pictures, using the words LION, ZEBRA, BIRD, DEER, ELEPHANT. 6. Categorization task - presentation of images for categorization (e.g., domestic animal: wild animal). 7. Long-term memory task (at the end of each session) - presentation of 5 images from the video and verification of recognition.
5th session	1. SVF task - - naming as many animals as possible in 1 minute. 2. Watching a VR video about marine animals (2 min 30 s). 3. Immediate memory task - recognition of images from the video, presented as 20 printed images (10 images from the video and 10 that were not). 4. Watching a VR video about marine animals (2 min 30 s). 5. Attention task - matching names with pictures, using the words FISH, DOLPHIN, TURTLE, CORAL, DIVER. 6. Categorization task - presentation of images for categorization (e.g., domestic animal: wild animal). 7. Long-term memory task (at the end of each session) - presentation of 5 images from the video and verification of recognition.

Statistical analysis

A descriptive analysis of the data was performed according to the characteristics of each variable (continuous or categorical), with mean and standard deviations/interquartile ranges or frequencies and percentages. SPSS version 22.0 software was used.

Results

The final sample consisted of 13 older women submitted to five VR sessions, divided into two groups. The first group consisted of 8 women diagnosed with MCI (the MCI group) and the second group containing 5 women diagnosed with dementia (the dementia group). The mean age was 81.77 (± 6.94) years. The mean age to the MCI Group was 81.75 (± 8.54) years and to the Dementia Group was 81.80 (±4.07) years. The duration of institutionalization it is observed that the total average time was 1.00 (± 0.519) years, for the MCI Group it was 1.63 (± 0.518) years and for the Dementia Group it was 1.20 (± 0.447) years. As for the education of the participants, analyzed in years of study, an overall average of 11.62 (± 3.28) years is observed, to the MCI Group it was 11.88 (± 3.83) years and to the dementia group was 11.20 (± 2.49) years.

Table 2 shows the characteristics of the study sample and the results. On tests immediately after the intervention, the MCI group showed an improvement in cognitive performance in MMSE, MoCA, and PVF and SVF scores.

Table 2 – Shows the results obtained and the differences between the groups. 2019-2020, Porto Alegre/RS

Variables	MCI Group	Dementia Group	Difference between groups
Patients	8 (61.5 %)	5 (38. 5 %)	-
MMSE	26.38 (± 2.13)	20.60 (± 5.94)	5.77 (±2.76)
MMSE immediately after	26.50 (± 2.07)	18.20 (± 6.68)	8.30 (±3.08)
MoCA	20.50 (± 3.29)	17.40 (± 6.65)	3.10 (±3.20)
MoCA immediately after	22.25 (± 3.88)	13.80 (± 8.26)	8.45 (±3.94)
PVF	23.63 (± 12.72)	10 (± 5.47)	13.62 (±5.12)
PVF immediately after	26.50 (± 10.32)	17.60 (± 6.02)	8.90 (±4.54)
PVF follow-up	29.50 (± 11.14)	12.80 (± 5.72)	16.7 (±4.70)
SVF	11.00 (± 3.62)	7.60 (± 4.56)	3.40 (±2.41)
SVF immediate post	12.88 (± 3.98)	9.40 (± 4.099)	3.47 (±2.31)
SVF follow-up	13.88 (± 6.03)	8.20 (± 5.12)	5.67 (±3.13)

MCI group = diagnosis of mild cognitive impairment. Dementia group = diagnosis of dementia. MMSE = Mini Mental State Examination. MoCA = Montreal Cognitive Assessment. PVF = phonemic verbal fluency. SVF = semantic verbal fluency.
VR = virtual reality.

Discussion

This study shows an improvement in the scores of the group with mild cognitive impairment for the pre-test and post-test phonemic verbal fluency tests after virtual reality as cognitive rehabilitation. Results showed a better benefit for the older participants in the MCI group, through the improvement scores on the cognitive tests and the maintenance of their cognitive performance 15 days after the intervention. In the dementia

group, the improvement was restricted to verbal fluency tests with a decline in these results by follow-up. Our results corroborate other studies[20,21] which found an improvement in the cognitive performance of elderly people with dementia after undergoing cognitive intervention with VR. In addition, the number of sessions used is in line with literature[22], which has described a training period of 4 weeks as sufficient for obtaining improvements in the participants' performance.

Other research[23,24,25] suggested that memory training can improve cognitive functioning in healthy older people and allow at least partial compensation for cognitive deficits in elderly people with MCI, due to factors such as age, education level and neuroplasticity[26].

It is believed that the newly learned strategies, which are still part of a learning process, may demand more attention and faster information processing from the older individuals[27], obliging them to focus on using these strategies. For a period of time, this may delay performance benefit. When the strategy is fully learned, they start to recruit fewer processing resources and can generate greater performance benefit while using it[28,29].

