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Comparison of the Effectiveness of Virtual Reality Exposure Therapy with Cognitive-Behavioral Therapy on Obsessive-Compulsive Disorder Symptoms in People with Obsessive-Compulsive Disorder

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A B S T R A C T

Objective: Obsessive-compulsive disorder affects the cognitive, mental and emotional order of sufferers and leads to a decrease in their performance. According to this this study was aimed at comparing the effectiveness of virtual reality exposure therapy with cognitive-behavioral therapy on obsessive-compulsive disorder symptoms amongst people with the disorder.

Materials and Methods: A quasi-experimental method was employed followed by a pretest-posttest and a two-month follow-up. The population consisted of all people referred to Nik Mehr Counseling and Psychological Services in Tehran in 2020 and 2021. From among them, 45 were selected through convenience sampling method, randomly put in experimental and control groups and received Maudsley's Obsessive-Compulsive Questionnaire. The follow-up was then implemented on subjects by receiving virtual reality exposure for 12 sessions (2 eight-minute sessions per week for 6 weeks) and cognitive-behavioral therapy for 12 sessions (2 forty-five-minute sessions per week for 6 weeks. The control group did not receive any intervention. Results were analyzed through ANOVA and Bonferroni Post-hoc Test with SPSS-23.

Findings: The results showed that both therapies appeared effective (F=192; Eta=0.67; P<0001) on people with the disorder as they reduced obsession syndromes. Also, the follow-up test indicated that there is no significant difference between the effectiveness of these two therapies on subjects with obsessive-compulsive disorder (P<0.05).

Conclusion: According to the results, since there is no difference in the effectiveness of virtual reality exposure therapy and cognitive-behavioral therapy, both can be applied to reduce obsession syndromes amongst people with the disorder.

Keywords: *Virtual reality exposure therapy, Cognitive-behavioral therapy, Obsessive-compulsive disorder.*

1. Introduction

Obsessive-Compulsive Disorder (OCD) is characterized by the presence of either obsessive thoughts or compulsive acts. Obsessive thoughts are recurrent, intrusive thoughts, impulses, or images experienced as intrusive and unwanted, while compulsive acts are repetitive behaviors or mental acts that the person feels driven to perform in response to an obsession or according to rules that must be applied rigidly (Riquelme-Marín et al., 2022). Other forms of OCD are characterized by mental preoccupations and repetitive behaviors or mental acts in response to these preoccupations (Cludius et al., 2021). Women are somewhat more affected by OCD in adulthood, although men tend to be more commonly affected in childhood (Pozza et al., 2021). OCD is associated with a reduced quality of life and high levels of social and occupational impairment (Fajnerova et al., 2020). Suicide thoughts occur in half of those affected by OCD and related suicide attempts in a quarter of these individuals (Sadock & Sadock, 2007). The primary characteristic of OCD is repetitive obsessive thoughts or actions. The intensity of these obsessive thoughts or acts is such that they are time-consuming and cause significant distress for the patient (Fontenelle et al., 2021). The content of obsessive thoughts often includes disturbing, contradictory, or even meaningless themes concerning dirtiness, contamination, doubt, unacceptable sexual acts, order, and precision (Asli Azad et al., 2019). Compulsive acts include stereotypical behaviors or mental acts performed in response to an obsessive thought aimed at preventing or reducing anxiety or distress. A compulsive act is usually accompanied by a strong desire to perform rituals and a feeling that one's voluntary control over them is reduced (Boger et al., 2020).

OCD is generally treated with a pharmacological and psychological approach, with few studies examining the combination of both treatments typically offered in clinical settings. The most common treatment method is cognitive-behavioral therapy (CBT), a structured, short-term approach based on clear concepts of cognitive levels including schema (or core beliefs), assumptions (or intermediate beliefs), and automatic thoughts or imaginations and the effect of these on information processing (Stang et al., 2020). This approach is based on a problem-focused educational model where therapists teach clients to evaluate and modify their thoughts and replace inefficient thoughts with more effective thinking patterns (McKay, 2019). Recent evidence has shown the effectiveness of CBT in improving the symptoms of OCD (Asl Alavi Paidar et al., 2020; Matsumoto et al., 2022; Mohyadini et al., 2021; Mortezaeifar et al., 2021; Remmerswaal et al., 2021; Wickberg et al., 2022). The results of a systematic review by Reid et al. (Reid et al., 2021) also indicate the significant effect of CBT with exposure and response prevention in reducing the symptoms of OCD.

