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The Effects of Virtual Reality Therapy on Acrophobia: A Literature Review

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Introduction

Specific phobias affect approximately 5%-10% of the U.S. population (Samra & Abdijadid, 2020). Examples of common specific phobias include animals, heights, flying, closed spaces, water, storms, and blood. Acrophobia is described as an extreme fear of heights and is one of the most common specific phobias (Eaton et al., 2018). Acrophobia can interfere with individuals' ability to perform everyday tasks and can induce avoidance behaviors. Phobias are characterized as anxiety disorders, and common signs and symptoms seen in phobias are difficulty breathing, nausea, chest tightness, dizziness, and fast heartbeat (Samra & Abdijadid, 2020). Many specific phobias begin in childhood and continue to persist throughout life, and many individuals unfortunately do not seek treatment (Eaton et al., 2018).

The current treatment for specific phobia includes pharmacological therapy, behavioral therapy and cognitive therapy (Thng et al., 2020). Another current line of treatment for those suffering from specific phobias includes in-vivo exposure therapy (Wolitzky-Taylor et al., 2008). During in-vivo exposure therapy, an individual is exposed to their phobia in real life, while virtual reality exposure therapy offers exposure in a controlled, virtual setting. This helps desensitize individuals to their phobia in a contained environment. The term "virtual reality" originated in 1989, and during the 1990's and 2000's, VR (virtual reality) began to be utilized in the form of exposure therapy (Maples-Keller et al., 2017). In 1995, a study was conducted that demonstrated the effectiveness of VR exposure therapy for individuals who suffered from acrophobia (Rothbaum et al., 1995), which prompted further research on the utilization of VR (Maples-Keller et al., 2017). Virtual reality can be used for a broad spectrum of reasons, which increases its versatility and functionality. Virtual reality treatment yields benefit for individuals

with post-traumatic stress disorder, panic disorder, generalized anxiety disorder, obsessive-compulsive disorder, acute and chronic pain, addiction, and more (Maples-Keller et al., 2017).

Through the use of a technology such as a VR headset, hand controls, gaze control, and more, VR aims to mimic a real-life experience. Virtual reality can offer exposure to a certain phobia through a life-like simulation. This literature review will focus on and examine the effects of virtual reality therapy treatment on the reduction of acrophobia.

Methods

Information Sources

Studies were systematically chosen through a search of the database MEDLINE Complete. Both Cinahl and Pubmed yielded similar results, and therefore MEDLINE Complete was the sole database used. A manual search of the articles based on eligibility criteria was also conducted.

Search Strategy

The subject headings used in MEDLINE Complete included *phobic disorder or phobia or specific phobia* AND *fear of heights OR acrophobia* AND *virtual reality exposure therapy or VR or virtual reality therapy.* Search limiters applied in MEDLINE Complete include time limits from 2000-2020 due to the limitations of the specific topics that observed virtual reality therapy, acrophobia, and the presence of a control group who received no treatment.

