

**Title:** Cognitive Rehabilitation for Improving Cognitive Functions and Reducing the Severity of Symptoms in adult Patients with Obsessive-Compulsive Disorder: A Systematic Review of Randomized Controlled Clinical Trials

**Running Title:** Cognitive Training Interventions in OCD

**Authors:** Farah Bakizadeh<sup>1</sup>, Saba Mokhtari<sup>2</sup>, Fahime Saeed<sup>3</sup>, Asieh Mokhtari<sup>4</sup>, Pouria Akbari Koli<sup>5</sup>, Mohammadreza Shalbafan<sup>6,7,\*</sup>

1. *Department of Psychology, University of Tehran, Tehran, Iran.*
2. *Department of Psychiatry, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.*
3. *Department of Psychiatry, Psychosis Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.*
4. *School of Allied Medical Sciences, Iran University of Medical Sciences, Tehran, Iran.*
5. *Shahid Beheshti University, Tehran, Iran.*
6. *Mental Health Research Center, Psychosocial Health Research Institute (PHRI), Department of Psychiatry, School of Medicine, Iran University of Medical Sciences, Tehran, Iran.*
7. *Brain and Cognition Clinic, Institute for Cognitive Sciences Studies, Tehran, Iran.*

**\*Corresponding Author:** Mohammadreza Shalbafan, Mental Health Research Center, Psychosocial Health Research Institute (PHRI), Department of Psychiatry, School of Medicine, Iran University of Medical Sciences, Tehran, Iran. E-mail: Shalbafan.mr@iums.ac.ir

To appear in: **Basic and Clinical Neuroscience**

**Received date:** 2022/10/16

**Revised date:** 2022/11/08

**Accepted date:** 2022/11/12

This is a “Just Accepted” manuscript, which has been examined by the peer-review process and has been accepted for publication. A “Just Accepted” manuscript is published online shortly after its acceptance, which is prior to technical editing and formatting and author proofing. *Basic and Clinical Neuroscience* provides “Just Accepted” as an optional and free service which allows authors to make their results available to the research community as soon as possible after acceptance. After a manuscript has been technically edited and formatted, it will be removed from the “Just Accepted” Web site and published as a published article. Please note that technical editing may introduce minor changes to the manuscript text and/or graphics which may affect the content, and all legal disclaimers that apply to the journal pertain.

**Please cite this article as:**

Bakizadeh, F., Mokhtari, S., Saeed, F., Mokhtari, A., Akbari Koli, P., Shalbafan, M. (In Press). Cognitive Rehabilitation for Improving Cognitive Functions and Reducing the Severity of Symptoms in adult Patients with Obsessive-Compulsive Disorder: A Systematic Review of Randomized Controlled Clinical Trials. *Basic and Clinical Neuroscience*. Just Accepted publication Jul. 10, 2022. Doi: <http://dx.doi.org/10.32598/bcn.2022.1604.3>

DOI: <http://dx.doi.org/10.32598/bcn.2022.1604.3>

## **Abstract:**

**Introduction:** Obsessive-compulsive disorder (OCD) is a disabling mental condition. Many studies have shown that OCD patients have cognitive deficits in various aspects of their cognition which are a worsening factor of the severity of symptoms, potential endophenotype, a predictor of insight and prognostic marker of OCD as well. We designed this systematic review to evaluate clinical efficacy of cognitive rehabilitation in cognitive deficits and symptom severity of patients with OCD, in accordance with PRISMA guidelines.

**Method:** We searched Pubmed, Scopus, Sciencedirect, Google scholar, and Cochrane library in this study with the MeSH terms and keywords of ‘cognitive rehabilitation’ and ‘obsessive-compulsive disorder’. The database searches identified 200 records of interest initially which 105 duplications removed from them. From 95 remaining studies, six articles were eligible for the study and met the inclusion criteria. The six articles describe individual RCT studies representing a wide variety of study designs.

**Results:** These six included studies investigate the efficacy of “organizational training”, “cognitive remediation”, “attention splitting” and “goal management training” on cognitive impairments and symptom severity of OCD patients.

There are a small number of studies, with different designs and some concerning biases which have investigated the efficacy of cognitive rehabilitation in OCD patients and they have inconsistent results about effect of cognitive rehabilitation on OCD symptom severity or cognitive deficits.

**Conclusion:** According to the results, we cannot conclude about the efficacy of cognitive rehabilitation in adults with OCD. On account of the importance of cognitive deficits in OCD patients, it is necessary to design and conduct standard trials to investigate the role of cognitive rehabilitation on these impairments.

**Key words:** Cognitive function, Obsessive-compulsive disorder, Systematic review

## **1 Introduction:**

Obsessive-compulsive disorder (OCD) is a chronic and disabling mental disorder(Eric Hollander et al., 1997). It is described by unwanted, repetitive and intrusive thoughts or mental images which generate anxiety and discomfort, with/without repetitive motor or mental acts which seek prevention or reduction of the associated anxiety(American Psychiatric Association, 2013). OCD affects 1-3% of the population across the world(Karno, Golding, Sorenson, & Burnam, 1988; Sasson et al., 1997) and has a significant negative effect on public health(Hollander, Stein, Broatch, Himelein, & Rowland, 1997; Murray, Lopez, & Organization, 1996). It is associated with a severe decrease in quality of life(Macy et al., 2013), an impairment in all aspects of function(Albert, Maina, Bogetto, Chiarle, & Mataix-Cols, 2010; DuPont, Rice, Shiraki, & Rowland, 1995), and an increase in suicide(Angelakis, Gooding, Tarrier, & Panagioti, 2015) ,and mortality rate(Meier et al., 2016). Apart from these effects on the personal life and the public health, OCD causes a considerable economic burden(Olesen et al., 2012).

It has been shown that OCD patients have cognitive deficits in various aspects of their cognition(Suhas & Rao, 2019). Cognitive shifting ability and cognitive inflexibility during task-switching are impaired among patient with OCD(Chamberlain, Solly, Hook, Vaghi, & Robbins, 2021; Gruner & Pittenger, 2017; Gu et al., 2008). Compared to normal population, OCD patients have poorer performance on planning(Van den Heuvel et al., 2005) and response inhibition(Chamberlain, Fineberg, Blackwell, Robbins, & Sahakian, 2006; Ghisi, Bottesi, Sica, Sanavio, & Freeston, 2013; Penades et al., 2007) and multiple studies suggested that executive dysfunction is one of the most important cognitive impairments among OCD patients(Kashyap, Kumar, Kandavel, & Reddy, 2013; Snyder, Kaiser, Warren, & Heller, 2015; Tarafder, Bhattacharya, Paul, Bandyopadhyay, & Mukhopadhyay, 2006) and it is independent from other

comorbidities such as depression and psychomotor retardation(Snyder et al., 2015). Research suggests impairments in attention(Burdick, Robinson, Malhotra, & Szeszko, 2008; Levy, 2018; Van den Heuvel et al., 2005) and a slowness in psychomotor and information processing(Harris & Dinn, 2003; Tükel et al., 2012). In addition, verbal and non-verbal memory has been shown to be impaired in patients with OCD (Benzina, Mallet, Burguière, N'diaye, & Pelissolo, 2016; Muller & Roberts, 2005; Savage et al., 1999; Savage et al., 2000; Segalas et al., 2008).

Multiple cognitive impairments have been evaluated and have been suggested as endophenotype markers of OCD(Cavedini, Zorzi, Piccinni, Cavallini, & Bellodi, 2010; Chamberlain, Blackwell, Fineberg, Robbins, & Sahakian, 2005; Naren P Rao, Reddy, Kumar, Kandavel, & Chandrashekar, 2008; Viswanath, Reddy, Kumar, Kandavel, & Chandrashekar, 2009). Different aspects of the importance of cognitive deficits of OCD have been evaluated in recent years. The connection between severity of symptoms and cognitive deficits has been shown in some studies (Abramovitch, Dar, Schweiger, & Hermesh, 2011; Lacerda et al., 2003; Naren Prahlada Rao, Arasappa, Reddy, Venkatasubramanian, & Reddy, 2010; Segalas et al., 2008). The cognitive impairments have a predictive role on the insight of patients with OCD (Erzegovesi et al., 2001; Kashyap, Kumar, Kandavel, & Reddy, 2012; Kishore, Samar, Reddy, Chandrasekhar, & Thennarasu, 2004). On top of the significant role of the insight in the prognosis of the OCD patients, the cognitive disturbances have a particular correlation with the prognosis in OCD(Chamberlain et al., 2005).