Another approach recently introduced in the treatment of OCD is virtual reality therapy (Fajnerova et al., 2020). Virtual reality is a complex user encounter involving real-time stimuli via multiple sensory channels, including visual, auditory, tactile, and olfactory inputs (Manshaee et al., 2020). Virtual reality places the user in a three-dimensional environment created by a computer that simulates real experiences, and the user can interact with the virtual world through their senses, as if they were actually there (Brinkman et al., 2010). The effectiveness of virtual reality therapy has been validated in various studies on OCD (Cullen et al., 2021), pain severity and mental health improvement in individuals with multiple sclerosis (Akkan et al., 2022), perceived pain and pain anxiety in burn patients (Kiani et al., 2020), improvement of attention and impulsivity in students with Attention Deficit/Hyperactivity Disorder (ADHD) (Tabrizi et al., 2020), social self-efficacy, focus of attention, and social anxiety (Farnoush et al., 2020), reduction of anxiety in individuals with driving phobia (Afsharian & Eebrahimighavam, 2016), and perceived pain among adolescents with cancer during two follow-up stages (Sharifpour et al., 2021).

In the context of causality, comparing these two treatments in the current study should be mentioned, although pharmacotherapy and cognitive-behavioral therapy have been employed for years in treating OCD, reviews regarding the effectiveness and sustainability of these methods have been challenging. Generally, in the domain of designing and reviewing the effectiveness of various non-invasive treatments for OCD, limited studies have been conducted, and most are single-case researches. Additionally, inconsistencies exist in the research findings related to the effectiveness of various non-invasive treatments in patients with OCD. Although recent efforts in Iran have focused on introducing and applying virtual reality exposure therapy, attention has not been sufficiently given to designing therapeutic interventions and reviewing their effectiveness on OCD and comparing these results with other invasive and non-invasive interventions, indicating a research gap in the current study.

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The necessity of conducting research can also be articulated by noting that OCD causes disruption in the socialization process, active family functioning, participation in group activities, and occupational environment among individuals. Such widespread disruption can also lead to concentration difficulties, lack of sufficient time to perform duties due to engagement with rituals, and failure or inability to return to tasks and responsibilities. Additionally, it should be mentioned that untreated OCD can gradually lead to the emergence of other psychological and emotional damages, as well as obsessive-compulsive personality disorder in these individuals. Accordingly, employing effective treatment methods can serve as a solution to improve the psychological components of these individuals. Given the psychological and emotional damages in individuals with OCD and the importance of utilizing appropriate therapeutic and interventional methods, and finally, the lack of research comparing the impact of virtual reality exposure therapy with cognitive-behavioral therapy on obsessive symptoms in individuals with OCD, the main issue of the present study was comparing the effect of virtual reality exposure therapy with cognitive-behavioral therapy on obsessive symptoms in individuals with OCD.

2. Methods and Materials

2.1. Study Design and Participants

This study was a quasi-experimental pretest-posttest design with a control group and a two-month follow-up period. The statistical population included all individuals referring to the branches of Nik Mehr Counseling Center in Tehran during 2019-2020. Given that the minimum sample size in experimental studies per group should be 15 for increasing internal validity (Boger et al., 2020), a total of 45 individuals were selected based on a cutoff score of 11 in the Obsessive-Compulsive Questionnaire and diagnostic interview by a clinical therapist according to the DSM-5 criteria for Obsessive-Compulsive Disorder (OCD). Participants were chosen using convenience sampling and were randomly assigned into experimental groups (15 individuals in the virtual reality exposure therapy group, 15 in the cognitive-behavioral therapy group, and 15 in the control group). Inclusion criteria were age between 18 to 45 years, diagnosis of OCD based on a cutoff score of 11 in the Obsessive-Compulsive Questionnaire and clinical psychologist's diagnostic interview according to DSM-5 criteria, a minimum education level of cycle; absence of severe medical or psychiatric disorders such as psychosis or personality disorders according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders based on psychiatrist's opinion; no history of substance or alcohol abuse or dependency according to psychiatric records; and consent to participate in the study with a signed written consent form. Exclusion criteria included use of psychiatric medication for OCD treatment, receiving other psychological treatments concurrently prior to entering the study, and non-cooperation or absence in two consecutive sessions.

To select the sample and conduct the study, after obtaining permission from the university and relevant authorities, visits were made to the northwest, central, and northeast branches of the Nik Mehr Counseling Center in Tehran. Coordination was done with patients who met the entry criteria for the study. The procedure and methodology were explained to each participant. The virtual reality exposure therapy and cognitive-behavioral therapy were conducted at the northwest branch of the Nik Mehr Counseling Center in Tehran. The first and second experimental groups were subjected to 12 eight-minute sessions of virtual reality exposure therapy (twice a week for 6 weeks) and 12 sixty-minute sessions of cognitive-behavioral therapy (twice a week for 6 weeks), respectively, while the control group received no intervention. All groups completed the Maudsley Obsessive-Compulsive Questionnaire during the pre-test, post-test, and follow-up phases. Furthermore, to adhere to ethical principles, consent was obtained from participants to take part in the study, and they signed a written consent form. The researcher assured participants that all information provided in the training sessions and questionnaire results would remain confidential.

