

Review Article

Virtual Reality as a Tool in the Treatment of Claustrophobia - A Review

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Received: 07 June 2023

Revised: 01 August 2023

Accepted: 05 August 2023

Published: 15 August 2023

Abstract - Within the context of psychology, virtual reality (VR) is presented as a technological tool to address and treat the symptoms of claustrophobia. Claustrophobia is distinguished by a fear of small or enclosed environments, which can be a challenge for conventional treatments. This research work focused on conducting a detailed analysis of the existing literature on using VR as an alternative tool to treat claustrophobia symptoms. The research results indicated that treatment with VR technology may be effective in providing a controlled and safe way to expose patients to situations such as those they fear, allowing them to overcome their fears more effectively. This review article provides a comprehensive analysis of the use of VR to treat claustrophobia. A total of 384 manuscripts from different virtual databases were analyzed, from which 61 major articles were selected. The results showed that VR allows for treating different types of phobias such as Acrophobia, Agoraphobia, Arachnophobia, claustrophobia, Fear of flying, Fear of public speaking and Fear of injections, achieving significant patient results. Studies have proven the effectiveness of VR in reducing the symptoms of claustrophobia, and it is anticipated that it will continue to be an important tool in the future.

Keywords - Analysis, Claustrophobia, Phobias, Therapy, Virtual reality.

1. Introduction

Claustrophobia is a type of anxiety disorder characterized by an irrational and disproportionate fear of enclosed or confined spaces [1]. People who have claustrophobia may experience anxiety or even panic at the thought of being in places such as elevators, airplanes, cars, tunnels, small rooms, and other confined spaces [2]. Symptoms of claustrophobia may include sweating, palpitations, tremors, shortness of breath, dizziness, nausea, chills, tightness in the chest and an intense desire to escape the situation [3]. This disorder is the most common, affecting 15% of women and 7% to 8% of men worldwide [4][5]. Claustrophobia can significantly interfere with a person's daily life, limiting their ability to perform activities and affecting their emotional well-being [6], [7], [8]. However, exposure therapy, which involves gradually confronting anxiety-provoking situations, can be an effective treatment for claustrophobia [9].

In some cases, medication may also be prescribed to reduce anxiety symptoms. Claustrophobia is a type of anxiety disorder that affects many people [10]. It is characterized by an intense fear of enclosed spaces, which can cause a variety of physical and emotional symptoms. It can be a significant problem for people, as it can limit their ability to perform activities and negatively affect their emotional well-being [11].

Fortunately, there are treatment options for those who have claustrophobia. Cognitive behavioral therapy is one of the most effective treatments, as it helps people identify and change negative thought patterns and avoidance behaviors related to enclosed spaces [8], [12]– [14]. Exposure therapy is also a viable option, as it involves gradually confronting anxiety-provoking situations to decrease the fear response. In some cases, medication may be prescribed to alleviate anxiety symptoms. However, it is important to note that medication should always be used in conjunction with therapy to ensure the best possible outcome. With proper treatment, people can learn to manage their symptoms and live a full life without the limitations of claustrophobia [15], [16].

Studies have shown that VR is an effective tool in the therapy of claustrophobia [17]. This is because it provides a safe and controlled environment for patients suffering from this condition. Patients can be exposed to anxiety-provoking situations using a VR headset in a safe and controlled environment [18]. Therapists can create specific virtual environments that mimic real-life situations, such as elevators, airplanes, trains, and other enclosed spaces [19], [20]. This allows patients to work with their therapists to address their fears and anxieties in a virtual environment without risking a real-life situation [21], [22]. Patients can practice relaxation



and breathing techniques while exploring the virtual environment [23] - [24]. As patients develop greater confidence in themselves and their ability to handle situations that previously caused them anxiety, VR can effectively treat claustrophobia and improve their quality of life [25], [26]. In this review, we examine the use of VR as a tool to assist patients in treating claustrophobia. To do so, it evaluates the current evidence available to gain a comprehensive understanding of this technology's efficacy in treating this disorder. This information will inform and guide future developments in this field.

This review article follows a clear and organized structure to present the research findings. In section 2, a detailed analysis of related papers published in the last 5 years is conducted, providing an overview of the field's current state. Section 3 presents the PRISMA methodology used to systematize the selected articles. Section 4 of the study details and examines the results obtained from the systematic review carried out. In section 5, a discussion of the results is carried out, and their implications and limitations are explored. Finally, section 6 presents the review's conclusions and highlights the main contributions and future research directions.

2. Related Work

Today, there are a significant number of people who may have indoor phobia without realizing it. This phobia can worsen over time, sometimes leading to anxiety attacks and general discomfort. Therefore, it is crucial to understand the underlying causes of this phobia so that it can be identified and prevented before it becomes a serious problem. To achieve this, a systematic review of a set of articles was conducted to gain a deeper understanding of this condition and ultimately provide useful guidance for its diagnosis and treatment.

In the study [27], the authors reviewed the available literature about the application of VR in psychiatric disorders. Their aim was to describe the current limitations of the technology and suggest possible avenues of research to incorporate it more effectively in psychiatric treatments. To carry out the review, an exhaustive search was performed in two databases, resulting in a total of 848 manuscripts, from which 70 articles meeting the inclusion criteria were selected for analysis. The authors concluded that VR positively impacts the therapy of psychiatric disorders, but its effectiveness may vary depending on the specific disorder in question.

They also noted that, as VR technology continues to evolve, further research in this field is needed to improve the application of this technology in psychiatric treatments. A study published in [28] conducted a systematic review using the PRISMA methodology. During the analysis of 438 articles, it was found that most of the studies on Virtual Reality Therapy (VRT) were of insufficient quality, suggesting that

this therapy is as effective as other forms of psychotherapy. However, the paucity of studies is due to the great diversity of methods used in VRT.

Consequently, it is recommended to focus on high-quality papers and further investigate the side effects and adverse events associated with VRT. The study conducted by the writers in the article [29] aimed to examine the existing literature on the psychological effects that arise when using virtual immersion. For this purpose, a search was conducted in five databases and 21 relevant studies were identified. According to the results, the review indicates that the use of virtual immersion has a significant effect in reducing the negative impact of proposed situations. In the review study conducted by the authors in [30], a comprehensive search of five databases was conducted to identify studies related to Internet-based interventions and mobile apps to treat specific phobias. 59 relevant studies were identified, in which scenario exposure was found to be the most common intervention used by all of them, and the most frequent phobia was related to animals. In addition, the results showed that the application of phobia treatment software significantly reduced the symptoms. In [31], a comprehensive review of 67 randomized controlled trials using RV exposure therapy was conducted, and 8 research design criteria were applied to assess their quality. The results showed that a larger sample size in the studies was associated with a greater reduction in the effect of VR. In conclusion, the authors recommend that, although VR can be an effective treatment method, it is important to be careful when interpreting the results and to carefully review the quality of the existing literature supporting the use of VR.

