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Effect of Cognitive Rehabilitation on Set-Shifting Attention of Adult with Mild Cognitive Impairment

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Abstract

The aim of the study was the effect of Cognitive Rehabilitation on the Set-Shifting Attention Ability of Adult Individuals with Mild Cognitive Impairment. The present study consisted of a quasi-experimental study with pre-test and post-test stages. The statistical population consisted of subjects of more than 55 years of age, referred to a neurology clinic in Tehran/Iran in 2012. Forty patients with mild cognitive impairment were selected by convenience sampling based on the diagnosis of a neurologist and a clinical psychologist (MMSE score lower than 25 and The Wechsler Memory Test). The experimental group (20 patients) attended 12 sessions of a cognitive rehabilitation program. As evaluated, by the Wisconsin Cart Sorting Test (WCST). Data were analyzed using MANCOVA. The findings demonstrated that the mean score of the experimental group was greater than the control group ($P<0.05$) in terms of their shifting attention. The follow-up test revealed that the experimental group experienced an effective rehabilitation intervention over a six month period. Cognitive rehabilitation can impact on improving Shifting attention in individuals with mild cognitive impairment.

Keywords: cognitive rehabilitation, shifting attention, mild cognitive disorder

1. Introduction

Mild Cognitive Impairment (MCI) disorder often shows early clinical symptoms of Alzheimer disorder (Lopez & DeKosky, 2003). Affecting about 10% of the population over the age of 65 by this disorder is reported (Stephan & Brayne, 2008). It is also reported that around 16-41% of people with MCI will develop dementia within one year (Amieva et al., 2005). Impairment in the domain of episodic memory, loss of executive function and limitations in daily life (Perneczky, Wagenpfeil, Komossa, Grimmer, Diehl, & Kurz, 2006). Furthermore, changes in behaviour and mood have been reported (Apostolova & Cummings, 2008). The disorder is accompanied by some abnormalities in terms of response inhibition and cognitive changes with regard to executive functions (Trakov et al., 2007).

The study by Rapp and Reischies (2005) shows the tasks that require executive control are a suitably reliable predictor in pre-clinically diagnosed Alzheimer's disorder, demonstrating that there is a keen emphasis on the attention and executive functions of individuals with MCI. Indeed, executive function is a broad conceptualization for cognitive processing such as concentration, shifting attention, sustained attention, fluency, flexibility in solving new problems, planning, and adaption. Many researchers such as Luria (1996), Hecan and Albert (1978) and Lezak (1995) have taken this issue into account (D'Esposito & Gazzaley, 2006). Shifting attention includes the ability to switch attention from one stimulus to another one (Marvin, 2012). This kind of attention is measured using the Wisconsin Card Sorting Test (WCST). The study by Traykove et al. (2007) showed that people with MCI disorder have higher perseveration errors in the WCST. Randomized Controlled studies (RCT) of people with MCI have shown that training in cognitive issues can lead to the recovery of memory, increased attention, improved behavior, mood and psychological well-being (Belleville, Chetrkow, & Gauthier, 2007; Cipriani, Bianchetti, & Trabucchi, 2006; Rozzini et al., 2007). However, the impact of the

process on daily life has not yet been recognized. The disorder challenges the patients' abilities and impact on their family members, along with an increased need for adaptation to change and significant planning for the future (Werner, 2012). Therefore, interventions increasing the performance of patients in daily life seem essential for optimizing their life quality (Clare, Woods, Moniz Cook, Orrell, & Spector, 2005).

Studies have shown that an eight-week cognitive rehabilitation program focusing on practical memory has a potentially positive impact on cognitive-speed (Talassi, 2007). Also a meta-analysis study led by (Li H., Li J., Li N., Li B., Wang, & Zhou, 2011) showed that over 17 cognitive interventions for people with MCI had a significant impact on the overall cognitive function. There were also a moderate impact on Self Rating Anxiety (SRA), language ability, and a low impact on memory, in particular in terms of semantic memory function, executive function, working memory, and attention process and speed; a positive impact was also observed in follow-up sessions (Li et al., 2011). It is shown that training in the form of a cognitive 12-week rehabilitation program not only reduces cognitive, attention, and memory problems, but also can be effective with a 6-week follow-up program; after six months training, the attention and cognitive stimulant activities were at the level of a post-test case (Herrera, Chambon, Micheal, Paban, & Alescio-Lautier, 2012). Also, cognitive rehabilitation is effective for recovering selective attention in people with an MCI disorder (Shomali Oskoei, Nejati, & Ajilchi, 2013). A study of eight patients with mild and moderate Alzheimer's showed that the intervention in the form of memory and attention rehabilitation measures reduced cognitive deficits in elderly individuals with dementia cognitive impairments (Amini, Dowlatshahi, Dadkhah, & Lotfi, 2010).

