Original Research

The Effectiveness of Virtual Reality (VR) Exposure Therapy on Anxiety and Avoidance Symptoms in Male Teenagers, Suffering from Cleaning Disorder

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Abstract:

Background:

The purpose of the present study is to evaluate the effectiveness of VR exposure therapy on anxiety and avoidance symptoms in male teenagers, suffering from cleaning disorder.

Method:

The methodology is quasi-experiment with pre- and post-survey design, with a control group and statistical population, including all available persons, who met the cleaning disorder diagnosis criteria and had visited clinical centers for therapy.

Results:

30 teenagers from 16 to 18 years old, suffering from obsessive-compulsive disorder (OCD) were chosen according to the Diagnostic and Statistical Manual: Fifth Edition (DSM-5) diagnostic criteria and Yale-Brown OCD scale, which Goodman created in 1986. And they were randomly assigned to test and control groups. In the pre- and post-survey stages all participants answered the Obvious and Hidden Anxiety questionnaire created by Spielberger in 1970, and the avoidance questionnaire, by Young and Rygh in 1994. But only the test group underwent VR exposure therapy for eight 30-minute sessions. The collected data were analyzed, using univariate and multivariate covariance analysis.

Conclusion:

The results of the analysis showed that VR exposure therapy has been able to reduce the obvious and hidden anxiety and avoidance symptoms in male teenagers from 16 to 18 years old, suffering from a cleaning disorder ($P<0.001$).

Keywords: Cleaning Disorder, Virtual Reality

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Introduction

Obsessive-compulsive disorder (OCD) is one of the most disabling anxiety disorders, although, at first it was believed that this disorder is rare. The recent epidemiology researches estimate the annual prevalence of this disorder between 1 to 1.6 percent, and this disorder is the fourth most common psychological disorder (1). The obsessive disorder includes thought, emotion, idea, or recurrent and bothersome feelings. Unlike obsessive disorder, which is a mental process, the compulsive disorder is a type of behavior, which has the features of conscious, standard, and recurrent compulsions, such as counting, controlling, and avoidance. Although compulsions may occur, in order to help reduce the anxiety caused by the obsessive disorder, but does not always reduce this anxiety, and it is possible that after the compulsion occurs, the anxiety is still the same, or even worse. Also, when hen the person resists the compulsions, anxiety increases (2). Contamination is the most common OCD pattern. The sufferers will clean excessively, or compulsively avoid objects that they think might be contaminated. The patients might wash their hands excessively, or in fact, rub and scratch their hands, or might even not be able to leave their houses, because of germaphobia; anxiety is the most common emotional reaction towards an object, of which the person is afraid. Contamination disorder patients usually believe that objects get contaminated through even the smallest touch of a contaminated object or person(2). The main treatment for OCD is called exposure and reaction prevention. During the encounter, first, the patient is "contaminated" (for example, the patient touches the toilet seat), which can cause extreme anxiety, and then the compulsions (for example, washing hands) are prevented, this method might help the patient to reduce their anxiety and turn it into a habit(3). Virtual reality (VR), which sometimes is also called full-scale multimedia, is a simulated 3D digital environment, which allows users to interact with it or explore it; in this technique, the user somehow becomes a part of this virtual world and can perform actions or alter objects. Most of the virtual reality environments provide users with means of visual interaction, while some of them use different audio and visual sensors to provide users with a more realistic environment (4). VR-based therapy is similar to traditional clinical approaches, nevertheless, compared to traditional approaches, VR is a safe and more cost-effective replacement in some situations, in which exposure to real clinical encounters is impractical and difficult, and dangerous, or the treatment is not cost-effective. Similar to visual exposure, VR exposure therapy takes place in a controlled environment (usually the doctor's office) and it is not required to expose patients to a real situation to provoke a fear response. Despite numerous psychological treatments for reducing OCD symptoms, with the increase in the use of technology and the appearance of VR therapies, VR can be considered a new treatment; therefore, this research means to evaluate the effectiveness of VR-based therapy on the anxiety and avoidance symptoms in patients, suffering from cleaning disorder.

Methodology

The present study is a quasi-experiment with pre- and post-survey design, with a control group and statistical population. In this research, given the objective, the statistical population includes all available persons, who meet the cleaning disorder diagnostic criteria and had sought treatment. Convenient sampling was chosen in this research. In such a way that in order to choose the sample, first advertisements were put up in hospitals and consulting centers, and then the volunteers who met the OCD diagnostic criteria, according to DSM5, were invited to participate in the research. 30 people were randomly chosen

among the volunteers, and in the next stage, they were randomly assigned to two groups: test group (15 people) and control group (15 people).