The study conducted by the authors in the article [32] consisted of comparing the effectiveness of VR exposure therapy with real-life exposure therapy in treating phobias in people. A comprehensive search of 6 databases was conducted using 19 related terms, and after exclusion criteria were applied, 30 relevant articles were selected for review. The results showed that exposure therapy in VR demonstrated positive results in treating most of the phobias evaluated. The author of article number [33] carried out a detailed and rigorous review of 49 studies that met the previously established inclusion requirements. To accomplish this, he conducted a thorough search of three databases. For the most part, the reviewed studies reported favourable results regarding the use of VR as a tool for the diagnosis and treatment of anxiety-related phobias.

3. Methodology

To carry out a thorough and rigorous search for research related to the topic of the study, the PRISMA methodology will be used. PRISMA is a methodology widely used in scientific research to ensure transparency and reproducibility in identifying, selecting, and synthesis of relevant literature [34], [35].

The PRISMA methodology consists of four well-defined stages, which are: Identification, Selection, Eligibility, and Inclusion. In the first stage, identification, a complete and systematic search of the relevant literature will be carried out in the main databases. In the second stage, Selection, inclusion, and exclusion criteria will be applied to identify relevant studies. In the third stage, Eligibility, the selected studies will be reviewed to ensure they meet the predefined eligibility criteria. Finally, in the fourth stage, inclusion, eligible studies will be included for analysis.

3.1. Research Questions

This section presents the research questions (RQ) specifically designed to guide the study and achieve its objectives.

3.2. Research Strategies

A systematic qualitative analysis was carried out to search for articles that responded to the research questions posed above. To meet the proposed objective, a thorough and detailed search of articles was carried out in a total of six virtual databases, including (Scopus, IEEE, Science Direct, Springer, Taylor & Francis, and EBSCO) covering the period

from 2018 to 2022. For the search for updated articles related to the use of VR in treating claustrophobia, the following search string was used: "Virtual and Reality and claustrophobia". The results obtained are shown in Fig. 1.

3.3. Inclusion and Exclusion Criteria

Table 2 provides a detailed list of the criteria that were used to perform the analysis of the set of articles obtained after the initial search. These criteria have been carefully defined to ensure that only relevant and pertinent studies are included in the analysis, and those not meeting the predefined criteria are excluded. The result of the search yielded manuscript results in English and Spanish.

Table 1. Research questions

	Description
RQ1	What type of phobia is most treated with VR?
RQ2	In what age range is VR most used to treat claustrophobia?
RQ3	How does the use of VR contribute to the treatment of claustrophobia?

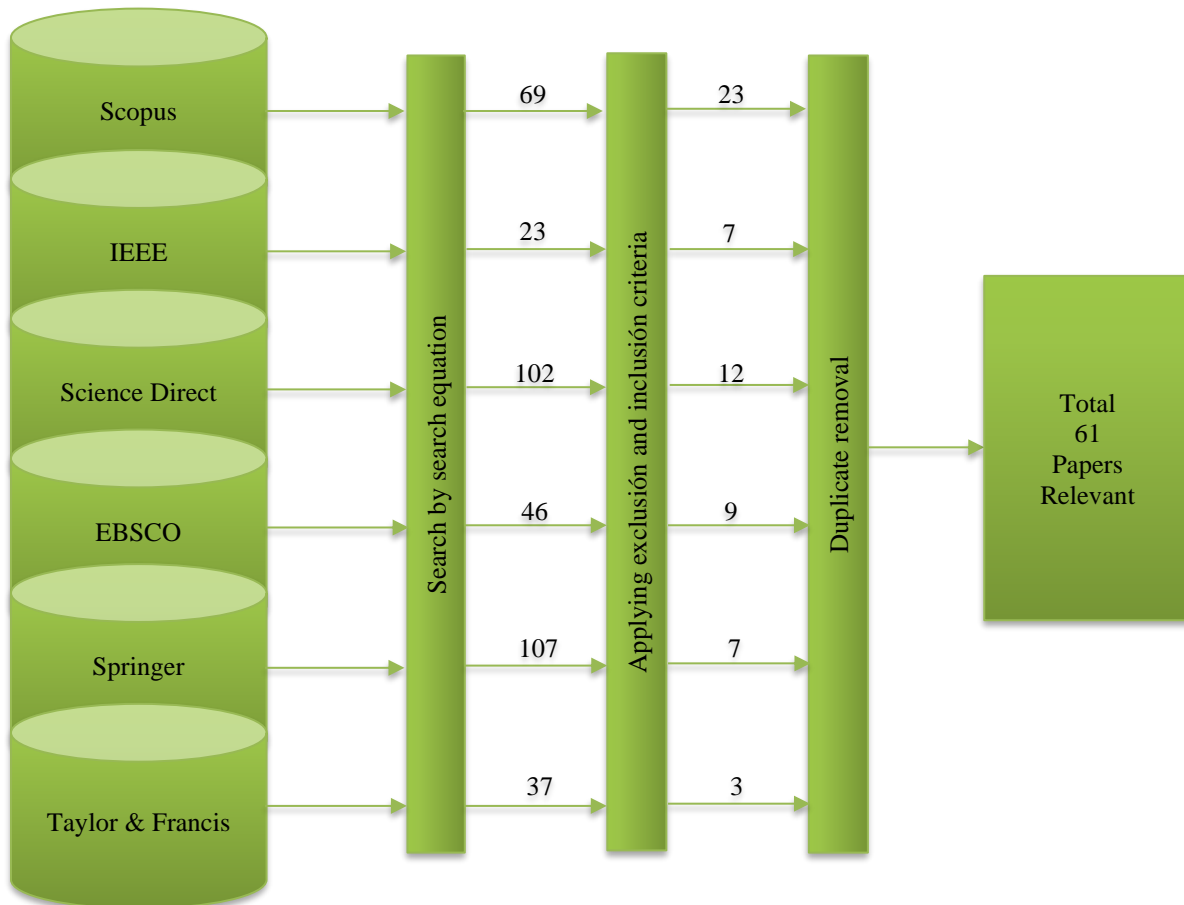


Fig. 1 Item inclusion chart

Table 2. Criteria

Criteria		
Inclusion	I01	Articles dealing with VR
	I02	Articles related to claustrophobia
	I03	Articles address the use of VR as a technological resource for the therapeutic approach to claustrophobia.
	I04	Articles from the last 5 years
Exclusion	E01	Books
	E02	Articles not related to the topic.
	E03	Duplicate Articles
	E04	Articles in the Spanish language

4. Results

After searching for articles in the 6 databases mentioned in Figure 1, 384 articles were found. After a thorough analysis, we proceeded to eliminate all those articles that did not meet the previously established inclusion criteria, resulting in a more specific and adequate selection for subsequent analysis. Finally, a set of 61 articles that met the previously defined inclusion and exclusion criteria were selected for review.

Fig. 3 shows the distribution of the number of articles by the database. Most of the selected articles come from the Scopus database, with a total of 23 articles. The Science Direct database also contributed significantly with 12 articles. On the other hand, the EBSCO, IEEE, and Springer databases contributed 9, 7, 7 and 3 articles, respectively.

