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Assessment of in Obsessive Compulsive Disorder

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Obsessive compulsive disorder (OCD) is a common and potentially debilitating disorder. Neuropsychological assessment provides unique complementary information that is critical for evaluating higher cortical abilities. This study aimed to assess the neuropsychological functions in OCD patients which can then point to the brain structures or pathways and to study the correlation between these assessments and different clinical variables.
Methods: This cross-sectional case control study had included sixty patients who were divided into two groups, Group I: thirty OCD patients diagnosed by DSM-IV and Group II: thirty healthy controls who were recruited from the community, matched with patients' age, gender, and education.
Results: The age of onset in our study was 19.13 ± 0.35 years, the mean duration was 7.44 ± 3.88 years, 40% of the studied cases had severe OCD symptoms and 33.3% of them were compulsive cleaners. There was a high significant difference between the two groups regarding WCST in favor of the control group. There was a high significant difference between the two groups regarding ROCF where the control group showed better results than the OCD patients.
Conclusions: Neuropsychological test performance remains an informative and objective means of investigation, especially when applied to psychiatric disorders. The executive functions in OCD patients were impaired in comparison to the normal study subjects.

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1. INTRODUCTION

Obsessive compulsive disorder (OCD) is a common and potentially debilitating disorder. It is characterized by the presence of obsessions and/or compulsions. Obsessions are intrusive thoughts, images or impulses that are experienced as repetitive and unwanted [1]. Compulsions are mental or physical acts that are done to relieve the distress provoked by obsessions. The content of obsessions can be about normal preoccupations and sometimes they can be bizarre, senseless, or magical [2].

The prevalence of OCD is 1.2 % of all adults. Although it has been considered rare in children and adolescents, recent studies have reported prevalence rates of 1–3% in children and young people aged 5–15 years. OCD has an equal incidence in both males and females [1].

Neuropsychological assessment is highly valid and reliable, with validity measures equalling or exceeding those of other medical tests, including neuroimaging [3]. Neuropsychological assessment provides unique complementary information that is critical for evaluating higher cortical abilities and function in ways that are not possible with other techniques [4].

The aim of this work is to; assess the neuropsychological functions in OCD patients which can then point to the brain structures or pathways that are affected in patients of OCD and to study the correlation between these assessments and different clinical variables.

2. PATIENTS AND METHODS

This cross sectional case control study had included thirty patients with OCD, diagnosed according to Diagnostic and Statistical Manual of Mental Disorders, IV Edition (DSM-IV) [5], and 30 subjects of normal controls matched for age, gender, and education who were selected and studied using a battery of neuropsychological tests.

Sixty participants were recruited in the study and were divided into two groups, Group I: thirty OCD patients diagnosed by DSM-IV selected from the outpatient psychiatry clinics in the Neuropsychiatry department of Tanta University Hospitals and Psychiatry, Neurology, and Neurosurgery Centre of Tanta University. Group II: thirty healthy controls who were recruited from the community, matched with patients' age, gender, and education.

Inclusion criteria were OCD patients diagnosed according to DSM-IV and are medication free or stopped medications by themselves for at least 3 months prior to the tests with average intellectual functions and average Intelligence Quotient (IQ). Both males and females were included. Age ranges from 18 to 65 years old. At least 12 years of education to be able to share neuropsychological tests.

While Patients with substantial neurological impairment, head injury and/or substance abuse, patients above 65 years old or less than 18 years with current or previous psychotic episodes, intellectual disabilities, illiterates (difficult to pass neuropsychological battery) or with major and minor Neurocognitive impairment were excluded.

Both the groups were subjected to the following:

- Complete history taking; including present history and past medical history. By history taking; we obtained demographic data, onset, course, duration, and subtypes of OCD. We also excluded those on medications for OCD, those with a history of substance abuse, and those with any other psychotic episodes previously suffered, or any other mental, or general systemic diseases.
- General and neurological examination to exclude any systemic or neurological impairment especially; substantial neurological impairment, or head injury.
- Psychiatric history and examination diagnosed by SCID-CV according to DSM-IV and using YBOCS to assess types and severity of OCD symptoms
- MMSE and IQ tests were carried out to exclude intellectual or cognitive disabilities.
- All of our participants were asked to do these neuropsychological tests;

1. Wisconsin Card Sorting Test (WCST) to evaluate executive functions; especially the planning, set-shifting/cognitive flexibility as well as attention.

