The efficacy of exposure and response prevention for Obsessive-Compulsive Disorder and Tourette Syndrome: A meta-analysis

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Research article

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Abstract

Background

Exposure and response prevention (ERP) is a form of cognitive behavioral therapy (CBT) that can effectively relieve obsessive-compulsive symptoms and tic symptoms in patients with obsessive-compulsive disorder (OCD) and Tourette syndrome (TS). However, the effect size of ERP is still unclear.

Methods

In this study, we performed a meta-analysis to identify the efficacy of ERP for individuals with OCD and TS. The standard mean difference (SMD) with a 95% confidence interval (CI) was calculated to assess the effect size of the efficacy for ERP. We used subgroup and meta-regression analysis to explore the heterogeneity of the pooled SMD of ERP for OCD.

Results

A total of 17 studies including a total of 926 patients with OCD and 66 patients with TS were identified. We observed a small-to-medium effect size of ERP for both OCD (SMD = -0.21, 95% CI: -0.47 to 0.06) and TS (SMD = -0.26, 95% CI: -0.75 to 0.22).

Conclusions

In conclusion, we found that ERP is effective for patients with OCD and TS. We suggest a combination with other therapies and the development of online ERP services that might prove a promising new direction for healthcare providers.

Background

Obsessive–compulsive disorder (OCD) is a chronic psychiatric disorder characterized by distressing and time-consuming obsessions and compulsions [1]. Obsessions are defined as intrusive and unwanted thoughts, urges, or images, and they are followed by compulsions, which aim to relieve these “uncomfortable feelings” [1, 2]. It is reported that the lifetime prevalence of OCD is about 1–3% [3, 4]. Patients are often affected by obsessions and compulsions that interfere in social, at home, educational attainment, and occupational aspects [1, 5].

Exposure and response prevention (ERP) is based on the cognitive behavioral therapy (CBT) and is the primary psychological treatment for OCD in children, adolescents, and adults [6–10]. ERP involves exposure to feared obsessional stimuli, while refraining from engaging in compulsive behaviors [11]. Research indicates that about 60–85% of patients who complete ERP treatment see significant success in alleviating obsessive-compulsive symptoms [12–14]. Moreover, CBT (including ERP) is recommended as the first-line treatment for mild-to-moderate OCD in youth [15]. Although serotonin reuptake inhibitors (SRIs) are effective in reducing symptoms compared with placebo, only moderate effect sizes are found when compared to CBT (including ERP) [9, 16]. Recently, it was reported that patient dropout rate for ERP was 10.24%, whereas patient dropout rate for pharmacotherapy was 17.29% [17]. Interestingly, the same study found that patients who did not respond to SRI augmentation with risperidone or placebo showed significant reductions in OCD symptoms and depression when treated with ERP, as well as better quality of life and social functioning [18]. However, ERP-based CBT has no or only partial improvement for many young patients with OCD. For example, one study found that 60% of patients in a ERP-based CBT condition failed to demonstrate clinical remission in a large RCT for children and adolescents with OCD [19]. Although about 60% of patients to complete treatment improved, only 25% of patients were asymptomatic [20]. This suggests that most patients treated with ERP continue to experience OCD symptoms [21]. Based on these studies, the efficacy of ERP in still unclear and the factors influencing ERP need to be explored.

Furthermore, ERP is applied not only in patients with OCD but also in patients with Tourette syndrome (TS). TS is characterized by sudden motor movements and/or vocalizations (referred to as tics) for at least 12 months [22]. It has been reported that the worldwide prevalence of TS is nearly 1% [23]. ERP has also been recommended as a first-line behavioral therapy in American, Canadian and European guidelines for tic disorders [24–26]. However, whether the efficacy of ERP for TS is as well as the habit reversal training for TS, which is the most common behavioral therapy [27], it needs to be clarified.

Therefore, in the current meta-analysis, we attempted to identify the efficacy of ERP for OCD and TS. A meta-analysis method provides the opportunity to statistically combine results of comparable trials [28], and we included CBT studies based on ERP in our analyses. We used meta-regression and subgroup to determine potential heterogeneities in these approaches.

Methods

Identification of included studies

An extensive literature search was conducted in the following databases: PubMed, Web of Science, PsycINFO, and Google Scholar. We only considered studies published before November 1, 2019. The search terms were as follows: “obsessive compulsive disorder” or “OCD” or obsessive/compulsive” or “Tourette’s syndrome or tics or tic orders,” and “cognitive behavior therapy” or “exposure and response” or “exposure and ritual prevention,” or “ERP” or “EX/RP” or “psychotherapy.” References of related articles were also searched for any other relevant studies.