The fact that the MCI group presented better responses in general cognitive functioning when compared to the dementia group, can be justified by the principle of neuroplasticity. While dementia is a chronic disease, characterized by a progressive deterioration in cognitive function, MCI patients have different abilities which may compensate in functional organization[7]. The results of this study can contribute to the search for better therapeutic resources, especially the better use of VR techniques in the cognitive rehabilitation of older patients[30].

Memory training with the aid of software was also the focus of another study[31], in which each group of exercises stimulated a certain cognitive function. Each participant underwent two individual training sessions with a difference of one month between them. The testing was carried out in three moments: before training, after training, and after three months. The study included ten elderly people with MCI, ten with Alzheimer's disease (AD), and a control group with three participants. The two groups that participated in the training showed improvements in different cognitive functions. The AD group improved in memory and attention, while the MCI group improved in working memory and psychomotor learning. Both groups improved their short and long-term memories, both verbally and visually. The control group showed no improvement. Although both tests involve verbal fluency, as their characteristic is different (phonological or semantic) they involve different skills as well as their score taking into account age and education (in phonology) and only education (in semantics), this is our hypothesis for immediate gains after training between MCI and dementia groups.

In our study, the level of performance of the MCI group was preserved for approximately 15 days. After that period, a decline in the performance of the MCI group on cognitive tasks was observed. However, these scores were still better than those of the pre-test, showing that the improved performance remained partial in this group. Results were found to be independent of patient education and length of institutional care. Intensive training points to positive effects in this population in the medium term. Studies found that the maintenance of benefits was restricted to the tasks trained, the main studies on cognitive training shows that the main results are limited to the trained activities, without generalizations to activities of daily living, based on these studies, the skills trained were those that elderly would use and that is why the test was based on these tasks.

The main limitations of this study were the small sample size, only one patient sex, and the lack of a control group. In addition, the scarcity of studies on cognitive training with VR in older prevents better comparisons regarding the reality of this population. For future research, we believe that therapy with more sessions may present more modifying results in the performance of these patients; furthermore, a randomized clinical trial needs to be conducted.

Conclusion

VR improved phonologic verbal fluency test in MCI after five sessions of intervention and the results were maintained in the follow up after 15 days, in this group. Although other studies with a large sample and longer follow-up are necessary, these results pointed to virtual reality as an interesting resource for the cognitive training of this population.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Petersen RC, Doody R, Kurz A, et al. Current concepts in mild cognitive impairment. Arch Neurol. 2001;58(12):1985-92. https://doi.org/10.1001/archneur.58.12.1985

2. Farias ST, Mungas D, Reed BR, et al. Progression of mild cognitive impairment to dementia in clinic - vs community-based cohorts. Arch Neurol. 2009;66(9):1151-7. https://doi.org/10.1001/archneurol.2009.106

3. Mitchell AJ, Monge-argilés JA, Sánchez-paya J. Do CSF biomarkers help clinicians predict the progression of mild cognitive impairment to dementia?. Pract Neurol. 2010;10(4):202-7. https://doi.org/10.1136/jnnp.2010.217778

4. Parmera JB, Nitrini R. Investigation and diagnostic evaluation of a patient with dementia. Rev Med (São Paulo). 2015 jul./set.;94(3):179-84. https://doi.org/10.11606/issn.1679-9836.v94i3p179-184

5. Pugnetti L, Mendozzi L, Motta A, et al. Evaluation and retraining of adults' cognitive impairment: which role for virtual reality technology? Comput Biol Med. 1995;25(2):213-27. https://doi.org/10.1016/0010-4825(94)00040-w

6. Loewenstein DA, Acevedo A, Czaja SJ, et al. "Cognitive rehabilitation of mildly impaired Alzheimer disease patients on cholinesterase inhibitors. Am J Geriatr Psychiatry. 2004;12(4):395-402. https://doi.org/10.1176/appi.ajgp.12.4.395

7. Maggio MG, Latella D, Maresca G, et al. Virtual Reality and Cognitive Rehabilitation in People With Stroke: An Overview. J Neurosci Nurs. 2019;51(2):101-5. https://doi.org/10.1097/JNN.0000000000000423

8. Marques A, Queirós C, Rocha N. Virtual reality and neuropsychology: a cognitive rehabilitation approach for people with psychiatric disabilities. In: Sharkey P, Lopes-dos-Santos P, Weiss PL, Brooks T., editors. Proceedings of 7th International Conference on Disability Virtual Reality and Associated Technologies. Maia, Portugal, 2008. p. 39-46.

9. De Bruin ED, Schoene D, Pichierri G, et al. Use of virtual reality technique for the training of motor control in the elderly. Some theoretical considerations. Z Gerontol Geriatr. 2010;43(4):229-34. https://doi.org/10.1007/s00391-010-0124-7

10. Levin MF. Can virtual reality offer enriched environments for rehabilitation? Expert Rev Neurother. 2011;11(2):153-5. https://doi.org/10.1586/ern.10.201

11. Moreno A, Wall KJ, Thangavelu K, et al. A systematic review of the use of virtual reality and its effects on cognition in individuals with neurocognitive disorders. Alzheimers Dement (N Y). 2019;5:834-50.

