

## Executive Functions and Reinforcement Sensitivity in Women with Obsessive Compulsive Symptoms

Malahat Amani\*, Safoora Keyvanlo

### Abstract

**Objective:** Obsessive-compulsive disorder is associated with cognitive and motivational deficits caused by abnormal activities in certain neural circuits. This study sets out to determine the contribution of each component of executive function and reinforcement sensitivity in prediction of obsessive-compulsive symptoms.

**Method:** In this cross-sectional study, the study population consisted of all adult women living in Sabzevar city (Iran). Using cluster sampling, 365 women were selected as the study sample. Participants completed the Obsessive-Compulsive Inventory, Sensitivity to Punishment and Sensitivity to Reward Questionnaire - Revised and Clarified (SPSRQ-RC) as well as Behavior Rating Inventory of Executive Function (BRIEF). Data analysis was conducted using correlation and regression tests.

**Results:** The results of stepwise regression analysis showed that inhibition, shift and initiation variables as well as sensitivity to punishment and reward were best predictors of obsessive-compulsive symptoms (adjusted R square = 0.34, F = 38.93, P < 0.0001).

**Conclusion:** It seems that impaired executive functions in cognition and sensitivity to reinforcement in motivation contribute to the emergence or sustainability of obsessive-compulsive symptoms.

**Key words:** *Executive Functions; Obsessive-Compulsive Disorder; Reinforcement*

Department of Psychology, Univeraity of Bojnoed, Bojnoed, Iran.

### \*Corresponding Author:

Address: Department of Psychology, Univeraity of Bojnoed, Bojnoed, Iran, Postal Code: 9453155111.  
Tel: 98-58 32201000, Fax: 98-58 32284605, Email: m.amani@ub.ac.ir, malahat\_amani@yahoo.com

### Article Information:

Received Date: 2020/04/23, Revised Date: 2021/09/21, Accepted Date: 2021/11/03



**O**bsessive-Compulsive Disorder (OCD) represents a set of symptoms including disturbing thoughts, obsessions, rituals and compulsions. Repeated obsessions and compulsions interrupt the normal course of life. Obsessions are recurring and distracting thoughts or senses whereas compulsions are obligatory and recurrent behaviors that their irrationality is clear to individuals (1). OCD is a psychiatric disorder. In a longitudinal cohort study, prevalence of OCD were 5.3% for women and 1.7% for men (2) and prevalence of sub-clinical Obsessive-Compulsive Symptoms (OCS) were higher in women than men (3). In Iran, prevalence of OCD among women has been shown to be higher than men (2.8% vs. 0.7%) (4). A number of studies have reported a higher prevalence of OCD among women, especially housewives (3%) (5). In some cases, a prevalence rate of 9.37% has been reported among Iranian women (6). Due to the higher prevalence of OCD among women, this study was conducted among women.

Neuropsychological findings have confirmed that damage in prefrontal-cortical circuits can produce Obsessive compulsive disorder (7). These neural circuits control executive functions (8-9). Regarding OCD etiology, a growing number of studies have focused on the association between OCD and executive functions (10-11).

Neurological processes in the prefrontal executive functions describe cognitive functions that enable individuals to predict, set goals, plan, organize, initiate behaviors, self-regulate, remain flexible, expand attention span and memory, and use feedbacks (12). A wide range of cognitive problems such as decision making, planning, learning strategies, shifting, response inhibition, memory, visual-spatial ability, and psychomotor function have been shown to be connected to OCD (13). Bulk of studies have utilized neuropsychological tools to evaluate executive functions. Given that these studies have recruited diverse tasks to measure components of executive functions, findings regarding the connection between OCD and executive function components are contradictory.

Regarding memory, some studies using the Rey Complex Figure Test have shown that patients with OCD displayed poor performance in delayed memory (14). In Iran, while some studies have not found significant difference between patients with OCD and healthy individuals by using the Wechsler span number-letter (15, 16), one study revealed that patients with OCD performed worse than the control group in the Wechsler memory test (17).

The Wisconsin Card Sort Test is widely used to evaluate flexibility and shifting. Results of studies on the Iranian population have mirrored poor performance of patients with OCD (15-17-18). In two meta-analyses, significantly higher error rates in patients with OCD was reported by using alternative object and delayed

alternative tasks (11) while the other study exhibited diminished accuracy scores of patients with OCD compared to the control group (18). Meta-analysis studies using the Trail Making Test B to evaluate flexibility in patients with OCD have reported poor performance of patients in this task (11, 19).

