RECENT DEVELOPMENTS IN THE APPLICATION OF VIRTUAL REALITY-BASED EXPOSURE IN THE TREATMENT OF SPECIFIC PHOBIAS

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Abstract

Specific phobias are a common anxiety disorder that is widely seen in all societies and has been researched by researchers for many years. There are various intervention methods for the treatment of specific phobia, but exposure-based interventions are the most effective treatments for SP, according to published research in vivo exposure and virtual reality-based exposure. Although the in vivo exposure intervention method has been in use for a long time, virtual reality-based exposure is relatively new and the evidence base is evolving rapidly, so it is important to conduct a review of recent studies. Researchers argue that virtual reality-based exposure intervention has significant advantages and that they can be beneficial for people with anxiety disorders and therapists. Therefore, five randomised controlled trials were critically reviewed and then discussed in the context of the wider literature.

According to study findings, VRET is a significant effect (77%) to treat specific phobia when comparing to the control group (50%). Also, study findings showed that VRET can reduce the anxiety of dental phobia and flight phobia. Studies showed that VRET is a cost-effective intervention method to treat phobias.

Overall, VRET is a kind of in vivo exposure and it is developing with technological innovations. Many study findings show that VRET is user-friendly, safe, affordable, realistic, and effective intervention method to treat different anxiety disorders, especially specific phobias.

Databases and Search Engines

The articles used in this study were taken from the following databases using the keywords provides below: Bournemouth University Online Library, Google Scholar, EBSCO host, PsycINFO, ScienceDirect, PsycArticles, Research Gate, and SAGE Journals.

Key words: specific phobia, virtual reality exposure method, anxiety disorders, effectiveness of VRET methods in anxiety disorders, in-vivo exposure method, 3D based exposure method, app-based virtual reality exposure method, acrophobia, dental phobia, fear of spiders, fear of heights,

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1. Introduction

Anxiety and stress have become a part of our daily life, and people of all ages can experience this in their life (Tuma & Maser, 2019). According to Stein and Bouwer, anxiety is seen as a reaction to unidentified, distant, uncertain dangers and it can affect a person's entire presence (1997). Also, anxiety, which is an alarm system in individuals, is usually activated when people face a threat or danger (Stein & Bouwer, 1997). According to the DSM-V, it is a reaction with behavioural, psychological, and physiological effects. To illustrate, some physiological symptoms include sweating, dry mouth, nausea, muscle tension, and irregular heart rhythm. Also, restlessness and worry can be an example of psychological symptoms of anxiety. Finally, an example of behavioural symptoms is that the person is unable to do their daily work and lose their ability to express themselves (5th ed.; DSM-V; American Psychiatric Association [APA], 2013).

All of these symptoms are very normal for people to feel anxiety in their daily life (Nezlek & Kuppens, 2008), for example, before an important exam, because the human brain increases the level of anxiety to adapt to challenging situations. However, when anxiety is excessive or related to an unusual situation, it can cause clinically distress and problematic behaviour in people (Rosen & Schulkin, 1998). DSM-5 examines anxiety and stress-related disorders under 6 main titles which are specific phobias, social anxiety disorder, panic disorder, generalized anxiety disorder (GAD), obsessive-compulsive disorder (OCD), and post-traumatic stress disorder (PTSD) (APA, 2013). This literature review will focus on specific phobias and recent developments in the application of virtual reality-based exposure.

The extreme level of fear associated with a specific situation or a specific object is called specific phobia and it is characterized by avoiding the object or situation that is the source of fear (APA, 2013). The individual is aware that his fear is irrational and disproportionate (Choy, Fyer & Lipsitz, 2007), but the person still avoids the phobic situation

or object (Ollendick, Davis & Muris, 2004). The fear-inducing stimulus does not cause any real danger, but it still causes avoidance behaviour in the individual with phobia (Rothschild, Hauri & Keefer, 2020).

According to DSM-5, three basic features are required to diagnose specific phobia. Firstly, fear must be directed to a specific object or stimulus. Secondly, if these stimuli are encountered, a strong fear response occurs. Thirdly, this fear reaches extreme points that will harm the functionality of daily life. Also, all of these symptoms must be seen for six months or more (APA, 2013).

In DSM-5, specific phobia types are divided into 5 main categories which are situational type, animal type, natural- environmental type, blood-injection type, and other types of phobias (APA, 2013).

2. Types of Phobias

2.1 Situational phobia

A situational phobia is the most common type of specific phobias (Davey, 2008). It is the type of phobia caused by a situation in which the individual is involved (Kendler et. al., 1992). Examples of situational phobias include avoiding public transport, avoiding entering tunnels, fear of crossing bridges, fear of cars and planes crashing (Lipsitz, 2002). For example, when people who have aviophobia board the plane, they are willing to take longer, more painful trips (Sugden, 2008). However, they have severe fears that the plane will fall when they have to board the plane (Silk, 2020). Also, they perceive even the tiniest shaking in the plane as if it would fall, so they feel extreme anxiety, this anxiety can even cause a heart attack (Silk, 2020).

2.2 Animal phobia

Animal phobia is a very common type of phobia in humans (Antony & Barlow, 1998). Furthermore, animals like insects, dogs, and cats are the most feared animals, but this might

change culture to culture (Kaskas, Ryan & Davis, 2017). To illustrate, according to Davey et. al. (1998), spider phobia is very common in English culture. On the contrary, it is not common in Turkish culture because the English people meet less spider in the UK.

The person who has animal phobia shows avoidance behaviour towards that animal to avoid experiencing high levels of fear and anxiety (Choy et. al., 2007). For example, he does not watch the movies which include spiders or he avoids visiting a friend who feeding a pet at his home (Pflugshaupt et. al., 2005).

2.3 Natural environmental phobia

Natural environmental phobias are related to the intense fear of natural events as thunder, height, water etc. (Barlow & Durand, 2015). For example, people who have astraphobia avoid leaving home on rainy days and in such days, the doors and windows are tightly closed so as not to hear the loud noise (Ashbaugh, 2015). Also, people who have acrophobia cannot go into high rise buildings or look at heights or even sit near the window in the room (Gkaris, 2017).

Nature-environment type phobias usually occur in childhood and are more common in women (Singh & Singh, 2016).

2.4 Blood- injection phobia

It is common for many individuals to experience discomfort when they see blood (Ayala, Meuret & Ritz, 2009). However, when people who have blood- injection type phobia are exposed to this situation, they feel extreme anxiety and they feel like they might faint (De Jongh et. al., 1998). Also, some phobic people avoid lifesaving interventions (Page & Tan, 2009). For instance, someone who is afraid of seeing blood may refrain from having surgery or a diabetic patient with a fear of needles may not do his needles (Page & Tan, 2009).

Blood- injection phobia generally starts in childhood and there is some evidence that it might have a genetic component because, in the family of someone with a blood phobia, this discomfort is often found (Benecke, 2016).

2.5 Other phobias

Specific phobias cover many conditions, so there are many types (APA, 2013). The fear of children from loud sounds or costumed characters such as clown can be given as an example of this kind of phobia (Ollendick et. al., 2010).

The variety of phobias is so much that it is seen that the diagnoses are gradually expanding (Ollendick et. al., 2010). To illustrate, increased use of technology and social media caused to appear a new type of phobias like nomophobia, which is defined as the fear of being deprived of a cell phone (King et. al., 2013).