The comorbidity of OCD with any other psychiatric disorder has a negative effect on the severity of OCD symptoms, the prognosis, and the response to pharmacotherapy(Shavitt et al., 2006). A number of studies have shown the connection of the cognitive deficits and other disorders as comorbidities of the OCD patients (Basso, Bornstein, Carona, & Morton, 2001; Purcell, Maruff,

Kyrios, & Pantelis, 1998; Naren P Rao et al., 2008). Independent of the comorbidities, the correlation of the cognitive impairments and the response to treatment has been shown in patients with OCD(Cavedini, Bassi, Zorzi, & Bellodi, 2004; Cavedini et al., 2002).

Cognitive impairments can seriously repress the abilities to earn, relearn and maintain the skills that are essential for suitable performances in complicated real-life situations and the association between real-life functioning and neuropsychological performance has been shown among patients with OCD(Perna et al., 2016).

Cognitive interventions that are expressed in articles as cognitive rehabilitation, training, and remediation are used in the management of some psychiatric disorders as well as neurological disorders. Cognitive training has been effective in mitigating neurocognitive impairments associated with traumatic brain injury, schizophrenia, various type of memory impairment, Alzheimer's disease, attention deficit hyperactivity disorder, mood, and anxiety disorders(Keshavan, Vinogradov, Rumsey, Sherrill, & Wagner, 2014). Therefore, this therapeutic approach is applicable for those disorders that are mostly comorbid conditions with OCD. Some studies have investigated neurocognitive intervention as a new approach in the treatment of OCD. However, these studies do not have a consistent result and the benefit of the cognitive rehabilitation interventions cannot be concluded from them. For instance, two studies have done in 2006 on the effect of cognitive training in patients with OCD and they even focus on the same approach (organizational strategies). Although one study has shown that cognitive training improves memory and symptom severity of OCD patients(Park et al., 2006), and the other study has shown no significant difference between training and control group(Buhlmann et al., 2006).

The trend to apply neurocognitive rehabilitation for psychiatric disorders has been increased. Consequently, some review articles are done in this context(Keshavan et al., 2014). With the

importance of the cognitive deficits in OCD patients and inconsistency and discrepancy in results of the previous studies, a systematic review on the interventions focused on cognitive deficits of patients with OCD is valuable and necessary. We aimed to conduct a systematic review of studies that used cognitive rehabilitation for patients with OCD. This study will determine the quality of evidence, the effectiveness of cognitive rehabilitation on different obsessive, compulsive and cognitive symptoms as well as severity.

## **2 METHODS**

### **2.1 Search strategy and selection criteria**

We conducted this study as a systematic review in accordance with PRISMA guidelines (Page et al., 2021). Search databases used in this study consist of PubMed, Scopus, Sciencedirect, Cochrane, and Google scholar. The primary search was conducted on 7<sup>th</sup> December 2021 by the first author.

The search strategy (shown in fig1) included the controlled clinical trials investigating the efficacy of cognitive rehabilitation in adults with OCD, by using MeSH terms and keywords of 'cognitive rehabilitation' and 'obsessive-compulsive disorder'. Eligible studies were provided OCD symptoms severity (OCD scales) or neuropsychological testing at baseline and post intervention. The included studies had adult participants (pediatric and geriatric studies were excluded), with established OCD diagnosis at baseline (The studies with preclinical participants were excluded). Although, there was no limitation for the clinical stage and studies with mild, moderate, severe and refractory participants were included. In the case of the studies with mixed diagnostic sample (e.g., included patients with OCD and other group of patients with major depressive disorder), the study was included if only the data of the participants with only OCD diagnosis could be obtained

from the reports of the study. The studies with cognitive rehabilitation, cognitive remediation and cognitive training were eligible and other pharmacological or non-pharmacological treatments (such as cognitive behavioral therapy or group therapies) were excluded. The details of the question and the key-words are shown in “fig1”.

The titles and abstracts of studies were screened by the first author and another researcher initially for duplications and irrelevant studies. Finally, a third researcher revised the outcome. The full texts of the remaining studies were purchased and then revised by the first author.

The final studies have significant differences in design and methodology. There were different interventions, metric or outcomes, and study designs, and in some of the studies there were many measurements per participant. These basic differences made the data unsuitable for meta-analysis.

We also evaluate the risk of bias of the studies for six main biases considering Cochrane ‘Risk of bias’ tool.



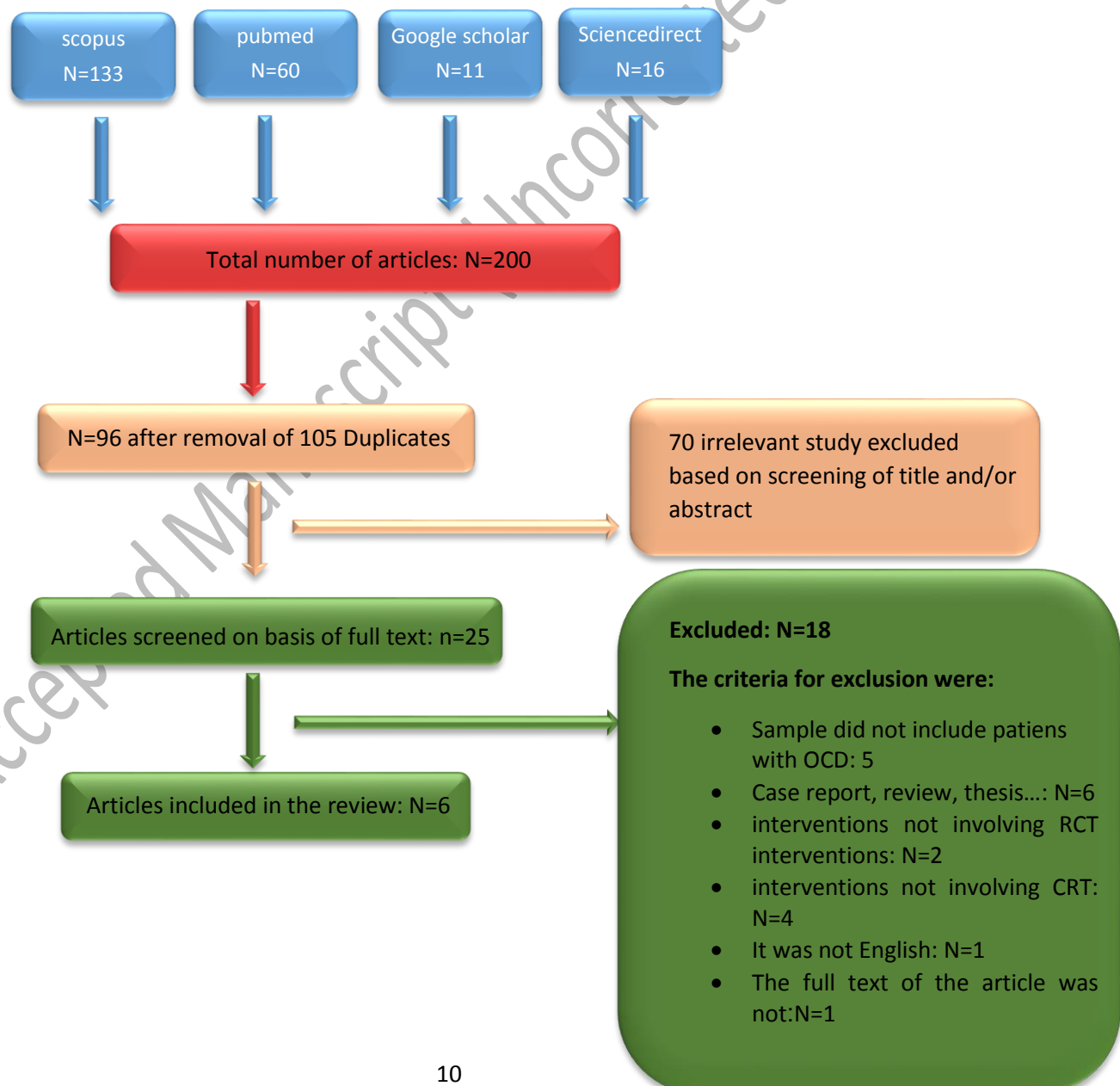
**Fig1. The details of the question and the key-words**

