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Effectiveness of Mixed Reality-Based Exposure and Response Prevention Therapy in Reducing Clinical Symptoms in Individuals with Obsessive-Compulsive Disorder

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ABSTRACT

Objective: This study investigated the efficacy of mixed reality (MR)-assisted exposure and response prevention (ERP) therapy in alleviating obsessive-compulsive disorder (OCD) symptoms.

Methods: Using a quasi-experimental design, 40 individuals with OCD were selected via convenience sampling and randomly assigned to either an intervention group (n=20) receiving 12 sessions of MR-based ERP therapy or a control group (n=20) with no intervention. Symptom severity was assessed using the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) at pre-test, post-test, and six-month follow-up.

Results: Repeated measures ANOVA revealed a significant group × time interaction in obsession scores ($p < 0.001$, $\eta^2 = 0.395$). The intervention group exhibited a substantial reduction in symptoms from pre-test to post-test, with effects persisting at follow-up, while the control group showed no significant change.

Conclusions: Findings suggest that MR-enhanced ERP therapy is an effective and durable intervention for reducing OCD symptoms, supporting its integration into future treatment protocols.

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Introduction

In the contemporary era, psychological disorders and neurotic illnesses have emerged as some of the most significant public health and social challenges. These disorders, encompassing a wide range of conditions such as anxiety, depression, and obsessive–compulsive disorder (OCD), exert profound effects on individuals' quality of life (Goodman et al., 2014; Koran, 2001). Among them, OCD is recognized as one of the most complex and challenging psychological disorders, characterized by distressing obsessions and compulsions such as repeated washing and checking (Murayama et al., 2013). This condition significantly impairs daily functioning and poses substantial challenges to the personal and social lives of patients (Abramowitz et al., 2024; Guzick et al., 2021). Notably, during the COVID-19 pandemic, the prevalence of OCD symptoms increased markedly (Alblowi et al., 2023). Recent studies further indicate that the contamination subtype of OCD is strongly influenced by multiple factors, with the severity of the COVID-19 pandemic identified as a key predictor of heightened contamination symptoms (Özer et al., 2022). Moreover, various environmental factors, including infections, childhood trauma, stressful life events, brain injuries, and even genetic vulnerabilities, contribute to the onset and exacerbation of OCD, although candidate genes have yet to be conclusively identified (Raposo-Lima & Morgado, 2020). Accurate identification and validation of OCD symptoms through clinical observation can provide a deeper understanding of the disorder's complexity and inform more effective therapeutic approaches (Pinciotti et al., 2023). For example, a study conducted among patients suspected of COVID-19 at Razi Hospital in Ahvaz revealed higher levels of obsessive beliefs, depression, and anxiety compared to healthy individuals (Fakhri et al.). Furthermore, recent research has emphasized the importance of considering lifestyle factors in predicting changes in OCD symptoms and problematic repetitive behaviors (Brierley et al., 2023). Studies have shown that stigma and symptom severity in OCD are negatively associated with overall quality of life, general health, satisfaction with physical health, mental health, and social relationships, underscoring the disorder's pervasive impact on multiple dimensions of life (Kaur et al., 2023).

Advances in technology have given rise to innovative approaches in mental health care, including virtual reality (VR)–based psychological treatments. A more recent and sophisticated development is mixed reality (MR), which integrates virtual environments with real-world objects to provide a more immersive and comprehensive experience for patients. MR can support individuals in

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managing negative emotions such as disgust, anger, and anxiety while improving control over compulsive behaviors. In particular, MR-based exposure and response prevention (ERP) therapy has emerged as a promising innovation in mental health. While VR situates individuals within entirely simulated environments, MR merges virtual data with real objects to enable more realistic interactions, thereby enhancing therapeutic engagement (Efe, 2022).

The core mechanism of this therapeutic approach involves creating a controlled, realistic environment in which patients are gradually and safely exposed to anxiety-provoking stimuli. This process can target specific OCD symptoms and, through more realistic experiences, reduce negative affect while improving compulsive control. The author posits that MR can be effective because it allows patients to interact more precisely and naturally with their environment in a safe, controlled context, thereby alleviating anxiety-related responses and overcoming the limitations of traditional treatments—such as fear of exposure and the need for highly specialized clinical settings.