3. Prevalence, Demographic Features, and Comorbidity

In the United States, specific phobia, which can be diagnosed in 12.5% of adults, was found to be one of the most common mental disorders (Kessler et al., 2012). Also, they are the most common type among the phobias group (Kessler et al., 2012). Similar studies have been found with other anxiety disorders that the prevalence rate among women (15 per cent) is statistically higher than that among men (7 per cent) (Craske et. al., 1996).

According research evidence, the average age of the people who diagnosed with a specific phobia is generally young because generally, it starts in childhood around 16 years (Ost et. al., 1984).

The comorbidity rate with other psychological disorders is very high in specific phobias (Rodriguez et. al., 2004). Recent studies show that comorbidity rates for women (44%) are higher than rates of men (34%) (Iancu et. al., 2006). It is frequently comorbid with other anxiety-based disorders, such as social anxiety disorder, obsessive-compulsive disorder

(Ollendick et. al., 2010; Silverman et al., 1999). Therefore, people with specific phobias might have at least one more anxiety disorder (Hofmeijer et. al., 2012).

Santos et. al. (2017) found that people with specific phobia show avoidance behaviour and it causes social disability. As a result, decreased social stimulus might cause depression.

4. The Aetiology of Specific Phobias

Although the source of the specific phobias is not known exactly, different scientists have tried to explain roots of phobias with various approaches which is the psychoanalytic approach by Freud and behavioural approach by Watson (Davis, Ollendick & Öst, 2012).

According to Freud, phobias are related to unconscious conflicts and are related to the oedipal complex (1955). Some repressed, unconscious fears are shifted and directed to an object or situation that would normally not cause anxiety, and phobias develop in this way (Compton, 1992).

Some scientists argued that phobias are congenital disorders and biological-based disease (Fox, Griggs & Mouchlianitis, 2007). On the contrary, others argued that SP is environmental-based disorders and they acquired by learning (Hettema et. al., 2005).

4.1 Behavioural accounts

According to Watson, specific phobias can be mainly related to the classical condition developed by Ivan Pavlov (Watson & Rayner, 1920). In this assumption based on the classical conditioning, anxiety is stimulated by a natural frightening stimulus associated with a second innate stimulus, so it has been found that when two stimuli successfully match several, a neutral stimulus can create anxiety alone (Merckelbach, de Jong, Muris & van Den Hout, 1996). In other words, the neutral stimulus can become a conditional stimulus in the formation of anxiety (Merckelbach, de Jong, Muris & van Den Hout, 1996).

In classical conditioning theory, if the conditional stimulus is not reinforced continuously with the unconditional stimulus, the response gradually weakens (Gormezano &

Moore, 1966). On the contrary, in phobias, even if the person is not repeatedly exposed to the stimulus, fear and avoidance behaviour lasts for years because anxiety is an impulse that motivates the organism in whatever it can do to prevent painful effect (Merckelbach, de Jong, Muris & van Den Hout, 1996). Thus, with coincidental behaviours, the organism develops behaviours that can avoid anxiety-causing attitudes, and these are reinforced even if they are unrealistic because the purpose of the organism is to protect itself (Watson & Rayner, 1920). For example, people with elevator phobia do not get on an elevator for not to faint (Lichtenberg, 1991).

Classical conditioning can clarify the development of phobias in humans. However, it cannot explain why it has not decreased in intensity over time (Muris, 2017). Ricketts & Donohoe argued that based on operant conditioning principles, avoidance behaviour can be negatively reinforced when the person temporarily avoids the feared stimulus. For example, a person with spider phobia may try to get away when the spider is seen (2017). This avoidance behaviour reduces the person's anxiety and the behaviour is negatively reinforced. Therefore, this increases the likelihood that the person will repeat this behaviour in the future (Ricketts & Donohoe, 2017).

There are some evidences that fear can be learned by modelling. Therefore, people can have a specific phobia by observing others (Askew & Field, 2008). Gerull & Rapee argued that a group of little children are exposed to toy snakes and spiders, while their mother's facial expression is in negative state. At the end of the experiment, children who saw negative facial expression of their mothers showed more avoidance behaviour than those who did not (2002).

According to Watson, behaviourism focuses on the observable behaviour of the individual rather than the intrinsic functions, so it is a measurable. Therefore, it is evidenced based approach to explaining the causes of phobias (2017).

Neenan argued that another strength of behavioural approach is that this can be adapted to therapy. For example, the behavioural approach has been used in a variety of therapeutic applications, with systematic desensitization and flooding in particular (2017).

According to Lee, unlike the strength of the behavioural approach, it also has some limitations. It is reviewed because it is very reductive and overly simple. For instance, it passes off the role of cognition causing phobias (2016).

4.2 Biological accounts of phobias: The role of evaluation

There are many theories about the origin of phobias, including that they may be biologically based (Seligman, 2016). Humans have been trying to adapt to their environment to survive and continue the generation of them since primitive times (Bennett, 2017). For instance, ancient people had to struggle to live with poisonous animals such as snakes, spiders to stay alive centuries ago (LaDuke, 2017). Undoubtedly, today's threats are different from those of our ancestors who lived in primitive times (Seligman, 2016).

According to Seligman, today, humans avoid dangerous animals such as snakes and spiders, as their ancestors because this defense mechanism is genetically transferred to them (1971). However, time is changing and technology is advancing, so people are having much greater dangers in their life's although fears for insects and reptiles never diminish (Öhman, Dimberg & Öst, 1985). To illustrate, traffic and electrical accidents are much more dangerous and widespread in the modern world, but when it was examined to the ancient times, there was no traffic problem or an armed attack, while the greatest danger to human life was poisonous animals such as snakes and spiders (De Silva, Rachman & Seligman, 1977).

Seligman argued that early humans learn to fear significant dangers easier than modern humans because they were perceiving the danger faster and taking action faster, so they were more likely to survive (1971). Moreover, Seligman explained the fears that could not be explained by environmental learning in the preparedness learning theory, accordingly,

the efforts to survive and fear are coded into human genes and passed on to new generations (Seligman, 1971). Therefore, it causes a modern human to be more sensitive to some dangers as spider, height, or snake compared to other dangers (Seligman, 1971).

As a result of new evidences, scientists realized that some information remained as biological heritage as a result of changes in Deoxyribonucleic acid (DNA). Therefore, some fears in human can be genetically inherited from their ancestors (Asok, Kandel & Rayman, 2019).

4.3 Multifactorial Model of Specific Phobias

Based on existing evidences, it seems unlikely that specific phobias can be accounted for by only environmental factors or biological factors (Van Houtem et. al., 2013). For instance, the phobias such as dog phobia, dentist phobia, or driving phobia may be caused by trauma (Fox, Griggs & Mouchlianitis, 2007). However, fear of insect or snake cannot be associated with environmental factors (Fox, Griggs & Mouchlianitis, 2007). Therefore, a multifactorial model has been developed that can explain the causes of specific phobias with scientific evidence (Muris & Merckelbach, 2012).

In this model, a bridge is established between normal fear and specific phobias (Muris & Merckelbach, 2012). Even though normal fears are very prevalent in humans, in some cases they can cause major problems (Fox, Griggs & Mouchlianitis, 2007).

Avoidance behavior from some dangerous animals or situations may have been genetically transmitted from their ancestors to people (Davis, Ollendick & Öst, 2012). Also, people can acquire this avoidance behaviour by modelling, condition, or negative information, so it is not correct to examine the source of phobias with a single approach (Davis, Ollendick & Öst, 2012). Finally, genetic and learning-acquired specific phobia causes avoidance and cognitive bias (Seligman, 1971). People with a specific phobia do not want to encounter the object or situation they fear due to avoidance behaviour (APA, 2013). In addition, people with

a phobia are extremely alerted to potential threats due to cognitive biases (APA, 2013). There are some evidences that people with phobia can have sleep problems because they are very worried about encountering the phobic stimulus even in their sleep, so they always want to be alerted (Simon et. al., 2016).