2. Rey-Osterrieth Complex Figure (ROCF) to evaluate visuospatial abilities and non-verbal visual memory; testing both immediate and delayed recall.
3. Trail Making test A to assess the cognitive processing speed and Part B as a measure of set-shifting/cognitive flexibility, a part of executive functioning.
4. Controlled Oral Word Association Test (COWAT) to test verbal semantic memory, verbal fluency, and executive functions.
5. Digit Span (DS) forward to measure attention and DS backward to measure working memory.

2.1 Statistical Analysis

Data were collected, tabulated, statistically analysed using a personal computer with Statistical Package of Social Science (SPSS) version 20, where the following statistics were applied; (A) Descriptive statistics e.g. Number (No), percentage (%), mean (X^-) and standard deviation (SD). Arithmetic mean (x): was used as a measure of central tendency. Standard deviation (SD): was used as a measure of dispersion. Percentage (%). Median: was used as a measure of central tendency. Range: was used as a measure of dispersion. (B) Analytic statistics: Chi-squared test ($\chi 2$): a parametric test used to find association between two or more qualitative variables. P-value ≤ 0.05 to be statistically significant.

3. RESULTS

There was no significant difference between the two groups regarding age, gender and education Table 1.

Regarding the age of onset in our study, it was 19.13 ± 0.35 years, the mean duration was 7.44 ± 3.88 years, 40% of the studied cases had severe OCD symptoms and 33.3% of them were compulsive cleaners Table 2.

There was a high significant difference between the two groups regarding WCST in favour of the control group Table 3.

There was a high significant difference between the two groups regarding ROCF where the control group showed better results than the OCD patients Table 4.

ROCF Copy and ROCF Recall were higher in males in both groups with high significant difference between them. Table 5.

There was a high significant difference between the two groups regarding the Trail-Making Test in favor of Group II. Table 6.

There was no significant difference between the two groups regarding COWAT Q as the mean in group I was 8 ± 0.01, while in group II, it was 8.8 ± 0.14. Table 7.

There was a high significant difference between the two groups regarding the Digit span test to the advantage of the control group. Table 8.

There was a significant positive correlation between neuropsychological test results and severity (r=0.32, P=0.02) but non-significant correlation was reported regarding the tests and onset (r=-0.149, p=0.360), duration (r=0.209, p=0.163), and subtypes (r=-0.192, p=0.235) Table 9.

Table 1. Comparison between the two studied groups according to demographic data

	Group I (n=30)		Group II (n=30)		Significance	p
	No.	%	No.	%		
Gender						
Male	12	40.0	15	50.0	χ^2= 0.307	FE p= 0.717
Female	18	60.0	15	50.0		
Age (years)						
Min. – Max.	50.0–18.0		50.0–18.0		t=0.303	0.767
Mean ± SD.	32.53 ± 1.01		30.70 ± 1.64			
Education	15.40± 1.46		15.12± 2.32		χ^2= 2.263	0.132
Mean ± SD.						

χ^2: Chi square test FE: Fisher Exact t: Student t-test, Group I: Patient, Group II: Control

Table 2. Clinical variables of the patient group

	Total (n = 30)	
	No.	**%**
Age of onset (years)		
Max.–Min.	20.0–19.0	
Mean ± SD.	19.13 ± 0.35	
Duration (years)		
Max.–Min.	8.0–2.25	
Mean ± SD.	7.44 ± 3.88	
Severity		
Mild	8(26.6%)	
Moderate	12(40%)	
Severe	6(20%)	
Extreme	4(13.3%)	
Subtypes		
Cleaning	10(33.3%)	
Ordering	7(23.3%)	
Checking	6(20%)	
Hoarding	4(13.3%)	
Intrusive	3(10%)	