In this context, MR has been identified as a promising technology capable of delivering comprehensive therapeutic experiences (Lopez-Espada & Linares-Palomino, 2023). Research is actively exploring MR-based ERP for patients with OCD, particularly those with contamination-related symptoms, in order to improve treatment efficacy and patient acceptance (Lohse et al., 2023). Preliminary evidence suggests that MR-based ERP can yield outcomes comparable to standard care for contamination-related OCD, with positive initial findings that warrant further refinement of practical applications (Miegel et al., 2023). Moreover, the effectiveness of such approaches has been documented in treating anxiety disorders, depression, post-traumatic stress disorder, psychosis, and stress (Pira et al., 2023). VR-based exposure therapy, in particular, has been shown to effectively treat anxiety disorders by providing a safe, gradual exposure to anxiety-provoking stimuli (Rahman et al., 2023). Promising results have also been reported in the treatment of schizophrenia, neurodevelopmental disorders, and eating disorders (Kothgassner et al., 2023). Furthermore, VR-based exposure has been found to be as effective as traditional exposure therapy and cognitive–behavioral therapy (CBT) for anxiety disorders (Wray et al., 2023). As evidence-based interventions, exposure therapies involve gradually confronting feared situations or stimuli and have demonstrated efficacy for specific anxiety-related disorders (Kaplan & Tolin, 2011). Nevertheless, traditional ERP for OCD continues to face limitations such as patients' reluctance

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to engage in exposure and the requirement for advanced clinical expertise (Miegel et al., 2023). MR-based ERP presents a potential solution to these challenges, though further research is needed to confirm its acceptability and safety (Lohse et al., 2023).

These findings highlight the importance of addressing the limitations of conventional treatments and enhancing everyday coping skills in OCD therapy. They also underscore the potential of emerging technologies such as MR to provide innovative and effective therapeutic methods. Accordingly, the present study aims to address this research gap by investigating the fundamental question: Does mixed reality–based exposure and response prevention therapy reduce clinical symptoms in individuals with obsessive–compulsive disorder?

Material and Methods

This study employed a quasi-experimental design with a pretest–posttest format and independent groups. The therapeutic effect of exposure and response prevention (ERP) was examined in two distinct groups: an intervention group, which received the treatment, and a control group, which received no intervention. This design enabled a direct comparison between the effects of the treatment and the natural course of the disorder.

Participants were first assessed during the pretest phase. Following the implementation of the intervention, a posttest was conducted to evaluate changes in obsessive–compulsive disorder (OCD) symptoms. To assess the durability of treatment effects, a six-month follow-up was carried out precisely six months after the final therapy session, enabling an accurate measurement of long-term changes.

Symptom severity was assessed using validated instruments, including the Yale–Brown Obsessive–Compulsive Scale (Y-BOCS) (Goodman et al., 1989). The Y-BOCS assesses both obsessive and compulsive symptoms separately across five dimensions: time occupied, interference, distress, resistance, and control. It consists of 10 items—five assessing obsessions and five assessing compulsions—regardless of the specific OCD subtype (Mousavi Madani et al., 2010). The reliability of the Persian version has been well-established, with an inter-rater reliability of $r = 0.98$, internal consistency of $\alpha = 0.89$, and two-week test–retest reliability of $r = 0.84$ (Izadi & Abedi, 2013).

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Mixed Reality Headset and Software: A Meta Quest 3 mixed reality headset was used in this study, enabling patients to visualize virtual images and objects within the context of their real-world environment. This allowed exposure to OCD-relevant scenarios without requiring physical presence in actual contamination-related environments, thus creating a controlled, safe, and realistic therapeutic setting.

Therapy scenarios were designed, programmed, and developed by the researcher using the Unity game engine, with culturally adapted 3D models representing contamination-related stimuli specific to Iranian society. These scenarios were tailored to each patient, creating an immersive, personalized therapeutic environment.

At the beginning of each therapy session, the therapist loaded the relevant scenario into the Unity-based application. The environment included stimuli such as contaminated objects, dirty surfaces, or situations involving contact with pollutants, all designed to trigger the patient's obsessive thoughts. After adjusting the settings, the system was switched to patient mode, and the participant wore the headset to begin exposure.

During the session, the patient—physically present in the therapy room—was exposed to digital contamination-related elements overlaid on real surroundings. This allowed gradual, therapist-guided exposure to anxiety-provoking stimuli while refraining from compulsive behaviors. The exposure hierarchy was progressively intensified to build anxiety tolerance and strengthen coping skills. This technology also allowed precise tailoring of therapeutic content, ensuring a dynamic, individualized, and evidence-based intervention. Key advantages included accessibility, reproducibility, and the ability to simulate stimuli that would otherwise be impractical or prohibitively expensive to recreate in real life.