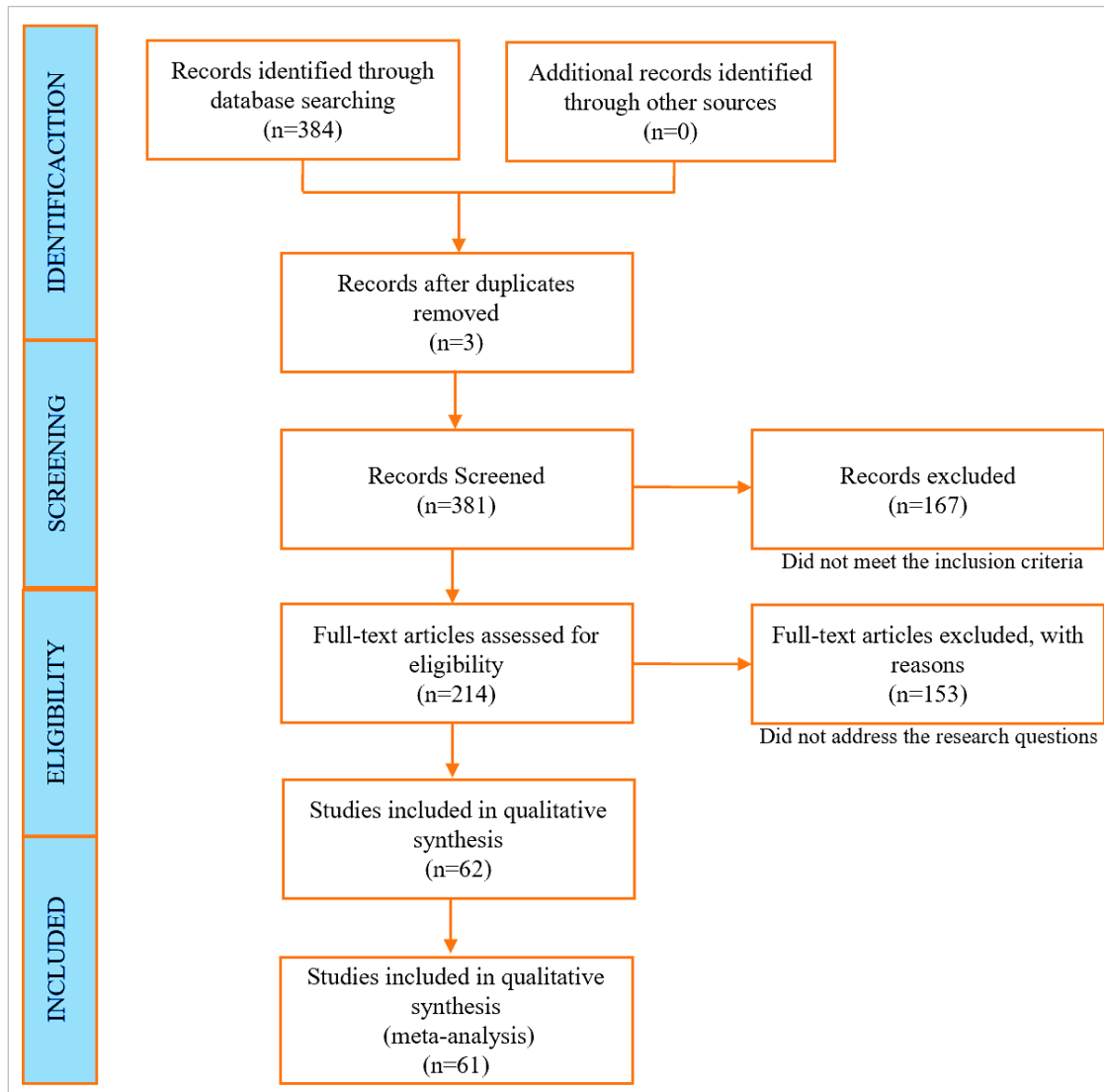


Fig. 2 Prisma methodology diagram

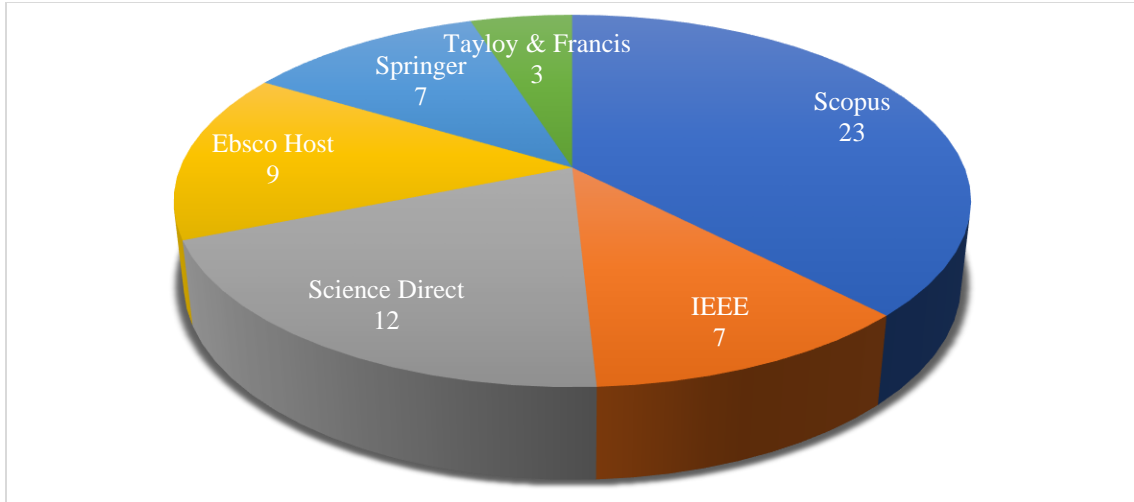


Fig. 3 Articles by database

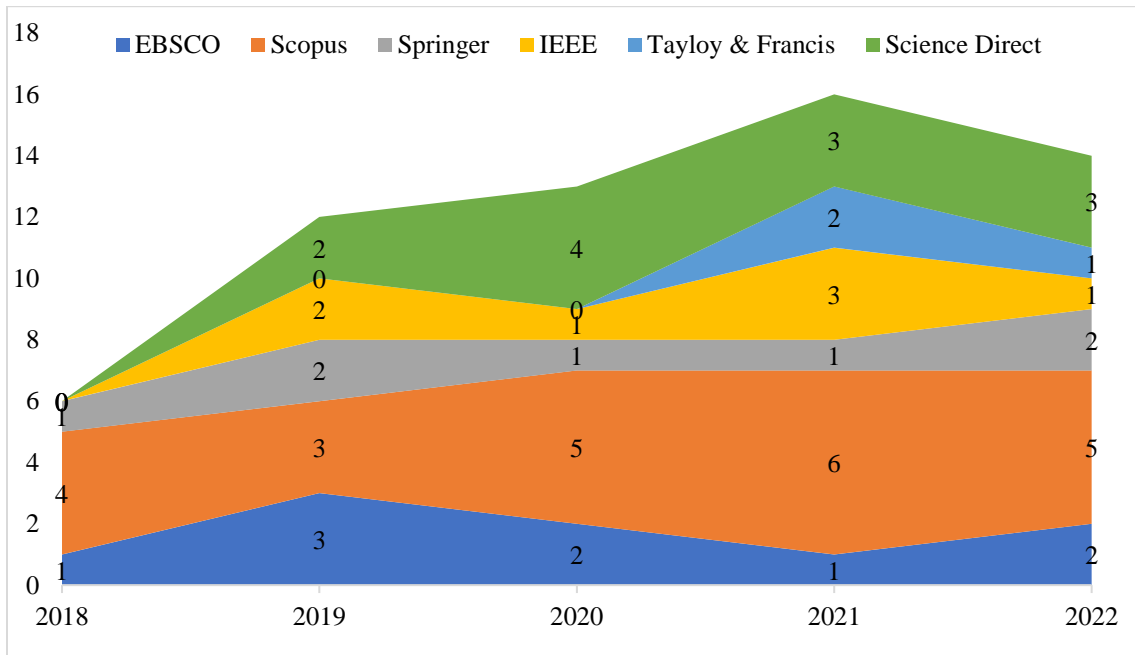


Fig. 4 Articles by year and database

Fig. 4 shows the annual distribution of articles published by each database, classified by year. It can be seen how the number of articles has been steadily increasing since 2018, with a peak in 2021. In addition, the Scopus database has been the main source of articles for most years, followed closely by the Science Direct database.

Bibliometrics is an effective scientific research technique to retrieve, evaluate, and analyze quantifiable data in scholarly literature, especially in each subject area [36]. Bibliometric analysis and the VOSviewer tool are of great help for systematic literature review research. These tools allow the identification of the most relevant publications. In addition, bibliometric analysis helps to detect research gaps, identify

key authors and potential collaborators, and provide an overview of the research network around a particular topic. The VOSviewer tool allows the visualization of bibliometric networks, which facilitates understanding the network structure and identifying potential collaborations between authors and research groups [37]. To carry out this bibliometric analysis, the VOSviewer software tool was used to examine the concurrence of the keywords used in the studies considered. From there, visualization maps were created to show the results presented in Fig. 5 and Fig. 6.