Inclusion criteria were as follows:
(1) ERP or CBT based on ERP;

(2) the symptoms of OCD measured by a validated scale, such as the Yale-Brown Obsessive-Compulsive Symptom Scale (Y-BOCS) [29] or the Children's Yale-Brown Obsessive-Compulsive Scale (CY-BOCS) [30], and the Yale Global Tic Severity Scale (YGTSS) was used to assess the tic symptoms;

(3) the Y-BOCS/ CY-BOCS or YGTSS was used to assess the efficacy of ERP; and

(4) written in English.

Exclusion criteria were as follows:

(1) no Y-BOCS/CY-BOCS data or YGTSS data;

(2) studies combined ERP with another type of behavioral therapy; (3) articles with duplicate records; and

(4) articles such as case reports, editorials, comments, and review papers.

Notably, Y-BOCS/CY-BOCS score range of severity for patients who have both obsession and compulsions was categorized as follows: mild OCD (< 13); moderate OCD (13–22), severe OCD (> 22) [30] (Fig. 1: Flowchart of the identification of the included studies). This meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to identify the included studies [31].

INSERT Fig.1

Quality assessment for included studies

The quality of each study was assessed by the modified Jadad scale [32]. Each study was evaluated using the following criteria: randomization, blinding strategy, withdrawals/dropouts, inclusion/exclusion criteria, adverse effects, and statistical analysis. Two authors (Junjuan Yan and Ying Li) independently scored each included trial, and discussed among each other to reach consensus on any differences (Table 1).

INSERT Table 1 (Jadad scale)

Data Extraction

We identified a total of 15 studies including 926 patients diagnosed with OCD. Two studies included 66 patients diagnosed as TS were included. Both children and adult patients were included. We extracted the following information from the included studies: authors, publication years, mean ages, numbers of males/females, sample sizes, diagnostic criteria, comparison group, online or face to face, outcome measurements, baseline of Y-BOCS/CY-BOCS value and YGTSS value, and the numbers of therapy sessions were all extracted from the included studies (Table 2).

INSERT Table 2 (The included studies)

Statistic analysis

A randomized effects model was used to examine the standard mean difference (SMD) of ERP. If the SMD was between 0.2 and 0.5, it meant the efficacy of ERP was mild-to-moderate, whereas SMD values between 0.5 and 0.8 indicated that the efficacy of ERP was moderate-to-large [33]. The $I^2$ and forest plots were used to identify the heterogeneity of ERP. If $I^2$ was greater than 50%, we used a random effects model [34]. We then used subgroup and meta-regression analyses to explore heterogeneities in the effect size for ERP. We considered a $p$ value < 0.05 to be statistically significant, and all of the analyses were performed in R (version 3.5.3) using the “meta” or “metafor” packages.

Results

The effect size of ERP

The pooled SMD of ERP for OCD was $-0.21$ (95% CI: -0.47 to 0.06) with a heterogeneity ($I^2$) of 71.2% (95% CI: 51.5%–82.9%, $p < 0.01$) based on random effects model. The pooled SMD of ERP for TS was $-0.26$ (95% CI: -0.75 to 0.22) with a heterogeneity ($I^2$) of 0% ($p = 0.90$) by a random effects model (Fig. 2).

INSERT Fig. 2 (combined)

Sensitivity analysis and publication bias

We used sensitivity analysis to explore the heterogeneity of the pooled SMD of ERP for OCD. This method omits one study at a time and tracks the change in $I^2$ to identify the contribution of each study to the heterogeneity [35]. In doing so, we observed changes in $I^2$ to be no more than 5% (Supplemental Fig. 1). Moreover, we did not observe any indication of publication bias using Egger's funnel plot ($p = 0.55$) (Supplemental Fig. 2).

Subgroup analysis

A subgroup analysis of the pooled SMD of ERP for OCD was conducted to identify the potential source of heterogeneity by different comparisons of ERP and different age groups. For the different comparisons of ERP, the heterogeneity was found in both the behavior/cognitive therapy (BT/CT) subgroup ($I^2 = 76.4, p$...
< 0.01) and medicine subgroup \((I^2 = 68.4\%, p < 0.01)\). Furthermore, we found no heterogeneity of ERP for OCD between the two groups \((p = 0.46)\) (Fig. 3). For the subgroup analysis of the different age groups, it found that the heterogeneity was in both adults \((I^2 = 67.8\%, p < 0.01)\) and children \((I^2 = 71.4\%, p < 0.01)\), but we found no significant heterogeneity between the two subgroups \((p = 0.27)\) (Fig. 4).