The study sample consisted of 40 participants, selected through convenience sampling in two stages:

1. Screening Stage – Individuals seeking psychological services were evaluated using the Y-BOCS (Goodman et al., 1989).
2. Selection Stage – Participants scoring at least two standard deviations above the mean (cut-off score of 16; Goodman et al., 1989) were included. Forty eligible individuals were randomly assigned to either the MR-based ERP intervention group (n = 20) or the control group (n = 20).

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Although experimental designs recommend a minimum of 15 participants per group (Delavar, 2013), convenience sampling was used due to the inability to recruit via random population sampling.

Inclusion criteria were:

- No severe psychological disorders (based on self-report and initial clinical interview)
- No alcohol or substance dependence
- No comorbid physical illnesses
- Not undergoing pharmacotherapy
- Non-chronic OCD
- Diagnosis of washing-type OCD based on DSM-5 criteria and Y-BOCS assessment
- Symptom duration of at least six months
- Age between 20 and 25 years
- Informed consent to participate

Exclusion criteria included:

- Missing more than three sessions
- Alcohol or substance dependence
- Comorbid psychiatric or physical disorders
- Concurrent participation in other pharmacological or psychotherapeutic treatments
- Withdrawal from the study for any reason

Structure and Procedure of the Intervention

A **novel mixed reality–based ERP protocol** was designed by the researcher and implemented over 12 weeks, with weekly sessions lasting 30–45 minutes. Participants were also assigned daily homework to be completed in their natural environments.

Initial sessions focused on:

- Psychoeducation about OCD
- An overview of cognitive–behavioral therapy principles
- Explanation of the rationale and benefits of MR-based ERP
- Technical training on using the mixed reality headset to prevent operational issues during later stages

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Subsequent sessions followed a gradual, anxiety-hierarchy-based exposure process. Using the MR headset, participants encountered contamination-related stimuli integrated into real clinical environments—for example, augmented images of dirt or simulated microbes overlaid on physical surfaces.

Sessions began with a review of homework and subjective anxiety ratings. During exposure, patients were encouraged—under close therapist supervision—to refrain from performing compulsions, thereby learning to tolerate anxiety without engaging in ritualistic behaviors. The intensity of stimuli was systematically increased over sessions to strengthen coping capacity. A detailed session-by-session treatment protocol is presented in Table 1.

Table 1. Summary of session-by-session treatment protocol

Session	Content
1. Introduction and initial assessment	Introduction to obsessive-compulsive disorder, explanation of the basics of cognitive behavioral therapy and the exposure and response inhibition approach based on mixed reality. Determination of treatment goals
2. Introduction to mixed reality technology	Learning how to use mixed reality (MR) devices; Introduction to mixed interactive environments. Explanation of how to integrate real and virtual elements to create treatment scenarios. Practice working with the system in a controlled environment.
3. Identification of anxiety-provoking stimuli and development of a hierarchy	A detailed examination of pollution-related stimuli based on personal experience; Compiling a list of stimuli from low to high and preparing an anxiety map.
4. Initial exposure to less harmful stimuli	Conducting exposure sessions in a mixed reality environment using augmented elements in the real environment; Focusing on less harmful stimuli to familiarize and reduce initial sensitivity.
5. Gradual increase in exposure intensity	Exposure to moderate stimuli by combining real and virtual images
6. Advanced exposure in a mixed environment	Implementing advanced scenarios with more intense stimuli; Focusing on preventing compulsive responses in the face of realistic contamination presented through augmented elements.
7. Integration of virtual and real exposure	Combining exposure sessions in a mixed environment with exposure exercises in the real world; Strengthening coping skills and transferring learning to daily life. Assignment: Perform small activities in a real environment and record the results obtained.
8. Strengthening self-efficacy and coping skills	Controlled exercises in a mixed environment with therapist supervision through gradual exposure to contamination stimuli.
9. Exposure to complex and multidimensional scenarios	Present complex scenarios that include a combination of several contamination stimuli with set goals and adjust coping strategies.
10. Consolidation of skills and ongoing practice	Re-practice advanced scenarios to consolidate learned skills; review feedback received and improve coping strategies based on past experiences.
11. Evaluation of progress and adjustment of individual strategies	Review the entire treatment course, assess progress through standard tools (obsession questionnaire); prepare a comprehensive progress report
12. Termination of treatment and prevention of symptom recurrence	Final session includes an overview of the treatment course, teaching strategies to prevent the return of symptoms

Results

Descriptive statistics (mean, standard deviation) and inferential statistics (repeated measures analysis of variance, RM-ANOVA) were employed to analyze the data, using **SPSS version 27**.