In patients with OCD, inhibition of irrelevant information is disturbed (20). Results of studies on inhibition in response tests in OCD patients are inconclusive. Most studies confirmed defective inhibition in individuals with OCD (16, 20). One study used the Go/No-go task to explore response inhibition in patients with OCD, showing that they have a significantly higher error rate (21). According to a meta-analysis, despite bulk of studies on this subject, the reaction time of stop signal reaction time task is not longer, but it is still unclear and ambiguous in Go/No-go task (19). The Stroop test is widely used to assess response inhibition. The findings of a meta-analysis manifest heterogeneous results regarding interference errors and error commitment in patients with OCD (10). In Iran some results have reported significant difference between patients with OCD and healthy subjects by using the Stroop test (17-18).

The Towers of London and Hanoi tests are typically used to evaluate planning and problem solving. Some studies have shown that planning and problem solving are not affected in OCD patients (21). In Iran, some researchers used the Tower of London test to measure planning and organization, finding that the performance of OCD patients was weaker than healthy subjects with respect to the aforementioned criteria (15, 22).

The main drawback of task-oriented tests in assessing executive functions is that they fail to measure the repeatability of a problem as they are designed to deal with new problems without measuring abilities. These tasks are impure and evaluate other cognitive processes. In addition, most of these tests utilize summary scores without specifying the components of executive functions. The results of these tests do not accurately reflect the actual performance of people (12). Given the limitations of neuropsychological instruments in assessing executive functions in daily routines, the present study has adopted Behavior Rating Inventory of Executive Function (BRIEF) to examine executive functions and their components in relation to Obsessive-Compulsive Symptoms (OCS).

Few studies have used questionnaires to evaluate executive functions in patients with OCD. One study observed that severity of OCS in patients is associated with low monitoring and cognitive flexibility, whereas hoarding and checking are linked to poor executive functions in daily life (23). McNamara *et al.* (24) found that impairment in shifting, inhibition, emotional control, planning/organizing, monitoring and initiation predicted higher scores of OCS in patients during treatment. In a study on the association between BRIEF scales and the Yale-Brown scale, it was observed that

emotional control was significantly related to obsessions whereas compulsions were related to inhibition, emotional control, planning/organization and shifting (25). Using BRIFE, it impaired executive functions have been demonstrated in patients with OCD (21).

Avoidance behaviors are common in OCD. In particular, patients learn to avoid negative stimuli. OCD patients tend to use compulsive actions to alleviate anxiety and tension, and avoid immediate punishment. There is also evidence that OCD patients demonstrate greater sensitivity to punishment at the behavioral level (26).

OCD is characterized with brain activity dysfunction in several regions linked to motivational stimulus processing. It seems that punishment and reward processing are particularly vital to understanding clinical symptoms. Sensitivity to punishment is considered within the framework of the reinforcement sensitivity theory (RST). The RST scheme consists of three distinct neurobiological systems involved in sensitivity and responsiveness to rewards and punishments. These systems include the Behavioral Activation System (BAS), Behavioral Inhibition System (BIS), and the Fight/Flight System (FFS) (27). Concerned with sensitivity to rewards, the BAS is activated by agreeable stimuli. Individuals with higher BAS sensitivity are more likely to show higher impulsivity, optimism, and positive emotional profile. The findings of studies have shown that patients with OCD are more reward-dependent (28-29).

BIS is related to sensitivity to punishment, responses to conditional disturbing stimuli and negative mood, bias towards conflicting sources, and reduced arousal. People with high BIS are more likely to react to punishment and anxiety (30). BIS is stimulated by conditional stimuli that are aligned with punishment. This system elicits anxiety and behavioral inhibition, interacted avoidance, extinction and expanded attention. The effects of BIS include disruption of current behaviors, negative moods, and attention bias against conflicting sources, increased arousal, and anxious response to stressful events. Driven by these outcomes, a person seeks to solve problems by avoiding the source of the threat (31).

Deficiencies in control of inhibition, especially in the face of a threatening punishment may be attributed to OCD. Control of inhibition under punishment threat is probably linked to functions of neural layers such as inferior frontal gyrus that mediate response inhibition (32). A study reported defective inhibition in OCD especially under punishment conditions (33). Another study observed low sensitivity of BAS and high sensitivity of BIS in OCD patients (34). Also, a notion has been presented that OCD is connected to altered sensitivity to expected rewards and losses in the prefrontal region, while there is no significant inaccurate activation in the dorsal and ventral striatal area during the reinforcement prediction (35).