Olsen (2004) suggests that neuropsychology intervention can increase plasticity and brain function through cognitive stimulants, and thought sensory and psychomotor activities.

The study by Clare et al. (2010) showed that people who were involved in cognitive rehabilitation had increased levels of blood oxygen in relation to visual encoding, learning (right fusiform face, right par hippocampal cortex, right medial prefrontal cortex, and right temporal parietal junction), while people in the control group had a reduction in their blood activity. The study by Small et al. (2006), implementing a 14-day brain stimulant combination program, verbal memory training, physical exercise, stress reduction , and a healthy food diet revealed better verbal fluency and the reduction of the left dorsolateral prefrontal cortex on the part of the participants. The reduction of the related cortex activity represents the cognitive skills of a brain region that is involved in working memory (Choi & Twamley, 2013). In summary, there are two main approaches regarding cognitive rehabilitation; the first one is the compensation or recovery process, while the second is cognitive therapy. It should be noted that these two approaches cannot be separated. The overlapping of each approach is inevitable. The main aim of the compensation approach is to adapt or introduce some changes in the environment and to remove the individual's restrictions with regard to habits.

In regard to the cognitive approach, the difficulty is to return the cognitive capacity of the individual by performing exercises and providing purposeful stimulants; the aim is to recover personal functions in terms of the completion of activities (Lee & Riccio, 2005). Since mild cognitive disorders happen earlier than dementia, there is no medication for treating the patient; hence, non-medication interventions are considered essential to increase cognitive affairs (Teixeira, Gobbi, Corazza, Stella, Costa, & Gobbi, 2012).

According to the following research question was examined in the present research: Is cognitive rehabilitation effective for recovering the shifting attention of individuals with mild cognitive disorder?

2. Method

2.1 Procedure

A quasi-experimental method was applied involving pre-test and post-test stages. Forty patients were selected and divided into experimental and control groups randomly. Both groups initially underwent shifting attention assessment using the (WCST). The experimental group received a cognitive rehabilitation program of 12 sessions, twice a week, each lasting almost two and a half hours. The control group did not receive any intervention. After the intervention, both groups were again assessed for shifting attention.

2.2 Participants

The study population consisted of patients referred to a neurology clinic in Tehran, Iran in 2012, with based on the clinical diagnosis of mild cognitive impairment made by a neurologist and a psychiatrist (based on the MMSE score of each patient being lower than 25 and the Wechsler Memory Test). Other criteria included: being over 55 years of age and with a minimum level of education and according to their nursing history and medical records, not being in possession of any neurological and or psychiatric conditions in the form of co-morbidities and impaired sensory and motor retardation.

2.3 Instruments

2.3.1 Mini Mental State Examination (MMSE)

The MMSE questionnaire is one of the most commonly used screening tests for determining cognitive disorders globally, and has been translated into several languages. Flostein et al. constructed the test in 1975 to facilitate the diagnosis of patients in hospital. The main application of the test is to evaluate the cognitive ability of patients. It has 11 options divided into two main sections: the first section focuses on verbal responses to orientation, memory, and the attention of individuals; the second section relates to reading and writing issues, including the ability to recall names, achieve verbal or written arrangements and write a statement and copy a figure. The maximum score on this examination is 30; a score below 25 suggests possible deterioration of cognition, and a score below 20 indicates a definite deterioration.

Foroughan et al. (2008), in a cross-sectional study of elderly people in Tehran, determined their psycho-metric properties. It was found that the validity of the test results was satisfactory (78%), and a specificity of 84% and sensitivity of 90% in a cut-off point of 21 was obtained. The correlation between scores with age and education was significant at 0.05.

2.3.2 Wisconsin Card Sorting Test (WCST)

The WCST is a very common test for evaluating executive function (Rossi, Arduini, Danelluzzo, Bustini, Prosperini, & Stratta, 2000). Ten years of continual examination has been undertaken to develop in terms of simplicity, speed and practicality.