Research tools

Yale-Brown OCD scale questionnaire: This test is a self-reporting tool for evaluating the level of OCD thoughts and obsessive/compulsive behaviors. This questionnaire includes 10 parts, each of which has five choices (in a 5-point Likert scale), and was designed by Goodman et al. in 1986. The inter-rater reliability of the mentioned scale in this research is 0.938.

Spielberger Obvious and Hidden Anxiety questionnaire: A.K.A the State-Trait Anxiety Inventory (STAI), this questionnaire includes separate self-reporting scales, for measuring obvious and hidden anxiety. This questionnaire consists of 40 questions, the first 20 of which evaluate the obvious anxiety, and each question is scored based on a 4-point Likert scale (poor – average – good – very good). The lowest score in this subscale is 20, and the highest is 80.Also, Cronbach's alpha results, respectively in obvious and hidden aspects, are 0.715 and 0.767.

Young and Rygh Avoidance Questionnaire: In 1994, Young and Rygh designed this questionnaire, which includes 40 items. The answer spectrum is between 1 (very rare) to 6 (very true), in which the higher score means more effects from avoidance schema therapy in the patient. The inter-rate reliability of this questionnaire was reported with acceptable Cronbach's alpha and split-half coefficient (0.7 and 0.79).

Head-up display (VR headset): This type of display is the most common visual display for viewing virtual images. They are made of two separate displays for each eye, which are mounted on the user's head. These displays have different qualities of the angle of view. Two cameras and data gloves are used in the therapy room to capture the patient's movements and actions and reactions to their surroundings. The achieved inter-rate reliability of the mentioned scale in this research was 0.941.

Research Method

Since the mentioned research is a quasi-experiment with a pre- and post-survey design, with a control group, after choosing the sample and randomly assigning participants in the groups, in the pre-survey stage, both groups answered the research's questionnaires (Obvious and Hidden Anxiety and Avoidance questionnaire). Then, the test group underwent VR exposure therapy for eight 30-minute sessions, held twice a week (the session reports are presented in table 1), but, the control group remained on the waiting list until the end of the research, due to ethical reasons. After the therapy sessions, in the post-survey stage, both groups again answered the questionnaires. The following protocol was used to provide VR exposure therapy.

Results

The descriptive results, concerning the variables of the research specific to each group, are presented in table 1.

As shown in Table 2, compared to the pre-survey stage, the average anxiety symptoms scores and their obvious and hidden anxiety aspects, and avoidance symptoms in the test group have reduced more in the post-survey stage, compared to the control group.

ANCOVA use requires some assumptions that the most important of them include normality of scores' distribution, homogeneity of variances using Levene's Test, homogeneity of the variance-covariance matrix using Box's test, and homogeneity of regression slope

based on the interaction between pretest and independent variable.

Kolmogorov-Smirnov results on the normality of data approved the assumption of the normal distribution of scores given to research variables in both groups within pretest and posttest (P>0.05). The outputs of Levene's test of variances homogeneity within pretest were as follows: manifest anxiety symptoms (F=0.201, sig=1.71), hidden anxiety symptoms (F=0.79, sig=3.072), and avoidance symptoms (F=0.461, sig=0.559). The posttest results of the abovementioned variables were obtained as follows: manifest anxiety symptoms (F=0.081, sig=3.27), hidden anxiety symptoms (F=0.303, sig=1.103), and avoidance symptoms (F=0.053, sig=0.04). Accordingly, the assumptions were accepted at both steps. The assumption of regression line slope showed that group-pretest interaction test at the posttest step obtained to (F=0.415, sig=0.685), (F=0.55, sig=1.12), and (F=0.092, sig=3.07) for manifest anxiety symptoms, hidden anxiety symptoms, and avoidance symptoms, respectively accepting the relevant assumption in all of the variables. Mbox results about the homogeneity of variance-covariance matrixes of variables' scores were accepted (Mbox=1.35, P<0.742, F=0.416).

ANCOVA can be used based on the normality of data, homogeneity of variances, and regression slopes in all of the studied variables.

MANCOVA results from covariance matrix using Box's test, and homogeneity of regression slope based on the interaction between pretest and independent variable. Kolmogorov-Smirnov results on the normality of data approved the assumption of the normal distribution of scores given to research variables in both groups within pretest and posttest (P>0.05). The outputs of Levene's test of variances homogeneity within pretest were as follows: manifest anxiety symptoms (F=0.201, sig=1.71), hidden anxiety symptoms (F=0.79, sig=3.072), and avoidance symptoms (F=0.461, sig=0.559). The posttest results of the abovementioned variables were obtained as follows: manifest anxiety symptoms (F=0.081, sig=3.27), hidden anxiety symptoms (F=0.303, sig=1.103), and avoidance symptoms (F=0.053, sig=0.04). Accordingly, the assumptions were accepted at both steps. The assumption of regression line slope showed that group-pretest interaction test at the posttest step obtained to (F=0.415, sig=0.685), (F=0.55, sig=1.12), and (F=0.092, sig=3.07) for manifest anxiety symptoms, hidden anxiety symptoms, and avoidance symptoms, respectively accepting the relevant assumption in all of the variables. Mbox results about the homogeneity of variance-covariance matrixes of variables' scores were accepted (Mbox=1.35, P<0.742, F=0.416).