Inclusion/Exclusion Criteria

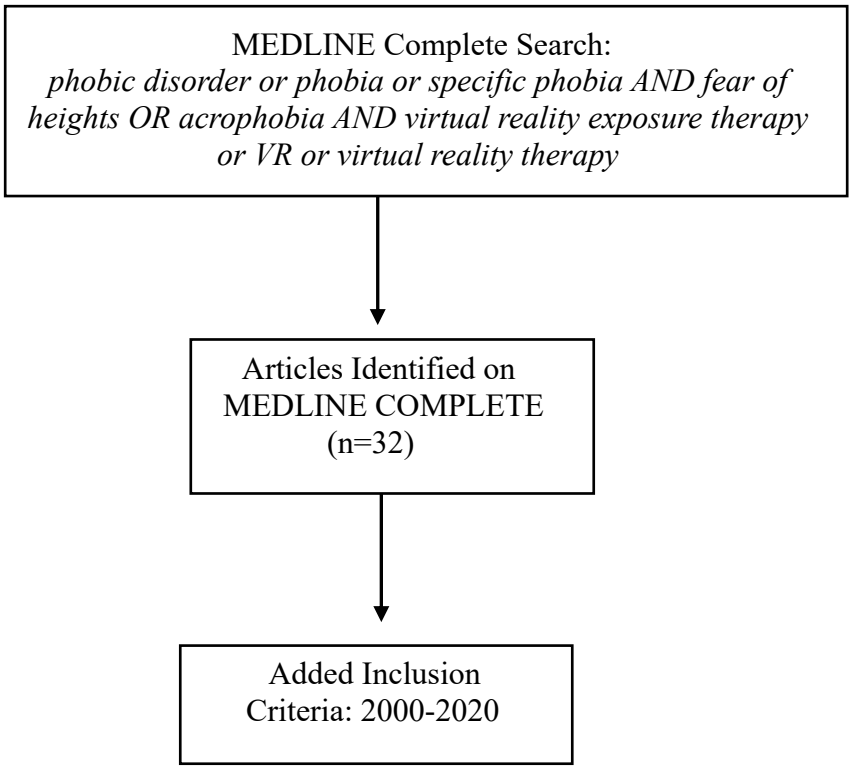
Eligibility of the study was determined by using the PICO elements: (a) the study was conducted in adults 18 years or older who suffered from a acrophobia (P); (b) the study demonstrated data on the effect of virtual reality exposure therapy as treatment for acrophobia (I); (c) the study presented data on the relationship between the effect of virtual reality exposure

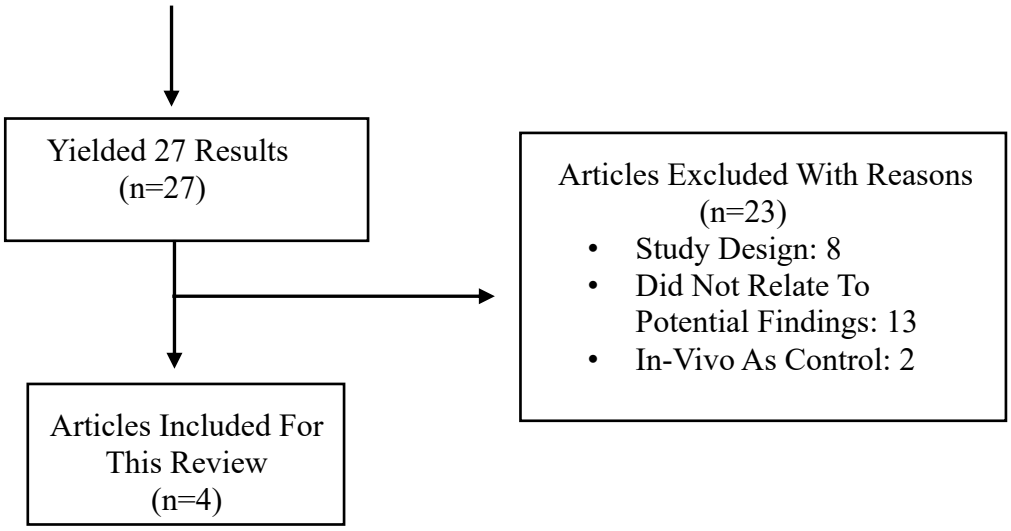
therapy compared to non-virtual reality exposure therapy intervention or no intervention (C); (d) the study presented the effects of virtual reality therapy on the reduction of the specific phobia (O). Studies were excluded if (a) the study design was not related to the potential findings, (b) unmet criteria regarding study design, or (c) the study included in-vivo therapy as a control group.

Search Results

The first search from MEDLINE complete with the appropriate subject headings yielded 32 results. Then, a time restriction from 2000-2020 was implemented, which resulted in a new total of 27 results that were considered for review. After a full review of the remaining articles, 23 were excluded for the following reasons: 8 because of unmet criteria regarding study design, 2 because of including in-vivo exposure therapy as a control, and 13 because they did not relate to the potential findings. Finally, a total of 4 articles were extracted and included in this review.

