The Role and Effect of Cognitive Rehabilitation in Reducing Executive Function Deficits in OCD Patients

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Abstract: The aim of this study is to investigate the therapeutic effectiveness and role of cognitive rehabilitation in reducing executive function deficits in patients with obsessive-compulsive disorder (OCD). The study is conducted as a quasi-experimental research. The research population consists of all male and female OCD patients who visited outpatient clinics in Tehran during 2011-2012. Volunteer sampling was used to initially determine 40 volunteer patients. In the next phase, 30 patients who were diagnosed with OCD, were chosen from the 40 volunteers; then, they were randomly appointed into one of the two groups of "control" or "experimental". The subjects in the experimental group underwent 16 sessions of individual cognitive rehabilitation therapy. Before, during and after the therapy, both groups were assessed by a number of research tools including Stroop, Wisconsin and Wechsler backward digit span. The survey's data were analyzed using both descriptive and inferential statistics (MANOVA and repeated measures tests). The results show that cognitive rehabilitation therapy *significantly* reduces executive function deficits. According to the findings of the present study, it can be concluded that cognitive rehabilitation therapy is effective in reducing the deficits of memory and cognitive and attention processing strategies.

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1. Introduction

Obsessive-Compulsive Disorder (OCD) is a complex neuropsychiatric syndrome mainly characterized by unwanted, recurring and distressing thoughts and repetitive, annoying and regular behaviors that are aimed at preventing stress or neutralizing obsessive thoughts (Association & DSM-IV., 1994).

The symptoms of OCD consist of different kinds of obsessions and compulsions with rituals, sensory abnormalities, doubts, overvalued ideas, speech abnormalities, emotional abnormalities (depression, anxiety, irritability, etc.), immediate memory alterations, and minor soft neurological signs (LÃ³pez-Ibor & LÃ³pez-Ibor, 2003).

Along with the emergence of theories regarding the etiology, symptomology, and treatment of OCD, new findings have been reached about the neuropsychological and neurological aspects of OCD. Research on biological features of OCD is substantially new and most of its literature has been developed during the current decade (Purcell, Maruff, Kyrios, & Pantelis, 1998).

Functional research and neurological structure studies besides to clinical examinations, demonstrate that central nervous system of OCD patients undergoes some changes. Specially, as pathophysiologic characteristics of obsession, some disorders were observed by these studies in the functions of brain's dorsolateral cortex, dorsolateral prefrontal cortex, cortical areas and right hemisphere (Gazzaniga, Ivry, Mangun, & Steven, 1998).

Frontal lobe is divided into three parts: 1) primary motor cortex, 2) motor association cortex that consists of secondary motor area, lateral premotor cortex, frontal eye field, Broca's area and posterior cingulate cortex, and 3) prefrontal cortex. One of the major features of all these three parts is that they link the massive network of motor areas to sensory perception areas and to limbic system. Huge signals are sent from almost all areas in the parietal lobe, temporal lobe, and occipital lobe to the prefrontal cortex. Further, cortical structures such as basal ganglia, cerebellum, and several nuclei of the brainstem send some indirect signals to the prefrontal cortex through a few intercepts. There are also some interactions between the frontal lobe and other parts of the brain.

The frontal lobe is responsible for activities often known as executive functions, functions such as prediction, reasoning, goal

setting, planning, time and situation management of behaviors, and feedback reviews (Prigatano, 1999).

Executive functions refer to individual's high-level cognitive processes such as determination, purposeful thoughts, planning, self-awareness, and behavior self-monitoring (Anderson, Jacobs, & Harvey, 2005).

The process involves gaining awareness about the subject, organizing the capabilities required for enabling the effectiveness of projects, progress evaluation, modifying the project in case of failure or ineffectiveness, comparing the results with the problem's conditions, completing the project when the conditions are satisfactory, saving the plan in mind, and using the same plan when similar problems occur (Peers, et al., 2005).

Some studies have directly assessed patients with OCD symptoms. These studies have compared neuropsychological performance of OCD patients with other groups. These studies have found a positive relation between the severity of OCD symptoms and patient's weak performance in cognitive domains.