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As shown in Table 2, the intervention group exhibited a significant reduction in Y-BOCS scores from pretest to posttest, with this reduction largely maintained at the six-month follow-up. In contrast, the control group demonstrated no notable changes across the three measurement points.

Table 2. Means and Standard Deviations of Yale–Brown Obsessive–Compulsive Scale (Y-BOCS) Scores for Intervention and Control Groups at Pretest, Posttest, and Follow-up

Phase	Group	Mean	SD
Pretest	Control	27.40	2.80
Pretest	Intervention	27.95	3.03
Posttest	Control	26.35	3.98
Posttest	Intervention	20.60	3.15
Follow up	Control	26.05	4.41
Follow up	Intervention	21.60	3.99

To assess the assumption of homogeneity of variances, Levene's test was applied at all three time points. The results for pretest (p = 0.472), posttest (p = 0.513), and follow-up (p = 0.720) were non-significant, indicating that the assumption was met. Given that each group comprised 20 participants, RM-ANOVA is considered robust to moderate deviations from normality. Therefore, formal normality tests such as Shapiro–Wilk were not conducted. However, visual inspection of histograms and Q–Q plots confirmed no severe or systematic deviations from normality at any stage.

Table 3 presents the results of RM-ANOVA. A significant main effect of time was observed, indicating that Y-BOCS scores changed meaningfully across the three assessment points. A significant time × group interaction was also found, confirming that the intervention produced greater symptom reduction compared to the control condition.

Table 3. Repeated Measures ANOVA for Y-BOCS Scores

Effect	F	p	η^2
Phase (time)	48.71	< .001	0.562
Group * Time	24.81	< .001	0.395
Group	10.29	0.003	0.213

Bonferroni-adjusted pairwise comparisons (Table 4) revealed a significant reduction in Y-BOCS scores from pretest to posttest and from pretest to follow-up in the intervention group. However, the difference between posttest and follow-up was non-significant, suggesting relative stability of treatment effects over the six-month period.

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Table 4. Bonferroni Post Hoc Pairwise Comparisons for Y-BOCS Scores

Comparison	Mean difference	P
Pretest-Posttest	7.35	.000
Pretest-Follow up	6.35	.000
Posttest-Follow up	1.00	.296

The results indicate that the mixed reality–based exposure and response prevention (MR-ERP) intervention led to a statistically significant reduction in OCD symptoms among participants in the intervention group, with effects persisting at follow-up. These findings support the efficacy and durability of MR-ERP as a therapeutic approach for individuals with OCD, particularly those with contamination-related symptoms.

Discussion

The present study aimed to examine the efficacy of mixed reality–based exposure and response prevention (MR-ERP) in reducing symptoms of obsessive–compulsive disorder (OCD). The results demonstrated that this intervention led to a statistically significant reduction in symptoms within the intervention group, with the improvement largely maintained at follow-up. In contrast, the control group did not exhibit significant change. These findings align with previous research on the effectiveness of virtual reality interventions in the treatment of anxiety disorders, including the studies of Keshavarz et al. (2021), Mayer et al. (2022), and Rubin et al. (2022).

ERP achieves therapeutic benefit by providing controlled exposure to anxiety-provoking stimuli while preventing compulsive responses, thereby weakening the underlying anxiety. Integrating ERP with mixed reality offers additional advantages, as it enables the design of safe, highly tailored, and immersive simulated environments. This technological integration can enhance treatment effectiveness by overcoming barriers such as logistical challenges of real-life exposure and patient resistance to in vivo situations.

Furthermore, the congruence of the present findings with Zamanifard and Robb (2023) reinforces the innovative role of technology in the treatment of anxiety disorders. While a slight increase in symptom scores was observed at follow-up, this change was not statistically significant, suggesting relative stability of treatment effects over time. Nevertheless, the results underscore the importance of strengthening and sustaining therapeutic engagement after the conclusion of primary sessions to reduce the risk of relapse.