2.2. Measures

2.2.1. Obsessive-Compulsive Questionnaire

Maudsley Obsessive-Compulsive Questionnaire (MOCQ): Developed by Hodgson & Rachman (Hodgson & Rachman, 1977), the MOCQ is a 30-item questionnaire with four subscales: checking (9 items), washing (11 items), slowness-repetition (7 items), and doubt-duty (7 items). Items are scored as 0 or 1, and the total score ranges from 0 to 30, with a cutoff score of 11 for diagnosing OCD. Higher scores indicate more severe symptoms of OCD. Hodgson & Rachman (Hodgson & Rachman, 1977) reported a test-retest reliability of 0.80 and internal consistency ranging from 0.70 to 0.80. Gharaee and Saberi (Qarali & saberi, 2020) reported

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Cronbach's alpha coefficients for the subscales of checking, washing, slowness-repetition, and doubt-duty as 0.87, 0.87, 0.90, and 0.72, respectively. In this study, alpha coefficients were 0.81, 0.86, 0.79, 0.78 for the respective subscales, and the overall alpha was 0.90.

2.2.2. Gear360 Camera

Manufactured by Samsung in 2015 to facilitate the production of virtual reality content, this virtual reality camera model is equipped with two 180-degree cameras of 15 megapixels each, offering a 360-degree view. It can connect to Samsung S6 and later models via Wi-Fi and be controlled remotely, allowing for image recording without the presence of a cameraman. The recorded videos and photos are viewable using smartphones equipped with a gyroscope and a virtual reality headset.

2.2.3. Virtual Reality Headset (VR SHANECON)

Manufactured by SHANECON company, this headset weighs 440 grams and has dimensions of 180mm x 115mm x 82mm with a 5.5-inch display screen. Notable features of the headset include compatibility with flash, memory, and gyroscope. It connects to the user's phone earphone with a 3.5mm audio jack and provides an immersive experience with a wide lens viewing angle. Users wearing the headset can rotate their head in all directions to see the image captured by the camera at that angle, essentially placing themselves at the camera's location for an immersive audio and visual experience.

2.2.4. Other Tools

Additionally, Adobe After Effects and Adobe Premiere Pro software were used for image editing and correction in this study. For video playback, the KM Player VR, a powerful and intelligent Android virtual reality software developed by the creators of KM Player and later by PaNDoRA.TV, was utilized. Virtual reality videos were viewed through this software without the need for the internet, using content stored on the mobile device.

2.3. Interventions

2.3.1. Virtual Reality Exposure Therapy

Virtual Reality Exposure Therapy was provided to the first experimental group over 12 eight-minute sessions (twice a week for six weeks). Initially, to create scenarios for the virtual reality exposure treatment, interviews were conducted with five individuals suffering from OCD and three specialists in virtual reality exposure therapy. These interviews aimed to compile scenarios of contaminating and anxiety-inducing situations, ranging from mild to severe. The scenarios were then filmed in the first-person perspective using the Gear360 camera. After the 360-degree video was created, five virtual reality treatment specialists reviewed it for content validity. They evaluated the quality of the images, the appropriateness of the contaminating and anxiety-inducing situations, the allocated time, and other important aspects. After incorporating their feedback, the video of the virtual reality exposure treatment was reviewed again, and the consensus among the evaluators on the content of the package was reported with a Kappa coefficient of one. In the next stage, to assess the preliminary effectiveness of the virtual reality exposure treatment (pilot stage), it was administered to a group of five individuals with OCD. The results of the pilot implementation were satisfactory. After validating the content and conducting the pilot stage, ensuring the suitability of the produced videos, the virtual reality exposure therapy was implemented on the first experimental group. The first session was dedicated to providing information about virtual reality treatment to the participants and teaching muscle relaxation techniques. The remaining sessions were dedicated to muscle relaxation training and exposure to anxiety-inducing situations. The hierarchy of anxiety-inducing situations for exposure in the virtual environment included:

1. Entering the house holding a shopping basket, entering the kitchen with shoes on, placing the shopping basket (containing apples, lettuce, baguette, chicken) on the kitchen table, taking out the chicken (without washing hands).
2. Taking out unwrapped apples from the basket and placing them next to the chicken (touching the chicken), taking out lettuce from the basket, opening the refrigerator door and placing it on the shelf next to an open cake (next to and touching each other so that the lettuce touches the cake), picking up and eating the cake with the same hand.
3. Taking a dirty cloth and cleaning the kitchen table (while apples and chicken are on the table), leaving the cloth on the table after cleaning, taking a knife from the sink and placing it on the dirty cloth, taking out bread from the basket and placing it on the table, cutting the bread with the knife on the cloth, and eating it with the same hand, leaving the knife on the dirty cloth.