Table 3. Comparison between the two studied groups according to WCST

WCST	Group I (n=30)	Group II (n=30)	t	p
Perseveration error				
Mean ± SD.	42.45 ± 4.19	10.3 ± 1.5	6.194*	0. 001*
Total Perseverations				
Mean ± SD.	45.67 ± 2.31	11.31 ± 2.55	8.617*	<0.001*
Categories				
Mean ± SD.	3.71 ± 0.26	5.28 ± 0.61	3.427*	0.001*
Trials				
Mean ± SD.	121.56 ± 9.35	88.38 ± 7.87	8.494*	<0.001*

t: Student t-test, Group I: Patient, Group II: Control

Table 4. Comparison between the two studied groups according to ROCF

ROCF	Group I (n=30)	Group II (n=30)	t	p
ROCF Copy				
Mean ± SD.	22.48 ± 8.8	32.74 ± 4.5	9.752*	<0.001*
ROCF Recall				
Mean ± SD.	15.51 ± 4.4	22.51 ± 5.1	68.041*	<0.001*

t: Student t-test, Group I: Patient, Group II: Control

Table 5. Comparison between the two studied groups according to ROCF as regards to sex

ROCF	Group I (n=30)	Group II (n=30)	χ^2=	p
ROCF Copy				
Male	23.14 ± 4.4	33.71 ± 4.5	36.322*	<0.001*
Female	21.47 ± 2.8	31.71 ± 4.5		
ROCF Recall				
Male	16.71 ± 3.7	23.57 ± 4.1	23.033*	<0.001*
Female	14.47 ± 3.1	20.47 ± 5.1		

χ^2=: Chi square test, Group I: Patient, Group II: Control

Table 6. Comparison between the two studied groups according to trail-making test

Trail-Making Test	Group I (n=30)	Group II (n=30)	t	p
TMTA				
Mean ± SD.	92.45 ± 8.4	28.48 ± 0.55	16.193*	<0.001*
TMTB				
Mean ± SD.	125.45± 15.8	72.91 ± 2.5	8.494*	<0.001*

t: Student t-test, Group I: Patient, Group II: Control

Table 7. Comparison between the two studied groups according to controlled oral word association test (COWAT) test

COWAT	Group I (n=30)	Group II (n=30)	Test of significance	p
COWAT W				
Mean ± SD.	8.60 ±0.09	10 ± 0.15	χ^2=85.89	<0.001*
COWAT R				
Mean ± SD.	7.55± 0.056	9.8 ± 0.05	χ^2=10.13	0.001*
COWAT Q			t=0.303	0.767
Mean ± SD.	8± 0.01	8.8 ± 0.14		
Total				<0.001*
Mean ± SD.	24.4 ±0.88	28.8 ±2.12	χ^2=64.02	
Semantic			χ^2=19.35	<0.001*
Mean ± SD.	10.7 ±0.59	16.7 ±1.59		

χ^2=: Chi square test, t: Student t-test, Group I: Patient, Group II: Control

Table 8. Comparison between the two studied groups according to Digit span test (DS)

Digit span	Group I (n=30)	Group II (n=30)	Test of sig	p
Digit span forward				
Mean ± SD.	5.62 ±0.04	8 ± 0.05	χ^2=30.04	<0.001*
Digit span backward				
Mean ± SD.	5.45± 0.08	7.8 ± 0.05	χ^2=33.9	<0.001*

χ^2: Chi square test, Group I: Patient, Group II: Control

Table 9. Correlation between clinical variables and neuropsychological function test results of the study group

Clinical Variables		Neuropsychological Function Tests
Onset	rs	-0.149
	p	0.360
Severity	rs	0.32
	p	0.02*
Duration	rs	0.209
	p	0.163
Subtypes	rs	-0.192
	p	0.235

rs: Spearman correlation co-efficient

4. DISCUSSION

As regards to WCST, there was a high significant difference between the control and the patients' groups. These findings were consistent with many previous studies including [6-7].

However, they disagreed with the studies done by Hwang et al. and Burdick et al. [8-9] who found no statistical difference between cases and control regarding WSCT. Using the results of our study regarding WCST, we concluded that

patients with OCD had deficits in the cognitive flexibility/set-shifting, planning, problem solving, and attention which are parts of executive functions [10].

This can also lead to concluding that these patients have as well deficits in organisational strategies according to [11] who stated that executive functions as measured by WCST are also part of organisational strategy. Our study results hence then concluded that patients with OCD show impairments in the *prefrontal cortex* especially the DLPFC which are highly sensitive to WCST. Nedeljkovic et al. [12] stated that the prefrontal cortex and especially the DLPFC were sensitive to WCST, which determined the set shifting ability index. In the current study, there was a high significant difference between the patients and control groups regarding ROCF which was agreeable with the studies by Shin et al. and Rajender et al. [13-14]. But it disagreed with the results given by Exner et al. [15]. According to these results we conclude that patients with OCD have deficits in non-verbal visual memory and *visuospatial abilities* [16].