Studies on patients with damage to their frontal lobe indicate poor performance in the WCST test (MacLeod, 1991). In addition, the test has been used to evaluate the response in terms of the transmission rates (Chan, Chen, & Law, 2006). The test consists of 64 different cards, on which there are diagrams of a triangle, star, cross, or a circle, as well as the numbers 1 to 4. Moreover, these cards are colored blue, red, yellow, or green. Hence, the cards have a figure (one of four types), a number (1-4), and a color (blue, red, yellow, or green). Two main outputs can be observed, namely the number of categories completed (achieved) and the number of preservative errors made as the main indices of measuring executive reactions (Rhodes, 2004; Strauss, Sherman, & Spreen, 2006). In the present study, the computerized WCST was used. Specialists have confirmed the content validity of the test (Axelrod, Woodard, & Henry, 1992); in the study by Lezak (2004), the validity of the test for measuring cognitive deficits after brain damage was estimated to be 0.86 (Karimi Ali Abad, Kafi, & Farahi, 2010).

The validity of the test was reported at 0.85 with regard to the Iranian population. The reliability of the software is achieved in terms of internal consistency (Cronbach's alpha coefficient) and the split-half coefficient which showed a suitable level of reliability (Naderi, 1996).

2.3.3 Wechsler Memory Scale (WMS-O)

The WMS-O is the most commonly used memory scale for adults. It was constructed and validated by David Wechsler in 1945 at a hospital in New York. This scale has two forms, A and B, and every form includes seven categories (orientation, general and personal information, mental control, digit repetition, logical memory, visual memory, and learning associations). Sarrami's study validates the Wechsler Memory Scale (Sarrami, 1993) and categorized into nine groups. The Cronbach's alpha reliability test result was 0.85, and the results of internal consistency and factor analysis, validity and face validity were acceptable. The results obtained showed scale features in line with those of other studies. Also Saaed, Roshan and Moradi obtained reliability coefficients for the subscales ranging from 0.65 to 0.85 (Saaed, Roshan, & Moradi, 2008).

2.3.4 NEurocognitive Joyful Attentive Training Intervention (NEJATI)

We offered four joyful computer-based tasks to participants as interventions. The tasks were graded, and their difficulty level increased based on user response. The grading of the task depended on the following criteria: flanker stimuli, velocity of stimuli presenting, number of goal stimuli, and changing task rule. For instance, for one of the tasks, the user was asked to arrange faces into various categories based on three features; emotional status (sad, angry and neutral), hair color (green, white and black), and skin color (yellow, white and black). Each face encompassed one distinct property from each category, and the individual was asked to act only based on the rule. In every task set, the user had to inhibit two face properties and act according to one of the features. The cognitive requirement associated with this task was the inhibition of irrelevant properties of stimuli and attention to the relevant one (Nejati, Pouretemad, & Bahrami, 2013). In this study the experimental group received a cognitive rehabilitation period of 12 sessions twice a week, lasting almost two and a half hours. The control group did not receive any intervention. After the intervention, both groups were again assessed for shifting attention.

3. Result

3.1 Overview of Analysis

Analysis was performed using SPPS version 20. Descriptive statistics for each of the continues variables was obtained (Please see Table 1 and Table 2 for Ms and SDs for the main variable in study). The WCST was used in order to determine the effect of cognitive rehabilitation on the set-shifting attention ability of individuals with MCI. Independent categorization variables (control and experimental groups) and dependent variables (the number of correct responses, the number of sets completed, and perseveration error in the WCST were applied. Multi-variable single-sided inter-group covariance analysis (MANCOVA) was also applied. Preliminary studies were carried out to obtain confidence, lack of ignorance of normality, linearity, variances' convergence and the validity of the measurements; the application circumstances were then governed (Please see Table 1 and Table 2). Finally Benfroni follow-up test was used for correct responses, number of Sets Completed, and Perseveration error (Please see Table 3).