Question	Key-words
Patients: adults with obsessive-compulsive disorder	Obsessive-Compulsive Disorders Obsessive Compulsive Disorder disorder, obsessive compulsive Disorders, Obsessive-Compulsive neurosis, obsessive compulsive Obsession Compulsion OCD
Intervention: cognitive rehabilitation	Cognitive rehabilitation Cognitive remediation Cognitive training Computerized cognitive rehabilitation Computerized cognitive remediation Computerized cognitive training CR CRT Cognitive Dysfunction / rehabilitation* Cognitive Remediation / methods Cognitive Remediation / standards* Computer-Assisted Instruction Obsessive-Compulsive Disorder* / therapy Obsessive-Compulsive Disorder* / rehabilitation
Comparison: control group with same disorder	Randomized Controlled Trial [Publication Type] Clinical Trials, Randomized Trials, Randomized Clinical Controlled Clinical Trials, Randomized Randomized Controlled Trials as Topic RCT
Outcome: improving cognitive deficits and symptom severity	Cognitive deficit Cognitive Dysfunctions Dysfunction, Cognitive Cognitive Impairments Cognitive Impairment Impairment, Cognitive Cognitive dysfunction Cognition Attention Processing speed executive function Working memory Verbal memory Verbal fluency Visuospatial Memory Neuropsychological Testing Testing, Neuropsychological Tests, Neuropsychological Cognitive Testing Testing, Cognitive Obsessive-Compulsive Disorder / diagnosis* Yale- brown obsessive-compulsive scale Y-BOCS Severity of Illness Index

### 3 Results

The database searches identified 200 records of interest initially which 105 duplications removed from them. From 95 remaining studies, six articles were eligible for the study and met the inclusion criteria. (Fig 2) The six articles describe individual RCT studies representing a wide variety of study designs.

**Fig2. The flowchart of studies**



Four of these studies are randomized control trials with a passive control group (one is a pilot study), two of the studies are randomized control trials with an active control group. Three studies have examined cognitive remediation and three studies have evaluated cognitive training tasks.

Five studies have evaluated the mean difference in Yale-Brown obsessive-compulsive score (Y-BOCS)(Goodman et al., 1989) ratings before and after intervention in experimental and control groups (one study just reports that the difference was not significant and another study just reports the two-way ANOVA test of group, time and group \* time and both studies don't report the mean, standard deviation, standard error or other statistics necessary for meta-analysis). Four studies have evaluated neuropsychological and cognitive symptoms of participants with various tests.

As stated before, the final studies have significant differences in design and methodology. There were different interventions, metric or outcomes, and study designs, and in some of the studies there were many measurements per participant. These basic differences made the data unsuitable for meta-analysis.

Studies' details are described in Table 1. Fig 3 is the result of the assessment of the main biases of the studies.

**Table1. Details of included studies**

Table-1: Controlled clinical trials reporting cognitive rehabilitation in adults with OCD				
	Study (first author, year of study)	Study patients and main groups	Interventions	Outcomes, results and relationships
1	Buhlmann et al, 2006	Patients with OCD(n=35) 1- control group (n=15)	1- Control group: RCFT test without training 2- Experimental group: RCFT copy1 and recall1 test then	➤ RCFT test: RCFT copy organization Mean difference 95%CI: 0.46 [-0.22, 1.14] p-value=0.17 RCFT copy accuracy Mean difference 95%CI: 1.7 [-3.63, 7.03] RCFT recall Mean difference 95%CI: -0.5 [-13.29, 12.29]

		2- <b>experimental group</b> (n=20)	receiving cognitive organizational training and after that copy2 and recall2 test	
2	Park et al, 2006	<b>Patients with OCD</b> (n=30) 1- <b>control group</b> (n=15) 2- <b>experimental group</b> (n=15)	1- <b>Control group:</b> wait list 2- <b>Experimental group:</b> cognitive organizational training (5weeks, twice a week, 60min sessions)	<ul style="list-style-type: none"> <li>➤ Y-BOCS: Mean difference 95%CI; 6.59 [0.85, 12.33] p-value= 0.0325</li> <li>➤ K-CVLT test:              the trial 1 recall <math>F_{1,27}=0.18</math>, <math>P=0.69</math>              the trial 5 recall <math>F_{1,27}=1.66</math>, <math>P=0.21</math>              the trial 1-5 recall <math>F_{1,27}=1.25</math>, <math>P=0.27</math>              the short-delay free recall <math>F_{1,27}=2.70</math>, <math>P=0.11</math>              the long-delay free recall <math>F_{1,27}=1.80</math>, <math>P&lt;0.19</math>              the retention recall rate <math>F_{1,27}=0.34</math>, <math>P=0.57</math>              the recognition rate <math>F_{1,27}=0.06</math>, <math>P=0.81</math>              the semantic clustering <math>F_{1,27}=0.65</math>, <math>P=0.43</math>              the trial B recall <math>F_{1,27}=5.67</math>, <math>P&lt;0.05</math></li> <li>➤ RCFT test:              RCFT copy organization main effect of group <math>F_{1,27}=0.95</math>, <math>P=0.34</math>              RCFT copy organization main effect of interaction <math>F_{1,27}=7.46</math>, <math>P&lt;0.05</math>              RCFT recall main effect of group <math>F_{1,27}=6.98</math>, <math>P&lt;0.05</math></li> </ul>
3	Morits et al, 2011	<b>Patients with OCD</b> (n=40) 1- <b>control group</b> (n=20) 2- <b>experimental group</b> (n=20)	1- <b>Control group:</b> wait list 2- <b>Experimental group:</b> The attention training technique (ATT) (15min sessions twice a day, 4 weeks)	<ul style="list-style-type: none"> <li>➤ Y-BOCS Group*Time interaction <math>F(1,67.5) = .03</math>, <math>P = .86</math></li> <li>➤ OCI-R Group*Time interaction <math>F(1,67) = .01</math>, <math>P = .74</math></li> </ul>
4	Jelinek et al 2018	<b>Patients with OCD</b> (n=109) 1- <b>control group</b> (n=54) 2- <b>experimental group</b> (n=25)	1. <b>Control group:</b> only CBT for 1 or 2 weeks then CBT+AST (Association splitting training) for 4weeks then CBT for 6month 2. <b>Experimental group:</b> only CBT for 1 or 2 weeks then CBT+ cognitive remediation therapy (Cogpack) for 4weeks then CBT for 6month	<ul style="list-style-type: none"> <li>➤ Y-BOCS              Week 4: <math>F(1, 106)=1.55</math>, <math>p=.217</math>              Month 6: <math>F(1, 106)=2.64</math>, <math>p=.107</math></li> <li>➤ OCI-R:              Week 4: <math>F(1, 102)=0.00</math>, <math>p=.987</math>              Month 6: <math>F(1, 102)=0.13</math>, <math>p=.716</math></li> <li>➤ HDRS              Week 4: <math>F(1, 105)=0.03</math>, <math>p=.868</math>              Month 6: <math>F(1, 105)=0.24</math>, <math>p=.628</math></li> </ul>
5	Cameron et al 2019	<b>Patients with OCD</b> (n=19) 1- <b>control group</b> (n=9) 2- <b>experimental group</b> (n=10)	1- <b>Control group:</b> wait list 2- <b>Experimental group:</b> Goal management training (GMT) (weekly 2h sessions for 9 weeks)	<ul style="list-style-type: none"> <li>➤ Tower of London <math>F(1,17) = 4.6</math>, <math>p = .047</math></li> <li>➤ CPT <math>F(1,16) = 47.1</math>, <math>p = .017</math></li> <li>➤ Sheehan Disability Scale:              work <math>F(1,17) = 3.6</math>, <math>p = .076</math>              social <math>F(1,17) = 3.8</math>, <math>p = .066</math>              family <math>F(1,17) = 3.6</math>, <math>p = .073</math></li> <li>➤ IIRS <math>F(1,17) = 3.6</math>, <math>p = .076</math></li> <li>➤ WHODAS 2.0 <math>F(1,17) = 4.8</math>, <math>p = .042</math></li> <li>➤ MACCS <math>F(1,17) = 8.2</math>, <math>p = .011</math></li> </ul>