ANCOVA can be used based on the normality of data, homogeneity of variances, and regression slopes in all of the studied variables.

MANCOVA results

The results from multivariate covariance analysis for evaluating the effect of therapy on the research variables are presented in Table 3. According to the results in table 3, the relationship between the pre-survey and post-survey in the scores of anxiety and avoidance symptoms is meaningful (p<0.05). By controlling this relationship, the average scores of the research variables in the post-survey stage in the test and control groups are meaningfully different (P=0.001). The results showed that 0.856 or 85.6% of the individual differences in improving the research variables, including anxiety and avoidance symptoms, in the post-survey stage are generally related to the difference between the two groups. In other words, VR exposure therapy has improved the research variables in the test group. The one-hundred-percent power of test shows that the accuracy of this research is favorable, moreover, the sample size for testing this theory was sufficient.

The results from univariate covariance analysis for comparing the post-survey scores of research variables in the two test and control groups, after evaluating the pre-survey scores, are presented in table 3.

The results in table 4 showed that the pre-survey scores of obvious and hidden anxiety symptoms and avoidance symptoms have a meaningful relationship with post-survey scores ($p<0.05$). By controlling these relationships, the difference between the balanced average scores of obvious and hidden anxiety symptoms and avoidance symptoms in the post-survey stage (after controlling the pre-survey scores) in two test and control groups is meaningful ($p<0.001$). In other words, VR exposure therapy has reduced the symptoms of obvious and hidden anxiety and avoidance in teenagers from 16 to 18, suffering from cleaning disorder. The amount of impact of these treatments in reducing the symptoms of obvious and hidden anxiety and avoidance, respectively, are 0.691, 0.66, and 0.606, i.e. respectively, 69.1, 66, and 60.6 percent of the symptoms of obvious and hidden anxiety and avoidance variance are related to group membership or VR exposure therapy impact. The one-hundred-percent power of the test in all three analyses shows that the accuracy of this research is favorable, moreover, the sample size for testing this theory is sufficient.

Discussion

In recent years, different therapy methods for anxiety disorders, such as OCD, have been used. However, given the technological advancement in today's world, it is expected to use these technologies in psychological treatments more than before, and to conduct studies to evaluate the effectiveness of these treatments. Therefore, the purpose of this research was to evaluate the effectiveness of VR exposure therapy in improving the VR-based treatment for reducing the anxiety and avoidance symptoms in patients suffering from cleaning disorder. The results in Tables 3 and 4 showed that the mentioned treatment has been able to improve the symptoms of obvious and hidden anxiety, as well as avoidance symptoms in these patients.

These results are in line with the findings of Powers and Emmelkamp (5), which showed that VR therapy can be effective in improving anxiety disorders. The results are also in line with the findings of Kim et al. (6), Carmen et al. (7) , Mylene and Bouchard et al. (8) , and Martin et al. (9) , which have shown in separate studies that VR therapy has been effective in improving OCD symptoms.

The logic of this method is that the patient is intentionally exposed to fear stimuli in the VR, while there is the possibility to reduce anxiety for the patient, avoiding the fear stimulus leads to continuous anxiety and frequent exposure to it leads to eliminating the fear, through the habituation and extinction process (10). VR exposure therapy is similar to vivo and imaginal exposure therapies in that it exposes patients to fear stimuli, and it is different from traditional behavior therapy in that it uses graphic visual technology, displays and input devices, and simulated environment, rather than the real world; and therefore, creates the feeling of presence in patients, which is followed by the feeling of floating in the moment of fear (11). Given the amount of anxiety OCD causes in patients, it can be classified in the spectrum of disorders, which can be improved by using VR treatment. In order to explain the effectiveness of VR therapy in reducing anxiety symptoms, it can be said that virtual reality is the user's complicated encounter, which includes real-time provocations, through multiple sensory channels. These sensory aspects are visual, auditory, somatosensory, and olfactory. VR places the user in a 3D environment, simulated by the computer, where real experiences are simulated and the user can interact with this virtual reality, through their senses (12).