However, this sparks quite a debate as the crude explanation of this test doesn't convey the actual meaning of it. Whereas individuals with OCD exhibit substantial underperformance on the ROCF, potential confounding factors hinder the ability to determine to what extent the individuals with OCD exhibit a specific deficit in non-verbal memory. Participants who took the ROCF test underwent multiple steps. The first condition of this task required examinees to copy a complex figure. This trial is frequently considered a measure of visuospatial abilities and to a lesser extent recognition. According to standard administration instructions, two subsequent memory trials were recommended: an immediate trial following the copy phase (immediate memory) and a delayed recall trial either 20 or 30 min after the copy phase (delayed memory) [17].

The ROCF is a unique memory test because examinees are never informed of the test's true nature (i.e., that this is a memory test). This is in contrast to other non-verbal memory tests (e.g., WMS Faces). In the ROCF, examinees were presented with a figure and were asked to copy it. Once they were done, the figure was removed, and examinees were subsequently requested to recreate the figure from memory on a blank piece of paper, without any preceding conscious attempt to code the information. In addition to the stress individuals with OCD may experience under any conditions associated with testing, they also require structure, prefer explicit instructions, and respond unfavourably to 'surprises'. Thus, it is possible that the surprise element inherent to the ROCF may have negatively influenced their performance on this test, and possibly to a significantly larger extent than the study's control participants. It would be useful for future research to explore this possible disorder-specific effect. This may be a particularly important line of research in OCD given three main reasons. First of all, nearly every study to date that assessed non-verbal memory in OCD has utilized the ROCF.

Reliance on more than a single measure for a given neuropsychological construct within a given study (as well as across studies), should be the rule and not the exception [18], especially when there is a reason to question a tests' psychometric integrity in a given population. In fact, studies utilizing other non-verbal memory tests (where examinees were informed as to the nature of the test) found comparable performance in OCD samples compared to controls [19-20].

Secondly, as demonstrated by two recent meta-analyses Abramovitch et al. and Shin et al. [21,22]**,** effect sizes for non-verbal memory/ROCF were found to be large (0.75), while effect sizes for verbal memory and visuospatial functions were found to be small. If basic visuospatial functions in OCD are not significantly impaired, a gap in memory functions within a given population is mostly unusual. Last but not least, performance on the ROCF is possibly mediated by organisational strategies.

In a seminal study, Savage et al. [23] demonstrated that a deficit in organisational and planning abilities in the copy phase of the ROCF mediated deficient performance on the immediate memory phase of the ROCF. This result led to the development of several scoring systems to assess organisational abilities using the ROCF**.**

Using these scoring systems, this mediation effect has been reliably replicated [24], suggesting that deficient organisational abilities of non-verbal information partially account for deficient performance on memory trials of the ROCF. This notion received support from a recent meta-analysis indicating that effect sizes for executive functions in OCD were significantly and positively correlated with effect sizes for non-

verbal memory (r¼0.60), but not with those of verbal memory [21].

These results suggested that organisational deficits may specifically mediate visuospatial dysfunctions in OCD, and further underscore the importance of a critical examination of the ROCF's construct validity in the context of OCD patients' visuospatial dysfunctions. Indeed, some researchers argued that non-verbal memory deficits may be secondary to *executive deficits* in OCD patients [25].

Moreover, it was speculated that visual memory and immediate non-verbal memory deficits in OCD appear only when patients have an active illness and failure in organisational strategies that mediate the recall process which may ultimately lead to deficits in both visual and verbal memory [26].

This agrees with our study where we only recruited drug naïve OCD patients or drug free patients for at least three months. Thus, we concluded using both results of WCST and ROCF that OCD patients have deficits in organisational strategies and executive functions. Inability to formulate an organisational strategy for information coding might also be related to executive dysfunction. As per Penadés et al. [24]; non-verbal memory deficits appeared to have less to do with memory per se and more to do with the degree of organisational strategies necessary to complete the task. The memory (including immediate recall and new learning) dysfunction in OCD seemed to be largely mediated by organisational deficits during the encoding phase that in turn made recall more difficult. Therefore, it can be argued that the memory impairment in OCD might be due to the failure of *organisational strategies* which was to a great extent proved by the present study.