The strength of this model is that it includes both environmental and biological risk factors. Thus, the development of phobias can be discussed and explained in detail (Muris & Merckelbach, 2012). It is easier to examine all the factors that cause phobias by looking at this model (Muris & Merckelbach, 2012).

The feature that limits this model is that it does not explain the risk groups in sufficient detail. For instance, there is evidence that being a woman, being young and low income are predictive in developing specific phobia (Sigström et al., 2011). According to Sigström, marital status also affects this situation. For example, widows and divorced people have more specific phobias than single and married people (2011).

5. Therapeutic Techniques in Treating Specific Phobias

There are various intervention methods used in the treatment of specific phobias such as Cognitive Behavioral Therapy (CBT), Exposure Therapies, and medication (Choy et. al., 2007).

Although medication is one of the methods used in the treatment of anxiety disorders, it is not recommended for disorders that are not very severe because medication has side effects such as loss of appetite, dizziness, insomnia etc. (Singh & Singh, 2016). Unlike psychological interventions, medication cannot be applied to everyone like pregnant women (Haas et. al., 2018). Studies have shown that relapse rates which is 40% are very high within 2 years after stopping drug treatment (Bandelow, Michaelis & Wedekind, 2017).

CBT in the treatment of phobias is a scientifically proven psychotherapy method (Ipser, Singh & Stein, 2013). In the CBT method used in the treatment of specific phobias,

irrational thoughts and negative thoughts are trying to be changed (Abramowitz & Arch, 2014). Thus, the thought is restructured and it is aimed to overcome the avoidance behaviour (Choy, Fyer & Lipsitz, 2007). However, the relapse rates are very high in CBT (Choy, Fyer & Lipsitz, 2007). There is evidence that the relapse rate is 53% of patients treated with CBT end of 1 year (Ali et. al., 2017).

Exposure therapy, a type of behavioural therapy developed by Joseph Wolpe, is the most effective and most common method used in the treatment of specific phobia (Miloff et. al., 2016). Kaplan & Tolin found that the percentage of success in treating people with a phobia is about 90% by exposure therapy (2011). People with phobia try to avoid the situation or object they fear (APA, 2013). The behaviour of getting away from the phobic object may provide relief for the person in the short term, but the person's anxiety and avoidance behavior increase in long term (Antony & Barlow, 1998). Therefore, exposure therapy aims to confront the person with the stimulus in which person exhibit avoidance behavior in a safe environment (Maskey et. al., 2014).

Exposure therapy can be applied using different methods such as graded exposure, systematic desensitization, and flooding (Ougrin, 2011).

In graded exposure, exposure therapy is applied to the person by creating a hierarchy in which the stimulus intensity is increased gradually from low to high (Vlaeyen et. al., 2001). The most recommended method is graded based exposure therapy (Wolitzky-Taylor et. al., 2008).

According to systematic desensitization procedure, exposure therapy is applied to the person with various relaxation techniques, so the person's avoidance behaviour becomes easier to deal with (Head & Gross, 2009).

Unlike these two methods, according to the flooding procedure, the person is suddenly exposed to the most frightening stimulus and tries to interfere with his fear (Boudewyns, 2012). There are different approaches to exposure therapy (Choy, Fyer & Lipsitz, 2007).

5.1 Imaginary Exposure Therapy

Imaginary Exposure is ensured that the person is exposed by using his imagination with the stimulus that causes him to show avoidance behaviours (Rentz, Powers, Smits, Cougle & Telch, 2003). Moreover, relaxation techniques are not used in imaginary exposure unlike systematic desensitization (Krijn et. al., 2004). In this approach, people are asked to write their fears on a piece of paper and are expected to repeat it in their minds until their reaction to phobic stimuli subsides (Choy, Fyer & Lipsitz, 2007). In doing so, it is very important to visualize even the worst of the feared object in the mind (Choy, Fyer & Lipsitz, 2007).

5.2 In Vivo Exposure Therapy

During in vivo exposure therapy, the person directly contacts the avoidant behaviour and the anxiety-causing stimulus in real life (Parsons & Rizzo, 2008). In this type of exposure, the person with a specific phobia is gradually exposed to the fear stimulus (Wolitzky-Taylor et. al., 2008). For example, a person with spider phobia is asked to look at the spider's picture first, then he is asked to watch a video containing a spider and then touch a toy spider (Soravia et. al., 2014). In the end, he is finally asked to pick up a live spider on his palm (Soravia et. al., 2014).

Up to 3 hours of sessions can be applied in this type of exposure therapy (Choy, Fyer & Lipsitz, 2007). In vivo exposure therapy is an effective intervention method, especially for people with animal phobia and relapse rate which is 3% is very low after treatment at the end of the 1 year (Maples-Keller, et. al., 2017).

5.3 Virtual Reality Based-Exposure

Technological developments and easy access to innovations have helped spread the application of virtual reality therapy in phobia intervention methods (Wiederhold & Riva, 2019). Virtual reality is a technology that aims to revive real or imaginary spaces in three dimensions in a computer environment and to provide the user with the feeling of being in the space created physically at a high level by using various peripherals (Riva, 2005). One of the most important accessories of virtual reality technology today is 360 ° virtual reality glasses that allow the reflection of virtual objects and place models to the entire field of view of the person (Rothbaum et al.,1997).

Virtual reality applications are one of the most effective methods of overcoming the phobias by reflecting the phobic situation in the most realistic way and using the exposure therapy methods (Choy et. al., 2007). In this method, the individual is left face to face with the phobic stimulus in a room resembling a phobic situation digitally (Parsons & Rizzo, 2008). Also, the sounds and images related to the phobic stimuli are reflected in the room and remain in the room until the individual gets used to or controls his fear (Parsons & Rizzo, 2008). Anxiety level and avoidance behaviours of people with environmental phobia increase when they expose to this environment visually and auditory (Parsons & Rizzo, 2008). In VR based exposure therapies, the person applying the therapy can adjust the triggers in the environment by adding smell and sound according to the patient's anxiety level and make the therapy more effective (Rothbaum, 2010). In virtual reality therapy, different approaches which are graded exposure, systematic desensitization, and flooding can be applied as in other exposure methods (Rothbaum, 2010).

Virtual reality is a new approach to exposure therapies techniques; patients feel more comfortable in this method because they know they are safe in the sheltered area (Mitrousia & Giotakos, 2016). It has been argued that a virtual environment is safer and cost-effective than

in vivo exposure, so it is more useful and effective compared to other exposure methods (e.g. Maples-Keller, et. al., 2017). People with phobia think that it is safer and more preferred because virtual reality therapy is terminated whenever they want (Mitrousia & Giotakos, 2016).

In in vivo therapy, it is difficult and dangerous to create certain conditions such as exposure to snakes (Maskey et. al., 2019). Besides, it can be very costly to create this situation, such as flight phobia, so VR based exposure is a powerful therapy method to treat phobias (Cardoş, David & David, 2017).

When VR is evaluated by the practitioner, the intensity and duration of the exposure can be controlled and the number of repetitions can be adjusted and this provides flexibility to therapy (Mitrousia & Giotakos, 2016). When compared with virtual based exposure therapy and imaginary exposure, virtual reality is more realistic and the person with phobia feels like it is there in the place (Choy et. al., 2007).