Fig. 5 shows 55 items generated in the VOSviewer application grouped in 4 main clusters, each one segmented with its respective color.

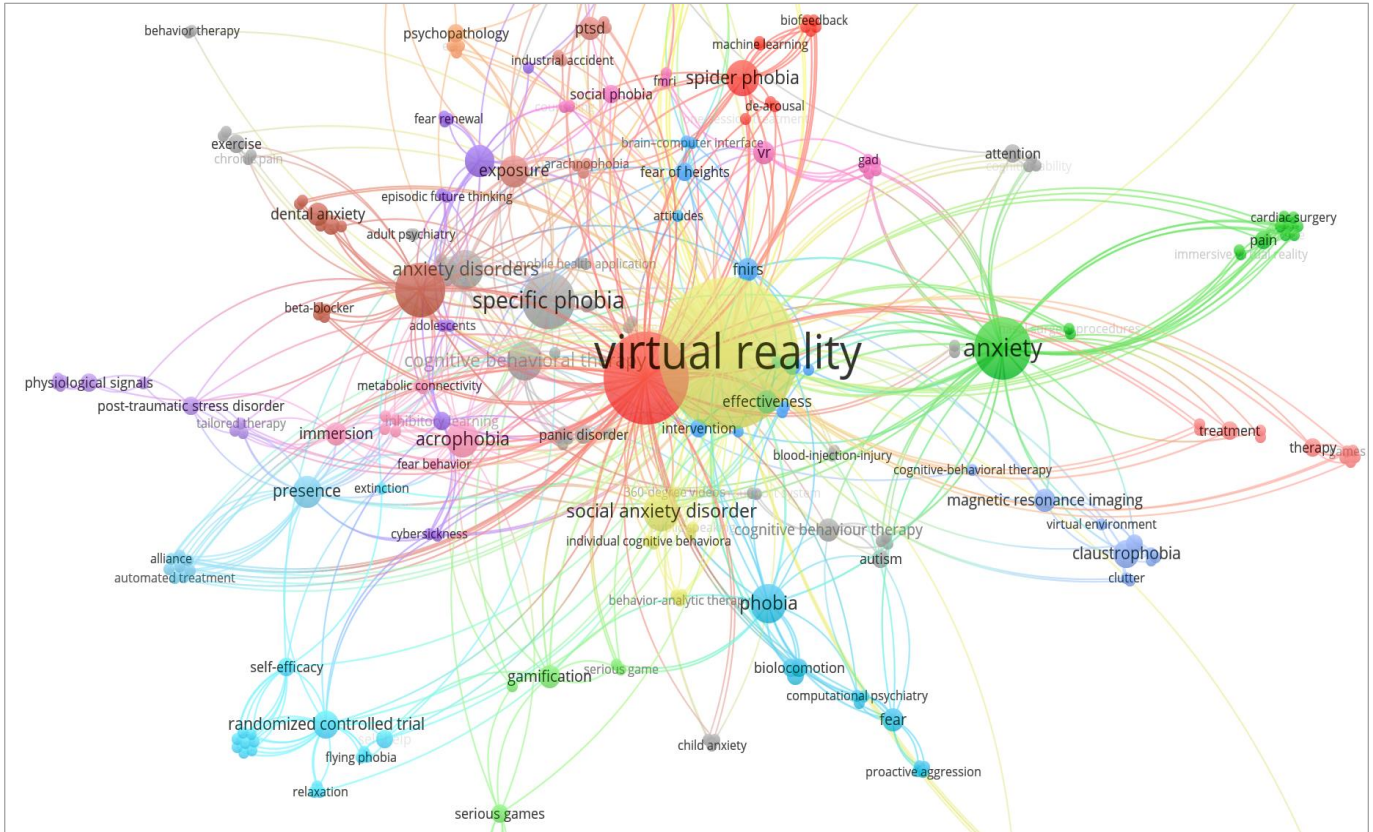


Fig. 5 Bibliometric analysis of database documents

4.1. Cluster 1 (Yellow)

Mental health, flying phobia, work burnout, work stress, stress reduction, self-help, anxiety stress test, cardiology, and fatigue, among others, are terms related to the use of VR in the treatment of claustrophobia.

4.2. Cluster 2 (Red)

Fatigue, hypnosis, immersive VR, intensive care units, surgery procedures, premedication classification, and attitudes are some of the terms related to Exposure Therapy.

4.3. Cluster 3 (Green)

Fear of heights, fear of public speaking, glossophobia, dementia, simulation, virtual audience, non-pharmacological therapies, cyber illness, and emotional thinking theory are some terms related to anxiety.

4.4. Cluster 4 (Brown)

Emotional processing theory, fear renewal, positive mental imagery, public speaking anxiety, technological interventions, VR exposure, spider phobia, dental phobia, psychotherapy, state anxiety, and social phobia are some terms related to VR Exposure Therapy terms.

Fig. 6 illustrates the relative frequency of keywords used in the articles analyzed using the VOSviewer software, which was used to carry out a bibliometric analysis.

Some terms that stand out in the list can be observed, such as VR, exposure therapy, anxiety, and VR exposure therapy.