				<ul style="list-style-type: none"> <li>➤ CFQ <math>F(1,17) = 9.2, p = .007</math></li> <li>➤ Other tests only are reported as insignificant</li> </ul>
6	Van Passel et al, 2020	<p><b>Patients with OCD (n=71)</b></p> <p>1- control group (n=34)</p> <p>2- experimental (n=37)</p>	<p>1. Control group: SAT for 6 weeks then CBT for 12 months</p> <p>2. Experimental: Cognitive remediation therapy for 6 weeks then CBT for 12 months</p>	<ul style="list-style-type: none"> <li>➤ Y-BOCS mean difference 95%CI -1.49 [-6.04, 3.06] p-value=0.52</li> <li>➤ DFlex mean difference 95%CI -0.05 [-0.57, 0.48]</li> </ul>

**Fig3. The assessment of the main biases of the studies.**

Study		D1	D2	D3	D4	D5	Overall	
Buhlmann 2006	1	+	+	+	+	+	+	Low risk
Cameron 2019	1	+	!	!	+	!	!	Some concerns
Jelinek 2018	1	+	!	+	+	-	-	High risk
Moritz 2011	1	+	+	+	!	+	!	
Park 2006	1	+	+	+	+	+	+	
van Passel 2020	1	+	+	+	+	!	!	

D1 Randomisation process

D2 Deviations from the intended interventions

D3 Missing outcome data

D4 Measurement of the outcome

D5 Selection of the reported result

### 3.1 Cognitive training for organizational impairment

Two of six studies have investigated the role of organization training in OCD patients. The Rey–Osterrieth Complex Figure Test (Shin, Park, Park, Seol, & Kwon, 2006) was administered before

and after cognitive training. Although, the training strategy and duration of studies are not the same.

In the study of Buhlmann et al in 2006(Buhlmann et al., 2006), 35 OCD patients were randomized to two training and non-training groups.

All patients were first asked to copy the RCFT (Copy I). Immediately, patients were asked to redraw the RCFT figure from memory (Recall I). 20 of patients received different training instructions with the Taylor Complex Figure(Lezak, Howieson, Loring, & Fischer, 2004) (breaking down complex figures into simpler or meaningful parts, drawing the basic units first and then filling the details and etc.) and 15 patients (control group) received no training. Afterward, all patients (training and non-training) were asked to copy the RCFT (Copy 2), and immediate recall of the RCFT (recall 2) and a 30min delayed recall.

This study's results have shown that OCD subjects had no significant difference in organizational abilities ( $p$ -value=0.17) and memory ( $p$ -value=0.93) between two groups.

In the study of Park et al in 2006(Park et al., 2006), 30 adults with OCD were randomized in two groups. 15 of subjects received the cognitive training program in nine 60-min individual sessions, twice a week, over a period of five weeks and 15 patients stayed on the waitlist.

The cognitive training program consisted of “Training for visual organizational strategies” and “training on organizational strategies in everyday life: training for problem-solving strategies”.

This study revised the block design, which is a subtest of Korean–Wechsler Adult Intelligence Scale(Yum, Park, Oh, Kim, & Lee, 1992) and used it as a training tool for visual organizational strategies. A total of 90 patterns (10 patterns in each session, started with simpler patterns) were used for training. In each session subjects trained that each component of patterns can be integrated

into a meaningful figure, to grasp the overall configuration of patterns and to create meaningful figures by putting components together.

Training for organizational strategies relating to everyday life was designed for this study and the training was administered with problem-solving strategies. In each session, patients used the information they got to draw up structured plans and work on their daily life problems.

The RCFT, Korean–California Verbal Learning Test(Kim & Kang, 1999; Savage et al., 2000) and Y-BOCS were administered at the beginning and endpoint of study.

In this study, the copy and the copy organization score of the RCFT had a significantly greater improvement in the treatment group ( $p\text{-value}<0.05$ ). Although, the immediate and delayed recall were the same. The results of K-CVLT were not significantly different, either. It can indicate that visual organizational training can improve visual memory and visuospatial skills in OCD patients but it doesn't have an effect on their verbal memory.

In the assessment of Y-BOCS, the obsessive-compulsive symptoms in all total, obsession and compulsion subscales were significantly different between groups and the treatment group has a greater improvement in their symptoms. ( $P\text{-value}<0.05$ )

### **3.2 The Attention Training Technique**

One study of 6 included studies has investigated the role of the attention training technique on OCD patients.

The attention training technique (ATT) is a cognitive training method that is focused on improving intrusive thoughts(Wells, 2007). The ATT trains the patient to shift their attention from internal events to external ones and can cause more attentional flexibility(Fergus & Bardeen, 2016). The

ATT sessions are at least 15min twice every day and the treatment continues for 4 weeks(Papageorgiou & Wells, 2004). Each ATT session has four steps: 1) Step one: several sharp noises should be deleted inside and outside a room. 2) Step two: attention should switch between each noise in the time of one minute while ignoring other sounds. 3) Step 3: attention switch between inside and outside noises should happen only when a noise has captured full attention. 4) Step 4: attention should be on all noises with counting them(Fergus & Bardeen, 2016).

In the study of Mortiz et al in 2011(Moritz, Wess, Treszl, & Jelinek, 2011), 80 OCD patients were randomized into two groups of the ATT treatment for four weeks and a control (waitlist) group. The participants were assessed via the internet and they completed questionnaires about their demographic information, medical history (they should have a previous OCD diagnosis by a health care professional), Obsessive-Compulsive Inventory-Revised (OCI-R)(Foa et al., 2002) and Y-BOCS. Participants were assessed by these two scales at the endpoint of the study as well.

The treatment manual which contains an introduction to ATT and a description of the treatment were sent to half of the participants via E-mail and the other half were informed that they are on a waitlist. Participants were encouraged to perform the techniques twice a day for at least 15 min.

The results of this study, which was conducted by a mixed two-way ANOVA, have shown no significance with the main effects of group ( $p$ -value=0.72), time ( $p$ -value=0.07, and the group\*time interaction ( $p$ -value=0.86) in total Y-BOCS scores, nor in its subscales. For OCI-R scores, only the effect of time was significant ( $p$ -value=0.04). Although, none of the total or subscales scores of OCI-R have achieved significance in the main effect of group (total score  $p$ -value=0.41) or group\*time interaction (total score  $p$ -value=0.74).



One of the participants acknowledged that he didn't respond honestly in post assessment and 11 participants (10 in ATT group) did not complete the study. There is another analysis in this study in which they removed the non-completer subjects which have shown no difference in results.

### **3.3 Cognitive Remediation Therapy**

Two of included studies investigate the effect of cognitive remediation therapy on OCD patients. Both studies have an active control group: one study developed a therapy with a similar structure of CRT and without cognitive treatments of it, as a control group. The other study was designed to investigate the effect of Association splitting therapy (AST) (a metacognition therapy)(Moritz, Jelinek, Klinge, & Naber, 2007) and used the CRT treatment as a control group. Due to this major and significant difference in the design of these two studies, we didn't analyze the data of these studies in conjunction.

In the study of Jelinek et al in 2018(Jelinek, Hauschildt, Hottenrott, Kellner, & Moritz, 2018), 109 OCD patients that were already receiving CBT were randomized to two groups of the cognitive remediation or the association splitting. Patients were evaluated by Y-BOCS, OCI-R and Hamilton depression rating scale in week 0 (t0), week 4 (t1) and after 6 months (t2). Both groups of patients have received CBT for one or two weeks when the CRT or the AST was added to their treatment. They received 6 sessions (50min) of the AST or the CRT for three weeks. (two sessions per week)

The CRT group received sessions one to six of the Cogpack training. Cogpack is a software designed by the marker software. It consists of 64 exercises categorized into domain-specific and non-domain-specific tasks. Domain-specific tasks work on verbal memory, verbal fluency, sustained and selective attention, motor coordination, working memory and executive function. Non-domain specific tasks do not focus on one cognitive function but cause a need to use different

aspects such as logical and mathematical skills or language skills, simultaneously(Caponnetto et al., 2018).