The feeling that the client has control over the virtual reality application can increase the sense of self-efficacy (Maskey et. al., 2019). The treatment is specially configured to the client because the therapist can manage the severity and content of the exposure (Mitrousia & Giotakos, 2016).

Another important point is that VR based exposure is easier to apply for people who have difficulties in imaginary exposure (Chesham, Malouff & Schutte, 2018). Finally, virtual reality technology can repeatedly provide situations that are difficult to re-experience such as war (Beidel et. al., 2019).

Specific phobias are very common and associated with a great deal of psychological suffering (Kessler et al., 2012). Research results show that many intervention methods can be used in the treatment of specific phobia, but it seems that the most effective method is exposure-based interventions. Yet, supported by scientific evidence, virtual reality-based

exposure has many advantages over traditional methods (Miloff et. al., 2016). Although some scientific research has proven the impact of virtual based exposure, it is rapidly developing field. Therefore, it is important to review up to date evidence and new developments (Kaplan & Tolin, 2011).

6. Critical Review

6.1 Selection of studies

The articles for the critical review were selected by searching between the years 2017 to 2020 several databases ScienceDirect, PsycInfo, PsycArticles, Research Gate, PubPsych, APA PsycNet, and Elsevier. The following keywords were used while scanning the studies in the titles and abstracts: "specific phobia", "virtual reality exposure method", "3D based exposure method", "anxiety disorders", "effectiveness of VRET methods in anxiety disorders", "acrophobia", "dental phobia", "fear of spiders", "fear of heights", "in-vivo exposure method", "app-based virtual reality exposure method" and, "medicines that are used in anxiety disorders".

1432 possible articles were found using this method. By looking at the title of articles, randomized control trials were selected. The abstracts of the remaining 16 articles were examined. As a result of the searching, five randomized controlled studies that examine effectiveness of virtual reality exposure-based methods in the specific phobias were selected: (Donker et al., 2019; Gujjar et al., 2019; Minns et al., 2019; Miloff et al., 2019 and, Meyerbröker et al., 2019).

6.2 Effectiveness Studies on Virtual Reality-Based Exposure Therapy

Minns et al., (2019)

The impact of 3D exposure therapy on spider phobia has been criticized based on previous studies and the present study (Minns et al., 2019) in this paper. Previous studies have shown that 3D exposure therapy can be used as an effective method in many psychological disorders such as anxiety disorders, specific phobias, and posttraumatic stress disorder (Powers

& Emmelkamp, 2008; Wolitzky-Taylor et al., 2008). According to the authors, the present study is the first study to examines the effect of immersive 3D exposure-based treatment on spider fear (Minns et al., 2019). Participants in this randomized controlled study were randomly assigned to two groups: the 3D exposure group and the psychoeducational group. The strengths and limitations of the research will be discussed in detail in the discussion part.

According to the authors, the present study is the first study to examine the effect of 3D exposure-based treatment on spider fear (Minns et al., 2019). In the article of the present study, no information was given about the calculation phase of the sample size, the power and significance level of the study. Seventy-seven participants (age range 18-23) who have >59 which means a cut-off score of the Fear of Spider Questionnaire, were assigned the study (Szymanski & O'Donohue, 1995). This study has a moderate sample size (N=77); therefore, analyzing this study to see whether applications of VR studies for treating specific phobias is good enough (LeBeau et. al., 2010). To identify the avoidance behaviours to feared stimuli of participants were asked complete Behavioral Approach Task (BAT) including 14 gradual steps of exposure to the spider. Participants who accomplished step 11 and after steps were excluded from the study. This exclusion criterion aimed at participants who have a significant fear of spiders at the behavioural level.

After the BAT was completed participants were randomly assigned the two groups: 3D exposure-based treatment group or psychoeducation control group. According to this enrolment, there are two independent variables in the study. IV has two levels: 3D exposure-based treatment group and wait-list group. Another IV is the time and was evaluated in three-level: pre-treatment, post-treatment and after one-week follow-up). In the present study, four measurements were examined as dependent variables: Fear of Spiders Questionnaire (FSQ) scores, Behavioral Approach Task (BAT) scores, Fear During the BAT scores, and anticipatory fear rating before the BAT scores. All these dependent variables were measured at the

frequency level. The design of the study is 2 (groups) x 3(times) repeated measures design. VR-based exposure method includes a 5-minutes video and the video has been presented by manipulating the intensity of spider progressively (spider being closer position and so on). Psychoeducational control condition includes participants have presented a neutral 30-minute video about music genres which are irrelevant from the fear of spiders.

To briefly summarize the study findings, there was a significant effect of group and time effect, and time-by group interaction effect was found in FSQ scores. These findings indicated that compared to the control group, participants' fear in the experimental group significantly reduced after they received the 3D exposure-method therapy. Similarly, BAT scores significantly improved for the 3D exposure-based group improved compared to the control group. In the fear during BAT outcomes, there was no main effect of the group however there was a main effect of time, indicating that the groups showed various improvements on BAT. Lastly, outcomes of anticipatory fear rating before the BAT indicated that there is a reduction from pre-treatment to post-treatment in 3D exposure-based treatment group compared to the control group. Overall, these findings indicated that there is a significant effect of 3D exposure-based therapy on reducing fear to spider.

The study has several strengths. For instance, it can be supposed that presenting psychoeducational videos to the control group makes it stronger. In other words, creating a control group that receives informational intervention about the spiders can indicate that people's fear of spiders did not decrease with logical and informative explanations. This manipulation can indicate that exposing the feared stimuli is more effective than have accurate knowledge about the feared stimuli. Moreover, in the present study, not only self-reports but also behavioural measurements which participant's behaviour is observed were evaluated, and using behavioral data made the research stronger because the reliability of self-reports is low, so using behavior measurement increases the reliability of the study. In other words, the use of

BAT measurement enables the researchers researching to observe the fear of the participants towards the spider, and this measurement is more reliable than self-report-based measurements since, in self-report-based measurements, the participants could report their fear levels under or overestimate.

The study has some limitations including that participant in the research consist of college students who have no diagnosis in fear of spiders, thus findings cannot be generalized to patients with clinical levels of phobia. Another limitation of this study is that the eye-tracking or taking electrophysiological measurements could not be used because participants were taking VR glasses, so using these measurements is not possible. The study would be more reliable if these measurements could be made.

The internal validity of the study was ensured by controlling possible confounding variables that could affect the research results, but due to the sample selection (for example, the age group, education level, the majority of women, and the lack of a clinical diagnosis of the participants) prevents the generalization of the research findings. In the research, another condition could be created in which the assistant was not present with the participants and it could be inferred how the participants would use their coping skills gained from the treatment when they encounter an alarming stimulus in real life.

As a result, although it is methodologically strong research, the findings of the research should be replicated using a sample with a clinical diagnosis. Also, longitudinal studies are needed to show whether this therapy method has a permanent effect and can be a treatment method.

Donker et al. (2019)

In recent years, alternative therapy methods have been used to treat psychological disorders (Choy et. al., 2007). These innovative methods using smartphone apps and low-cost virtual reality have the potential to improve the accessibility and scalability of psychological treatments (Wiederhold & Riva, 2019).

There is good quality empirical support that the effectiveness of virtual reality therapy, but the treatment required still expensive technology (Freeman et al., 2018). Donker et al., (2019) aims to examine the effectiveness and user-friendliness of ZeroPhobia which is a virtual reality cognitive behavioural therapy (VR CBT) for people with height phobia in their study.