Simulation, visualization, dereism, sense of presence, and security are used in this therapy. In other words, in this therapy, the situation is simulated for the patients, they begin to visualize, and the reality forms in their minds through imagination, then, the sense of real presence forms in the situation, while users feel more secure. The main bases that must be taken into consideration in the therapy are floating, interaction, and sense of presence. Floating in the VR is one of the parts that cause a virtual world to become a virtual reality world and feel real. In this virtual world, the users feel floating and sinking in the virtual world, and feel as if they are a part of that world and have a role. In interaction, they feel they can interact with the world in front of them, and in fact, there is a reciprocal relationship between them and that virtual world. And in presence, the patient's whole attention focuses on the virtual world. Therefore, given the principles and bases of VR therapy in explaining the effectiveness of therapy in improving the symptoms of anxiety and avoidance in patients, suffering from OCD, it can be said that VR therapy, through patients' exposure to situations, which they avoid and cause anxiety in them, is the best way of reducing this type of anxiety and avoidance. During the first sessions, due to the patients' complete floating in the new and unfamiliar environment, simultaneously with the situation, which they avoid and causes anxiety in them, causes anxiety to significantly increase in them. When the therapy period ends, the amount of anxiety and avoidance reduces significantly. Moreover, it can be said that in fact, VR through patients' exposure to situations, which cause obvious anxiety in them, is the best way of reducing this type of anxiety.

Study limitations

The present research has limitations which must be taken into consideration. The statistical population of this research were 16-18 male teenagers; therefore, the results must be generalized with caution due to gender and age limitation. Also, few domestic researches on evaluating the effectiveness of VR therapy for different disorders have been conducted; therefore, there were limitations to evaluate and compare the achieved results. It is recommended that future researchers design studies for evaluating the effectiveness of the mentioned treatment and compare the achieved results with traditional treatments, such as behavior therapy.

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Tables

Table 1:

Session	Content
One	Getting familiar with the purposes and rules of the therapy sessions, teaching how to use the headset and data gloves, creating a clinical relationship, and taking pre-survey tests.
Two	Playing the Swimming in Poop game, and relaxing the patient, using VR films (displaying relaxing views).
Three	Playing the games from the last session again and relaxing the patient.
Four	Playing the game and restroom VR film and relaxing the patient.
Five	Playing the VR restroom film and touching the walls and doors and relaxing the patient.
Six	Playing the VR restroom film and sitting on the toilet seat and touching the toilet seat and relaxing the patient.
Seven	Repeating the last session, staying in the environment for a longer time, and touching the innermost part of the toilet seat, and relaxing the patient.
Eight	Combining all the previous sessions and relaxing the patient, and taking post-survey tests and satisfaction questionnaire.

Table 2: Descriptive indices of the research variables scores, specific to each group

Groups' variables		Test		Control	
		Pre-survey	Post-survey	Pre-survey	Post-survey
Obvious anxiety	Average	52.8	46.53	50.33	49.93
	Standard deviation	7.002	7.32	4.91	4.58
Hidden anxiety	Average	49.73	44.27	48.66	48.4
	Standard deviation	4.35	3.51	2.94	3.52
Anxiety symptoms	Average	102.53	90.8	99	98.33
	Standard deviation	7.24	7.67	5.95	5.98
Avoidance symptoms	Average	105.13	84.86	107.47	107.33
	Standard deviation	18.11	25.57	21.34	21.39

Table 3: General results from multivariate covariance analysis of the effectiveness of play therapy based on cognitive behavioral therapy on the research variables

Source	Coefficient	F	Degree-of-freedom Assumption	Degree-of-freedom Error	Significance	Amount of impact	Power of the test
Pre-survey Anxiety symptoms	0.107	104.55	2	25	0.001	0.893	1.000
Pre-survey Avoidance symptoms	0.115	96.11	2	25	0.001	0.885	1.000
Group	0.144	74.32	2	25	0.001	0.856	1.000

Table 4.

Variable	Source of changes	Sum of Squares	Degree-of-freedom	Mean squares	F	Significance	Amount of impact	Power of test
Obvious anxiety symptoms	Pre-survey	939.923	1	939.923	237.746	0.001	0.898	1.000
	Group membership	238.506	1	238.506	60.33	0.001	0.691	1.000
	Error	106.744	27	3.95				
Hidden anxiety symptoms	Pre-survey	252.12	1	252.12	72.101	0.001	0.728	1.000
	Group membership	183.088	1	183.088	52.36	0.001	0.66	1.000
	Error	94.41	27	3.49				
Avoidance symptoms	Pre-survey	13650.592	1	13650.592	192.11	0.001	0.877	1.000
	Group membership	2948.363	1	2948.363	41.49	0.001	0.606	1.000
	Error	1918.475	27	71.055				