The results of this study have shown no significant difference between two groups in none of the tests or their subscales scores (total Y-BOCS score t1 p-value:0.21, t2 p-value=0.1) The t1 evaluation was after estimation of two weeks of treatment and the t2 evaluation was after estimation of 4.5 months of the ending of the CRT or the AST and keep receiving the CBT.

In the study of Van Passel in 2020(van Passel et al., 2020), 71 adults with OCD were randomized in two groups of receiving CRT or SAT for five weeks (45 min session, twice weekly), followed by CBT. They used Y-BOCS and Detail and Flexibility questionnaire (DFlex)(Roberts, Barthel, Lopez, Tchanturia, & Treasure, 2011) for evaluating the participants in week 0 (t0), week 6 (t1) and after 6 (t2) and 12 months (t3).

The cognitive remediation therapy used for this study was based on the CRT model for patients with anorexia nervosa(Tchanturia, Davies, Reeder, & Wykes, 2010). This intervention uses different tasks to modify cognitive flexibility and information processing.

The control group received the SAT which was specifically designed for this study. The overall structure of the SAT, such as duration and inclusion of homework assignments, is the same as the CRT but the cognitive training parts of the CRT are removed from it.

After 5 weeks of receiving the CRT or the SAT, all patients receive CBT (once or twice a week session, 45 to 90 min) for the next year.

The results of this study have shown no significance in the main effect of group or group\*time interaction in t1, t2 or t3 in Y-BOCS total or subscales score, (t1 total Y-BOCS p-value= 0.52) nor in Dflex score. (t1 Dflex p-value=0.84)

### 3.4 Goal Management Training (GMT)

One study of included studies investigates the efficacy of goal management training in adults with OCD.

In the pilot study of Cameron et al in 2020(Cameron, McCabe, Rowa, O'Connor, & McKinnon, 2020), 19 patients with OCD were randomized into two groups of GMT and waitlist control. 10 OCD patients received nine weeks (2h sessions, once weekly) of GMT. The mean of sessions completed by the treatment group was 7.2.

Goal management training (GMT) is a short-term, structured, present-oriented cognitive remediation therapy that is focused on the attention system, goal-directed behaviors and executive function. It uses a top-down processing approach focusing on regulating planning, set-shifting, goal setting and monitoring process(Levine et al., 2000; Stamenova & Levine, 2018).

The assessment of participants was conducted by multiple tests and scales (Y-BOCS, Depression, Anxiety and Stress Scales (DASS-21)(Lovibond & Lovibond, 1995), Cognitive Failures Questionnaire (CFQ) (Broadbent, Cooper, FitzGerald, & Parkes, 1982), Dysexecutive Questionnaire (DEX )(Simblett & Bateman, 2011), memory and cognitive confidence scale (MACCS )(Nedeljkovic & Kyrios, 2007), WHO Disability Assessment Scale (WHODAS) 2.0(Üstün et al., 2010), Illness Intrusiveness Rating Scale (IIRS)(Devins, 2010), Sheehan Disability Scale (SDS)(Sheehan, 1983), Conners' Continuous Performance Task (CPT)(Conners et al., 2000), Stroop Color and Word Test(Golden, 1976), Tower of London(Culbertson & Zillmer, 2001), California Verbal Learning Test—Second Edition (CVLT-II)(Delis, Kramer, Kaplan, & Ober, 2000), Wechsler Test of Adult Reading(Wechsler, 2001) which study provides only the data of significant scores.

The results of this study indicate that there was a significant difference between groups after nine weeks in TOL, CPT, all functional outcome tests and subjective cognition tests. Although, there was no significant difference in symptom severity tests. In the three months follow-up, there was no significance in any of the scales. Although, only six participants were available for this assessment.

#### **4 Discussion**

Many studies have shown that OCD patients have cognitive deficits in various aspects of their cognition(Suhas & Rao, 2019). These neuropsychological and cognitive deficits have also been shown as a worsening factor of the severity of symptoms(Abramovitch et al., 2011; Lacerda et al., 2003; Naren Prahlada Rao et al., 2010; Segalas et al., 2008), potential endophenotype(Naren P Rao et al., 2008; Viswanath et al., 2009), a predictor of insight(Erzegovesi et al., 2001; Kashyap et al., 2012; Kishore et al., 2004) and response to treatment(Cavedini et al., 2004; D'Alcante et al., 2012), a potential factor of some comorbidities(Basso et al., 2001; Purcell et al., 1998; Naren P Rao et al., 2008), and prognostic marker(Chamberlain et al., 2005; Suhas & Rao, 2019) of OCD as well.

Based on the findings of this review, current cognitive rehabilitation therapies are not successful in reducing symptoms of OCD. The publications are not consistent on the same result and due to significant differences in design and methodology, they are unsuitable for meta-analysis. With lack of meta-analysis, there is not enough statistical evidence to conclude about the effect of cognitive rehabilitation on cognitive deficits and the daily function of adults with OCD.

As it is shown in fig 3, the overall bias of most studies is concerning and some potential biases of some studies are worth mentioning:

In the study of van pasel et al in 2020, the cognitive remediation model, the therapy of control model and the measurement scale that they used are basely designed for the patients with anorexia nervosa. Before relying on the conclusion of this study, it seems necessary to test the validity and reliability of these model and assessment tool in OCD patients.

In the study of Moritz et al in 2011, the whole assessment and intervention are self-conducted and all the processes are done via the internet. It can cause some concerns about the reliability and validity of reported data from participants. The diagnosis and history of them have not been checked by a professional and there is no evidence that all precipitants have completed the treatment or have done the techniques in the right way.

The study of Cameron et al in 2020 is a pilot study so it has a very small sample size. Moreover, the trial was not completed by all the treatment group. As reported in the manuscript the mean number of sessions completed by treatment group is 7.2 which seems to be a limitation to a conclusive result for a pilot study. Also, multiple scales and tests are performed in the study that may cause a confusion in the overall decision on this model.

The study of Jelineck et al in 2018 has some biases in design and methodology. The study needs more rationale and logic to choose cognitive remediation and a metacognition therapy to compare with each other. It seems that none of these techniques can be a control group for another. There are many differences in the baseline treatment of participants and all of the subjects are receiving different kinds of CBT therapy which can be a very important confounding variable. The beginning time of interventions is not the same between participants (the manuscript reports that it is in estimation of two weeks) so the time of the assessments are not the same, too. The first evaluation after the baseline is in estimation of only two weeks of the beginning of treatment which seems to be not enough for estimating the effect. Finally, this study used six sessions of Cogpack as

cognitive remediation which is not studied on OCD patients and cannot be performed in only six sessions.

## **5 Conclusion**

In summary, based on the findings of this review, current cognitive rehabilitation therapies are not successful in reducing symptoms of OCD. The results finding by this review show that there are limited number of studies on this matter and due to the multiple differences in design and methodology they are unsuitable for meta-analysis. With lack of meta-analysis, there is not enough statistical evidence to conclude about the effect of cognitive rehabilitation on cognitive deficits and the daily function of adults with OCD. Another issue regarding the studies of this review is multiple biases and methodological errors that are addressed before. Due to the importance of cognitive deficits in OCD patients, it is necessary to design and conduct standard trials to investigate the role of cognitive rehabilitation on these impairments.

## **6 Limitations and suggestion for further studies**

As mentioned before, the most important limitation of this study is the limited number of clinical trials on cognitive rehabilitation for OCD patients and the methodological differences and errors of available studies. Further studies can be conducted double-blinded by providing similar tasks without training parts (instead of waiting list or different therapies) and separating the operational and analysis teams. Another matter that can help homogeneity in the studies can be differentiating the severity of symptoms and separate analysis for mild, moderate and severe OCD. Also, performing a follow-up measure can be very valuable for further studies. Additionally, as multiple studies have shown the areas of the cognitive deficits in OCD patients, further studies should focus on tasks that target those affected areas.

### **Conflict of Interest**

The authors have no conflicts of interest to report.

### **Authors' contributions**

Conceptualization and design: FB, FS, PA and MS; Data collection: FB , SM, PA, AM and MS;

Initial draft preparation: FB, SM, FS and MS; Editing & review: All authors.

### **Ethical Considerations**

Because of the type of article (Review), there was no need for obtaining ethical approval.

### **Acknowledgments**

The authors would like to appreciate Sina Tavakoli for his cooperation in performing this study.