Regarding Trail-Making Test, there was a high significant difference between the control and the patient's groups which coincided with the studies done by Burdick et al., and Hashimoto et al [9,27]. In contrast to Hwang et al. and Krishna et al. [8,28] who disagreed with our results and stated that there were no differences between OCD and control samples on Trial-Making Test. Hence, we concluded that OCD patients have deficits in *cognitive processing speed* and cognitive flexibility/set-shifting as a part of *executive functions*. The earlier being measured by the first part of the test and the latter by the second [29].

Cognitive processing speed assessment was proved to be a part of the functions of the left posterior parietal lobe thus we concluded that OCD patients in our study had troubles related to the parietal lobe provided by the results consistent with Catani et al. [30]. In the current study, there was a high significant difference between the two groups regarding COWAT especially COWAT "W", COWAT "R", Total and Semantic variants. Regardless there was no significant difference between the two groups regarding COWAT "Q" which were almost identical to the results by Exner et al. [15]. However, other studies reported comparable performance differences between OCD and control groups. This leaded us to conclude that the patients with OCD have deficits in semantic verbal memory (animals) and executive functions (letters) [18].

However, in a meta-analysis specifically examining performance on Verbal fluency (VF) tests in OCD, [31] reported that reduced performance on VF tests did not reflect the executive function deficits in OCD, but rather a general cognitive impairment. Conversely, some research has shown imaging data suggesting activation of structures related to executive functions when applying VF tests [32].

Attention was also concluded to be affected in patients with OCD as per Ruff et al. [33] who found that the COWAT correlated with the attention and word knowledge measurements in addition, they stated that long-term memory was among the most important determinants for performance on the COWAT. Another conclusion that we have made was that OCD and healthy controls used different strategies at the encoding level of information processing. OCD patients coded words during objective verbal memory tests, whereas healthy individuals tended to use an organisational strategy, such as semantic relationships. OCD patients had difficulty formulating an organisational strategy, but were able to implement one once formulated this was also found by the study made by Çetinay Aydın and Güleç Öyekçin [26].

Regarding DS; our study found that there was a high significant difference between the control and the patients' groups. This disagreed with the study done by Kohli et al. [11] who stated that there were no significant differences between the clinical and normal sample where they suggested that deficit in intelligence is not a core characteristic in OCD.

This as well is in line with our study on a different level where any OCD patient with low IQ (measured by Stanford-Binet test) than average was excluded from the study. However, Reynolds, and Groth-Marnat et al [34-35] stated that DSF is a good measure of simple attention while DSB represents a qualitatively different type of task that relies more upon working memory skills.

Other studies citing significant differences between patients with OCD and normal controls may be attributed to the possibility that executive dysfunction among patients with OCD was associated with coexistent depression or subclinical depressive symptoms. Depression has been associated with volume reduction in the frontal lobe and medial orbitofrontal cortex as well as atrophy of these areas. This was associated with disturbances in memory and executive functions [36].

Prior studies that have reported performance deficits on tests of executive functions in OCD were associated with other co-morbid conditions (e.g., personality disorders). In prior works, it was observed that OCD patients who did poorly on executive function tasks obtained high scores on a measure of schizotypal personality [37].

These shortcomings were taken into consideration in our study by excluding those patients with comorbidities that might have affected the results of the study.

Regarding the severity of symptoms; our results concluded that the impairments obtained by the neuropsychological tests were directly proportional to the severity of the symptoms. This agreed with the study made by Kashyap et al. [38] who reported the presence of deficits in non-verbal memory and executive dysfunction in patients with severe OCD symptoms (YBOCS score of at least 20). However, they also reported similar deficits in patients with OCD who had various co-morbid illnesses. This was not the case with our study as we excluded other co-morbidities. Meanwhile, they stated that the possible reasons for the the results they obtained could be different illness duration, different educational years, lack of clinical stability and variation in use of anti-obsessional agents.