The past studies have only investigated the role of BAS/BIS or executive functions in prediction of OCS

while this study tried to examine contemporaneous role reinforcement systems and executive function related to daily functioning in prediction of OCS.

### Materials and Methods

This study was cross-sectional with a correlational method since this study seeks to investigate the role of the components of executive functions and sensitivity to reinforcement in predicting OCS.

#### Study Population and Sample

The statistical population consisted of all adult women living in Sabzevar city in 2018. According to the Cochran's formula for the size of the unknown population, the sample size was 384 people, which was considered 400 samples with probability of drop off.

Sampling was conducted using the multi-stage cluster sampling method. At first, a region was randomly selected. In the next step, an area was randomly selected. For data collection, the participating women were visited at their homes. The questionnaires were distributed among participants and they had a two-day period to complete the questionnaires. Of this figure, 365 questionnaires were fully completed and returned to the researchers. In compliance with ethical considerations, participants signed a written consent form before taking part in the study. It is worth noting that questionnaires were completed anonymously. The study was approved by the ethical Committee of University of Bojnord (code: 131820).

#### Instruments

Obsessive-Compulsive Inventory (OCI): Foa, Kozak, Salkovskis, Coles and Amir (36) developed OCI and Psychometric properties were studied in patients and healthy individuals. This inventory contains 42 items that are measured on a 5-point Likert scale. It consists of sub-scales consisting of washing, controlling, doubting, ordering, obsession, hoarding, and neutralizing. Among healthy individuals, Foa and colleagues (36) reported Cronbach's alpha for the total questionnaire at 0.94, and subscales ranged from 0.74 to 0.85, retest reliability for the total questionnaire was 0.90 and for the subscales was in the range of 0.82 to 0.88. Also, the correlation of this questionnaire with Yale-Brown obsessive-compulsive scale was 0.49 and with Maudsley obsessive compulsive inventory was 0.67. In Iran, it was reported that Cronbach's alpha was 0.94 for the total inventory (7).

Behavior Rating Inventory of Executive Function (BRIEF): Roth, Isquith and Gioia designed (37) BRIEF to measure adult executive functions in daily activities in normal environments. It consisted of 75 items that measure inhibition, shift, emotional control, self-monitoring, and initiation, working memory, planning /organization, task monitoring and organization of materials. The Cronbach's alpha of scales was in the range of 0.73 to 0.9 with a global executive composite of 0.96. The test-retest reliability of scales over 4 weeks was between 0.82 and 0.93 with a global executive

composite of 94.4. The inter-rater reliability of scales was in the range of 0.44 to 0.68 for the entire index and 0.63 for the global executive composite. The internal consistency coefficient was calculated in the range of .35 to .98 for subscales (37). In Iran, Mani *et al.* (38) translated BRIEF-A and examined its psychometric properties, reporting that Cronbach's alpha of BRIEF-A subscales was in the range of 0.65 to 0.83.

Sensitivity to Punishment and Sensitivity to Reward Questionnaire- Revised and Clarified (SPSRQ-RC): Conner, Rahm-Knigge, Jenkins (39) developed SPSRQ-RC. This 20-item scale measures sensitivity to reward (SR) and sensitivity to punishment (SP), which are scored on a 5-point Likert scale (from "totally correct" to "totally incorrect"). Cronbach's alpha for SR and SP scores was 0.80 and 0.86, respectively. The test-retest reliability was 0.82 for SR and 0.86 for SP over 8 weeks. The reliability of Cronbach's alpha was estimated at 0.77 for SR and 0.80 for SP. Mohammad Zadeh and Rahimi (40) have translated SPSRQ-RC into Persian and reported a Cronbach's alpha coefficient of 0.865 and 0.736 for this 20-items scale, respectively. Moreover, the re-test correlation coefficient for SP and SR were estimated at 0.85 and 0.65, respectively.

## **Results**

Participants were in the age range of 20 to 57 years with a mean age of 14.35 and a standard deviation of 6.33. In regard to education, 1.4% of subjects had primary education, 24.7% had high school diploma, 69.9% had a bachelor's degree and 4.1% had a master's degree. Prior to correlation and regression analyses, the mean and standard deviation of predictive variables and OCS were calculated. As Table 1 shows, women score higher in symptoms of ordering and washing. Also, among components of executive functions, women had higher scores in emotional control and shift.

According to Table 2, although all components of executive functions were strongly correlated with OCS but organizational material was not significantly related to the ordering. The results also suggest that scores of sensitivity to punishment and rewards are strongly correlated with OCS.