**Discussion**

In this study, we conducted a meta-analysis to identify the efficacy of ERP for OCD and TS. A small-to-moderate effect size of ERP was found in the experimental groups compared to the control groups. The effect sizes were comparable with the medicine (i.e. risperidone, fluoxetine, clomipramine, and sertraline) and other behavior therapies. The results therefore indicate that ERP can be effective in alleviating obsessive-compulsive and tic symptoms.

In this present study, we found that the ERP for OCD can be applied in both adults and children. For example, in a randomized controlled trial, ERP based CBT alone did not differ from sertraline alone \((p = 0.24)\) after 12 weeks of treatment in OCD patients aged 7 through 17 years [19]. For adults patients with OCD, ERP has been found to be comparable to first-line pharmacological treatments (e.g., SRI) [11]. But whether the ERP for OCD showed differences between the children and adults, more studies including different age groups are needed in the future. Moreover, it should be noted that, the \(I^2\) of the pooled SMD of ERP for OCD was 73% (95% CI: 53.4–84.6%, \(p < 0.01\)), suggesting substantial heterogeneity. In follow-up analyses, however, no associated factors were found to significantly explain the heterogeneity. The potential reasons need to be explored in future studies.

Currently, the modifications of the CBT formats, such as CBT augmented with d-cycloserine [36], internet-delivered treatments [37], video teleconferencing methods [38], and the Bergen 4-day treatment (B4DT) [39], were also used in OCD patients. The modifications of ERP programs based on different individual needs may require further investigation in the future. Many patients with OCD have no access to ERP [40], and possible barriers include clinician-related factors, aspects of the phenomenology of OCD, willingness to experience unpleasant sensations during ERP, financial barriers, and geographical factors [41, 42]. Several options of accessing the online CBT have been developed in order to make it easier to access this treatment [43, 44], but further research is needed to extend the reach of ERP online. Furthermore, more research is needed regarding the long-term efficacy of ERP, as longer treatment durations may yield reduced OCD symptoms. The potential benefits of combination of behavioral therapy and pharmacotherapy are also required to help patients nonresponsive to monotherapy or with severe OCD.

In this study, we found evidence to support the efficacy of ERP for reducing obsession-compulsion and tic symptoms. Behavioral therapy and SRIs were found to be comparable in improving the symptoms in adults with OCD among three head-to-head RCTs [45], and ERP also exhibited comparable reductions in tic severity with habit reversal therapy (HRT) [46–48]. It appears that the mechanisms that underlie the treatment of OCD and tic disorders are similar to some extent. Indeed, OCD and TS overlap in many aspects, such as their clinical phenomenology and tendency to co-occur in affected individuals. A tic-related OCD subtype in the Diagnostic and statistical manual of mental disorders, fifth edition (DSM-5) may occur in 10–40% of patients diagnosed with childhood OCD [1, 49], and approximately 25–50% of patients with TS meet criteria for OCD [50, 51]. Similarly, about 30% of patients with OCD have a history of combined TS [52, 53]. Both animal studies and neuroimaging studies suggest that abnormal function of cortical basal ganglia circuitry results in tics and compulsive behaviors [54–56]. The abnormalities of the dopaminergic system may be the common pathophysiologic mechanism of TS and OCD [57], and based on these similarities, it is perhaps not surprising that ERP was not only effective for the mild-to-moderate OCD and TS, but may be also a promising behavior therapy for the tic-related OCD subtype.

In addition, we additionally found that the effect size of ERP for TS was comparable with the Habit reversal therapy (HRT). Patients with tic disorder are trained to endure the premonitory urges (PUs), or “uncomfortable bodily feelings,” a longing to make things “just right” [58, 59] in order to suppress tic symptoms in ERP. The long period of time exposed to the unpleasant sensation and to resist the tic symptoms, the patients will learn to endure the sensation [24]. HRT is another form of CBT, which is effective for the treatment of tic disorder and includes awareness training, relaxation training, and competing-response training as its core procedures. ERP and HRT are both recommended as first-line behavioral treatments for tic disorder [24, 25, 60], and the combination of the two maybe a new direction for behavior therapy in the future.

In addition to OCD and TS, ERP has also been applied to the anorexia nervosa, body dysmorphic disorder, anxiety disorder, hypochondriasis, and repetitive behaviors in autism [8, 61–65].