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4. Picking up the knife from the dirty cloth and then taking one of the apples from the table touching the chicken, cutting and eating it with the knife, picking up the chicken from the table and placing it in the refrigerator next to the lettuce, wiping hands with clothes, taking a juice bottle from inside the trash can and placing it on the table, taking a glass from the shelf with the same hand and filling it with juice, taking some ice from the freezer and dropping it into the juice, stirring it with a finger, and drinking it.

2.3.2. *Cognitive-Behavioral Therapy*

Cognitive-Behavioral Therapy, based on the protocol of Leahy, Holland, and McGinn (Shaygan Manesh et al., 2018), was administered to the second experimental group over 12 sixty-minute sessions (twice a week for six weeks).

Table 1

Cognitive-Behavioral Therapy Sessions

Sessions	Content
First and Second Session	Assessment of symptoms, identification of obsessive-compulsive thoughts and actions, identification of avoidance behaviors, determination of fear-inducing consequences, identification of internal and external triggers of obsessive thoughts, assessment of dysfunction in social, educational, and occupational functioning, determination of social support and family involvement in rituals, assessment of substance use, evaluation of comorbid disorders, educating the patient about the diagnosis, and providing general information about obsessive-compulsive disorder, teaching about the basic principles of cognitive-behavioral therapy, assigning reading homework on cognitive-behavioral therapy and obsessive-compulsive disorder.
Third and Fourth Session	Assessment and review of homework. Mood assessment, a review of all obsessive-compulsive thoughts and avoidance situations, assessment of patient motivation for treatment, motivation building, describing cognitive-behavioral conceptualization about obsessive-compulsive disorder and its treatment, presenting research findings to the patient for better familiarization with the disorder and treatment method, introducing the cognitive model, teaching the identification of automatic thoughts, anxiety arising from obsessive-compulsive thoughts and triggering situations. Evaluation of automatic thoughts, assignment of homework.
Fifth and Sixth Session	Assessment and review of homework, reassessment using self-assessment tools to evaluate anxiety and treatment progress, normalizing intrusive thoughts, assessing the accuracy of automatic thoughts and dysfunctional assumptions about danger, challenging magical thoughts, identifying and correcting excessive responsibility, helping the patient to design behavioral experiments (like avoidance and non-avoidance of thoughts and tracking the outcomes), helping the patient to design a hierarchy of obsessive-compulsive thoughts and avoidance situations or other stimuli, assignment of homework.
Seventh to Tenth Session	Anxiety assessment and homework review, continuation of correcting automatic thoughts, dysfunctional assumptions, and responsibility schemas, self-blaming, and vulnerability to harm. Continue helping the patient in designing behavioral experiments, assisting the patient to complete exposure hierarchies, planning initial exposure sessions, conducting exposure for the first item in the hierarchy of obsessive-compulsive thoughts and avoidance situations/other stimuli, teaching postponing, slowing down, and changing repetitions related to rituals and helping the patient to stop all rituals, assignment of homework.
Eleventh to Sixteenth Session	Anxiety assessment and homework review, reviewing and challenging any thoughts related to avoidance of exposure, reviewing and challenging any thoughts related to recurrence of rituals, helping the patient to evaluate the pros and cons of rituals. Continue correcting assumptions and schemas related to danger, responsibility, continuing exposure by moving towards higher items in the hierarchy of obsessive-compulsive thoughts and avoidance situations/other stimuli, monitoring the continuity of safety behaviors or any avoidance in performing homework exposure, ensuring the implementation of both real and imaginal exposures, reviewing any relapse in response prevention, assignment of homework.
Seventeenth to Twentieth Session	Anxiety assessment and homework review, decision-making for gradual reduction of therapy sessions based on the level of goal achievement, reviewing progress in identifying and correcting thoughts, evaluating and identifying residual symptoms, reviewing any life problems related to obsessive-compulsive disorder with patient improvement, cognitive challenge with schemas of danger, responsibility, asking the patient to employ cognitive skills, ensuring exposure implementation for the highest item in the hierarchy, ensuring reduction of fears related to obsessive thoughts, continuing to help the patient stop all rituals. Monitoring any relapse and recurrence, preventing recurrence by teaching the patient about the possibility of persistence of some symptoms, evaluating potential future stressors, reviewing coping skills, addressing current life problems of the patient, preparing a list of skills learned during the treatment and summarizing the sessions.

2.4. *Data Analysis*

In this study, descriptive and inferential statistics were used for data analysis. At the descriptive level, mean and standard deviation were used, and at the inferential level, the Shapiro-Wilk test was used to check the normality of variable distributions, Levene's test for equality of variances, Mauchly's test for sphericity assumption, and repeated measures ANOVA to compare the effectiveness of virtual reality exposure therapy with cognitive-behavioral therapy on the symptoms of OCD. The data were analyzed using SPSS software version 23.