According to several studies that have investigated the changeability of mental sets, involuntary repetitive behaviors such as obsessive actions, are attributed to the impaired ability of frontal lobe circuits that were to prevent movement of corpus callosum and cognitive programs (Kuelz, Hohagen, & Voderholzer, 2004; Muller & Roberts, 2005).

Visual-spatial function disorder in OCD groups has been demonstrated through several examinations such as Wechsler's cubes (Bannon, Gonsalvez, Croft, & Boyce, 2002; Fennig, Craig, Lavelle, Kovasznay, & Bromet, 1994).

A group of researchers have extended the findings about nonverbal memory impairment in OCD patients. They proved that OCD patients show some weaknesses in verbal memory examination. In summary, recent researches about verbal and nonverbal memory in OCD patients indicate that the observed weaknesses are secondary to fundamental executive dysfunction. Additionally, OCD patients have difficulties in finding a certain structure based on which they can encounter stimuli. Therefore, OCD patients suffer faulty code-switching for both verbal and nonverbal information (Aronowitz, et al., 1994; Delis, 2000; Moritz, et al., 2002).

The term "cognitive rehabilitation therapy" is derived from "rehabilis" that means "again" + "suitable"; the prefix "re-" refers to the process of restoring and recovering lost abilities.

In other words, "cognitive rehabilitation" or "neuropsychological rehabilitation" can be defined as follows:

A series of intervening methods and strategies that are aimed to empower treatment-seeking patients and adjust, control and reduce their cognitive deficits.

Due to the nature of OCD's neuropsychological deficits, it seems that executive functions deficits' interactions with different learning situations intensify the clinical symptoms of patients. Accordingly, the present research tries to answer the following main research question:

Are cognitive rehabilitation programs which are focused on improving executive functions effective in reducing executive function deficits in OCD patients?

Our initial guess is that cognitive rehabilitation would result in the improvement of executive functions in OCD patients.

2. Material and Methods

The present study is an applied research type. Moreover, the methodology of this survey is designed based on the quasi-experimental method with control group.

The research population consists of all male and female OCD patients who visited outpatient clinics in Tehran during 2011-2012. After explaining the treatment program to the treatment-seeking patients, 40 patients volunteered to take part in the program. Then, the psychiatrist studied volunteers' medical records and gave specific tests to confirm the OCD diagnosis. Afterwards, a series of interviews and preliminary examinations were conducted that narrowed down the sample to 30 patients. These 30 patients were randomly appointed into one of the "control group (in the waitlist of receiving treatment)" or the "experimental group". The inclusion criteria were as follows:

1. Acquiring a minimum score of 8 in Yale-Brown Obsessive Compulsive Scale (Y-BOCS)
2. Diagnosed as an OCD patient by the psychiatrist based on DSM-IV criteria
3. Confirmed diagnosis through a structured clinical interview for DSM disorders (SCID)
4. Having a stable Psychiatric status during at least the last two weeks

5. Having an intelligence quotient (IQ) score within the normal range
6. Being 25-40 years old

The exclusion criteria were as follows:

1. Acquiring a minimum score of 20 in Beck Depression Inventory (BDI)
2. Having a history of brain trauma and injuries
3. Having history of neurodevelopmental disorders such as epilepsy
4. Having received electric shocks during the last 6 months
5. Having a history of substance abuse

Cognitive Rehabilitation Program

The cognitive rehabilitation program invoked in this study is based on the hierarchical model (Sohlberg & Mateer, 2001). This model puts emphasis on the enhancement of infrastructural and molecular cognitive processes. Thus, in the first stages, cognitive functions such conceptualization, diligence, initiation, planning, and memorizing through repetitive exercises were selected as treatment targets. In the next phase, higher-level skills and functions were taught to the patients.

The program consists of 16 sessions. The sessions are private and last between 30 to 45 minutes. The first 12 sessions involve focused exercises on working-memory; diligence and changing the problem solving set; response prevention; initiation; and planning. The next 4 sessions are assigned to a review of previous exercises.