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Overall, mixed reality appears to be a novel, effective, and acceptable approach for the treatment of OCD. The present findings indicate that MR-ERP significantly reduces OCD symptoms, as reflected by substantial reductions in Yale–Brown Obsessive–Compulsive Scale (Y-BOCS) scores in the intervention group compared with the control group, with effects largely maintained at follow-up. These results suggest that emerging technologies such as mixed reality can enhance the efficacy of established therapeutic modalities and provide innovative tools for mental health service delivery. In particular, MR-ERP may be a promising alternative for individuals resistant to traditional face-to-face exposure therapy.

Despite the strengths of its design, this study had several limitations. First, reliance exclusively on quantitative measures such as the Y-BOCS, without incorporating qualitative data, limited the ability to gain deeper insight into participants' subjective experiences. Second, the specialized equipment required for mixed reality interventions may restrict accessibility in some clinical settings. Third, the absence of long-term follow-up beyond six months precluded a more comprehensive assessment of the durability of treatment effects.

Future research should employ mixed-method approaches that integrate quantitative and qualitative data to provide a richer understanding of participant experiences. Also, future studies should conduct extended follow-up studies (e.g., one year or longer) to evaluate the long-term sustainability of MR-ERP treatment gains.

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Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by ethics committee of Islamic Azad University.

Author contributions

All authors contributed to the study conception and design, material preparation, data collection and analysis. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

References

Abramowitz, J. S., Myers, N. S., Friedman, J. B., Juel, E. K., Nestadt, G., Kimmel, M., . . . Nestadt, P. S. (2024). Psychometric properties of the OCI-4: a brief screening tool for perinatal obsessive-compulsive disorder. *Archives of Women's Mental Health*, 1-8.

Alblowi, M. A., Alkhammash, W. M., Alzahrani, T. M., Hakeem, M. H., Alsarar, S. A., Alqahtani, A. A., . . . Al Binhar, T. H. (2023). Prevalence of post-COVID symptoms of obsessive-compulsive disorder in Saudi Arabia. *Neurosciences Journal*, *28*(1), 27-35.

Brierley, M.-E. E., Albertella, L., Christensen, E., Rotaru, K., Jacka, F. N., Segrave, R. A., . . . Hughes, S. (2023). Lifestyle risk factors for obsessive-compulsive symptoms and related phenomena: What should lifestyle interventions target? *Australian & New Zealand Journal of Psychiatry*, *57*(3), 379-390.

Efe, A. (2022). Taking virtual reality and augmented reality to the next level: Artificial intelligence with mixed reality. *Kamu Yönetimi ve Teknoloji Dergisi*, *4*(2), 141-165.

Fakhri, A., Mohsenikhah, M., Hamedpour, H., Sadeghi, B., Davarpanah, M., Delshad, E., . . . Moradi-Joo, E. Comparison of Obsessive Beliefs, Depression and Anxiety in Patients with Suspected COVID-19 and Healthy Patients in Razi Hospital, Ahvaz. *International journal of health sciences*, *6*(S8), 382-392.

Goodman, W. K., Grice, D. E., Lapidus, K. A., & Coffey, B. J. (2014). Obsessive-compulsive disorder. *Psychiatric clinics*, *37*(3), 257-267.

[DOI: 10.22034/ieepj.2025.7.2.1012]

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., . . . Charney, D. S. (1989). The Yale-Brown obsessive compulsive scale: I. Development, use, and reliability. *Archives of general psychiatry*, *46*(11), 1006-1011.

Guzick, A. G., Candelari, A., Wiese, A. D., Schneider, S. C., Goodman, W. K., & Storch, E. A. (2021). Obsessive–compulsive disorder during the COVID-19 pandemic: a systematic review. *Current psychiatry reports*, *23*(11), 71.

Izadi, R., & Abedi, M. R. (2013). Alleviation of obsessive symptoms in treatment-resistant obsessive-compulsive disorder using acceptance and commitment-based therapy [Research]. *Feyz Medical Sciences Journal*, *17*(3), 275-286. http://feyz.kaums.ac.ir/article-1-1963-fa.html

Kaplan, J. S., & Tolin, D. F. (2011). Exposure therapy for anxiety disorders: theoretical mechanisms of exposure and treatment strategies. *Psychiatric Times*, *28*(9), 33-33.

Kaur, R., Garg, R., & Raj, R. (2023). Quality of life among patients with obsessive compulsive disorder: Impact of stigma, severity of illness, insight, and beliefs. *Industrial Psychiatry Journal*, *32*(1), 130-135.