3. Findings and Results

In this study, 45 patients (25 women and 20 men) with OCD participated, with mean ages in the virtual reality exposure therapy group, cognitive-behavioral therapy group, and control group being 34.00 ± 6.43, 35.47 ± 8.56, and 33.87 ± 7.17, respectively. Descriptive statistics for the variable of Obsessive-Compulsive symptoms in the study

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groups during the assessment stages are presented in Table 2.

Table 2

Descriptive Statistics of Obsessive-Compulsive Symptoms and Subscales in Groups During Assessment Phases

Variable	Group	Mean±SD Pre-test	Mean±SD Post-test	Mean±SD Follow-up
OCD	Virtual Reality Treatment	18.73±0.79	10.20±1.42	10.27±1.48
	Cognitive-Behavioral Therapy	18.74±1.62	11.80±1.65	11.20±1.6
	Control	19.20±1.20	15.73±1.90	15.27±1.94
Checking	Virtual Reality Treatment	3.33±1.11	2.27±1.03	2.40±0.91
	Cognitive-Behavioral Therapy	3.40±0.98	2.67±0.72	2.37±0.88
	Control	3.07±0.88	2.93±0.96	3.00±1.06
Washing	Virtual Reality Treatment	7.33±1.04	2.67±0.97	2.80±0.86
	Cognitive-Behavioral Therapy	7.20±0.94	3.47±0.91	2.87±0.99
	Control	7.87±1.35	4.60±1.05	4.53±0.91
Slowness-Repetition	Virtual Reality Treatment	4.80±1.26	3.13±1.24	3.00±0.84
	Cognitive-Behavioral Therapy	4.33±1.04	3.00±0.84	3.07±0.79
	Control	4.47±1.06	4.33±1.04	4.00±1.19
Doubt-Duty	Virtual Reality Treatment	3.27±0.79	2.13±0.74	2.07±0.70
	Cognitive-Behavioral Therapy	3.81±0.94	2.67±1.04	2.53±0.99
	Control	3.80±0.14	3.87±1.30	3.73±1.03

The results from Table 2 indicate that the mean scores of obsessive symptoms and their sub-scales (checking, washing, slowness-repetition, and doubt-duty) in the experimental groups have decreased as a result of receiving virtual reality exposure therapy and cognitive-behavioral therapy in the post-test and follow-up stages. However, the significance of this decrease and the examination of the difference in the effectiveness of the current interventions will be further investigated using repeated measures analysis of variance. The use of parametric repeated measures tests requires adherence to several initial assumptions including the normality of scores, equality of variances, and equality of covariance matrices. These tests can be used if the group sizes are less than 40 and the assumptions are met and confirmed.

The aim of assessing the normality assumption is to examine the distribution of scores as equivalent to the population distribution. This assumption implies that the observed difference between the sample group's score distribution and the normal distribution in the population is zero. For this purpose, the Shapiro-Wilk test was used. The results of implementing this assumption regarding the research variables' scores showed that the null hypothesis of normal distribution of scores in the research variables remains at all three stages of pre-test, post-test, and follow-up (all significance levels were greater than 0.05).

To investigate the assumption of equal variances, Levene's test was used. The results indicate that for overall obsessive symptoms in the pre-test (sig=0.109, F=2.11), post-test (sig=0.863, F=0.247), and follow-up (sig=0.822, F=0.305), in the checking dimension pre-test (sig=0.512, F=0.777), post-test (sig=0.167, F=1.75), and follow-up (sig=0.630, F=0.581), washing in the pre-test (sig=0.468, F=0.859), post-test (sig=0.470, F=0.855), and follow-up (sig=0.630, F=0.581), slowness in the pre-test (sig=0.440, F=0.914), post-test (sig=0.698, F=0.480), and follow-up (sig=0.055, F=2.69), and in the doubt dimension pre-test (sig=0.285, F=1.3), post-test (sig=0.228, F=1.48), and follow-up (sig=0.256, F=1.39). These results collectively confirm the assumption of equal variances in the symptoms of obsession and its dimensions across all three stages. Mauchly's test results for assessing the homogeneity of covariances in groups for overall obsessive symptoms (Mauchly's W=0.823, chi2=7.99, sig=0.018), checking dimension (Mauchly's W=0.915, chi2=3.64, sig=0.162), washing (Mauchly's W=0.771, chi2=10.68, sig=0.005), slowness (Mauchly's W=0.738, chi2=12.44, sig=0.002) and doubt (Mauchly's W=0.885, chi2=5.03, sig=0.088) show confirmation in the overall obsessive symptoms and the dimensions of checking and doubt and disconfirmation in the dimensions of washing and slowness. Accordingly, in the within-subject analyses in repeated measures ANOVA for overall obsessive symptoms and dimensions of checking and doubt, tests with the sphericity assumption are used, and for the dimensions of washing and slowness, conservative tests like Greenhouse-Geisser are utilized. The comparative results between and within subjects for the research variables are presented in Table 3.