Several limitations are needed to be noted. First, the included studies and sample size are limited, and this might reduce the credibility of the results. Second, the validated scales for OCD were restricted in widely used scales of Y-BOCS and CY-BOCS, and the studies applied the other scales were not included. Third, the studies included not only the ERP but also the ERP based CBT, this might increase the heterogeneity of the data. Despite these limitations, this study provided evidence that the treatment effect of ERP to OCD and TS.

**Conclusion**
In summary, we identified a small-to-medium effect size of ERP to relieve obsessive-compulsive and tic disorders. We suggest that combining ERP with other therapies and online service might be an ideal direction for ERP in the future, in addition to more studies to identify the efficacy of ERP in alleviating symptoms of OCD and TS.

**Abbreviations**


**Declarations**

**Ethics approval and consent to participate**

Not applicable.

**Consent for publication**

Not applicable.

**Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Competing interests**

None of the authors has any conflicts of interest to disclose.

**Competing interests**

All of the authors declare that they have no competing interests.

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**Authors’ contributions**

For this manuscript, YC took the initiative. FW( Fang Wen), LY, FW(Fang Wang), LJ and MW finished the data collection. YL performed the data analysis and JY finished the draft. All authors have read and approved the manuscript.

**Acknowledgments**

Thanks very much to all participants involved in this study.

**References**


Efficacy of Augmentation of Cognitive Behavior Therapy With Weight-Adjusted d-Cycloserine vs Placebo in Pediatric Obsessive-Compulsive Disorder: A Randomized Clinical Trial. JAMA


### Tables

#### Table 1. The Modified Jadad scores of the included studies

<table>
<thead>
<tr>
<th>Published Year</th>
<th>Was the research described as randomized?</th>
<th>Was the approach of randomization appropriate?</th>
<th>Was the research described as blinding?</th>
<th>Was the approach of blinding appropriate?</th>
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<th>Was there a presentation of the inclusion/exclusion criteria?</th>
<th>Was the approach used to assess adverse effects described?</th>
<th>Was the approach of statistical analysis described?</th>
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#### Table 2. The Included Studies
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<th>Sample Size</th>
<th>Comparison Group</th>
<th>Outcome or Face to face</th>
<th>Outcome measurements</th>
<th>Baseline Y-BOCS/CY-BOCS or YGTSS</th>
<th>Sessions</th>
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<td>Kyrillos¹</td>
<td>2018</td>
<td>32.59 ± 9.86; IPRT: 34.23 ± 9.88</td>
<td>DSM-IV-TR</td>
<td>61/117</td>
<td>IPRT</td>
<td>Online</td>
<td>Y-BOCS, GAF, HAM-D, HAM-A</td>
<td>EPR: 22.58 ± 5.53; IPRT: 22.22 ± 5.76</td>
<td>12 sessions/12 weeks</td>
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<td>Peris²</td>
<td>2017</td>
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<td>DSM-IV-TR</td>
<td>35/27</td>
<td>PFIT</td>
<td>Face to Face</td>
<td>CY-BOCS, CGI, COG- RPFA, FES PABS</td>
<td>EPR: 25.43 ± 3.33; PFIT: 25.53 ± 3.72</td>
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<tr>
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<td>33.31 ± 15.37; EMDR: 30.90 ± 9.79</td>
<td>DSM-IV</td>
<td>21/34</td>
<td>EMDR</td>
<td>Face to Face</td>
<td>Y-BOCS, OC/LPHQ-9, GAD-7, WSAS</td>
<td>EPR: 26.65 ± 6.61; EMDR: 25.07 ± 6.23</td>
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<td>34.47 ± 13.09; RIS: 42.5 ± 11.73</td>
<td>DSM-IV</td>
<td>17/21</td>
<td>RIS</td>
<td>Face to Face</td>
<td>Y-BOCS, HDRS</td>
<td>EPR: 27.5 ± 3.88; RIS: 24.13 ± 4.29</td>
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<td>DSM-IV</td>
<td>34/15</td>
<td>SSRI</td>
<td>Face to Face</td>
<td>Y-BOCS, HDRS, HARS, Q-LES-Q, SAS-SR</td>
<td>EPR: 25.1 ± 4.7; SMT: 26.4 ± 4.7</td>
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<td>DSM-IV</td>
<td>11/18</td>
<td>Fluoxetine</td>
<td>Face to Face</td>
<td>Y-BOCS, DYS, BDI, BAI</td>
<td>EPR: 27.3 ± 5.2; Fluoxetine: 23.5 ± 4.9</td>
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<td>39.94 ± 11.1; SSRI: 34.12 ± 10.6</td>
<td>DSM-IV</td>
<td>71/87</td>
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<td>Y-BOCS</td>
<td>EPR: 25.97 ± 5.48; SSRI: 25.82 ± 5.10</td>
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<td>Face to Face</td>
<td>Y-BOCS, Padua, CIQ, BAI, BDI</td>
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<td>CBT</td>
<td>Face to Face</td>
<td>Y-BOCS, BDI</td>
<td>EPR: 21.66 ± 5.9; CBT: 23.50 ± 4.3</td>
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<td>19/46</td>
<td>CLOM</td>
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<td>Y-BOCS, CGI</td>
<td>EPR: 24.6 ± 4.8; CLOM: 26.3 ± 4.4</td>
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<td>6/14</td>
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<td>Y-BOCS, CGI, S, GAF, HAM-A/D</td>
<td>E/RP: 29.9 ± 3.1; FLV: 28.4 ± 3.8</td>
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<tr>
<td>POTSM¹²</td>
<td>2004</td>
<td>11.4 ± 2.8; Sertraline: 11.7 ± 2.4</td>
<td>DSM-IV</td>
<td>31/25</td>
<td>Sertraline</td>
<td>Face to Face</td>
<td>CY-BOCS, CGI</td>
<td>EPR: 26.0 ± 4.7; Sertraline: 22.5 ± 4.7</td>
<td>12 sessions/12 weeks</td>
</tr>
<tr>
<td>de Haan¹³</td>
<td>1998</td>
<td>13.25 ± 2.73; CLOM: 14.28 ± 3.19</td>
<td>DSM-IIR</td>
<td>11/11</td>
<td>CLOM</td>
<td>Face to Face</td>
<td>CY-BOCS, LOI-CV</td>
<td>EPR: 21.5 ± 5.9; CLOM: 23.8 ± 7.2</td>
<td>12 sessions/12 weeks</td>
</tr>
<tr>
<td>van Balkom¹⁴</td>
<td>1998</td>
<td>13.25 ± 2.78; CT: 14.28 ± 3.19</td>
<td>DSM-IIR</td>
<td>17/19</td>
<td>CT</td>
<td>Face to Face</td>
<td>CY-BOCS, BD, SCL-90</td>
<td>EPR: 25.0 ± 7.9; CLOM: 25.3 ± 6.6</td>
<td>16 sessions/16 weeks</td>
</tr>
<tr>
<td>de Haan¹⁵</td>
<td>1997</td>
<td>N/A</td>
<td>DSM-IIR</td>
<td>47</td>
<td>Cognitive</td>
<td>Face</td>
<td>Y-BOCS, SCL-90</td>
<td>EPR: 24.7 ±</td>
<td>16</td>
</tr>
</tbody>
</table>