1. Session 1: Building a therapeutic relationship with the subject; explaining cognitive exercises and their objectives to him/her; offering the first exercise regarding the working memory by teaching and using segmentation method to help the subjects remember a sequence of numbers.
2. Session 2: Doing some exercise regarding the working-memory by narrating a short story and asking the subjects about its events, details and what they have deduced from the presented information.
3. Session 3: Practicing the functions of conceptualization by providing the subjects with a concrete object and asking them to focus their attention on its general and differentiating features; repeating the very same procedure by another object and identifying both objects common features. After the subjects have mastered the procedure, the same process will be repeated through using objects' images. In the next stage, the process will be repeated in an abstract way (verbally).
4. Session 4: Continuing exercises on functions of conceptualization by categorizing images of a group of objects according to different criteria and repeating the same procedure by using words.
5. Session 5: Practicing the functions of mental flexibility and helping the subjects change their mental set by frequently offering "addition-subtraction" exercises and also by asking simple "yes-no" question.
6. Session 6: Continuing to help the subjects change their mental set by utilizing a task containing the Stroop effect.
7. Session 7: Practicing initiation and planning; with the help of the therapist, the subject specifies a simple task that should be done within a day (such as toothbrushing). The subject, then, designs its executive plans and determines specific signs (a certain time or routine activity) that triggers its initiation and make it progress to the different executive phases. Afterwards, during the day, he/she will operate according to the plan.
8. Session 8: Continuing exercises in planning, initiation and objective management by using hint cards. To do so, a task is set as the objective. Then, its executive stages are reviewed through hint cards. The hint cards include questions such as "what am I doing?", "what should I do?", "What minor tasks should I do to complete my current task?", "Do I know how to take these minor steps?", "Am I currently doing the task?", and "Have I done what I have wanted to do?"
9. Session 9: Exercises in response-prevention are scheduled for this session. A series of easy "yes-no" questions are read for the subjects and he/she should avoid answering the questions that have a "yes" for the answer.
10. Session 10: The remaining response-prevention exercises are done in this session. Simple instructions (such as raise your right hand, bow, sit, etc.) will be given to the subjects. They should perform all the instructions except the one which is predetermined.
11. Session 11: Practicing problem solving by presenting a story which describes a problem. Then, different solutions are

offered. Advantages and disadvantages of each of the solutions are discussed; and finally, the best solution is selected.

12. Session 12: Continuing problem solving exercises by using the self-talk method; models of different stages are first demonstrated by the therapist. Then, with the help of the therapist, the subject performs the same procedures. After the subjects have mastered the process, they themselves can self-talk loudly. In the next stages, the self-talking continues through whispering. Finally, the last stage involves silent self-talking.
13. Sessions 13-16: Based on their weaknesses, the subjects review/take more exercises of the weakness area.

Research Tools

- Yale-Brown Obsessive Compulsive Scale (Y-BOCS) (SCALE): The scale consists of 10 questions. These questions enable the interviewer to separately rate persistent obsessions and compulsions of the subject based on: the amount of time he/she spends on them, the extent of their interference with functions of daily life, the degree of distress caused by them, the degree of resistance and control he/she has over them. Y-BOCS was developed by Goodman, Price, Rasmussen, Mazure and Delgado (1989).
- Wisconsin Card Sorting Test (WCST) (Grant & Berg, 1993): The test assesses abstract reasoning ability and the ability to shift cognitive strategies in response to changing environmental contingencies. This test requires strategic planning, organized searching, and utilizing environmental feedback to shift cognitive sets (Cavallaro, et al., 2003). WCST was first developed by Grant and Berg (Grant & Berg, 1993) (quoted from (Lezak, 2004)) and has 64 cards. The figures on cards differ from each other with respect to color, shape and quantity. The subject should categorize the cards according to a specific principle determined by the tester. The principle is based on the verbal feedback received after each response. After the subject recognizes the principle, the tester changes the current principle and develops a new one. Thus, WCST assesses individuals' cognitive flexibility and their conceptualization ability.
- Backward Digit Span Subscale of Reconsidered Wechsler (Wechsler, 1981) Adult Intelligence Scale: The scale consists of two parts: forward digit span and backward digit span. The latter is more complex and requires attention and code-switching. Furthermore, the subject must keep information in his/her mind for longer periods, perform certain operation on it, and finally express it.
- Stroop Color-Word Test: The test is a classic scale developed to assess attention processing and the ability to shift cognitive set. Generally, Stroop test studies the effects of different dimensions of stimuli on individuals' attention and individuals' ability to shift attention from a specific dimension to another one.