The present study was conducted as a controlled field experiment in which participants were assigned to conditions by randomizing and they participate in the experiment in their natural place (e.g., their home). The study can be classified as an experimental study because the researchers manipulated the conditions by using the experimental group (VR-CBT group) and control group (wait-list group). The design of the study is between-subjects design since there are two groups (VR-CBT and wait-list) and these groups were compared in terms of a self-report measure of acrophobia. The sample size has been calculated with 80 % power at a 5 % significance level and has been found that 180 participants are required. As a result of the statistical calculations, the present study has been conducted with 193 participants (large enough sample size). There is a nominal independent variable (groups) and, IV has two levels (intervention and wait-list control group) in the study. In this randomized study, 193 participants aged 18 to 65 years with acrophobia which is extreme or irrational fear of heights symptoms were randomly assigned to a VR-CBT application or waiting list control group by an independent researcher.

The main dependent variable of the study is Acrophobia Questionnaire (AQ) scores. This scale, which has two subscales (anxiety and avoidance) and 40-items that includes height-relevant items (e.g., riding a Ferris wheel) developed by Cohen (1977) to measure acrophobia symptoms, is widely used in screening acrophobia symptoms. The type of dependent variable is frequency (Cohen, 1977). The researchers used the AQ total score as a primary measurement; however, they also measured two different subdivisions of the questionnaire: anxiety and avoidance (Cohen 1977).

At the beginning of the study, the participants' baseline AQ scores were measured. During the research, VR-CBT participants were asked to use the application and complete the entire intervention within three weeks in their day-to-day lives. Final of the three weeks, the AQ scores of all participants were remeasured as post-test scores. Lastly, participants were asked to complete the Acrophobia Questionnaire after three-months. The same procedure was valid for secondary measurements. Since repeated measures were received from participants, the present study can be classified as repeated measures design.

In addition to the primary measurement, researchers used secondary measurements to control some variables that can affect the results of the study. These secondary measurements are the Attention to Height Questionnaire (ATHQ), Beck Anxiety Inventory (BAI), and Patient Health Questionnaire (PHQ).

Results indicated that compared to the wait-list control group acrophobia symptoms of participants in the intervention group significantly reduced in terms of AQ scores that is primary measurement. Similarly, secondary measurement outcomes indicated that there is a significant effect of the intervention on the attention to height scores (ATHQ) and general anxiety scores (BAI); however, there were no significant differences between two groups in terms of PHQ scores.

Researchers supposed that the present study is the first study that indicates virtual reality acrophobia treatment can be provided at home without the intervention of a therapist. Compare to other studies, Donker et al. (2019) conducted a therapy method that includes highly accessible and has a low cost by using a smart-phone application.

One of the strengths of the study is that the therapy method is easily accessible. However, this strength might also seem a limitation at the same time. Since there cannot be an intervention of a therapist, the possible confounding variables cannot be controlled.

This research is that using secondary measurements in terms of both examining the correlation between acrophobia and other variables and controlling the possible confounding variables. It is important to note that confounding variables can increase or decrease the effectiveness of the therapy method.

Another strength of the study is the low cost. For example, a meta-analysis of Freeman et al. (2018) indicated that VRET is an effective therapy method and has a large effect size. However, this method is expensive thus it is not accessible to everyone. According to Fairburn & Patel (2017) treatment coverage is below 50 %. This ratio indicates that people who suffer from a psychological cannot reach treatments or healthcare professionals. One of the most important reasons for this situation can be financial deficiencies. The present study provides a chance to receive treatment for almost every socio-economic level individual.

In a previous study (Cuijpers et al., 2013), it was revealed that treatment twice a week was more efficient than treatment once a week. Therefore, this study was designed to have therapy three times a week. This methodological change, which was made to increase the effectiveness of therapy, is one of the strengths of the study.

As the authors say, the conduct of the study in the natural environment of the participants increases its ecological validity, but it also decreases the internal validity of the

study (Donker et. al., 2019). The design of the study can be considered both strengths and limitation of the study.

Research data and results are based on self-reported measurements. The researchers did not conduct a diagnostic interview because human involvement could affect the results of the research (Andersson & Titov, 2014; Buntrock et al., 2016), and they wanted to isolate the real effect of the virtual reality application. This situation prevents the effectiveness of the application in the clinical field and reduces the reliability and validity of the findings since the outcomes of all measurement based on the self-report. If a diagnostic interview has been conducted or behavioural data has been obtained, the findings could be more reliable.

The broad age range of participants in the study may have influenced the results. Since the ability to use smartphones of older people is weaker than young people. After collecting the data, making different analyses according to age groups could make the research findings stronger.

The fact that the participants can practice at any time can be considered as another confounding variable. It is not possible to control how much time participants spend in practice; therefore, the optimal duration of therapy cannot be determined clearly. Although the fact that the participants can practice whenever they want can increase the effectiveness of the therapy, at the same time it to cannot be measured how much each participant has practiced is a confounding variable that reduces the validity of the study.

Another limitation that reduces the external validity of the study is the level of education of the participants. About 80% of the participants have a post-secondary education. However, the level of education of these participants (whether they graduated from high school, undergraduate, or master) was not clearly stated.

In conclusion, the fact that the research is carried out in the natural environment of the participants and its cheap cost makes the research strong but also causes the research to have

limitation. In such studies with high ecological validity, I suppose that variables such as medical history, current life events should also be considered when calculating the power and effect size of the research. Besides, a placebo control group of participants using any other application should have been created. In this study, the exposure technique was used based on cognitive behavioural therapy, yet a clear conclusion still cannot be made as to whether it is related to the content of the application used to reduce the fear of heights.

Further studies are needed in which the participants are equally distributed in terms of their socioeconomic and educational levels, and the life events and the time they use the application are taken under control, and the research findings are examined according to age groups.

Gujjar et al. (2019)

It is estimated that approximately 5-10% of the population has dental fear and 4% of the population is diagnosed with dental phobia (Hill et al., 2013; Oosterink, de Jongh, & Hoogstraten, 2009). People with a fear of dentists avoid going to the dentist and this avoidance behaviour negatively affects their oral and dental health and, consequently, their quality of life (Oosterink et al., 2008). Visual Reality Exposure Therapy (VRET) method, which has been widely used in specific phobias and anxiety disorders in recent years, is also used in dental phobia (Choy et. al., 2007). Several studies are examining whether VRET has a positive effect on dental phobia, but these studies have limitations such as the small sample size, and some variables (e.g., presence, distress during VRET) that may affect the effectiveness of therapy have not been evaluated (Gujjar et al., 2019).

The researchers conducted the present study to replicate the positive findings of previous research and establish the efficiency of the VRET method on dental phobia without the limitations of those previous studies (Heaton et. al., 2013).

In the present study, there is one independent variable and has two levels: the VET group and the IP (Informational Pamphlet) group. The sample size has been calculated with 90% power; however, the significance level has not been stated in the article and the researchers finally have been conducted the present study with 30 participants (moderate sample size). Thirty participants (aged between 18-50 years) who have 15 scores and more of MDAS (Modified Dental Anxiety Scale; Humphris et al., 2000) were randomly assigned to the groups. Researchers manipulated the conditions by using a control group, thus this research is that a controlled laboratory experiment.

Dependent variables consist of primary outcome measures (VAS-A: Visual analogue scale for anxiety, MDAS: Modified Dental Anxiety Scale and, DFS: Dental Fear Survey; Kleinknecht et al., 1973) and secondary outcome measures (behavioural avoidance, heart rate, attitude to VR experience during and post the VRET and, acceptance of dental treatment). Primary outcome measures were evaluated in six different times (baseline, pre- and post-intervention, 1 week, 3 months and, 6 months). Participants in the VRET condition were given a virtual dentist examination experience with the help of virtual reality, while the participants in the IP condition read a booklet with articles on dental fear throughout 45 minutes; however, both groups were seated in the dentist chair (Gujjar et al., 2019).