### **Funding**

The authors disclose receipt of the following financial support for the research, authorship, and/or publication of this article: This study was funded by cognitive sciences and technologies council (Grant no: 15745).

## References:

- Abramovitch, Amitai, Dar, Reuven, Schweiger, Avraham, & Hermesh, Haggai. (2011). Neuropsychological impairments and their association with obsessive-compulsive symptom severity in obsessive-compulsive disorder. *Archives of Clinical Neuropsychology*, 26(4), 364-376.
- Albert, Umberto, Maina, Giuseppe, Bogetto, Filippo, Chiarle, Alice, & Mataix-Cols, David. (2010). Clinical predictors of health-related quality of life in obsessive-compulsive disorder. *Comprehensive psychiatry*, 51(2), 193-200.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*: American Psychiatric Pub.
- Angelakis, Ioannis, Gooding, Patricia, Tarrier, Nichoas, & Panagioti, Maria. (2015). Suicidality in obsessive compulsive disorder (OCD): a systematic review and meta-analysis. *Clinical psychology review*, 39, 1-15.
- Arabzadeh, Somaye, Shahhossenie, Maryam, Mesgarpour, Bita, Rezaei, Farzin, Shalbafan, Mohammad Reza, Ghiasi, Zahra, & Akhondzadeh, Shahin. (2017). L-carnosine as an adjuvant to fluvoxamine in treatment of obsessive compulsive disorder: A randomized double-blind study. *Human Psychopharmacology: clinical and experimental*, 32(4), e2584.
- Askari, Sanaz, Mokhtari, Saba, Shariat, Seyed Vahid, Shariati, Behnam, Yarahmadi, Masoomah, & Shalbafan, Mohammadreza. (2022). Memantine augmentation of sertraline in the treatment of symptoms and executive function among patients with obsessive-compulsive disorder: A double-blind placebo-controlled, randomized clinical trial. *BMC psychiatry*, 22(1), 1-13.
- Basso, Michael R, Bornstein, Robert A, Carona, Francine, & Morton, Robert. (2001). Depression accounts for executive function deficits in obsessive-compulsive disorder. *Cognitive and Behavioral Neurology*, 14(4), 241-245.
- Benzina, Nabil, Mallet, Luc, Burguière, Eric, N'diaye, Karim, & Pelissolo, Antoine. (2016). Cognitive dysfunction in obsessive-compulsive disorder. *Current psychiatry reports*, 18(9), 1-11.
- Broadbent, Donald E, Cooper, P Fitzgerald, FitzGerald, Paul, & Parkes, Katharine R. (1982). The cognitive failures questionnaire (CFQ) and its correlates. *British journal of clinical psychology*, 21(1), 1-16.
- Buhlmann, Ulrike, Deckersbach, Thilo, Engelhard, Iris, Cook, Laura M, Rauch, Scott L, Kathmann, Norbert, . . . Savage, Cary R. (2006). Cognitive retraining for organizational impairment in obsessive-compulsive disorder. *Psychiatry Research*, 144(2-3), 109-116.
- Burdick, Katherine E, Robinson, Delbert G, Malhotra, Anil K, & Szeszko, Philip R. (2008). Neurocognitive profile analysis in obsessive-compulsive disorder. *Journal of the International Neuropsychological Society*, 14(4), 640-645.
- Cameron, Duncan H, McCabe, Randi E, Rowa, Karen, O'Connor, Charlene, & McKinnon, Margaret C. (2020). A pilot study examining the use of Goal Management Training in individuals with obsessive-compulsive disorder. *Pilot and Feasibility Studies*, 6(1), 1-12.
- Caponnetto, Pasquale, Maglia, Marilena, Auditore, Roberta, Bocchieri, Marta, Caruso, Antonio, DiPiazza, Jennifer, & Polosa, Riccardo. (2018). Improving neurocognitive functioning in schizophrenia by addition of cognitive remediation therapy to a standard treatment of metacognitive training. *Mental illness*.
- Cavedini, Paolo, Bassi, Tommaso, Zorzi, Claudia, & Bellodi, Laura. (2004). The advantages of choosing antiobsessive therapy according to decision-making functioning. *Journal of Clinical Psychopharmacology*, 24(6), 628-631.
- Cavedini, Paolo, Riboldi, Giovanna, D'Annuncci, Arcangela, Belotti, Patrizia, Cisima, Michele, & Bellodi, Laura. (2002). Decision-making heterogeneity in obsessive-compulsive disorder: ventromedial prefrontal cortex function predicts different treatment outcomes. *Neuropsychologia*, 40(2), 205-211.



- Cavedini, Paolo, Zorzi, Claudia, Piccinni, Monica, Cavallini, Maria Cristina, & Bellodi, Laura. (2010). Executive dysfunctions in obsessive-compulsive patients and unaffected relatives: searching for a new intermediate phenotype. *Biological psychiatry*, 67(12), 1178-1184.
- Chamberlain, Samuel R, Blackwell, Andrew D, Fineberg, Naomi A, Robbins, Trevor W, & Sahakian, Barbara J. (2005). The neuropsychology of obsessive compulsive disorder: the importance of failures in cognitive and behavioural inhibition as candidate endophenotypic markers. *Neuroscience & Biobehavioral Reviews*, 29(3), 399-419.
- Chamberlain, Samuel R, Fineberg, Naomi A, Blackwell, Andrew D, Robbins, Trevor W, & Sahakian, Barbara J. (2006). Motor inhibition and cognitive flexibility in obsessive-compulsive disorder and trichotillomania. *American Journal of Psychiatry*, 163(7), 1282-1284.
- Chamberlain, Samuel R, Solly, Jeremy E, Hook, Roxanne W, Vaghi, Matilde M, & Robbins, Trevor W. (2021). Cognitive inflexibility in OCD and related disorders *The Neurobiology and Treatment of OCD: Accelerating Progress* (pp. 125-145): Springer.
- Conners, C Keith, Staff, MHS, Connelly, V, Campbell, S, MacLean, M, & Barnes, J. (2000). Conners' continuous performance Test II (CPT II v. 5). *Multi-Health Syst Inc*, 29, 175-196.
- Culbertson, WC, & Zillmer, EA. (2001). The tower of London DX (TOLDX) manual. *North Tonawanda, NY: Multi-Health Systems*.
- D'Alcante, Carina C, Diniz, Juliana B, Fossaluza, Victor, Batistuzzo, Marcelo C, Lopes, Antonio C, Shavitt, Roseli G, . . . Hoexter, Marcelo Q. (2012). Neuropsychological predictors of response to randomized treatment in obsessive-compulsive disorder. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 39(2), 310-317.
- Delis, Dean C, Kramer, Joel H, Kaplan, Edith, & Ober, Beth A. (2000). California verbal learning test. *Assessment*.
- Devins, Gerald M. (2010). Using the illness intrusiveness ratings scale to understand health-related quality of life in chronic disease. *Journal of psychosomatic research*, 68(6), 591-602.
- DuPont, Robert L, Rice, DP, Shiraki, S, & Rowland, CR. (1995). Economic costs of obsessive-compulsive disorder. *Medical interface*, 8(4), 102-109.
- Erzegovesi, Stefano, Cavallini, Maria Cristina, Cavedini, Paolo, Diaferia, Giuseppina, Locatelli, Marco, & Bellodi, Laura. (2001). Clinical predictors of drug response in obsessive-compulsive disorder. *Journal of clinical psychopharmacology*, 21(5), 488-492.
- Fergus, Thomas A, & Bardeen, Joseph R. (2016). The attention training technique: a review of a neurobehavioral therapy for emotional disorders. *Cognitive and Behavioral Practice*, 23(4), 502-516.
- Foa, Edna B, Huppert, Jonathan D, Leiberg, Susanne, Langner, Robert, Kichic, Rafael, Hajcak, Greg, & Salkovskis, Paul M. (2002). The Obsessive-Compulsive Inventory: development and validation of a short version. *Psychological assessment*, 14(4), 485.
- Foa, Edna B, Liebowitz, Michael R, Kozak, Michael J, Davies, Sharon, Campeas, Rafael, Franklin, Martin E, . . . Schmidt, Andrew B. (2005). Randomized, placebo-controlled trial of exposure and ritual prevention, clomipramine, and their combination in the treatment of obsessive-compulsive disorder. *American Journal of psychiatry*, 162(1), 151-161.
- Ghisi, Marta, Bottesi, Gioia, Sica, Claudio, Sanavio, Ezio, & Freeston, Mark H. (2013). Is performance on the Go/Nogo task related to not just right experiences in patients with obsessive compulsive disorder? *Cognitive Therapy and Research*, 37(6), 1121-1131.
- Golden, Charles J. (1976). Identification of brain disorders by the Stroop Color and Word Test. *Journal of clinical psychology*.
- Goodman, Wayne K, Price, Lawrence H, Rasmussen, Steven A, Mazure, Carolyn, Fleischmann, Roberta L, Hill, Candy L, . . . Charney, Dennis S. (1989). The Yale-Brown obsessive compulsive scale: I. Development, use, and reliability. *Archives of general psychiatry*, 46(11), 1006-1011.