12. Saposnik G, Teasell R, Mamdani M, et al. Effectiveness of virtual reality using Wii gaming technology in stroke rehabilitation: a pilot randomized clinical trial and proof of principle. Stroke. 2010;41(7):1477-84. https://doi.org/10.1161/strokeaha.110.584979

13. Deutsch JE. Using virtual reality to improve walking post-stroke: translation to individuals with diabetes. J Diabetes Sci Technol. 2011;5(2):309-14. https://doi.org/10.1177/193229681100500216

14. Saposnik G, Mamdani M, Bayley M, et al. Effectiveness of Virtual Reality Exercises in STroke Rehabilitation (EVREST): rationale, design, and protocol of a pilot randomized clinical trial assessing the Wii gaming system. Int J Stroke. 2010;5(1):47-51. https://doi.org/10.1111/j.1747-4949.2009.00404.x

15. Foloppe DA, Richard P, Yamaguchi T, et al. The potential of virtual reality-based training to enhance the functional autonomy of Alzheimer's disease patients in cooking activities: A single case study. Neuropsychol Rehabil. 2018;28(5):709-33. https://doi.org/10.1080/09602011.2015.1094394

16. Serino S, Pedroli E, Tuena C, et al. A Novel Virtual Reality-Based Training Protocol for the Enhancement of the "Mental Frame Syncing" in Individuals with Alzheimer's Disease: A Development-of-Concept Trial. Front Aging Neurosci. 2017;9:240. https://doi.org/10.3389/fnagi.2017.00240

17. Lourenço RA, Veras RP. Mini-Exame do Estado Mental: características psicométricas em idosos ambulatoriais. Rev. Saúde Pública. 2006;40(4):712-19. https://doi.org/10.1590/S0034-89102006000500023

18. Freitas S, Simões MR, Martins C, et al. Estudos de adaptação do Montreal Cognitive Assessment (MoCA) para a população portuguesa. Aval. psicol. Interamerican Journal of Psychological Assessment. 2010;9(3):345-57.

19. Rodrigues AB, Yamashita ÉT, Chiappetta ALML. Teste de fluência verbal no adulto e no idoso: verificação da aprendizagem verbal. Rev CEFAC. 2008;10(4):443-51. https://doi.org/10.1590/S1516-18462008000400004

20. Burdea G, Polistico K, Krishnamoorthy A, et al. Feasibility study of the BrightBrainerTM integrative cognitive rehabilitation system for elderly with dementia. Disabil Rehabil Assist Technol. 2015;10(5):421-32. https://doi.org/10.3109/17483107.2014.900575

21. Manera V, Chapoulie E, Bourgeois J, et al. A Feasibility Study with Image-Based Rendered Virtual Reality in Patients with Mild Cognitive Impairment and Dementia. PLoS One. 2016;11(3). https://doi.org/10.1371/journal.pone.0151487

22. White PJF, Moussavi Z. Neurocognitive Treatment for a Patient with Alzheimer's Disease Using a Virtual Reality Navigational Environment. J Exp Neurosci. 2016;8;10:129-35. doi:10.4137/JEN.S40827.

23. Dunlosky J, Hertzog C. In: Hacker DJ, Dunlosky J, Graesser AC, orgs. Metacognition in educational theory and practice, Mahwah; NJ: Erlbaum, 1998. p. 249-76.

24. Belleville S. Cognitive training for persons with mild cognitive impairment. Int Psychogeriatr. 2008;20(1):57-66. https://doi.org/10.1017/S104161020700631X

25. Olchik MR, Farina J, Steibel N, Teixeira AR, Yassuda MS. Memory training (MT) in mild cognitive impairment (MCI) generates change in cognitive performance. Arch Gerontol Geriatr. 2013;56(3):442-7. https://doi.org/10.1016/j.archger.2012.11.007

26. Calero MD, Navarro E. Cognitive plasticity as a modulating variable on the effects of memory training in elderly persons. Arch of Clinical Neuropsy. 2007;22:63-72. https://doi.org/10.1016/j.acn.2006.06.020

27. Salthouse TA. Reduced Processing Resoucers. In: Hillsdale, NJ: Theoretical perspectives on cognitive again. 1991. p. 1-49.

28. West RL, Thorn RM. Goal-setting, self efficacy and feedback on memory performance and beliefs among older and younger adults. Psychology and Aging. 2001;16(2):240-50. https://doi.org/10.1080/03610730126109

29. Yassuda MS. Memory belifs and memoru training: the effects of educational intervention. EUA: Florida University, 1999.

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 affects buy mild cognitive impairment. Arch of Gerontol and Geriatr. 2006; 43:327-35. https://doi.org/10.1016/j.archger.2005.12.003

31. Meneghini V, Hauser E, Lourenço CLM, Barbosa AR. Effects Of Exergames And Resistance Training On Well-Being In Older Adults: A Randomized Clinical Trial. Gerontol Aging. 2020;14(3):152-61. https://doi.org/10.1016/j.chb.2013.01.042

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