3.2 Statistical Analysis

Table 1. Descriptive indices and summary of multi variable covariance results for the shifting attention (WCST)

Group index		Descriptive indices				Multi covariance	
		Experimental		Control			
Variable	Stage	Mean	Sd[a]	Mean	Sd[a]	F (1,27)	effect Size
Correct Responses	Pre test	25.26	9.97	27.39	7.43	16.80*	0.40
	Post test	41.94	8.97	28.26	6.76		
Number of sets completed	Pre test	2.20	1.01	2.23	1.25	18.79*	0.43
	Post test	4.04	0.96	2.36	1.80		
Preservation error	Pre test	21.06	6.20	20.56	4.52	10.68*	0.3
	Post test	11.95	4.89	21.01	8.32		

[a] Standard deviation, * P<0.05.

According to Table 1, F values are significant at p<0.05 for the real response, and the number of clusters and perseveration errors are specified; after the elimination of the pre-test impact, a significant difference was found between the variables. The mean values showed that the difference is due to the increase in the number of correct responses, the number of sets completed, and the reduction in the perseveration error of the experimental group in terms of cognitive rehabilitation. The values are actually larger than they would normally appear to be, thus showing the potential effectiveness of the rehabilitation program.

3.3 Results of the Follow-Up Test

Table 2. Summary of statistical indices of participants' scores regarding the measurement of shifting attention (Correct responses, number of sets completed, and perseveration error)

Variables	Stage	Mean	Sd[a]	N	Mocheli test	F	Size of effect
Correct Responses	Pre test	25.26	9.97	15	0.766	14.075*	0.501
	Post test	41.94	8.97	15			
	Follow-up	39.13	12.07	15			
Number of Sets Completed	Pre test	2.20	1.01	15	0.878	13.911*	0.498
	Post test	4.04	0.961	15			
	Follow-up	3.80	1.82	15			
Preservation error	Pre test	21.06	6.20	15	0.985	8.985*	0.593
	Post test	11.95	4.89	15			
	Follow-up	14.33	8.32	15			

[a] Standard deviation, * P<0.05.

Based on Table 2, we can conclude that there is a significant difference between the three variables regarding shifting attention. The paired comparison of differences in measurement is given in Table 3 below.

Table 3. Summary of the Benfroni follow-up test (Correct responses, number of sets completed, and perseveration error)

	Number of correct responses			Number of sets completed			Perseveration error		
Stage	1	2	3	1	2	3	1	2	3
1. Pre test	-	-15.667*	-10.867*	-	-1.733*	-1.600*	-	8.733*	6.733*
2. Post test	-	-	-4.800	-	-	-0.133	-	-	2.00
3. Follow up	-	-	-	-	-	-	-	-	-

* P<0.05.

Table 3 represents significant differences between the three elements of the pre-test in comparison to the post-test and follow-up; the lack of difference can be seen in the three related elements in the post-test and follow-up tests.

4. Discussion and Conclusion

Table 1 represents the significant differences between each group in terms of increases in the correct responses, the number of Sets Completed, and the reduction in the perseveration error in the experimental group. Thus, it can be stated that cognitive rehabilitation is potentially effective in recovering the shifting attention function in MCI individuals, which is inconsistent with many research findings (Cipriani et al., 2006; Rozzini et al., 2007; Talassi et al., 2007; Herrera et al., 2012; Shomali Oskoei et al., 2013; Amini et al., 2010).

According to Olsen (2004), it seems that training can increase the plasticity of the brain as a result of cognitive stimulation and sensory and psychic activities (Choi & Twamley, 2013). Also, the attempt to return the missing cognitive capacities through exercises and target-based stimulants (training) led to recovery on the part of MCI individuals in the experimental group. Tables 2 and 3 (displaying the results of the six month follow-up test) demonstrate that after six months of follow-up courses of cognitive training the results were confirmed. This finding is consistent with studies of Li et al. and Herrera et al. (Li et al., 2011; Herrera et al., 2012). The findings regarding the cognitive and functional decline of healthy elderly people is that they can be postponed by cognitive practices, representing the considerable fruitful results of applying cognitive interventions in people with MCI disorder. The interventions also play a preventative role in people with moderate mild cognitive impairment, potentially delaying the onset of Alzheimer's disorder.

These intervention programs are highly effective and promise considerable positive effects on relation to the cognitive abilities and life quality of such people (Belleville et al., 2007). The MMSI studies in Iran show that about 30-37% of elderly people have MCI disorders (Joghataee & Nejati, 2006; Nejati, 2010).

4.1 Limitations

Taking into account the needs of vulnerable MCI individuals, research in Iran is, in fact, at the preliminary stage, and it is recommended that the effects on different age groups be investigated through further experimental work.

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