The present study has been conducted to test the assumptions that the VRET method will reduce anxiety and avoidance behaviours, increase the heart rate of the participants during the VR experience, but there will be a significant decrease in heart rate after therapy, and that participants will be more willing to make dental appointments after therapy.

The primary measure results were as predicted, the anxiety levels of the participants in the VRET group gradually decreased during their sitting in the dental chair, but no significant reduction in the IP group. The secondary measurement results showed a significant reduction in BAT scores of participants in the VRET group after the intervention compared to the IP

group. There was a significant decrease in the heart rate scores of all participants from the baseline to the T2. Lastly, the VR experience was evaluated in terms of presence, realism, cybersickness, and distress and there were no significant differences from the rating of steps of VR scenarios (V1 to V5). The last result of the study is that the participants in the VRET group (77%), compared to the participants in the control group (50%), Those in the VRET group are more willing to go to the dentist, so the improvement was found in the VRET group (Gujjar et. al., 2019).

All these results indicate that VRET provides a significant reduction in dentist anxiety and avoidance behaviour, so the VRET method can be used in the clinical field to treat dental phobia.

One of the strengths of the research is that the participants had repeated measurements at certain time intervals. Participants were asked to fill the VAS-A, MDAS and DFS scales periodically (one week later, 3 months later, and 6 months later), but these measurements are based on self-report only. Obtaining repeated measurements from the participants is important in terms of evaluating whether the effect of the therapy method continues in the long term, in other words, whether it has a permanent effect, yet it is a disadvantage that only self-report measurements were taken in the follow-up process. At one of these time intervals, for example, at 3 months, re-exposing the participants to VRET (not as a therapy method) would be useful in detecting changes in secondary measurements (heart rate during VRET, attitudes to VRET experience). This assessment would allow us to observe whether the persistent effects of therapy on the behavioural level.

As the authors say, one of the limitations of the study is that the sample consists of subclinical participants. Although VRET reduced participants' fear of going to the dentist and avoidance behaviour, the generalizability of the findings to the population is poor. The method used can be valid and reliable as a treatment method, but the sampling VRET

diagnosed with a dental phobia at the clinical level may not be applied with the steps in this study (participants may need to be relieved by different methods before VRET) or longer time may be required for VRET to reduce phobia.

The experience of being examined at the dentist may include other feared stimuli such as saliva and blood, depending on the type of procedure to be performed, and a study using these stimuli can be designed to provide participants with a more realistic experience. The use of stimuli could also increase participants' perception of reality. As Maples-Keller (2017) mentioned, multiple realistic stimuli used during VRET can activate the mechanisms underlying fear.

In general, these research findings show that the VRET method can reduce dental phobia and this application can be used as a therapy and treatment method. Nevertheless, further studies are needed in which the findings of the research were carried out with a larger sample of dental phobia at the clinical level.

Meyerbröker et al., (2018)

A modern treatment strategy which is using short-acting medicines with exposure treatment has been created in anxiety disorders. The present study aims to examine the effects of YOH and Propranolol in participants with specific phobia by using the VRET method and manipulating drug using in three groups.

In the present study, there are 56 participants (large enough sample size) with specific phobias (fear of flying and acrophobia) in the age range from 18-65. A sample size of the present study has been calculated with 80 % power at a 5 % significance level and has been found that 52 participants are needed. These participants were randomly assigned to three groups: VRET plus YOH group, VRET plus Propranolol group, and VRET plus placebo group). The type of investigation is a controlled laboratory experiment. Type of independent variable is

nominal and dependent variables were measured as frequency. The present study examines the main effect of drugs (YOH and Propranolol) and the interaction effect of drugs with VRET. To examine the overall effect of drugs 3 (drugs) x 3 (time: pre, post, and follow-up) mixed repeated-measures ANOVA was conducted. All participants were exposed to feared stimuli after one hour they took up the drugs and were measured their anxiety levels three times in two weeks (Meyerbröker et. al., 2018).

The study results indicated that there is a main effect of time on the flight anxiety and acrophobia; however, there is no main effect of groups and interaction effect of time by the condition. The first hypothesis of the research was confirmed, participants improved significantly on anxiety specific measures regardless of drug condition. The second hypothesis of the study was not confirmed. There was no significant difference between the YOH group and the placebo group in terms of the improvement of their coping mechanisms with anxiety. The last hypothesis was not confirmed, too. There was no significant reducing anxiety in the Propranolol group compare to the YOH group and placebo group. Anxiety specific measures were consistent with previous studies in terms of efficacy of VRET in specific phobias (Meyerbröker, 2014). The study findings at 3-months follow up measures, it seems that the placebo group profited most from treatment. Possible causes of this unexpected result will be discussed in detail.

One of the strengths of the study is that the placebo group has been created. However, there are several limitations to the study. The first limitation is that participants have different specific phobias. Since they have different phobias, their results were evaluated based on their anxiety levels. Thus, the findings cannot generalize to the population who have specific phobias, and the measuring method threats to the external validity of the study.

While choosing the drugs used in the research, the possible side effects of the drugs (such as nausea) and possible impacts of side effects of the drugs on the response to feared

stimulus were not considered in detail (Meyerbröker et al., 2018). The wide range of age (18-65) is problematic in terms of the therapeutic effects and side effects of the drugs used. These medicines have several side effects such as feeling tired, dizzy, light-headed, and nausea and the severity of side effects can differentiate in terms of individual differences such as gender and age and these differences can be confounding variables.

As the authors say, the anxiety levels and responses to the feared stimuli of the participants who were given propranolol may have decreased at that moment due to the drug, but it may have prevented them to develop learning or coping strategies for feared situations in the long-term.

Another feature of drugs that is not considered is the fact that these drugs act as an antagonist of alpha and beta receptors, and in cases where there is no drug use, receptor upregulation occurs (Bittner & Martyn, 2013). In the measurements taken three months later, the anxiety levels of the placebo group were lower than the other groups, and the receptor upregulation did not occur in the placebo group. In psychology researches that are used the drugs that affect the sympathetic nervous system, Doctor of Medicine should also take an active role in the research, through variables in the research can be better controlled and the possible results can be predicted better. The fact that the medical variables may have caused a systematic problem in the research design and may have caused the misuse of the research findings (Meyerbr*öker et. al., 2018).*

It is not explicitly stated in the article whether the drug used as a placebo is the same in terms of shape and size as other drugs. For this reason, the fact that the participants' estimates of the drug they used were so accurate remained open to discussion. Consequently, a multidisciplinary and longitudinal further study is needed to replicate and extend the research findings and to acquire more clear results.

Miloff et al. (2019)

The current study aims to examine the effectiveness of the VRET in-vivo session method in individuals diagnosed with spider phobia without the limitations of previous studies, and also aims to indicate that compared to in-vivo one session therapy, the VRET method is non-inferior in the long-term. The sample size of the present study has been calculated based on a non-inferiority margin of 80% power at a 5% significance level than 100 participants have been required. In the current study, 100 people were randomly assigned to two different groups: OST (One-Session Therapy) or VRET (Visual Reality Exposure Therapy).