3. Specific Methodology of This Research

Descriptive statistical methods are used to display data frequency and percentage. Further, inferential statistical methods such as MANOVA and repeated measures are used to study the significance levels.

4. Findings

Demographic features of subjects in both groups are shown in table 1.

The mean scores of experimental and control groups in clinical and neuropsychological tests (the number of correct categories and preservative errors (WCST), interference error (Stroop test), memory (Wechsler backward digit span) and nonrecognition (Image recognition test)) are shown in Table 2. As it is obvious from table 2, there is a significant difference between the scores of Wisconsin, Stroop, Wechsler and image recognition tests of the experimental group and control group. According to table 3 and the results of Maukhly's Sphericity test, Mauckhly's W values are not significant (d=0.05) and a normal distribution diagram can be observed. Further, based on table 3 and with emphasis on the significant F Values (d=0.05) obtained from the examined variables, it shall be noted that there is a significant difference between variables' values of experimental group and control group. Moreover, according to the "impact intensity" indicator, "cognitive rehabilitation" greatly affects the examined variables and reduces executive function deficits.

Table (1) Demographic Features of Subjects

Variables		Total (n=30)	Experimental Group (n=15)	Control Group (n=15)
		Quantity (Percentage)		
Gender	Female	16 (53.3%)	7 (23.3%)	7 (23.3%)
	Male	14 (46.7%)	8 (26.7%)	8 (26.7%)
Age	25-30	8 (26.7%)	4 (13.3%)	4 (13.3%)
	31-35	14 (46.8%)	7 (23.3%)	7 (23.3%)
	36-40	8 (26.7%)	4 (13.3%)	4 (13.3%)
Education	Elementary School Degree	7 (15%)	4 (15%)	3 (10%)
	Between Elementary School Degree and Diploma	17 (65%)	8 (35%)	9 (30%)
	Diploma or Higher	6 (20%)	3 (10%)	3 (10%)
Marital Status	Married	16 (53.3%)	7 (23.3%)	8 (46.7%)
	Single	14 (46.7%)	8 (46.8%)	6 (34.2%)

Table (2) Mean and Standard Deviation of Scores for Clinical and Neuropsychological Tests in Experimental and Control Groups

Variable			Experimental Group Standard Deviation/Mean	Control Group Standard Deviation/Mean	T (df*=28)
WCST	Number of Correct Categories	Pre-Interference	9.32/35.66	9.56/33.53	0.61
		Interference	11.56/39.66	9.92/33.20	
		Post-Interference	11.08/42.40	9.52/32.40	
	Preservative Error	Pre-Interference	1.16/4.73	0.97/4.66	0.17
		Interference	1.29/3.33	1.06/4.53	
		Post-Interference	0.50/2.40	0.77/4.80	
Stroop Test	Interference Error	Pre-Interference	0.52/3.33	0.89/2.33	0.26
		Interference	0.63/2.73	0.74/4.46	
		Post-interference	0.98/2.13	0.89/2.46	
Wechsler Backward Digit Span	Pre-Interference		1.52/9.20	0.89/2.46	0.89
	Interference		1.57/10.06	2.09/8.60	
	Post-Interference		0.77/11.20	2.19/8.40	
Image Recognition Test	Non-recognition	Pre-Interference	1.38/4.06	1.34/4.33	1.49
		Interference	1.52/4.80	1.30/4.46	
		Post-Interference	1.18/50.46	1.30/4.53	