Keshavarz, N., Hashemi, T., Beyrami, M., Mahmoud alilou, M., & Bakhshipour, A. (2021). Effectiveness of virtual reality -based worry exposure therapy on the symptoms of generalized anxiety disorder [Research]. *Rooyesh-e-Ravanshenasi Journal(RRJ)*, *10*(1), 121-132. http://frooyesh.ir/article-1-2440-fa.html

Koran, L. M. (2001). Obsessive compulsive disorder and quality of life. *Obsessive compulsive disorder: A practical guide*, 51-60.

Kothgassner, O. D., Reichmann, A., & Bock, M. M. (2023). Virtual reality interventions for mental health. In *Virtual Reality in Behavioral Neuroscience: New Insights and Methods* (pp. 371-387). Springer.

Lohse, L., Jelinek, L., Moritz, S., Blömer, J., Bücker, L., & Miegel, F. (2023). Efficacy of exposure and response prevention therapy in mixed reality for patients with obsessive-compulsive disorder: study protocol for a randomized controlled trial. *BMC psychology*, *11*(1), 113.

Lopez-Espada, C., & Linares-Palomino, J. (2023). Mixed reality: a promising technology for Therapeutic Patient Education. In: Hogrefe AG.

Mayer, G., Gronewold, N., Polte, K., Hummel, S., Barniske, J., Korbel, J. J., . . . Schultz, J.-H. (2022). Experiences of patients and therapists testing a virtual reality exposure app for symptoms of claustrophobia: mixed methods study. *JMIR Mental Health*, *9*(12), e40056.

Miegel, F., Jelinek, L., Moritz, S., Lohse, L., Yassari, A. H., & Bücker, L. (2023). Mixed results for exposure and response prevention therapy in mixed reality for patients with contamination-related

[DOI: 10.22034/ieepj.2025.7.2.1012]

obsessive-compulsive disorder: A randomized controlled pilot study. *Journal of Clinical Psychology*, *79*(10), 2317-2336.

Murayama, K., Nakao, T., Sanematsu, H., Okada, K., Yoshiura, T., Tomita, M., . . . Kanba, S. (2013). Differential neural network of checking versus washing symptoms in obsessive-compulsive disorder. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *40*, 160-166.

Özer, Z., Bahçecioğlu Turan, G., & Teke, N. (2022). The relationship between fear, obsession and quality of life in chronic patients due to COVID-19 pandemic. *Psychiatria Danubina*.

Pinciotti, C. M., Bulkes, N. Z., Bailey, B. E., Storch, E. A., Abramowitz, J. S., Fontenelle, L. F., & Riemann, B. C. (2023). Common rituals in obsessive–compulsive disorder and implications for treatment: A mixed-methods study. *Psychological assessment*, *35*(9), 763.

Pira, G. L., Aquilini, B., Davoli, A., Grandi, S., & Ruini, C. (2023). The use of virtual reality interventions to promote positive mental health: systematic literature review. *JMIR Mental Health*, *10*(1), e44998.

Rahman, M. A., Brown, D. J., Mahmud, M., Harris, M., Shopland, N., Heym, N., . . . Downes, D. (2023). Enhancing biofeedback-driven self-guided virtual reality exposure therapy through arousal detection from multimodal data using machine learning. *Brain Informatics*, *10*(1), 14.

Raposo-Lima, C., & Morgado, P. (2020). The role of stress in obsessive-compulsive disorder: a narrative review. *Harvard review of psychiatry*, *28*(6), 356-370.

Rubin, M., Muller, K., Hayhoe, M. M., & Telch, M. J. (2022). Attention guidance augmentation of virtual reality exposure therapy for social anxiety disorder: a pilot randomized controlled trial. *Cognitive Behaviour Therapy*, *51*(5), 371-387.

Wray, T. B., Kemp, J. J., & Larsen, M. A. (2023). Virtual reality (VR) treatments for anxiety disorders are unambiguously successful, so why are so few therapists using it? Barriers to adoption and potential solutions. *Cognitive Behaviour Therapy*, *52*(6), 603-624.

Zamanifard, S., & Robb, A. (2023). Social virtual reality is my therapist: overcoming social anxiety disorder through using social virtual reality. Extended abstracts of the 2023 CHI conference on human factors in computing systems,

[DOI: 10.22034/ieepj.2025.7.2.1012]