5. CONCLUSIONS

Neuropsychological test performance remains an informative and objective means of investigation, especially when applied to psychiatric disorders. There was a highly significant impairment of executive functions especially; set-shifting/cognitive flexibility, planning, attention, and working memory, as well as organisational strategies in OCD patients in comparison to the normal study subjects of the same age, gender, and education. In addition to -but to a lesser extent- the verbal memory, and cognitive speed. We also noticed that there was a positive correlation between the severity of OCD and the neurocognitive impairments; as the severity of OCD increased, the neurocognitive impairment among those patients also increased. Although, there is undoubtedly a specific biological basis for OCD, such as the OCD-loop, we deducted -according to our results- that the areas mostly affected was the prefrontal area of the brain especially DLPFC. This doesn't exclude the complex involvement of various neural networks that might cause the clinical diversity, and the variable reactions in response to the OCD treatment.

CONSENT AND ETHICAL APPROVAL

All patients recruited signed a written informed consent form according to the rules of the ethical committee involved in the study. This study was carried out from August 2019 till February 2020.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Heyman I, Fombonne E, Simmons H, Ford T, Meltzer H, Goodman R. Prevalence of obsessive-compulsive disorder in the British nationwide survey of child mental health. Br J Psychiatry. 2001;179:324-9.
2. Volz C, Heyman I. Case series: transformation obsession in young people with obsessive-compulsive disorder (OCD). ADHD. 2007;46:766-72.
3. Gure TR, Kabeto MU, Plassman BL, Piette JD, Langa KM. Differences in functional impairment across subtypes of dementia. J Gerontol A Biol Sci Med Sci. 2010;65:434-41.
4. Stilley CS, Bender CM, Dunbar-Jacob J, Sereika S, Ryan CM. The impact of cognitive function on medication management: three studies. Health Psychol. 2010;29:50-5.

5. APA. Diagnostic and statistical manual of mental disorders. 4th ed. Washington, DC: American Psychiatric Association; 2000.
6. Hekmati I. Comparison of executive functions in subclinical obsessive-compulsive disorder without depressive symptoms. IJBS. 2012;6:39-47.
7. Nejati V, Zabihzadeh A, Maleki G, Safarzadeh M. The comparison of executive functions in patients with obsessive-compulsive disorder and normal individuals. J Clin Psychol; 2013.
8. Hwang SH, Kwon JS, Shin YW, Lee KJ, Kim YY, Kim MS. Neuropsychological profiles of patients with obsessive-compulsive disorder: early onset versus late onset. J Int Neuropsychol Soc. 2007;13:30-7.
9. Burdick KE, Robinson DG, Malhotra AK, Szeszko PR. Neurocognitive profile analysis in obsessive-compulsive disorder. J Int Neuropsychol Soc. 2008;14:640-5.
10. Lezak M, Howieson D, Loring D. Neuropsychological assessment. 4th ed. New York: Oxford University Press; 2004.
11. Kohli A, Rana DK, Gupta N, Kulhara P. Neuropsychological assessment in obsessive-compulsive disorder. Indian J Psychol Med. 2015;37:205-11.
12. Nedeljkovic M, Kyrios M, Moulding R, Doron G, Wainwright K, Pantelis C, et al. Differences in neuropsychological performance between subtypes of obsessive-compulsive disorder. Aust N Z J Psychiatry. 2009;43:216-26.
13. Shin M, Park S, Kim M, Lee Y, Ha T, Kwon J. Deficits of organizational strategy and visual memory in obsessive-compulsive disorder. J Neuropsychol. 2004;18:665.
14. Rajender G, Bhatia MS, Kanwal K, Malhotra S, Singh TB, Chaudhary D. Study of neurocognitive endophenotypes in drug-naïve obsessive-compulsive disorder patients, their first-degree relatives and healthy controls. Acta Psychiatr Scand. 2011;124:152-61.
15. Exner C, Kohl A, Zaudig M, Langs G, Lincoln TM, Rief W. Metacognition and episodic memory in obsessive-compulsive disorder. J Anxiety Disord. 2009;23:624-31.
16. Bonne K, Ananth J, Philpott L, et al. Neuropsychological characteristics of non-depressed adults with obsessive-compulsive disorder. Neuropsychiatry, Neuropsychology, and Behavioural Neurology. 1991;4:109-96.
17. Shin MS, Park SY, Park SR, Seol SH, Kwon JS. Clinical and empirical applications of the Rey-Osterrieth Complex Figure Test. Nat Protoc. 2006;1:892-9.
18. Lezak M, Howieson D, Bigler E, al e. Neuropsychological assessment. 5th ed. Oxford: Oxford University Press; 2012.
19. Moritz S, Wahl K, Zurowski B, Jelinek L, Hand I, Fricke S. Enhanced perceived responsibility decreases metamemory but not memory accuracy in obsessive–compulsive disorder (OCD). J Behav Res Ther. 2007;45:2044-52.
20. Moritz S, Kloss M, von Eckstaedt FV, Jelinek L. Comparable performance of patients with obsessive-compulsive disorder (OCD) and healthy controls for verbal and nonverbal memory accuracy and confidence: time to forget the forgetfulness hypothesis of OCD? Psychiatry Res. 2009;166:247-53.
21. Abramovitch A, Abramowitz JS, Mittelman A. The neuropsychology of adult obsessive-compulsive disorder: a meta-analysis. Clin Psychol Rev. 2013;33:1163-71.
22. Shin NY, Lee TY, Kim E, Kwon JS. Cognitive functioning in obsessive-compulsive disorder: a meta-analysis. Psychol Med. 2014;44:1121-30.
23. Savage CR, Baer L, Keuthen NJ, Brown HD, Rauch SL, Jenike MA. Organizational strategies mediate nonverbal memory impairment in obsessive-compulsive disorder. Biol Psychiatry. 1999;45:905-16.
24. Penadés R, Catalán R, Rubia K, Andrés S, Salamero M, Gastó C. Impaired response inhibition in obsessive compulsive disorder. Eur Psychiatry. 2007;22:404-10.
25. Olley A, Malhi G, Sachdev P. Memory and executive functioning in obsessive-compulsive disorder: a selective review. J Affect Disord. 2007;104:15-23.
26. Çetinay Aydın P, Güleç Öyekçin D. [Cognitive functions in patients with obsessive compulsive disorder]. Turk Psikiyatri Derg. 2013;24:266-74.
27. Hashimoto N, Nakaaki S, Omori IM, Fujioi J, Noguchi Y, Murata Y, et al. Distinct neuropsychological profiles of three major symptom dimensions in obsessive-compulsive disorder. Psychiatry Res. 2011;187:166-73.
28. Krishna R, Udupa S, George CM, Kumar KJ, Viswanath B, Kandavel T, et al. Neuropsychological performance in OCD: a study in medication-naïve patients. Prog