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Table 3

Analysis of Between-Subjects and Within-Subjects Effects for Research Variables

Variable	Effect	Source	SS	Df	MS	F	p	Effect size
OCD	Between-Subjects	Group	331.837	2	165.919	40.22	0.001	0.59
	Within-Subjects	Time	1261.348	1.69	742.46	192.35	0.001	0.673
		Time × Group Effect	15.63	3.39	36.97	19.54	0.001	0.482
Checking	Between-Subjects	Group	2.8	2	1.4	0.907	0.411	0.041
	Within-Subjects	Time	10.978	2	5.49	9.07	0.001	0.178
		Time × Group Effect	14.22	4	7.06	5.74	0.01	0.11
Washing	Between-Subjects	Group	50.33	2	25.16	13.65	0.001	0.394
	Within-Subjects	Time	475.393	1.63	292.205	379.43	0.001	0.80
		Time × Group Effect	10.652	3.25	3.27	4.25	0.001	0.168
Slowness-repetition	Between-Subjects	Group	15.88	2	7.94	4.41	0.018	0.174
	Within-Subjects	Time	37.437	1.58	23.62	24.64	0.001	0.37
		Time × Group Effect	11.407	3.17	3.59	3.75	0.013	0.152
Doubt-Duty	Between-Subjects	Group	39.304	2	19.652	11.29	0.001	0.35
	Within-Subjects	Time	18.95	2	9.47	16.23	0.001	0.279
		Time × Group Effect	9.36	3.58	2.61	4.01	0.007	0.16

According to the findings in Table 3, in the between-subject analysis, the mean scores of overall obsessive symptoms and its dimensions except for checking in the two experimental groups (virtual reality treatment and cognitive-behavioral therapy) and control show significant differences ($p<0.05$). Based on the results in the within-subject analysis, the main effect of time is significant, indicating that there is a significant difference overall in the mean scores of each of the general obsessive symptoms and its dimensions including checking, washing, slowness, and doubt across the stages of the study ($p<0.001$). The results also indicate that the interaction effect of time and group membership is significant in general obsessive symptoms and all dimensions except for checking ($p<0.05$), meaning that changes in the stages of pre-test, post-test, and follow-up in each group are significant. The magnitude of stage differences in the groups for overall obsessive symptoms is 48.2%, in the washing dimension is 16.8%, slowness and repetition is 15.2%, and in the doubt dimension is 16%. The results of the post hoc test for comparing experimental and control groups in the stages of the study for research variables are presented in Table 4.

Table 4

Results of the Post-hoc Test for Comparing the Three Groups According to the Research Variables at Three Stages

Variable	Stage	Groups	Mean Difference	Significance	Effect Size
OCD	Post-test	VRT vs. Control	-5.53	0.001	0.661
		CBT vs. Control	-3.93	0.001	0.496
		VRT vs. CBT	1.6	0.012	0.14
	Follow-up	VRT vs. Control	-5	0.001	0.601
		CBT vs. Control	-4.07	0.001	0.5
		VRT vs. CBT	0.933	0.145	0.05
Checking	Post-test	VRT vs. Control	-0.667	0.053	0.087
		CBT vs. Control	-0.267	0.043	0.015
		VRT vs. CBT	0.4	0.238	0.033
	Follow-up	VRT vs. Control	-0.6	0.094	0.065
		CBT vs. Control	-0.267	0.045	0.014
		VRT vs. CBT	0.33	0.346	0.021
Washing	Post-test	VRT vs. Control	-1.93	0.001	0.408
		CBT vs. Control	-1.13	0.003	0.192
		VRT vs. CBT	0.8	0.031	0.106
	Follow-up	VRT vs. Control	-1.73	0.001	0.386
		CBT vs. Control	-1.67	0.001	0.367

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		VRT vs. CBT	0.067	0.844	0.001
Slowness-Repetition	Post-test	VRT vs. Control	-1.2	0.003	0.187
		CBT vs. Control	-1.33	0.001	0.221
		VRT vs. CBT	-0.133	0.732	0.003
	Follow-up	VRT vs. Control	-1	0.007	0.162
		CBT vs. Control	-0.933	0.011	0.144
		VRT vs. CBT	0.067	0.851	0.001
Doubt.Duty	Post-test	VRT vs. Control	-1.73	0.001	0.325
		CBT vs. Control	-1.2	0.003	0.188
		VRT vs. CBT	0.533	0.174	0.044
	Follow-up	VRT vs. Control	-1.66	0.001	0.369
		CBT vs. Control	-1.2	0.001	0.233
		VRT vs. CBT	0.467	0.172	0.044