Before performing regression analysis, it is necessary to check the presuppositions of this test. The first presupposition is the independence of errors from each other. Errors are the difference between the actual values and the predicted values by the regression equation. In SPSS software, the Durbin-Watson test is used to check the independence of errors from each other. The results show that the value of the Durbin-Watson was 1.60, which is between 1.5 and 2.5, and the assumption of independence between errors is accepted. In another presupposition, errors must have a normal distribution. Diagram of the error's frequency distribution were compared with diagram of normal distribution. The result showed that the error distribution is almost normal. Another assumption is co-linearity. Co-linearity

indicates that each of the independent variables is a linear function of the other independent variables in the regression line equation. In this study, Variance Inflation Factor (VIF) was less than 10 indicating lack of collinearity of independent variables and lack of effect of correlation between predictor variables on parameter estimation. Thus, it seems that the presuppositions of regression have been observed.

R-squared (R<sup>2</sup>) value in the regression analysis indicates the power of explaining variance in OCS. According to Table 3, predicting variables explain 0.34 of variance in OCS.

Table 3 presents the results of ANOVA, according to which F values of the models are significant ( $P < 0.001$ ). Therefore, inhibition, initiation, shift, SP and SR variables can significantly predict OCS.

In stepwise regression analysis, all components of executive functions and sensitivity to punishment and reward were modeled. As table 4 showed that variables of inhibition, shift, initiation, sensitivity to punishment and sensitivity to reward were strong predictors of OCS. In each of these four variables, t-value was significant ( $P < 0.05$ ). Only the variable of shift could not predict OCS in third and fourth models.

Table 1. Mean and Standard Deviation of Variables

	Variables	Mean	Std. Deviation
Components of executive functions	Emotional control	1.84	3.59
	Inhibition	1.63	2.83
	Shift	1.77	1.99
	Self-monitoring	1.64	2.20
	Initiation	1.71	2.55
	Working memory	1.67	2.64
	Planning/Organization	1.65	3.11
	Task monitoring	1.70	1.94
Sensitivity to punishment/ reward	Organization of material	1.47	2.89
	Sensitivity to Punishment (SP)	3.12	7.10
Obsessive-compulsive symptoms	Sensitivity to Reward (SR)	3.22	6.02
	washing	2.06	5.76
	controlling	1.85	6.08
	doubting	1.76	2.70
	ordering	2.33	3.53
	obsession	1.84	5.16
	hoarding	1.99	2.51
	Neutralizing	1.81	4.22
	OCS	1.94	24.85

OCS: obsessive-compulsive symptoms

Table 2. Correlation of Executive Function Components and Sensitivity to Punishment/Reward with Obsessive-Compulsive Symptoms

	Emotional control	Inhibition	shift	Self-monitoring	Initiation	Working memory	Planning/organization	Task monitoring	Org of material	SP	SR
OCS	0.43**	0.43**	0.42**	0.32**	0.43**	0.41**	0.40**	0.30**	0.24**	0.49**	0.35**
Neutralizing	0.38**	0.35**	0.39**	0.27**	0.40**	0.36**	0.38**	0.29**	0.30**	0.39**	0.26**
Hoarding	0.27**	0.21**	0.20**	0.13*	0.28**	0.25**	0.29**	0.19**	0.17**	0.19**	0.27**
Obsession	0.37**	0.42**	0.41**	0.31**	0.43**	0.40**	0.40**	0.33**	0.29**	0.47**	0.29**
Ordering	0.38**	0.32**	0.33**	0.22**	0.26**	0.30**	0.23**	0.19**	0.04	0.45**	0.25**
Doubting	0.41**	0.41**	0.40**	0.29**	0.37**	0.37**	0.37**	0.29**	0.25**	0.44**	0.25**
Controlling	0.33**	0.33**	0.37**	0.23**	0.34**	0.31**	0.31**	0.21**	0.17**	0.38**	0.31**
Washing	0.36**	0.41**	0.31**	0.31**	0.36**	0.34**	0.34**	0.22**	0.16**	0.43**	0.32**

OCS: obsessive-compulsive symptoms

**Table 3. Summary of Predicted Obsessive-Compulsive Symptoms Based on Relationship Executive Function Components and Sensitivity to Punishment/Reward**

Model	Predicting variables	R Square	Adjusted R Square	F	sig
1	Inhibition	0.189	0.187	84.677	0.0001
2	inhibition, initiation	0.243	0.239	58.070	0.0001
3	inhibition, initiation, shift	0.264	0.258	43.217	0.0001
4	inhibition, initiation, shift, SP	0.333	0.326	44.969	0.0001
5	inhibition, initiation, shift, SP, SR	0.352	0.343	38.930	0.0001