Figure 1: Exclusion and Inclusion Criteria Flowchart





Results

Characteristics of Identified Studies

A total of 340 participants were included in the four studies reviewed. All participants suffered from acrophobia (fear of heights). To participate in the study, each study measured the participants fear of heights differently to be considered to for inclusion. Donker et al. (2019) required participants to score at least 45.45 on the on the anxiety portion of the Acrophobia Questionnaire (AQ), while Freeman et al. (2018) required participants to score at least a 29 on the Heights Interpretation Questionnaire (HIQ). The participants in both Krijn et al. (2004) and Coelho et al. (2006) required individuals to meet the DSM-IV criteria for specific phobia, with acrophobia as the main complaint. All individuals in the four studies were 18 years of age or older. Donker et al. (2019) and Freeman et al. (2018) randomly divided their participants into two groups, one group which received VR treatment and one group that received no treatment (control group). Krijn et al. (2004) randomly allocated their participants into three groups: one group received VR treatment using computer automated virtual environment (CAVE-system),

one group received VR treatment using a head-mounted display (HDM), and one group received no treatment (control group). All Participants in Coelho et al. (2006) received the VR treatment. Results from participants prior to receiving VR treatment were compared to results after treatment. Baseline data, post test data, and follow up data were collected in all studies.

Software Used

Each study used different VR technology software to implement treatment. Donker et al. (2019) utilized a self-paced smartphone app that required individuals to wear VR goggles to implement their virtual reality therapy. Freeman et al. (2018) and Coelho et al. (2006) also used a VR-head mounted display. For one of their treatment groups, Krijn et al. (2004) implemented CAVE-system, which uses projections to implement VR and projects images on all four sides of the participants. For the other treatment group, they utilized a Head Mounted Display (HDM) in a dark laboratory room. Each study implemented VR therapy over a period of weeks. Coelho et al. (2006) provided 30–40-minute sessions each week over three weeks, while Freeman et al. (2018) provided six sessions over a period of two weeks, and Donker et al. (2019) used a smartphone app and participants were asked to complete 6 modules over a period of three weeks (modules included a combination of virtual reality and cognitive behavior therapy [CBT]). Coelho et al. (2006) implemented their study with weekly sessions that lasted 1.5 hours over a period of three weeks.

Outcome Test Used

Krijn et al. (2004), Donker et al. (2019), and Coelho et al. (2006) utilized the Acrophobia Questionnaire (AQ). The AQ is a self-reporting questionnaire that consists of 40 questions in which participants rate their anxiety on a scale from 0-6, and their avoidance on a scale from 0-2 (Freeman et al., 2018). The total score ranges from 0-160, with higher scores portraying a more

severe fear of heights. Freeman et al. (2018) also utilized the Acrophobia Questionnaire as a secondary outcome measure, but the primary outcome measure used was the Height Interpretation Questionnaire (HIQ), which consists of individuals rating their fears and anxiety while imagining different height scenarios through a 16 item self-assessment. Similar to the AQ, higher scores on the HIQ demonstrate a more severe fear of heights (Freeman et al., 2018). Krijn et al. (2004) and Coelho et al. (2006) also utilized the Behavioral Avoidance Test (BAT), which measures avoidance behavior. Donker et al. (2019), Coelho et al. (2006), and Krijn et al. (2004) also utilized the Attitudes Towards Heights Questionnaire (ATHQ). Data from the questionnaires were extracted at baseline, directly after treatment, 4 weeks (Freeman et al., 2018), 3 months (Donker et al., 2019), 6 months (Krijn et al., 2004), and 1 year (Coelho et al., 2006) for follow up.

Findings

All four studies utilized the Acrophobia Questionnaire and concluded that the VR therapy was more effective than the control group (no treatment). Donker et al. (2019) concluded according to the AQ, there was a reduction in symptoms of acrophobia in the participants that received treatment that compared to the control group (no intervention). Krijn et al. (2004) analyzed that in all questionnaires measured (AQ, ATHQ, and BAT), VR therapy was significantly more effective than no treatment. Freeman et al. (2018) analyzed the HIQ for the primary outcome and found that directly after treatment, all participants who received VR treatment showed reductions in their fear of heights. Freeman et al. (2018) discussed how their findings demonstrated the effectiveness of VR therapy for the reduction of acrophobia. For both the AQ and ATHQ, Coelho et al. (2006) found that although some subjects had higher fear scores directly after treatment, the results were statically significant using the test of Wilcoxon,

which suggests “extremely positive impact of the applications of VR in the treatment of phobias...” (Coelho et al., 2006, p. 338-339).