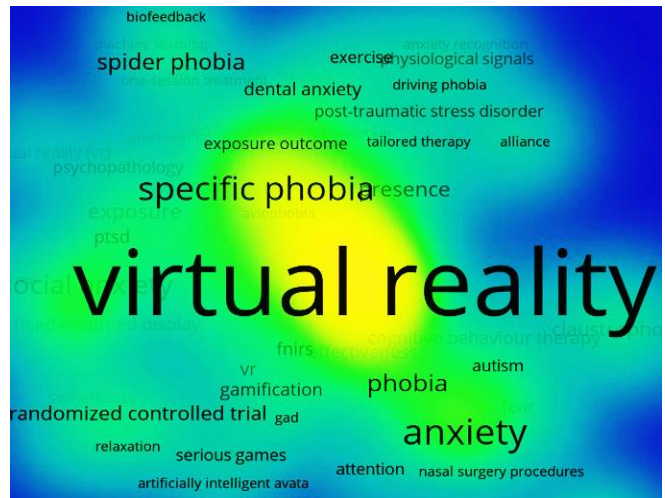


Fig. 6 Keyword density in the systematization of articles

Fig. 7 shows a tree map detailing the percentages corresponding to the most recurrent words detected in the bibliometric analysis performed. The visualization makes it possible to observe the relationship between the words and the frequency of occurrence of each of them in the corpus of texts analyzed.

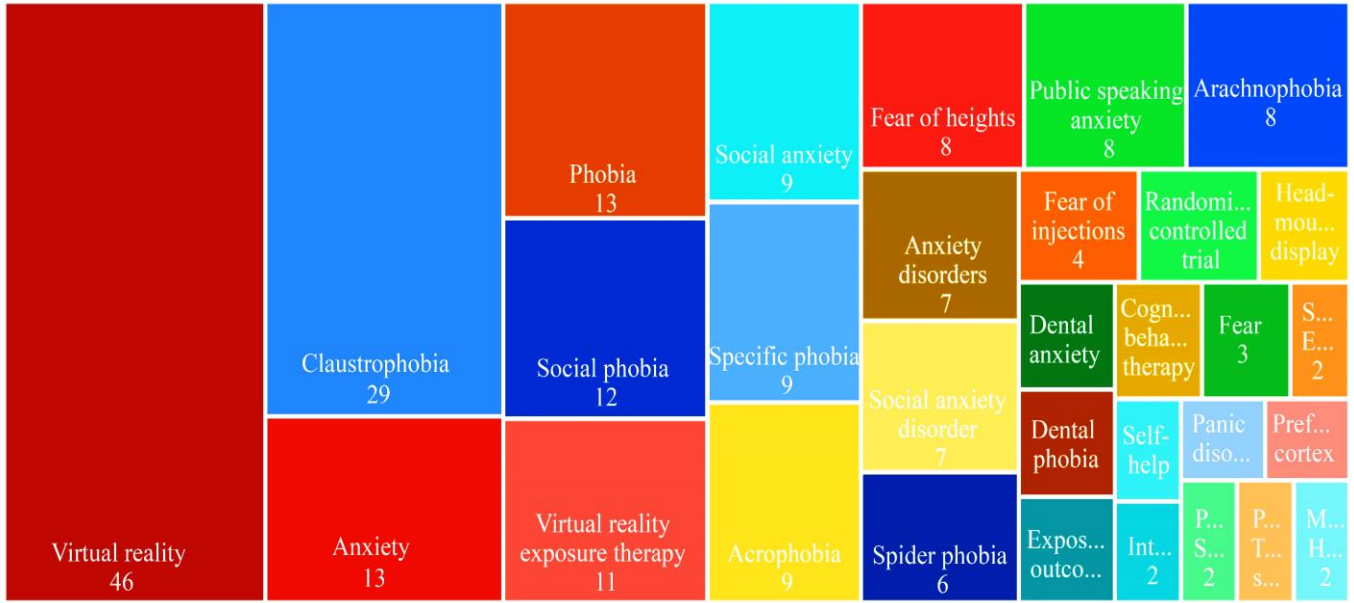


Fig. 7 Visualization of word occurrences from bibliometric analysis

Fig. 8 shows the most common terms in the articles analyzed, classified by country, and ordered by frequency.

Fig. 9 shows the count of articles analyzed by continent, focusing on the most common terminologies used in treating claustrophobia.