- Gruner, Patricia, & Pittenger, Christopher. (2017). Cognitive inflexibility in obsessive-compulsive disorder. *Neuroscience*, 345, 243-255.
- Gu, Bon-Mi, Park, Ji-Young, Kang, Do-Hyung, Lee, Seung Jae, Yoo, So Young, Jo, Hang Joon, . . . Kwon, Jun Soo. (2008). Neural correlates of cognitive inflexibility during task-switching in obsessive-compulsive disorder. *Brain*, 131(1), 155-164.
- Hadi, Fatemeh, Kashefinejad, Shayan, Kamalzadeh, Leila, Hoobehfekar, Saba, & Shalbafan, Mohammadreza. (2021). Glutamatergic medications as adjunctive therapy for moderate to severe obsessive-compulsive disorder in adults: a systematic review and meta-analysis. *BMC Pharmacology and Toxicology*, 22(1), 1-11.
- Harris, Catherine L, & Dinn, Wayne M. (2003). Subtyping obsessive-compulsive disorder: Neuropsychological correlates. *Behavioural Neurology*, 14(3-4), 75-87.
- Hibar, Derrek P, Stein, Jason L, Renteria, Miguel E, Arias-Vasquez, Alejandro, Desrivieres, Sylvane, Jahanshad, Neda, . . . Andersson, Micael. (2015). Common genetic variants influence human subcortical brain structures. *Nature*, 520(7546), 224-229.
- Hollander, E, Stein, DJ, Broatch, J, Himelein, C, & Rowland, C. (1997). A pharmacoeconomic and quality of life study of obsessive-compulsive disorder. *CNS Spectr*, 2, 16-25.
- Hollander, Eric, Stein, Dan J, Kwon, Jee H, Rowland, Clayton, Wong, Cheryl M, Broatch, James, & Himelein, Carol. (1997). Psychosocial function and economic costs of obsessive-compulsive disorder. *CNS spectrums*, 2(10), 16-25.
- Jelinek, Lena, Hauschildt, Marit, Hottenrott, Birgit, Kellner, Michael, & Moritz, Steffen. (2018). "Association splitting" versus cognitive remediation in obsessive-compulsive disorder: A randomized controlled trial. *Journal of anxiety disorders*, 56, 17-25.
- Karno, Marvin, Golding, Jacqueline M, Sorenson, Susan B, & Burnam, M Audrey. (1988). The epidemiology of obsessive-compulsive disorder in five US communities. *Archives of general psychiatry*, 45(12), 1094-1099.
- Kashyap, Himani, Kumar, J Keshav, Kandavel, Thennarasu, & Reddy, YC Janardhan. (2013). Neuropsychological functioning in obsessive-compulsive disorder: are executive functions the key deficit? *Comprehensive Psychiatry*, 54(5), 533-540.
- Kashyap, Himani, Kumar, JK, Kandavel, Thennarasu, & Reddy, YC Janardhan. (2012). Neuropsychological correlates of insight in obsessive-compulsive disorder. *Acta Psychiatrica Scandinavica*, 126(2), 106-114.
- Keshavan, Matcheri S, Vinogradov, Sophia, Rumsey, Judith, Sherrill, Joel, & Wagner, Ann. (2014). Cognitive training in mental disorders: update and future directions. *American Journal of Psychiatry*, 171(5), 510-522.
- Kim, Jung K, & Kang, Yeonwook. (1999). Brief report normative study of the Korean-California Verbal Learning Test (K-CVLT). *The Clinical Neuropsychologist*, 13(3), 365-369.
- Kishore, V Ravi, Samar, R, Reddy, YC Janardhan, Chandrasekhar, CR, & Thennarasu, K. (2004). Clinical characteristics and treatment response in poor and good insight obsessive-compulsive disorder. *European Psychiatry*, 19(4), 202-208.
- Lacerda, Acioly LT, Dalgalarondo, Paulo, Caetano, Dorgival, Haas, Gretchen L, Camargo, Edwaldo E, & Keshavan, Matcheri S. (2003). Neuropsychological performance and regional cerebral blood flow in obsessive-compulsive disorder. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 27(4), 657-665.
- Levine, BRIAN, Robertson, Ian H, Clare, LINDA, Carter, GINA, Hong, JULIA, Wilson, Barbara A, . . . Stuss, Donald T. (2000). Rehabilitation of executive functioning: An experimental-clinical validation of Goal Management Training. *Journal of the International Neuropsychological Society*, 6(3), 299-312.
- Levy, Neil. (2018). Obsessive-compulsive disorder as a disorder of attention. *Mind & Language*, 33(1), 3-16.

- Lezak, Muriel Deutsch, Howieson, Diane B, Loring, David W, & Fischer, Jill S. (2004). *Neuropsychological assessment*: Oxford University Press, USA.
- Lovibond, Peter F, & Lovibond, Sydney H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour research and therapy*, 33(3), 335-343.
- Macy, Alexandra S, Theo, Jonathan N, Kaufmann, Sonia CV, Ghazzaoui, Rassil B, Pawlowski, Paul A, Fakhry, Hala I, . . . IsHak, Waguih William. (2013). Quality of life in obsessive compulsive disorder. *CNS spectrums*, 18(1), 21-33.
- Meier, Sandra M, Mattheisen, Manuel, Mors, Ole, Schendel, Diana E, Mortensen, Preben B, & Plessen, Kerstin J. (2016). Mortality among persons with obsessive-compulsive disorder in Denmark. *JAMA psychiatry*, 73(3), 268-274.
- Moritz, Steffen, Jelinek, Lena, Klinge, Ruth, & Naber, Dieter. (2007). Fight fire with fireflies! Association splitting: A novel cognitive technique to reduce obsessive thoughts. *Behavioural and Cognitive Psychotherapy*, 35(5), 631-635.
- Moritz, Steffen, Wess, Nathalie, Treszl, András, & Jelinek, Lena. (2011). The attention training technique as an attempt to decrease intrusive thoughts in obsessive-compulsive disorder (OCD): From cognitive theory to practice and back. *Journal of Contemporary Psychotherapy*, 41(3), 135-143.
- Muller, Jeffrey, & Roberts, John E. (2005). Memory and attention in obsessive-compulsive disorder: a review. *Journal of anxiety disorders*, 19(1), 1-28.
- Murray, Christopher JL, Lopez, Alan D, & Organization, World Health. (1996). *The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020: summary*: World Health Organization.
- Nedeljkovic, Maja, & Kyrios, Michael. (2007). Confidence in memory and other cognitive processes in obsessive-compulsive disorder. *Behaviour research and therapy*, 45(12), 2899-2914.
- Olesen, Jes, Gustavsson, Anders, Svensson, Mikael, Wittchen, H-U, Jönsson, B, Group, CDBE Study, & Council, European Brain. (2012). The economic cost of brain disorders in Europe. *European journal of neurology*, 19(1), 155-162.
- Page, Matthew J, McKenzie, Joanne E, Bossuyt, Patrick M, Boutron, Isabelle, Hoffmann, Tammy C, Mulrow, Cynthia D, . . . Brennan, Sue E. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Bmj*, 372.
- Papageorgiou, Costas, & Wells, Adrian. (2004). *Depressive rumination: Nature, theory and treatment*: John Wiley & Sons.
- Park, Hee Soo, SHIN, YONG-WOOK, Ha, Tae Hyon, Shin, Min Sup, Kim, Young Youn, Lee, Young Ho, & Kwon, Jun Soo. (2006). Effect of cognitive training focusing on organizational strategies in patients with obsessive-compulsive disorder. *Psychiatry and Clinical Neurosciences*, 60(6), 718-726.
- Penades, R, Catalan, R, Rubia, K, Andres, S, Salamero, M, & Gasto, C. (2007). Impaired response inhibition in obsessive compulsive disorder. *European Psychiatry*, 22(6), 404-410.
- Perna, Giampaolo, Cavedini, Paolo, Harvey, Philip D, Di Chiaro, Nunzia Valentina, Daccò, Silvia, & Caldirola, Daniela. (2016). Does neuropsychological performance impact on real-life functional achievements in obsessive-compulsive disorder? A preliminary study. *International journal of psychiatry in clinical practice*, 20(4), 224-231.
- Pigott, Teresa A, & Seay, Sheila M. (1999). A review of the efficacy of selective serotonin reuptake inhibitors in obsessive-compulsive disorder. *The Journal of clinical psychiatry*, 60(2), 101-106.
- Purcell, Rosemary, Maruff, Paul, Kyrios, Michael, & Pantelis, Christos. (1998). Neuropsychological deficits in obsessive-compulsive disorder: a comparison with unipolar depression, panic disorder, and normal controls. *Archives of General Psychiatry*, 55(5), 415-423.