Neuropsychopharmacol Biol Psychiatry. 2011;35:1969-76.
29. Tombaugh TN. Trail Making Test A and B: normative data stratified by age and education. Arch Clin Neuropsychol. 2004;19:203-14.
30. Catani M, Jones DK, Donato R, Ffytche DH. Occipito-temporal connections in the human brain. Brain. 2003;126:2093-107.
31. Henry JD. A meta-analytic review of Wisconsin Card Sorting Test and verbal fluency performance in obsessive-compulsive disorder. Cogn Neuropsychiatry. 2006;11:156-76.
32. Senhorini MC, Cerqueira CT, Schaufelberger MS, Almeida JC, Amaro E, Sato JR, et al. Brain activity patterns during phonological verbal fluency performance with varying levels of difficulty: a functional magnetic resonance imaging study in Portuguese-speaking healthy individuals. J Clin Exp Neuropsychol. 2011;33:864-73.
33. Ruff RM, Light RH, Parker SB, Levin HS. The psychological construct of word fluency. Brain Lang. 1997;57:394-405.
34. Reynolds CR. Forward and backward memory span should not be combined for clinical analysis. Arch Clin Neuropsychol. 1997;12:29-40.
35. Groth-Marnat G, Haier R, Colom R, al e. Gray matter and intelligence factors: is there a neuro-g? Handbook of psychological assessment. 37. 5th ed: Intelligence. 2009;136–44.
36. Lesser I, Chung J, Cummings J, al e. The Human Frontal Lobes: Functions and Disorders. 2nd ed. New York: Guilford Press; 2007.
37. Harris CL, Dinn WM. Subtyping obsessive-compulsive disorder: neuropsychological correlates. Behav Neurol. 2003;14:75-87.
38. Kashyap H, Kumar JK, Kandavel T, Reddy YC. Neuropsychological functioning in obsessive-compulsive disorder: are executive functions the key deficit? Compr Psychiatry. 2013;54:533-40.

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