Discussion

All four studies highlighted the importance of Virtual Realty Exposure Therapy as a treatment for acrophobia. Each study demonstrated that VR therapy was more effective in reducing symptoms of acrophobia than no treatment. In each study, there were multiple outcome measure questionnaires, which was beneficial in differentiating different aspects of acrophobia. All of the studies reviewed used the Acrophobia Questionnaire (AQ), which was advantageous when comparing the data. Each study was designed differently, but data was gathered in the studies prior to treatment (baseline), post treatment, and follow up after treatment: 4 weeks (Freeman et al., 2018), 3 months (Donker et al., 2019), 6 months (Krijn et al., 2004), and 1 year (Coelho et al., 2006) for follow up. Freeman et al. (2018) collected follow up data two weeks after the completion of treatment and found that many participant’s HIQ score was lower than before treatment began, and participants showed a reduction in fear of heights two weeks after treatment ended. Coelho et al. (2006) collected follow up data 1 year after the completion of treatment, and the findings demonstrated that the participants maintained reduced fear of heights according to the BAT and ATHQ, but results were not maintained in the AQ. Data collected at different follow up periods after the completion of treatment in each study is beneficial in helping determine how long the effectiveness of VR is sustained after a period of treatment sessions. While three of the studies participants underwent treatment under the supervision of a researcher, Donker et al. (2019) utilized a self-paced smartphone app that gave individuals preference to complete the modules on their own time, which offered convenience and accessibility for the participants. Donker et al. (2019) was also the only study reviewed that

incorporated a combination of cognitive behavior therapy (CBT) and virtual reality therapy into their treatment modules, which is important to recognize during the comparison of these studies. All of the studies reviewed utilized self-reporting questionnaires prior to and after treatment, but two of the studies [(Coelho et al., 2006), (Krijn et al., 2004)] also had participants rate their anxiety during VR treatment during height simulation, which can help further assess participants anxiety at different points in the simulation.

VR therapy can be utilized in many different ways and can be integrated into treatment plans in conjunction with cognitive and behavioral therapy. The versatility of VR therapy is demonstrated throughout the duration of this paper and can be utilized in an outpatient environment through scheduled session or with the smartphone app as seen in research from Donker et al. (2019). Freeman et al. (2018) discussed that although the cost of the initial VR software and development was high, the cost of providing treatment to participants was low. The ability to conduct VR therapy through an individuals' own smartphone also aids in reduction in cost of VR therapy. Compared to in-vivo therapy, VR therapy offers an interactive and controlled environment in which individuals can experience and be exposed to their phobias. The contents of VR therapy can also be individualized to the participant and can yield benefit for those who suffer from specific phobias, post-traumatic stress disorder, anxiety disorders, and more. As mentioned in the results section, VR therapy can help improve individuals' attitudes towards heights, as well as a reduction in avoidance behavior and fear of heights.

Limitations and Implications for Further Research

Two of the studies [(Coelho et al., 2006), (Krijn et al., 2004)] were not completed within the last five years, which may impact their applicability. Even though technology and methods of VR therapy have improved and expanded, the findings from the two studies serve as an

important contribution to the effects of VR therapy for acrophobia. The studies reviewed completed their research over a number of weeks, and Coelho et al. (2006) was the only study reviewed that collected follow up data 1 year after treatment. It would be beneficial to consider the use of VR therapy over a long period of time, and the subsequent effects on the reduction of acrophobia symptoms. It would also be interesting to explore the effects of VR therapy versus in-vivo therapy in individuals with specific phobias. The studies reviewed utilized different software, timeframes, and height simulations, which is important to recognize during the evaluation and analyses of the results.

Conclusion

Virtual reality exposure therapy can offer many benefits in the medical and nursing profession. Individuals who suffer from specific phobias, post-traumatic stress disorder, anxiety disorders, and more can utilize VR therapy to help minimize symptoms and feel more comfortable in certain situations. The literature review offers extensive insight regarding successful methods of VR therapy pertaining to acrophobia and discussed the significance of VR therapy treatment in the reduction in elements of acrophobia compared to no treatment. Virtual reality therapy is a promising and valuable tool for those suffering acrophobia as well as other specific phobias.

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