- Rao, Naren P, Reddy, YC Janardhan, Kumar, Keshav J, Kandavel, Thennarasu, & Chandrashekar, CR. (2008). Are neuropsychological deficits trait markers in OCD? *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 32(6), 1574-1579.
- Rao, Naren Prahlada, Arasappa, Rashmi, Reddy, Nalini Narayana, Venkatasubramanian, Ganesan, & Reddy, YC Janardhan. (2010). Emotional interference in obsessive-compulsive disorder: A neuropsychological study using optimized emotional Stroop test. *Psychiatry research*, 180(2-3), 99-104.
- Roberts, Marion E, Barthel, Friederike M-S, Lopez, Carolina, Tchanturia, Kate, & Treasure, Janet L. (2011). Development and validation of the Detail and Flexibility Questionnaire (DFlex) in eating disorders. *Eating behaviors*, 12(3), 168-174.
- Sasson, Yehuda, Zohar, Joseph, Chopra, Miriam, Lustig, Michal, Iancu, Iulian, & Hendler, Talma. (1997). Epidemiology of obsessive-compulsive disorder: a world view. *Journal of Clinical Psychiatry*, 58(12), 7-10.
- Savage, Cary R, Baer, Lee, Keuthen, Nancy J, Brown, Halle D, Rauch, Scott L, & Jenike, Michael A. (1999). Organizational strategies mediate nonverbal memory impairment in obsessive-compulsive disorder. *Biological psychiatry*, 45(7), 905-916.
- Savage, Cary R, Deckersbach, Thilo, Wilhelm, Sabine, Rauch, Scott L, Baer, Lee, Reid, Tracey, & Jenike, Michael A. (2000). Strategic processing and episodic memory impairment in obsessive compulsive disorder. *Neuropsychology*, 14(1), 141.
- Segalas, Cinto, Alonso, Pino, Labad, Javier, Jaurrieta, Nuria, Real, Eva, Jiménez, Susana, . . . Vallejo, Julio. (2008). Verbal and nonverbal memory processing in patients with obsessive-compulsive disorder: Its relationship to clinical variables. *Neuropsychology*, 22(2), 262.
- Shalbafan, Mohammadreza, Malekpour, Farzaneh, Tadayon Najafabadi, Borna, Ghamari, Kiandokht, Dastgheib, Seyed-Ali, Mowla, Arash, . . . Akhondzadeh, Shahin. (2019). Fluvoxamine combination therapy with tropisetron for obsessive-compulsive disorder patients: A placebo-controlled, randomized clinical trial. *Journal of Psychopharmacology*, 33(11), 1407-1414.
- Shavitt, Roseli G, Belotto, Cristina, Curi, Mariana, Hounie, Ana G, Rosário-Campos, Maria C, Diniz, Juliana B, . . . Miguel, Eurípedes C. (2006). Clinical features associated with treatment response in obsessive-compulsive disorder. *Comprehensive psychiatry*, 47(4), 276-281.
- Sheehan, DV. (1983). Sheehan disability scale. *Handbook of psychiatric measures*, 2, 100-102.
- Shin, Min-Sup, Park, Sun-Young, Park, Se-Ran, Seol, Soon-Ho, & Kwon, Jun Soo. (2006). Clinical and empirical applications of the Rey-Osterrieth complex figure test. *Nature protocols*, 1(2), 892-899.
- Simblett, Sara K, & Bateman, Andrew. (2011). Dimensions of the Dysexecutive Questionnaire (DEX) examined using Rasch analysis. *Neuropsychological rehabilitation*, 21(1), 1-25.
- Snyder, Hannah R, Kaiser, Roselinde H, Warren, Stacie L, & Heller, Wendy. (2015). Obsessive-compulsive disorder is associated with broad impairments in executive function: A meta-analysis. *Clinical Psychological Science*, 3(2), 301-330.
- Stamenova, Vessela, & Levine, Brian. (2018). Effectiveness of goal management training® in improving executive functions: A meta-analysis. *Neuropsychological rehabilitation*.
- Suhas, Satish, & Rao, Naren P. (2019). Neurocognitive deficits in obsessive-compulsive disorder: A selective review. *Indian journal of psychiatry*, 61(Suppl 1), S30.
- Tarafder, Sreemoyee, Bhattacharya, Pallabi, Paul, Debika, Bandyopadhyay, Gautam, & Mukhopadhyay, Pritha. (2006). Neuropsychological disposition and its impact on the executive functions and cognitive style in patients with obsessive-compulsive disorder. *Indian Journal of Psychiatry*, 48(2), 102.
- Tchanturia, K, Davies, H, Reeder, C, & Wykes, T. (2010). Cognitive remediation programme for anorexia nervosa: a manual for practitioners. *London: Institute of Psychiatry*.

- Tükel, Raşit, Gürvit, Hakan, Ertekin, Banu Aslantaş, Oflaz, Serap, Ertekin, Erhan, Baran, Bengi, . . . Atalay, Figen. (2012). Neuropsychological function in obsessive-compulsive disorder. *Comprehensive psychiatry*, 53(2), 167-175.
- Üstün, T Bedirhan, Chatterji, Somnath, Kostanjsek, Nenad, Rehm, Jürgen, Kennedy, Cille, Epping-Jordan, Joanne, . . . Pull, Charles. (2010). Developing the World Health Organization disability assessment schedule 2.0. *Bulletin of the World Health Organization*, 88, 815-823.
- Van den Heuvel, Odile A, Veltman, Dick J, Groenewegen, Henk J, Witter, Menno P, Merkelbach, Jille, Cath, Danielle C, . . . van Dyck, Richard. (2005). Disorder-specific neuroanatomical correlates of attentional bias in obsessive-compulsive disorder, panic disorder, and hypochondriasis. *Archives of general psychiatry*, 62(8), 922-933.
- van Passel, Boris, Danner, Unna N, Dingemans, Alexandra E, Aarts, Emmeke, Sternheim, Lot C, Becker, Eni S, . . . Cath, Daniëlle C. (2020). Cognitive remediation therapy does not enhance treatment effect in obsessive-compulsive disorder and anorexia nervosa: a randomized controlled trial. *Psychotherapy and psychosomatics*, 89(4), 228-241.
- Viswanath, Biju, Reddy, YC Janardhan, Kumar, Keshav J, Kandavel, Thennarasu, & Chandrashekar, CR. (2009). Cognitive endophenotypes in OCD: a study of unaffected siblings of probands with familial OCD. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 33(4), 610-615.
- Wechsler, David. (2001). *Wechsler Test of Adult Reading: WTAR*: Psychological Corporation.
- Wells, Adrian. (2007). The attention training technique: Theory, effects, and a metacognitive hypothesis on auditory hallucinations. *Cognitive and Behavioral Practice*, 14(2), 134-138.
- Yum, TH, Park, YS, Oh, KJ, Kim, JG, & Lee, YH. (1992). The manual of Korean-Wechsler adult intelligence scale. *Seoul: Korea Guidance*.