**Table 4. Regression Coefficients' Relationship Executive Function Components and Sensitivity to Punishment/Reward in Prediction Obsessive-Compulsive Symptoms**

Model		Standardized Coefficients		t	Sig.
		Beta			
1	Inhibition	0.435		9.202	0.000
2	Inhibition	0.283		5.163	0.000
	Initiation	0.277		5.070	0.000
3	Inhibition	0.228		4.041	0.000
	Initiation	0.196		3.278	0.001
	Shift	0.189		3.236	0.001
4	Inhibition	0.186		3.421	0.001
	Initiation	0.143		2.494	0.013
	Shift	0.094		1.631	0.104
	SP	0.308		6.101	0.000
5	Inhibition	0.165		3.056	0.002
	Initiation	0.129		2.257	0.025
	Shift	0.106		1.855	0.064
	SP	0.262		5.046	0.000
	SR	0.148		3.191	0.002

**Discussion**

The strong point of this study was to contemporaneously evaluate the role of each component of executive functions and reinforcement sensitivity in predicting OCS. The results exhibit that the inhibition component of executive functions is significantly correlated with OCS, and it can be predicted by shift. This finding is aligned with several studies (20, 21, 24, 25). Inhibition describes the ability to resist or refrain from impulsive behaviors or to stop a certain type of behavior at the right time. OCD is characterized with three features of persistent rumination, impulsivity, and repetitive movements. Accordingly, people with OCD are less likely to inhibit their behavioral responses or display lower reaction time in inhibiting stimuli. Inability to inhibit responses in OCD patients may be due to selective attention defect, shift, and response control, which could be attributed to obsessions that elicit repetition and dominated responses in these people. Due to this resistance, memory is unable to recapture its attention from the previous source; therefore, set-shifting is not directed at the main source or the correct answer. Also, individuals with OCD may consciously maintain their attention on previous responses, which could be induced by rumination on stimuli and dangers.

In this study, emotional control was found to be significantly correlated with OCS. This finding is consistent with some studies (24, 25). People who fail to control and manage emotional responses in their daily events may experience prolonged and severe distressful episodes, which may lead to anxiety and OCD. Given that individuals with OCD, due to misperception of their emotions and lack of control over emotions, are unaware of their anxiety, such anxieties may appear as neutralizing behaviors or compulsions. Ultimately, compulsive behaviors are employed as a means of reducing anxiety.

Also, studies have mirrored a significant correlation between shift and OCS with the former acting as a predictor of the latter. This finding is aligned with several studies (11, 15- 19, 23-25). The key dimensions of shift are transferring ability, flexible problem solving and switching attention from one topic to another (37). Patients with OCD are often reminded that their obsessive thoughts are wrong, but they keep clinging to their obsessions as they find themselves incapable of getting rid of their obsessive thoughts due to defective shifting. Also, anxiety can interfere with the attention process, so that patients with OCD have a tendency to focus merely on some certain stimuli related to their OCS and have trouble avoiding other stimuli, meaning that anxiety disturbs the processing of environmental stimuli.

The present study revealed that initiation was linked to OCS and could predict OCS. This means individuals with high OCS scores are more likely to have trouble starting an assignment or activity, or come up with ideas, responses, or problem-solving strategies on their own.

This finding is in line with some studies (24, 21). Individuals with OCD often have difficulty starting and completing their tasks or retaining attention as they are frequently engrossed in obsessions and compulsions.

In addition, the present study showed that working memory was correlated with OCS. Doubting is another property of OCD, which is rooted in memory defects. The theories underlying memory impairment have proclaimed that people with OCD have a general memory defect, do not trust their memory, and are unable to distinguish between real and imaginary memories. Although OCD patients have trouble remembering things, there is evidence that distrust in memory may be the result of checking or compulsive actions (1). The working memory of individuals with OCD is partially occupied by obsessions, which can diminish the capacity available for storing and processing other assignments. Evidence also suggests that individuals with OCD are defective in the encoding stage (determining information that should be recorded in the memory). Therefore, it can be posited that these patients suffer from disassociation in strategies related to information organization in the memory, which is a major cause of OCS. That is, memory should be organized as a whole, but they tend to focus only on a particular stage of information organization in the memory. In other words, limited working memory capacity in individuals with OCD can be attributed to difficulty in the organization of documents (16).