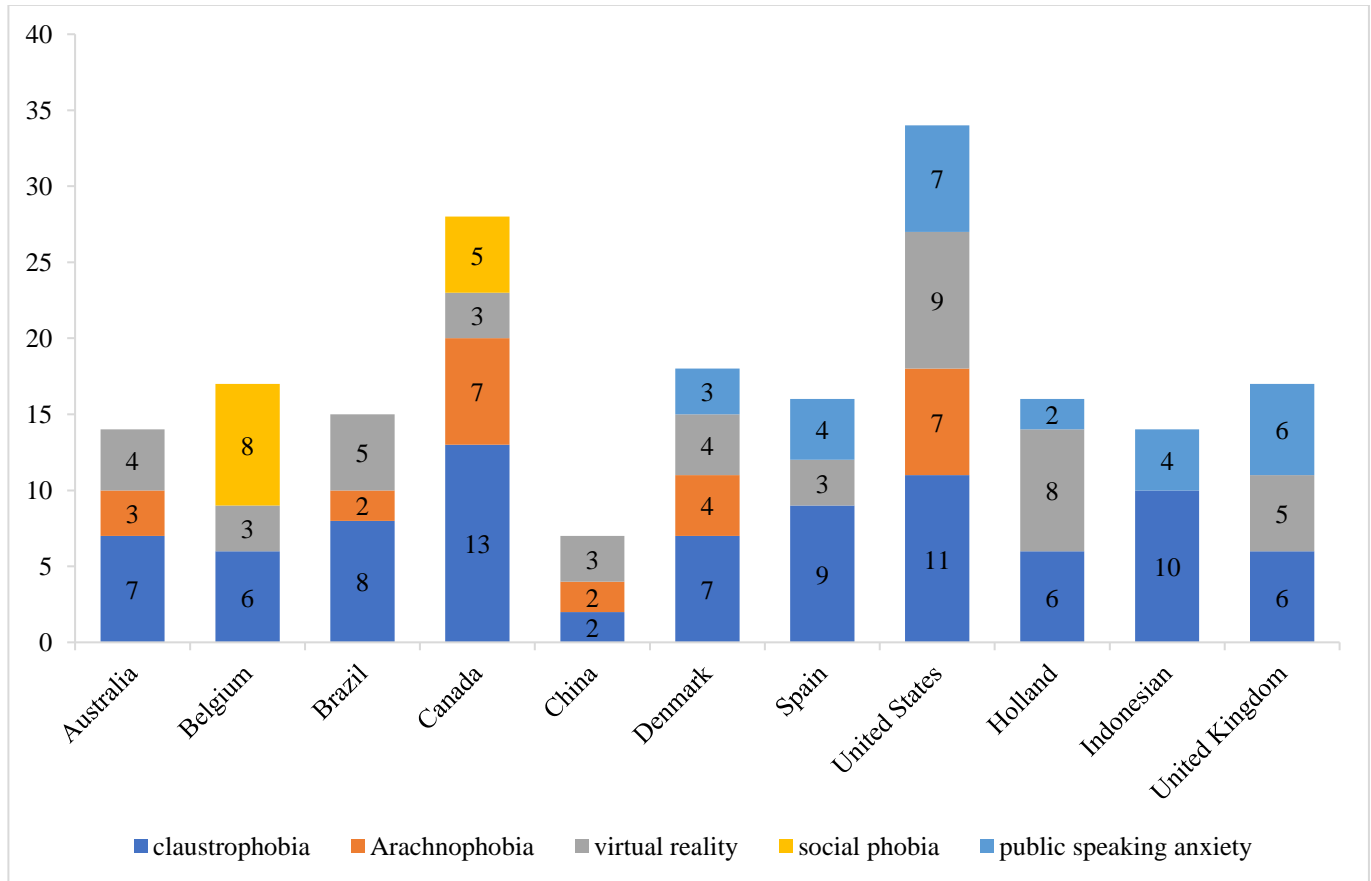


Fig. 8 Most common terms in the articles analyzed by country

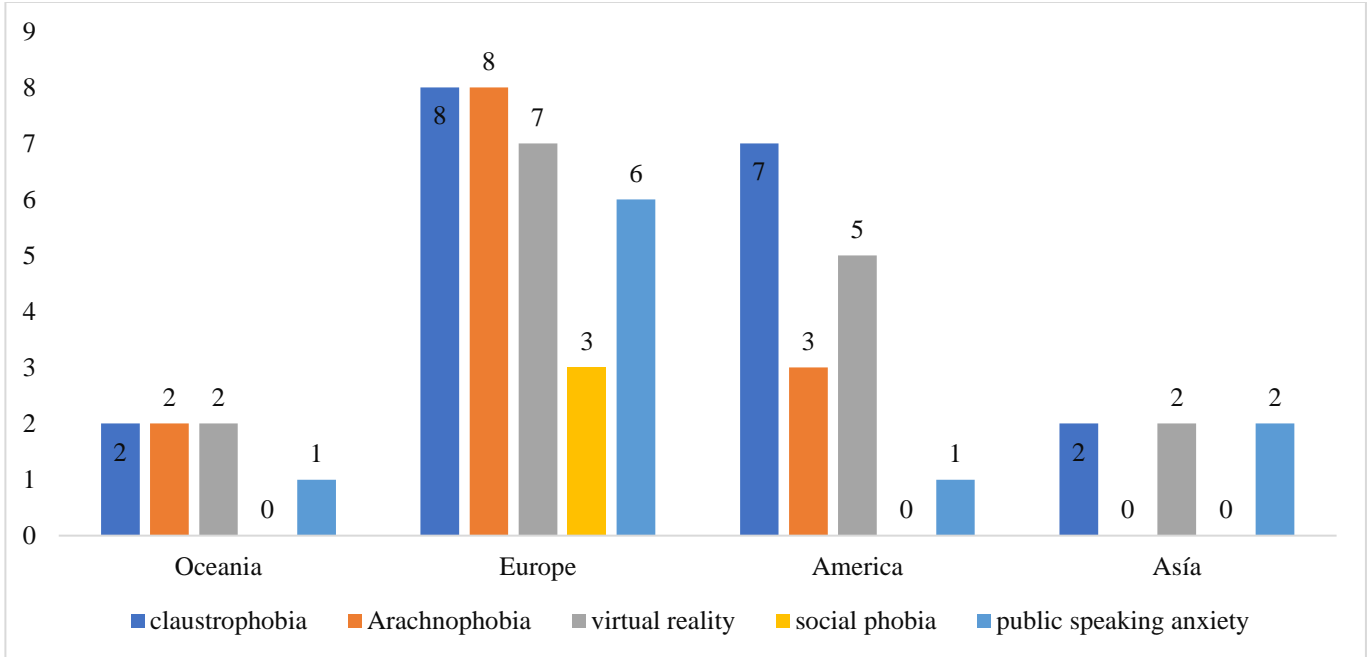


Fig. 9 Number of items analyzed by continent

5. Discussion

5.1. RQ1: What type of Phobia is most Treated with VR?

Analysis of the articles reviewed shows that there are a variety of phobias that can be treated with VR, including Acrophobia, Agoraphobia, Arachnophobia, Claustrophobia, Fear of flying, Fear of public speaking, and Fear of injections, among others. Acrophobia and claustrophobia are the most common in the analyzed items. Although some previous

studies, such as [31], [33], suggest that the most common phobia is associated with heights, the results obtained in this review suggest the need to conduct broader searches to confirm which is the most common phobia in the population. Fig. 10 shows that acrophobia and claustrophobia are the most discussed in the articles reviewed, indicating that people may experience fear in their social interactions. There is a wide variety of phobias that can be treated using VR as a therapeutic tool, as shown in Fig. 10.