**Table 3 Results of Meta-regression Analysis of the pooled SMD of ERP for OCD**

<table>
<thead>
<tr>
<th>Predictors</th>
<th>tau²</th>
<th>ℓ²</th>
<th>φ²</th>
<th>R²</th>
<th>The Test of Moderators (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication Year</td>
<td>0.218</td>
<td>76.5%</td>
<td>4.26</td>
<td>0.00%</td>
<td>0.129</td>
</tr>
<tr>
<td>Mean Age</td>
<td>0.191</td>
<td>74.36%</td>
<td>3.94</td>
<td>3.98%</td>
<td>0.318</td>
</tr>
<tr>
<td>Male%</td>
<td>0.219</td>
<td>76.82%</td>
<td>4.31</td>
<td>0.00%</td>
<td>0.957</td>
</tr>
</tbody>
</table>

**Figures**

**Figure 1**

ERP for Patients with OCD

![Figure 2](image)

**Figure 2**

Forest plots of the meta-analysis of efficacy for ERP.

- For Patients with OCD:

- For Patients with TD:
  - **Study:** Andren 2018, Verdileen 2004.

**ERF for Patients with TD**

- **Study:** Andren 2018, Verdileen 2004.

**Fixed effect model**

**Random effects model**

- Heterogeneity: $I^2 = 71\%$, $t^2 = 0.1779$, $p < 0.01$
Figure 3
Forest plots of the subgroup analysis by different comparison for efficacy of ERP (medicine and BT/CT).

Figure 4
Forest plots of the subgroup analysis by age groups for efficacy of ERP (adults and children).

Supplementary Files
This is a list of supplementary files associated with this preprint. Click to download.

- PRISMA2009checklist.doc
- FunnelPlot.tiff
- Sensitiveanalysis.tiff