The results in Table 4 indicate that the difference between both experimental groups, namely virtual reality treatment and cognitive-behavioral therapy, and the control group is significant in both the post-test and follow-up stages for overall obsessive symptoms and the dimensions of washing, slowness-repetition, and doubt-duty ($p<0.05$), indicating the effect of virtual reality treatment on obsessive symptoms and dimensions of washing, slowness, and doubt in the post-test is respectively 66%, 40.8%, 18.7%, 32.5% and the effects of this treatment in the follow-up stage respectively are 60.1%, 38.6%, 16.2%, 36.9%. Likewise, the effect of cognitive-behavioral therapy on obsessive symptoms and dimensions of washing, slowness, and doubt in the post-test are respectively 49.6%, 19.2%, 22.1%, 18.8% and the effects in the follow-up stage respectively are 50%, 36.7%, 14.4%, 23.3%. However, in the checking dimension, the difference between the mean scores in the experimental and control groups in both the post-test and follow-up stages is not significant ($p>0.05$).

The results in Table 3 indicate that the difference between both experimental groups, namely virtual reality treatment and cognitive-behavioral therapy, and the control group is significant in both the post-test and follow-up stages for overall obsessive symptoms and the dimensions of washing, slowness-repetition, and doubt-duty ($p<0.05$), indicating the effect of virtual reality treatment on obsessive symptoms and dimensions of washing, slowness, and doubt in the post-test is respectively 66%, 40.8%, 18.7%, 32.5% and the effects of this treatment in the follow-up stage respectively are 60.1%, 38.6%, 16.2%, 36.9%. Likewise, the effect of cognitive-behavioral therapy on obsessive symptoms and dimensions of washing, slowness, and doubt in the post-test are respectively 49.6%, 19.2%, 22.1%, 18.8% and the effects in the follow-up stage respectively are 50%, 36.7%, 14.4%, 23.3%. However, in the checking dimension, the difference between the mean scores in the experimental and control groups in both the post-test and follow-up stages is not significant ($p>0.05$).

Comparing the two therapeutic approaches, the results show that the difference between virtual reality treatment and cognitive-behavioral therapy in the total score of obsessive symptoms and the washing dimension in the post-test is significant ($p<0.05$) while in the follow-up stage, the difference between the two therapeutic interventions is not significant ($p>0.05$). In the dimensions of slowness and doubt as well, no significant difference in the effectiveness of the two therapeutic groups was found in either the post-test or follow-up stages ($p>0.05$). In the checking dimension, no significant difference in the effectiveness of the two therapeutic methods was found ($p>0.05$).

In a general conclusion, it can be said that both virtual reality treatment and cognitive-behavioral therapy are effective in reducing the overall symptoms of obsession and the dimensions of washing, slowness, and doubt in the post-test stage, and the effects of both treatments remain in the follow-up stage. However, both treatments were not effective in reducing checking symptoms in both the post-test and follow-up stages. Comparing the two therapeutic approaches, the results indicate that virtual reality treatment is more effective than cognitive-behavioral therapy in overall obsessive symptoms and the washing dimension in the post-test stage, and no significant differences were observed between the two therapeutic interventions in the follow-up stage for overall obsessive symptoms and the washing dimension as well as in both the post-test and follow-up stages for the dimensions of checking, slowness, and doubt.

4. Discussion and Conclusion

The aim of the current research was to compare the effectiveness of virtual reality exposure therapy with cognitive-behavioral therapy on the symptoms of obsession

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in individuals with OCD. The results indicated that both virtual reality exposure therapy and cognitive-behavioral therapy effectively reduce obsessive symptoms and their sub-scales (checking, washing, slowness-repetition, and doubt-duty) in individuals suffering from OCD. Furthermore, follow-up tests showed no significant difference between the effectiveness of these treatments on obsessive symptoms and their sub-scales in individuals with OCD.

The first finding of this research suggests that cognitive-behavioral therapy is effective in reducing obsessive symptoms and their sub-scales in individuals with OCD. This finding aligns with results from previous studies (Asl Alavi Paidar et al., 2020; Matsumoto et al., 2022; Mohyadini et al., 2021; Mortezaeifar et al., 2021; Remmerswaal et al., 2021; Wickberg et al., 2022) regarding the effectiveness of cognitive-behavioral therapy in improving the symptoms of OCD. Cognitive-behavioral therapy is a psychological intervention based on the general notion that negative behaviors and thought patterns significantly influence personal emotions. Therefore, this approach considers obsessive behavior as a consequence of inefficient, illogical, and incompatible thought patterns, as well as biased and destructive information processing patterns. In this approach, obsessive symptoms emerge when systematic biases in information processing at the automatic level lead to behavioral responses, which in turn reinforce perceptions, beliefs, and maladaptive thinking patterns in a defective cycle (Remmerswaal et al., 2021). Cognitive-behavioral therapy teaches patients with OCD practical techniques such as cognitive reconstruction for revising obsessive thoughts and behavioral skills like exposure and response prevention to combat obsessive thoughts. Moreover, treatment methods for OCD can help patients understand the root of their obsessive thoughts, why they feel that way, what causes their obsessive thoughts, and what needs to be done to maintain health. Cognitive-behavioral therapy combines behavioral and cognitive theories to help the patient realize that their perception of a situation more than the reality determines their reaction to it. When an individual is upset or disappointed, their perspective might not be realistic. Therefore, changing patients' way of thinking and view of the world can alter their response to situations, leading to a reduction in obsessive-compulsive symptoms.