*d.f. = degree of freedom

Table (3) Multivariate Tests Associated with Dependent Variables and Maukhly's Sphericity Test

Multivariate Test (Pillai's Trace Test)		F value	Significance Level	Maukhly's Sphericity	Impact Intensity
Number of Correct Categories in WCST	Control Group	2.09	0.163	0.26	0.13
	Experimental Group	8.81	0.004	0.86	0.44
Preservative Error in WCST	Control Group	0.26	0.770	0.95	0.02
	Experimental Group	38.68	0.001	0.48	0.53
Stroop Interference Error	Control Group	2.36	0.001	0.52	0.11
	Experimental Group	11.32	13.33	0.45	0.55
Wechsler Backward Digit Span	Control Group	0.91	0.424	0.55	0.058
	Experimental Group	13.71	0.001	0.97	0.50
Image Recognition	Control Group	1.37	0.288	0.56	0.057
	Experimental Group	12.26	0.001	0.84	0.49

5. Discussion and Conclusion

The present study aimed to investigate the effect of cognitive rehabilitation program on executive functions of obsessive-compulsive disorder (OCD) patients.

To the best of our knowledge, no history of the effects of cognitive rehabilitation on executive functions of OCD patients was found in the research literature (However, there were some mentions to the existence of executive function deficits in OCD patients). OCD patients are unable to control and reduce their obsessions and resist their compulsions. Furthermore, their thoughts and compulsions have such a persistent nature that despite treatment, they still suffer from functional deficits and struggle with some remaining problems. Based on the aforementioned points, it is assumed that in OCD patients, those parts of the brain that are responsible for processing emotional data and modifying behaviors have been damaged and failed to function as expected (Otto, 1992). The important role of brain's frontal lobe and its associated disorders in producing executive function deficits in OCD patients is undeniable.

From the perspective of neuropsychology, executive function deficits in potential OCD patients can be associated to the dysfunction of frontal-striatal circuits (Savage, et al., 2000). Data management hypothesis, formulated by Savage (1998) (Savage, et al., 2000), tries to explain cognitive damages in OCD patients. The hypothesis is based on four principles:

1. The most important cause for development of obsession symptoms is the dysfunction of frontal-striatal circuits.
2. Any deficits in frontal-striatal circuits can initially damage executive functions and consequently lead to impairment of nonverbal memory.
3. Neuropsychological deficits affect the clinical status of obsession symptoms.
4. The disorder's symptoms which interact with cognitive deficits make a vicious loop.

If we accept the current views about the vital role of executive function deficits in obsessive-compulsive disorder besides to the effectiveness of cognitive rehabilitation in reducing cognitive deficits and even psychiatric symptoms, we can expect that the interferences reduce the intensity and frequency of symptoms in OCD patients. Cognitive rehabilitation consists of a series of interferential methods and strategies that are aimed to empower treatment-seeking patients and adjust control and reduce their cognitive deficits. Utilizing this therapeutic method is targeted at improving the ability of individuals to process and interpret information and enhancing their performance in both social and family life (Sohlberg & Mateer, 2001). As for the cognitive nature of OCD, the primary objective of cognitive rehabilitation is functional improvement through adjusting the patient. Preventing and reducing incompatible behaviors will be considered the second objective. The final objective would be restoring some of the lost functionalities.

As to the question of "how cognitive and neuropsychological rehabilitation can enhance cognitive functions?", Caleb and Kendall, two contemporary prominent psychiatrists, assume that the action and interaction of neurons create the infrastructure of behavior. If we accept this preliminary hypothesis, we should also inevitably accept that any pathological damage inflicted on behaviors is due to a deficit in neuronal system. Therefore, this logic should be utilized in the next phase; consequently, any enhancement in executive functions is associated with cellular-neurological and chemical-neurological processes.

In summary, the cognitive rehabilitation approach utilized in this research manages to enhance executive functions through restoring damaged functions, enhancing and optimizing the remaining functions, and recovering lost functions. Besides, the approach of this survey employs current healthy working functions as another tool for improving executive functions of OCDs.

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