The results of this study exhibited that components in organization of materials and planning/organization is linked to the OCS. This is in agreement with findings of other studies (24- 25, 15, 21, 22). Organization of material involves regular sorting of work and storage spaces such as benches, lockers, book packs and rooms. It appears that obsessions and compulsions consume the time that could be otherwise dedicated to sorting. In this study, however, people with ordering obsession turned out to be more organized and orderly. Individuals that display this symptom do not gain high scores in organization of materials. The lateral dorsal cortex is closely linked to planning tasks. Also, considering that people with OCD have defective memory, they have trouble in personal planning, determining strategies and organizing stimuli and cognitive resources (15).

The results also revealed that self-monitoring and task monitoring are correlated with OCS. This finding is aligned with some studies (21, 23). It has been reported that OCD patients face problems with the prefrontal striatal-thalamic circuit and any damage in this area leads to OCS. Also, it has been shown that circuit impairment is associated with difficulty in monitoring tasks. Accordingly, the results manifest that part of this system monitors events and generates error signals when risk boundaries are crossed (41). Therefore, individuals with OCD have trouble monitoring their actions or the consequences of their behaviors, as they are overwhelmed with their obsessions.

We also found that sensitivity to punishment is associated with all OCS and is a predictor of OCS. This finding is in line with several studies (28, 26, 33, 29) demonstrating that patients with OCD gained high scores in behavioral inhibition and sensitivity to punishment.

Evidence suggests that OCD is linked to extreme sensitivity and irregularity in frontostriatal circuits (10), and this area plays a key role in behavioral inhibition and attention processes. They also match with the neuroanatomical bases of the inhibition system. BIS expands attention and leads to the effective discovery of negative information. It is pertained to behaviors such as controlling along with efforts, emergency, self-control, inhibition, conflict resolution and error detection (42). BIS prompts anxiety and behavioral inhibition, accusative avoidance and extinction. In other words, BIS is excited by stimuli associated with punishment, new stimuli or stimuli that are inherently appalling (43). Therefore, since patients with OCD focus their attention on stimuli related to OCS, they strive to prevent anxiety induced by their obsessions by executing compulsive actions.

Also, the present study illustrated that sensitivity to rewards is associated with OCS and can be a predictor of OCS. However, this finding contradicts studies showing that OCD individuals do not score high on insensitivity to reward (28-29). On the other hand, it is in keeping with studies that stress the reliance of OCD on sensitivity to reward (44). Since the sample did not include any clinical participants, high scores in sensitivity to rewards were reported.

### **Limitation**

This study has a number of limitations. First, this study was conducted by a correlation method and relations between variables are not causal. Another limitation is concerned with the use of self-report questionnaires for data collection, particularly in light of the bias inherent in the completion of these questionnaires. In view of these limitations, future studies are recommended to investigate male demographics and clinical samples.

### **Conclusion**

This study indicated executive functions as well as sensitivity to punishment and reward were predictors of obsessive-compulsive symptoms. The details of results suggested variables of inhibition, shift, initiation, sensitivity to punishment and sensitivity to reward were strong predictors of OCS. It seems that impaired cognition and motivation contribute to emergence or sustainability of obsessive-compulsive symptoms. Given these findings, clinical psychology can design programs based on strengthening of executive functions and motivation processes to improve OCS.

### **Acknowledgment**

The authors would like to thank the participants of this study.

### **Conflict of Interest**

None.