There is an independent variable (IV) that is nominal and has two levels: the OST group and the VRET group (Miloff et. al., 2019). Three dependent variables are measured as frequency including one primary measure (Behavioral Avoidance Task (BAT)) and two secondary measures (specific phobia diagnosis and the SPQ (Spider Phobia Questionnaire). To examine the effect of two therapy methods, participants were evaluated in four different times: pre-treatment, post-treatment, after 3 months and, after 12 months). The present study was conducted as a controlled laboratory experiment because the participants were randomly assigned to two different groups and exposed to different therapy methods. The design of the study is mixed: there is a between-subject design (two different groups) and the repeated measure was obtained from the two groups.

The findings of the present study showed that there was a significant decrease in symptoms and avoidance behaviour after therapy in both the VRET group and the OST group. Non-inferiority seems that the OST method is superior to the VRET method in the post-treatment measures. However, it was seen that this superiority disappeared in the evaluation 3 months and 12 months later and the effects of both therapies were similar. These results indicate us that in-vivo therapy may be more effective initially, but in the long term, it is not a superior method to the VRET method. The findings show that the VRET method can be used as a

treatment method for specific phobia and is as effective as in-vivo exposure therapy, which is considered the gold standard.

There are some strengths and limitations of the study, the fact that clinically diagnosed people were examined two different therapy methods that are widely used, makes the study strong. Also, this long-term follow-up research is quite important in terms of the show that the two therapy methods have equal effectiveness in the long-term. In this way, this method, which requires less cost and is more accessible, can be used in the clinical field and can be beneficial to more people.

One of the limitations of the study is that participant losses were experienced in BAT measurements during the follow-up process. The loss of the participants could have negatively affected the conclusion (Wolitzky-Taylor et al., 2019) in terms of the effectiveness of the therapy methods did not change in the long-term, because the information obtained from the participants during the long-term follow-up was based on self-report. To prevent a similar situation in future studies and to obtain more reliable findings, a satisfactory reward can be given to the participants for each period they participate.

In the next study evaluating the effectiveness of treatments, the VR-CBT method, which was created as a smartphone application, which is less costly and has no effect from the therapist, can be used. For instance, Donker et al. (2019) showed that the self-guided VR-CBT application significantly reduced the symptoms of acrophobia.

Possible confounding variables that could affect the study were taken under control (by making appropriate sampling, make stabilized conditions for each participant, etc.) and the internal validity of the study was ensured, but the reliability of the inferences in the long-term evaluation is low due to the loss of participants. To better explain the effectiveness of these therapy methods when they are used as a treatment method, behavioural measurements should be taken for a long time, and future studies that can provide this condition are needed.

7. Discussion

As mentioned in detail in the previous sections of the article, a specific phobia is a serious disorder characterized by avoidance of the fearful object or situation (APA, 2013). Virtual reality-based therapy methods provide people with a specific phobia to be exposed to the feared object or situation in a virtual environment and provide the people with phobia perceive the feared stimuli as realistic by manipulating several features of stimuli such as shape, size, and proximity (Riva, 2005).

The effectiveness of the visual reality exposure methods has been examined on specific phobias such as dental phobia (Gujjar et al., 2019), acrophobia and fear of flying (Donker et al., 2019; Meyerbröker et al., 2018) and spider phobia (Miloff et al., 2019 & Minns et al., 2019). Previous studies indicated that the VRET method has a significant effect on reducing dentist anxiety and avoidance behaviors (Gujjar et al., 2019) and reduced the fear of spiders, and avoidance behaviors of participants with spider phobia (Miloff et al., 2019 & Minns et al., 2019). Although studies of Miloff et al. (2019) and Minns et al. (2019) examine the effect of the VRET method on spider phobia, there were some methodological differences. While both studies, which were designed as randomized control, showed with different methods that the VRET method is an effective method in reducing avoidance behaviors and fear of spiders, and Miloff et al. (2019) also showed that the VRET method is more effective in the long-term than the one-session in-vivo therapy method. Unlike the classical studies examining the effect of the VRET method on specific phobias, the study that examines the effect of the VRET method with widely used medicines in anxiety disorders (YOH and propranolol) indicated that there is no significant difference between the three groups in terms of effectiveness in reducing anxiety (Meyerbröker et al., 2018).

Lastly, unlike the other four examined studies, Donker et al. (2019) designed a study that used the smartphone app-based VRET method to measure whether acrophobia symptoms

would decrease without the accompaniment of a therapist and showed that the app-based VRET method reduced acrophobia symptoms.

Considering all randomized controlled studies examined in general, it can be supposed that the VRET method has a significant effect in reducing anxiety and avoidance behaviors in specific phobias and can be used as a treatment method. The VRET method is considered as more convenient, cost-effective, and safe in some respects than other exposure methods (Maples-Keller et al., 2017; Mitrousia & Giotakos, 2016).

An important advantage of the VRET method compare to other exposure methods, for instance, compare to imaginary exposure, to perceive of participants with a phobia the stimuli that are used in VR more realistic. For instance, Maples-Keller et al. (2017) showed that multiple 3D stimuli used in the VRET method increase the perception of reality and enable the mechanisms underlying fear to act. According to the previous study, participants with specific phobia reported that they feel like they seem like in that place during VR experience (Choy et. al., 2007). In VR based exposure therapies, therapists can manipulate the visual stimuli by adding smell and sound according to the patient's anxiety level and it can make the therapy more effective (Rothbaum, 2010). The fact that it is more realistic than the imaginary exposure method and that the researcher/clinician can be manipulated more easily and is safer than the in-vivo exposure method shows us the strengths and usable of this therapy method as a treatment method.

Another advantage of the VRET method is that it is safer than other exposure methods because people with a specific phobia are not exposed to the feared stimuli or situations compared to the in-vivo exposure method (Maskey et. al., 2019), which is based on exposure to real stimuli in a real environment. Parallel to this point of view, the previous study indicated that people with phobia think that it is safer and more preferred because virtual reality therapy can be terminated whenever they want (Mitrousia & Giotakos, 2016).

Although the in-vivo exposure method, known as the gold standard in specific phobias, has been shown to be more effective than the VRET method in the short term, it has been observed that in the long-term these two therapy methods are equivalent to each other in terms of effectiveness (Michaliszyn et al., 2010). Similarly, a meta-analysis study showed that both in-vivo exposure therapy and the VRET method have a large effect size in terms of reducing symptoms in specific phobia, and there is no significant difference between these effect sizes (Carl et al., 2019) and Miloff et al. (2019) showed that the VRET method was equally effective in reducing symptoms and avoidance behaviors compared to the in vivo one-session therapy method. The fact that the participants feel more secure may increase their willingness to participate in this therapy method, and thus more people with phobia can be helped in the clinical field (Maskey et. al., 2014).

VRET method has been considered that provides more realistic experience (Choy et. al., 2007) compared to the imaginary exposure method, in terms of some characteristics such as the type, intensity, and duration of the stimuli can be manipulated (Mitrousia & Giotakos, 2016).

Another important point should be mentioned that is the using of the medicines with VRET method. In the long-term study of Meyerbröker et al. (2018) they used the VRET method together with the medicines used for the treatment of anxiety disorders, it has been shown that the VRET method is more effective than the medicines in the long term and this finding is important in terms of providing the information that the VRET method can be used as a treatment method in the clinical field. However, the mechanism of action arising from the short-term use of these drugs may have affected the research findings; therefore, more studies are needed in this area.

Compare to other studies, Donker et al. (2019) conducted a therapy method that includes highly accessible and has a low cost by using a smart-phone application and indicated that the

app-based VR method could reduce acrophobia symptoms. If smartphone-based VR applications are developed and more studies are conducted showing that these applications are effective in reducing phobia and anxiety, it can be used as a cost-effective and highly accessible new therapy method that does not require the accompaniment of a therapist (Choy et. al., 2007).