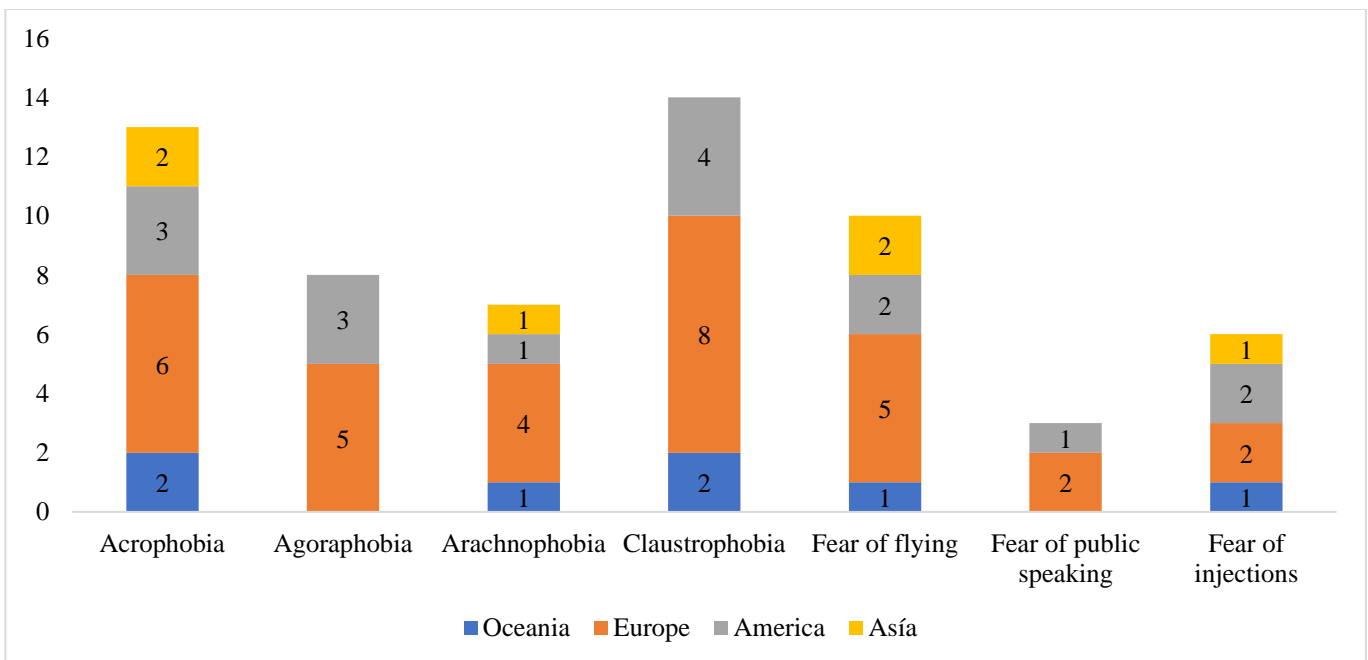


Fig. 10 Number of articles by type of phobias

Table 3 presents a summary of the articles reviewed that focus on using VR to treat different types of phobias. It lists the most common phobias that have been treated with this technology and the treatment's efficacy in reducing phobic symptoms. By reviewing this Table 3, it is possible to get a general idea of the phobias that have been successfully treated using VR and how these treatments have been carried out in practice.

Fig. 11 presents a distribution of the number of publications of organized manuscripts according to country of origin. Spain has the highest number of selected articles, with a total of 9, while Australia, the United States, and the United Kingdom have 7, and Belgium, the Netherlands, and Denmark have 6 articles published each. Brazil and China have 5 and 4 publications, respectively, while Canada has 4 and Indonesia has only 2 publications.

5.2. RQ2: In what Age Range is VR most used for Claustrophobia?

Fig. 12 shows that most articles reviewed focus on working with different age groups, starting with older adults (60-100), followed by adults between 18 and 59 years of age, and minors. According to Table 4, it is observed that VR is mostly used to treat phobias in adults; this result is like what has been analyzed in manuscripts [28], [30], where it is suggested that treatment does not need to target a specific age. Regarding older adults, all the articles reviewed focused on people with war trauma who use VR to improve their condition.

Table 3. Types of phobias that are treated with VR

Types of phobias	Quantity	Ref.
Acrophobia	13	[38],[39],[40],[41],[42],[43],[44],[45],[46],[47],[48],[33],[34]
Agoraphobia	8	[49],[50],[51],[52],[38],[53],[54],[55]
Arachnophobia	7	[56],[57],[58],[59],[60],[61],[62]
Claustrophobia	14	[63],[64],[65],[66],[67],[68],[69],[70],[71],[72],[73],[74],[75],[76]
Fear of flying	10	[77],[78],[79],[80],[81],[82],[83],[84],[85],[86]
Fear of public speaking	3	[87],[88],[89]
Fear of injections	6	[90],[91],[92],[93],[94],[95]