Another finding of this research demonstrated that virtual reality exposure therapy effectively reduces obsessive symptoms and their sub-scales in individuals with OCD. This finding is consistent with the results from a study by Cullen et al. (Cullen et al., 2021) on the impact of virtual reality exposure therapy in reducing the symptoms of OCD. Additionally, this finding aligns with studies that have shown the effectiveness of virtual reality treatment on perceived pain intensity and pain anxiety in burn patients (Kiani et al., 2020), improvement in attention and impulsivity in students with Attention Deficit/Hyperactivity Disorder (Tabrizi et al., 2020), social self-efficacy, attention focus and social anxiety (Farnoush et al., 2020), reduction of driving phobia anxiety (Afsharian & Eebrahimighavam, 2016), and perceived pain among adolescents with cancer during follow-up stages (Sharifpour et al., 2021). It should be noted that a unique advantage of virtual reality exposure therapy, in addition to being non-invasive, is that it allows the patient to engage in a controlled environment, with a sense of presence and a controlled level of anxiety, to complete tasks. More precisely, in this therapeutic method, the patient, by stepping out of their usual self and engaging in another behavioral model or other selves, overcomes their fears and can prevail over the real world. Moreover, patients feel competent, efficient, and in control; virtual reality exposure therapy helps patients extend their self-efficacy to other situations. In virtual reality exposure, patients experience control over themselves and the situation, predictability, and self-efficacy without fear, anxiety, worry, and avoidance, and for the first time, have a different experience of the situation. Therefore, with more hope, assurance, and perseverance, they remain committed to performing tasks and continuing treatment. Also, since virtual reality exposure, like imaginal exposure therapy, occurs in a controlled environment, it is safer for the individual, and the person knows they can stop using the conditions they are in whenever they want. Thus, this sense of control can impact the individual's self-efficacy and effectiveness on the surrounding environment and reduce avoidance and aversion to the situation and environment (Manshaee et al., 2020), ultimately decreasing obsessive symptoms.

According to the most important findings of the current research, no difference was found between the impact of virtual reality exposure therapy and cognitive-behavioral therapy on the symptoms of OCD; meaning that both treatments have an equal effect in reducing the symptoms of patients with OCD. No similar study was found that compared the effectiveness of the mentioned interventions, and confirming this finding requires more research. Explaining the lack of difference in the impact of virtual reality exposure therapy and cognitive-behavioral therapy in

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reducing the symptoms of OCD, it should be mentioned that the research history of each of these treatments has shown appropriate clinical efficacy. As the results from previous studies (Asl Alavi Paidar et al., 2020; Matsumoto et al., 2022; Mohyadini et al., 2021; Mortezaeifar et al., 2021; Remmerswaal et al., 2021) indicated that cognitive-behavioral therapy is effective in reducing the symptoms of OCD. Meanwhile, the results from the study by Cullen et al. (Cullen et al., 2021) also indicated that virtual reality exposure therapy is effective in reducing the symptoms of OCD. Therefore, these treatments have shown in previous research that they are capable of reducing obsessive symptoms, but no significant difference in efficacy was found between them.

5. Limitations & Suggestions

The current study, like other research, faced limitations, such as being restricted to individuals with OCD referring to Nik Mehr counseling and psychological service centers in Tehran, not controlling personality, physiological, social, and familial variables affecting individuals' obsession, and not using random sampling methods. Therefore, it is recommended that to increase the generalizability of the results, this research be conducted in other cities (considering the role of culture and family in the occurrence of obsessive symptoms), other individuals with psychological disorders such as Obsessive-Compulsive Personality Disorder, depression, anxiety, etc., controlling the mentioned factors, and using random sampling methods. Given the effectiveness of virtual reality exposure therapy and cognitive-behavioral therapy on obsessive symptoms and their sub-scales (checking, washing, slowness-repetition, and doubt-duty) in individuals with OCD, it is suggested that officials of counseling and psychological service centers activate specialists and psychologists to conduct effective psychological courses such as virtual reality exposure therapy and cognitive-behavioral therapy so that through these measures, they can reduce obsessive symptoms in individuals with OCD and create an environment for improving their mental, emotional, and cognitive health.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. This research was registered at the Islamic Azad University, Isfahan (Khorasgan) Branch with the ethics code number IR.IAU.KHUISF.REC.1399.281.

Authors' Contributions

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