### **References**

1. Sadock BJ. Sadock's synopsis of psychiatry: behavioral sciences/clinical psychiatry 11th, North American: Edition Lippincott Williams & Wilkins; 2015.
2. Fineberg NA, Hengartner MP, Bergbaum CE, Gale TM, Gamma A, Ajdacic-Gross V, et al. A prospective population-based cohort study of the prevalence, incidence and impact of obsessive-compulsive symptomatology. *Int J Psychiatry Clin Pract.* 2013;17(3):170-8.
3. Politis S, Magklara K, Petrikis P, Michalis G, Simos G, Skapinakis P. Epidemiology and comorbidity of obsessive-compulsive disorder in late adolescence: a cross-sectional study in senior high schools in Greece. *Int J Psychiatry Clin Pract.* 2017;21(3):188-94.
4. Mohammadi MR, Ghanizadeh A, Rahgozar M, Noorbala AA, Davidian H, Afzali HM, et al. Prevalence of obsessive-compulsive disorder in Iran. *BMC Psychiatry.* 2004;4:2.
5. Khosravi S, Naseri A. Prevalence of obsessive compulsive disorder in people aged 12-46 years in Jahrom city. *Par J Med Sci.* 2017; 15(3): 1-8.
6. Amani M, Abolghasemi A, Ahadi B, Narimani M. The prevalence of obsessive-compulsive disorder among the women 20 to 40 years old of Ardabil city, Western part of Iran. *J Fund Mental Health.* 2013; 15 (59):233-42.
7. La Paglia F, La Cascia C, Rizzo R, Cangialosi F, Sanna M, Riva G, et al. Cognitive Assessment of OCD Patients: NeuroVR vs Neuropsychological Test. *Stud Health Technol Inform.* 2014;199:40-4.
8. Pauls DL, Abramovitch A, Rauch SL, Geller DA. Obsessive-compulsive disorder: an integrative genetic and neurobiological perspective. *Nat Rev Neurosci.* 2014;15(6):410-24.
9. Wilson L, Horton L, Kunzmann K, Sahakian BJ, Newcombe VF, Stamatakis EA, et al. Understanding the relationship between cognitive performance and function in daily life after traumatic brain injury. *J Neurol Neurosurg Psychiatry.* 2021; 92(4): 407-417.
10. Abramovitch A, Abramowitz JS, Mittelman A. The neuropsychology of adult obsessive-compulsive disorder: a meta-analysis. *Clin Psychol Rev.* 2013;33(8):1163-71.
11. Shin NY, Lee TY, Kim E, Kwon JS. Cognitive functioning in obsessive-compulsive disorder: a meta-analysis. *Psychol Med.* 2014;44(6):1121-30.



12. Anderson P. Assessment and development of executive function (EF) during childhood. *Child Neuropsychol.* 2002;8(2):71-82.
13. Sarwar MA, Ashraf R, Khan AM, Afzal HM. Frequency of Impairment of Executive Functioning among Patients having Obsessive-Compulsive Disorder. *Int J Contem Med Res.* 2020;7(7):G10-G13.
14. Deckersbach T, Otto MW, Savage CR, Baer L, Jenike MA. The relationship between semantic organization and memory in obsessive-compulsive disorder. *Psychother Psychosom.* 2000;69(2):101-7.
15. Kazempoor-Jahromi A, Bigdeli I, Rafieinia P. The Comparison of Executive Functions and Working Memory in Individuals with Obsessive - Compulsive Disorder and Normal People. *JCP.* 2015; 7(2): 15-28.
16. Hekmati I, Hashemi T, Pirzadeh J. Comparison of executive functions in subclinical obsessive compulsive disorder without depressive symptoms with healthy control. *IGBS.* 2012; 6(1): 39-47.
17. Hamidian S, Pourshahbaz A, Ananloo ES, Dolatshahi B, Ohadi M, Davoudi M. The story of memory and executive functions in obsessive-compulsive disorder: a case-control study. *Trends Psychiatry Psychother.* 2021.
18. Yazdi-Ravandi S, Shamsaei F, Matinnia N, Moghimbeigi A, Shams J, Ahmadpanah M, et al. Executive functions, selective attention and information processing in patients with obsessive compulsive disorder: A study from west of Iran. *Asian J Psychiatr.* 2018;37:140-5.
19. Snyder HR, Miyake A, Hankin BL. Advancing understanding of executive function impairments and psychopathology: bridging the gap between clinical and cognitive approaches. *Front Psychol.* 2015;6:328.
20. Bannon S, Gonsalvez CJ, Croft RJ, Boyce PM. Response inhibition deficits in obsessive-compulsive disorder. *Psychiatry Res.* 2002;110(2):165-74.
21. Bouvard M, Fournet N, Sixdenier A, Polosan M. Intrusive Thoughts and Executive Functions in Obsessive Compulsive Disorder. *J Behav Brain Sci.* 2018;8(07):399-414.
22. Past N, Khosravi Z. The Investigation of Planning Function in Patients with Obsessive Compulsive Disorder and Obsessive Compulsive Personality Disorder. *Adv Cog Sci.* 2015; 17 (3) :1-11.
23. Kumbhani SR, Roth RM, Kruck CL, Flashman LA, McAllister TW. Nonclinical obsessive-compulsive symptoms and executive functions in schizophrenia. *J Neuropsychiatry Clin Neurosci.* 2010;22(3):304-12.
24. McNamara JP, Reid AM, Balkhi AM, Bussing R, Storch EA, Murphy TK, et al. Self-regulation and other executive functions relationship to pediatric OCD severity and treatment outcome. *J Psychopathol Behav Assess.* 2014;36(3):432-42.
25. Schwam DM, King TZ, Greenberg D. Characteristics of Executive Functioning in a Small Sample of Children With Tourette Syndrome. *Appl Neuropsychol Child.* 2015;4(4):297-308.
26. Fullana MA, Mataix-Cols D, Caseras X, Alonso P, Manuel Menchón J, Vallejo J, et al. High sensitivity to punishment and low impulsivity in obsessive-compulsive patients with hoarding symptoms. *Psychiatry Res.* 2004;129(1):21-7.
27. Conner BT, Rahm-Knigge RL, Jenkins AL. Revision and clarification of the sensitivity to punishment sensitivity to reward questionnaire. *Pers Individ Dif.* 2018;121:31-40.
28. Bejerot S, Schlette P, Ekselius L, Adolfsson R, von Knorring L. Personality disorders and relationship to personality dimensions measured by the Temperament and Character Inventory in patients with obsessive-compulsive disorder. *Acta Psychiatr Scand.* 1998;98(3):243-9.
29. Lyoo IK, Lee DW, Kim YS, Kong SW, Kwon JS. Patterns of temperament and character in subjects with obsessive-compulsive disorder. *J Clin Psychiatry.* 2001;62(8):637-41.
30. Smillie LD, Pickering AD, Jackson CJ. The new reinforcement sensitivity theory: implications for personality measurement. *Pers Soc Psychol Rev.* 2006;10(4):320-35.
31. Franken IH, Muris P. Individual differences in reward sensitivity are related to food craving and relative body weight in healthy women. *Appetite.* 2005;45(2):198-201.
32. Menzies L, Chamberlain SR, Laird AR, Thelen SM, Sahakian BJ, Bullmore ET. Integrating evidence from neuroimaging and neuropsychological studies of obsessive-compulsive disorder: the orbitofronto-striatal model revisited. *Neurosci Biobehav Rev.* 2008;32(3):525-49.
33. Morein-Zamir S, Pappmeyer M, Gillan CM, Crockett MJ, Fineberg NA, Sahakian BJ, et al. Punishment promotes response control deficits in obsessive-compulsive disorder: evidence from a motivational go/no-go task. *Psychol Med.* 2013;43(2):391-400.
34. Alilou MM, Bakhshipoor Roudsari A, Nasiri M. Structural Relationships Between Behavioral Brain Systems, Disgust Sensitivity, and Obsessive-Compulsive Disorder. *IJPCP.* 2018; 23(4):466-79.
35. Kaufmann C, Beucke JC, Preuße F, Endrass T, Schlagenhauf F, Heinz A, et al. Medial prefrontal brain activation to anticipated reward and loss in obsessive-compulsive disorder. *Neuroimage Clin.* 2013;2:212-20.
36. Foa EB, Kozak MJ, Salkovskis PM, Coles ME, Amir N. The validation of a new obsessive-compulsive disorder scale: The obsessive-compulsive inventory. *Psychol Assess.* 1998; 10: 206-14.
37. Roth RM, Isquith PK, Gioia GA. Assessment of executive functioning using the Behavior Rating Inventory of Executive Function (BRIEF). New York: Springer; 2014.
38. Mani A, Ghelijkhani S, Haghghat R, Ahmadzadeh L, Chochedri E, et al. Validity and Reliability of the Persian Version of the Self-