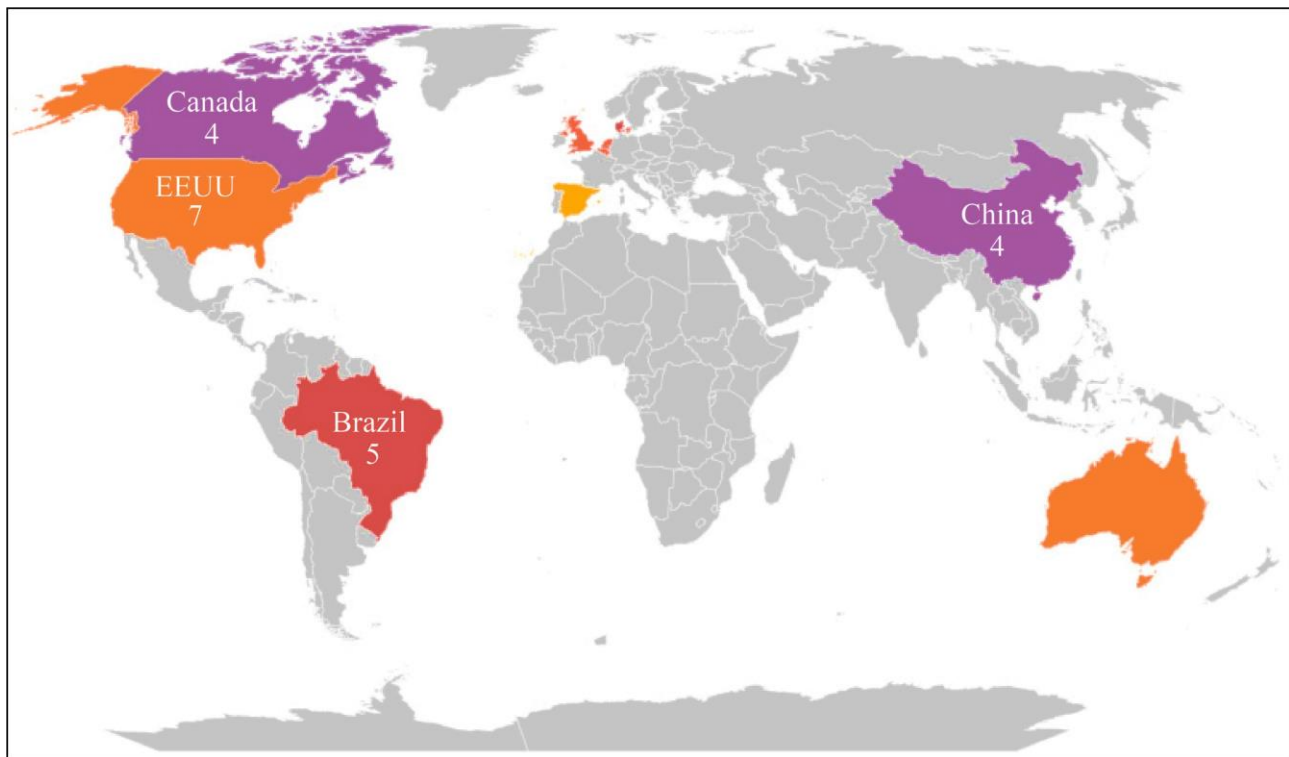


Fig. 11 Distribution of items by country

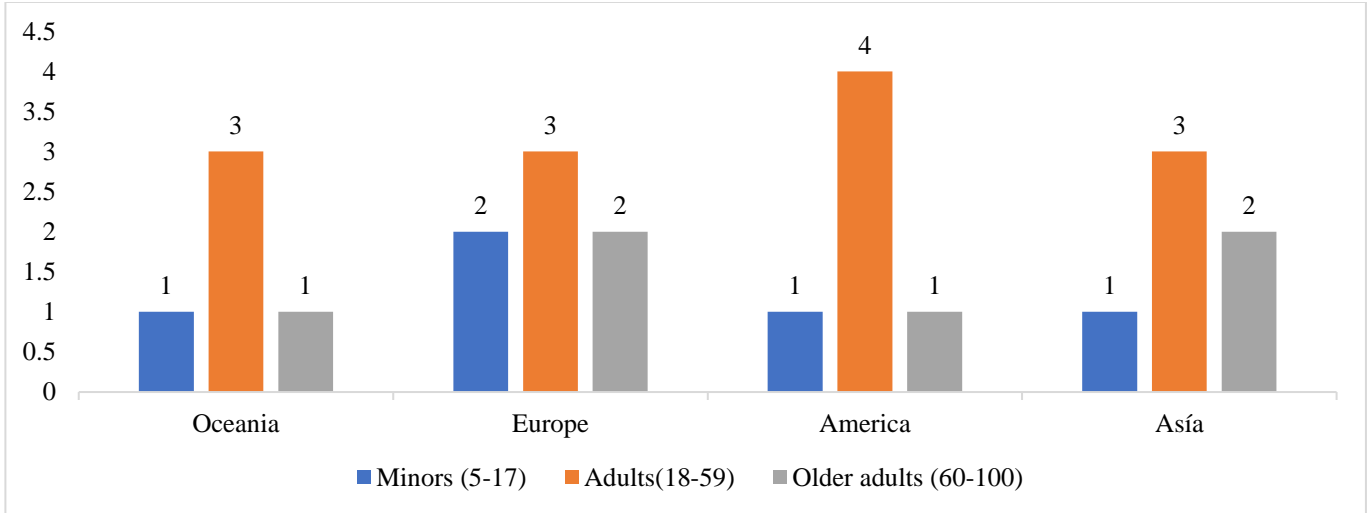


Fig. 12 Distribution of items by age range and geographic region

Table 4 presents the articles addressing the second question of this paper, which are classified by age range and focus on the use of VR for the treatment of phobias.

Table 4. VR-Related manuscripts for the treatment of phobias, according to age ranges

Age range	Quantity	Ref.
Minors (5-17)	5	[38], [43],[48],[33],[34]
Adults (18-59)	13	[85],[86],[87],[88],[89],[90],[91],[92],[93],[94],[95], [83], [84]
Older adults (60-100)	6	[56],[57],[58], [82],[83], [84]

5.3. RQ3: How does the use of VR Contribute to the Treatment of Claustrophobia?

As can be seen in Fig. 13, the use of VR technology and exposure to it by people with diagnosed or self-diagnosed phobias has shown a significant reduction in their phobias, either partially or completely. These results are consistent with those of the article [27], in which VR was also used to treat people with phobias.

In addition, results have been obtained showing that VR can recreate scenarios that produce effective stimuli in people suffering from phobias, like those encountered in real life. However, some articles such as [29], [32] have shown that the use of VR does not always result in an improvement of people's phobias.

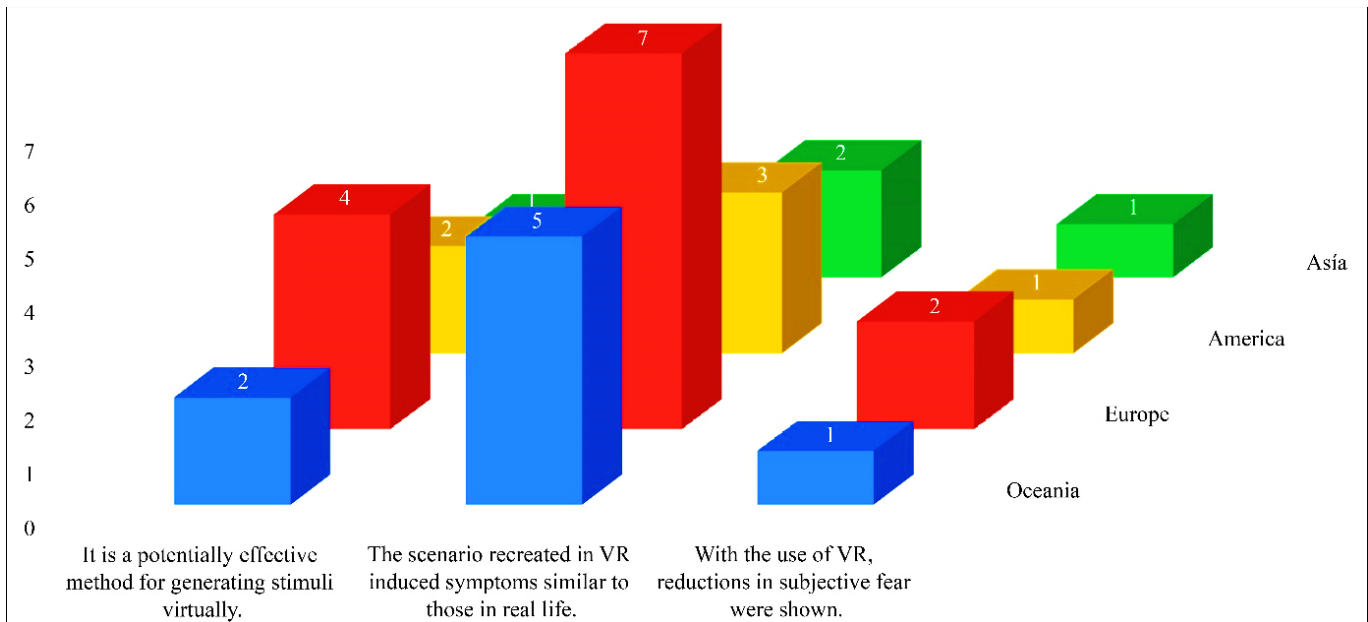


Fig. 13 Elements of VR contributing to the treatment of phobias

Table 5 lists items related to elements of the RV that can contribute to the treatment of phobias and can be found there.

Table 5. Organization of articles by elements of VR that contribute to the treatment of phobias

Elements	Quantity	Ref.
It is a potentially effective method for generating stimuli virtually.	9	[51], [54],[58],[39], [90], [71], [95], [84], [42]
The scenario recreated in VR induced symptoms like those in real life.	17	[85],[38],[86],[53], [55],[89],[64],[91], [93], [96],[72], [81],[47], [60],[61],[62], [50]
With the use of VR, reductions in subjective fear were shown.	5	[74],[78], [56],[57],[88]

6. Conclusion

After reviewing and analyzing the use of VR as a tool in the treatment of claustrophobia, different studies have been found that suggest that this technology can effectively reduce

the symptoms of this phobia. Likewise, it was observed that VR therapy for claustrophobia is an effective and viable alternative to traditional therapies since patients can be exposed to situations like those they fear in a controlled and gradual way, allowing them to overcome their fears more efficiently and without having to expose themselves to real situations that could be dangerous or traumatic for their lives. Most of the studies were found to use VR devices such as VR helmets or goggles, which were combined with specific software to simulate closed or cramped environments. These virtual environments are designed to be as realistic as possible and to provide patients with a sense of immersion in the simulated environment. It was also found that VR allows for treating other types of phobias, such as Acrophobia, Agoraphobia, Arachnophobia, Fear of flying, Fear of public speaking and Fear of injections, achieving significant results in patients.

Going forward, VR technologies are expected to continue to improve and evolve, allowing for greater immersion in virtual environments and greater personalization of VR therapies. In addition, new VR applications and devices are expected to be developed, allowing patients to receive treatment remotely, which could increase the accessibility and convenience of VR therapies for phobias.

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