One of the most important advantages of the VRET method is that the stimuli in virtual reality can be easily created according to each specific phobia, and even allows to develop a completely personalized therapy method when necessary (Beidel et. al., 2019). Similarly, VRET is a useful therapy method, as it enables the re-experiencing of some fearful events such as war that could not be applied in other exposure methods (Beidel et. al., 2019). Although it is a very useful method in reducing the fear of situations such as war that cannot be experienced in real life, this advantage of the VRET method is very important not only in specific phobias but also in other disorders such as posttraumatic stress disorder (Beidel et. al., 2019).

When the limitations of these studies are mentioned, it has been seen that one of the most important limitations is the selection of the sample (Andersson & Titov, 2014). Almost all studies in the literature were conducted on a subclinical sample that was not clinically diagnosed and obtained from this sample reduces the generalizability of the findings to people with specific phobia. Similarly, since the sample consists of subclinical participants, the symptoms of the participants and the severity of these symptoms are based on self-report (Andersson & Titov, 2014; Buntrock et al., 2016). In order to make the findings more reliable, behavioral, and physiological measurements should be included more in addition to self-report. Although the BAT method was used to observe avoidance behaviors in some studies (Gujjar et al., Miloff et al., 2019), only the pre-treatment and post-treatment stages were administered BAT to the participants. The anxiety or specific phobia data has been obtained based on self-report in the follow-up, thus the effectiveness of the therapy could not clearly be determined in terms of the persistency. In addition, obtaining physiological or electrophysiological

measurements during, before, or after VRET in studies can ensure that the findings are not limited to self-report or behavioral data, but also the neurological basis of specific phobias.

One of the most important limitations of these studies again depends on the selection of samples, while in some studies only university students constituted the sample (Minns et al., 2019), in others, the sample age range was very wide (Donker et al., 2019) and the results were not analyzed according to age. The fact that the sample consists of only college students prevents the generalization of the findings to the population while keeping the age range-wide can affect the results in terms of different age groups' ability to use technological tools such as smartphones, computers, VR applications. In order to eliminate the limitations arising from sample selection, different age groups should be used, and the data collected from these age groups should be compared. Although the VRET method is cost-effective, it is still not affordable to anyone in need of therapy in the population. Smartphone-based VR therapies can be widespread so that this new therapy method can benefit more people who differ from each other's socioeconomically.

One of the limitations of the studies is that exposure to the fearful stimulus or situation is mostly based on visual stimuli. As has been known, adding different types of stimuli (such as smell, sound) to the simulation increases the participants' perception of reality and triggers the mechanisms related to fear and could increase the effectiveness of therapy (Rothbaum, 2010). The fact that the VRET method is less realistic compared to the in-vivo exposure method can be eliminated by manipulating the characteristic features of fearful stimuli in the VR experience. In addition to the VRET method, studies with drugs used in anxiety disorders should be calculated in more detail due to the fact that the short-term and long-term action mechanisms and side effects of the drugs require medical knowledge. Studies conducted (Meyerbröker et al., 2018) with the medicines used in anxiety disorders are not structured by

creating a multidisciplinary way and this can be a gap in this area. Besides, point of view of different fields is important to specify of the effectiveness of medicines plus VRET therapy.

One of the limitations is that although the VRET method is designed specifically for the phobia, it has been known that specific phobias show a high rate (average 40%) of comorbidity with at least one of the other anxiety disorders (Hofmeijer et. al., 2012). In studies examining the effectiveness of the VRET method, participants with comorbid disorders should be evaluated in different groups or other anxiety disorders should be excluded. Another limitation is that English resources, which is accepted as a universal language in the literature, are limited, translation of studies in different languages into English and collecting research findings in a common pool is important in terms of comparing and replicating the findings. Another limitation is that VRET studies are recent therapy methods and there are not enough randomized controlled studies. Conducting more randomized controlled trials in this area and to replicate the findings are necessary to both strengthen the theoretical basis and integrate it into clinical practice. Besides randomized controlled studies, non-inferiority studies comparing the VRET method with other exposure therapy methods (e.g., in-vivo exposure therapy method) are limited. More non-inferiority studies are needed in order to better understand the advantages and disadvantages of the VRET method compared to other methods and to make it a common therapy method. In order to fill the gaps in the existing literature and to suggest that this therapy method can be used as a treatment method, more randomized controlled and non-inferiority studies should be conducted with participants diagnosed with a specific phobia.

Consequently, the literature examining the effectiveness of the VRET method on specific phobias is expanding. Although the VRET method has many advantages such as being a safe, cost-effective, and realistic therapy method, it has many limitations due to its being recent and not enough randomized controlled studies. Despite all these limitations, the findings showed that this therapy method is effective in reducing specific phobia symptoms and

avoidance behaviors and can be used as a treatment method. In order to overcome these limitations, to increase the validity and reliability of the findings and to ensure that they can be used as a treatment method, further studies conducted in clinical samples with randomized control are needed.

8. Future Recommendations

Specific phobias are a very common disorder for all populations (APA,2013). According to the conclusion of the study, VRET is an evidence-based intervention for treating specific phobias, so it has several strengths and limitations for future research. The future scientist can search whether VRET is cost-effective in treating specific phobias because the equipment used in virtual reality therapy is getting more expensive. Also, VRET is relatively new and the evidence base is evolving rapidly, so it has to be supported by randomized control trials and long-term studies. Moreover, there are some language problems in the literature. The number of articles published in English is quite low, so the future researcher can publish his research in English. Also, the selected sample of participants in the recent studies are very limited, so it can be expanded and the study results can be generalised to more people.

For therapists, according to the findings of this study, VRET has very good reliability and validity rates, so the therapist can safely apply this intervention method to the person with a specific phobia. Moreover, based on literature findings, VRET provides the participants with a virtual environment and the therapist can adjust this environment according to the intensity of the avoidance behaviour, so the therapist can gradually increase the intensity of the feared stimulus to increase the effectiveness of therapy. Finally, Virtual reality technology is evolving day by day, so the therapist must closely follow innovations in this field and provide new equipment to increase success rates.

9. Conclusion

Specific phobias are an anxiety disorder that is common in all societies and has been studied for a long time. There are different types of specific phobias and situational type is the most common one (APA, 2013). Women (15%) have higher prevalence rates than men (7%) and it mostly occurs in during childhood (Craske et. al., 1996). Studies show that specific phobias can be highly comorbid with other anxiety disorders (Rodriguez et. al., 2004).

There are various intervention methods for treating specific phobias. However, published articles showed that in the treatment of phobias, exposure to the feared stimulus has long been known to be an effective method of treatment. With the development of virtual reality technology, this technology has been used in the treatment of anxiety disorders, especially phobias.

As stated above, it is clear that virtual reality technology can have many advantages over traditional treatments. Firstly, according to the findings of the current study, it is clear that virtual reality technology can be used as an effective tool in the treatment of phobia due to the sense of reality it creates. Secondly, in exposure therapy it is very difficult and costly to create certain environments in the real world, such as creating an aircraft environment for people with aeroplane phobia, so VRET is cost-effective intervention method for treating phobias. Finally, the findings of the literature showed that reliability and validity rates are very high in VRET, so it can be used safely in the treatment of phobias.

Overall, studies show that virtual reality therapy has a great effect on the treatment of specific phobias. However, it is relatively new, so more studies need to be conducted on the advantages and disadvantages of VRET. Studies show that advancements in technology have an important role in the development of virtual reality therapy, so innovations that will be developed over the years will increase the effect of VRET.

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