## Amani, Keyvanlo

- Report Form of Behavior Rating Inventory of Executive Function-Adult version (BRIEF-A), Shiraz E-Med J. 2018 ; 19(2):e14295.
39. Conner BT, Rahm-Knigge RL, Jenkins AL. Revision and clarification of the sensitivity to punishment sensitivity to reward questionnaire. *Pers Individ Dif.* 2018; 121: 31-40.
  40. Mohammadzadeh Ebrahimi A, Rahimi Pordanjani T. The Psychometric Properties of the Persian Version of Sensitivity to Punishment and Sensitivity to Reward Questionnaire-Clarified and Revised. *J Res Behav Sci.* 2018;16(3): 241-52.
  41. Gehring WJ, Himle J, Nisenson LG. Action-monitoring dysfunction in obsessive-compulsive disorder. *Psychol Sci.* 2000;11(1):1-6.
  42. Carver CS, Connor-Smith J. Personality and coping. *Annu Rev Psychol.* 2010; 61: 679–704.
  43. Corr PJ. Reinforcement sensitivity theory and personality. *Neurosci Biobehav Rev.* 28(3):317-32.
  44. Khanjani Z, Mohammadi F, Hashemi T, Bakhshipour A, Bairami M. The effect of brain-behavioural systems and affects on dimensional obsessive-compulsive signs, *J Kermanshah Univ Med Sci.* 2014;18(2):e74166.