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Virtual reality in psychiatric disorders: A systematic review of reviews

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ABSTRACT

Background: Virtual reality (VR) is being used more and more often as a therapeutic tool in psychology or psychiatry. In recent years, VR interventions appear more extensively also in disorders such as depression, anxiety and phobia. However, there has yet to be a comprehensive synthesis and critical review of the literature to identify future directions to advance the field in this area.

Objectives: To broadly characterize the literature to date on the application of VR in psychiatric disorders by conducting a systematic review of reviews, describe the limitations of existing research, suggest avenues for future research to address gaps in the current literature and provide practical recommendations for incorporating VR into various treatments for psychiatric disorders.

Methods: PubMed and Web of Science databases were searched for reviews on VR use in psychiatric disorders (e.g. various pain perceptions, post-traumatic stress disorder, phobias, attention deficit hyperactivity disorder, psychosis, depression). The methodological quality of each literature review was assessed using AMSTAR.

Results: The original search identified 848 reviews, of which 70 were included in the systematic review of reviews. Broadly, the literature indicates that various VR interventions could be useful in different psychiatric disorders.

Conclusion: This study provides evidence supporting the positive impact of VR therapy in psychiatric disorders. However, the impact is defined differently according to the studied area. Nevertheless, due to the continuous development of VR hardware and software, it is essential to conduct further research in the area of psychiatric disorders, especially as no review has concluded that VR does not work.

1. Introduction

Despite growing knowledge on the aetiology of mental disorders and increasing access to specialists dealing with the treatment and therapy of mental disorders, the number of people experiencing this type of problem is still high. According to the systematic review and meta-analysis published by Steel et al. in 2014, the aggregate lifetime prevalence of a common mental disorder (anxiety disorder, mood disorder, major depressive disorder or substance-use disorders) was estimated at 29.2 %.[1]

Today, anxiety disorder is the most common mental disorder in the USA, affecting approximately 40 million adults annually, but only 36.9 % receive any treatment. In 2015, 16.1 million US adults had experienced at least one major depressive episode within the past year.[2] Depression will be the second leading disease by 2020.[3] Anxiety-depressive disorder accompanies many somatic diseases, constituting both their cause and effect. This problem affects heart disease,[4] diabetes,[5] obesity[6] and a number of other medical conditions that require long-term treatment and a lasting lifestyle change. Mood disorders adversely affect the course of treatment and hinder the introduction of health-oriented lifestyle changes.[7] A similar dependency may be observed in the rehabilitation of disabled patients, such as stroke survivors. Emotional disturbance significantly reduces the efficacy of physiotherapy, which often results in permanent disability and dependence on third parties (family or institutions).[8]

Fortunately, psychiatric disorders are treatable, with most

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individuals able to be helped with the appropriate professional care. Sometimes pharmacotherapy needs to be introduced but in other cases it seems advisable to use psychotherapy or a combination of the two. Nevertheless, due to the long period of training for psychotherapists and the invested funds, the therapy costs are usually high. Psychotherapy requires determination on the part of the patient and intensive effort in terms of active participation in the therapeutic process. This is not possible for all who need such support, especially when dealing with a person who has a disease, disability or low social status. It should be highlighted that, currently, only 41 % of US adults with mental disorders received mental health services in the past year.[9] In turn, in the European Union, the median number of psychiatrists working in government child and adolescent mental health services is less than two psychiatrists per 100,000 children and adolescents (0–19 years).[10]

These facts are concerning and suggest the need for new treatments for mental disorders to be included exclusively or as an adjunct to traditional treatments.[9] A technological revolution in mental health care is approaching. At the forefront may be virtual reality (VR), a powerful tool for individuals to acquire new learning for the benefit of their psychological well-being. VR can produce scenarios that are therapeutically helpful if used in the right way but nearly impossible to recreate in real life.[11] VR allows repeated, immediately available and greater treatment input and can reduce inconsistency of treatment delivery.[11] With VR, individuals can enter simulations of difficult situations and be coached with inappropriate responses, based upon the best theoretical understanding of the specific disorder. The simulations can be graded in difficulty and repeatedly experienced until the right learning is made, hence patients will much more easily face difficult situations in VR environment than in real life and be able to try out new therapeutic strategies.[11] Findings show that patients report satisfaction with VR-based therapy and may find it more acceptable than traditional approaches.[12,13]

At present, there are many different ways to create a fully or partially virtual world. Depending on what real and virtual objects are presented in the image, there are four basic categories: (1) Reality, the real world; (2) Augmented Reality, where computer-generated data are merged into a real-world image; (3) Augmented Virtuality, where real-life data are merged into a computer-generated world; and (4) Virtual Reality, where the world has been created entirely by a computer.[14] Whatever limits the real world imposes on us, the virtual world is its ideal, unlimited reflection and creates a space where the impossible becomes possible, where modern technological solutions generate a new reality. VR is no longer an abstract concept, accessible only to advanced enthusiasts of computer games. We can currently see VR being used in many areas of daily life, including medicine. The emergence of VR kits, which, thanks to high-performance computers and VR goggles, offer a total immersion in the computer-generated world, opens up new, broad opportunities also in the treatment of psychiatric disorders.

The growing interest in medical applications of VR is highlighted by the increasing number of articles published on this topic in scientific databases: 45 articles in 1995, 951 in 2003, 3203 in 2010[15] and, in 2017 alone, 8890 articles containing the keyword 'virtual reality' were found in the Medline database. VR-based treatments for different mental health conditions have produced positive findings but unfortunately many of the articles are case studies or quasi-experiments. In some cases, treatment trials were small in size and seldom conducted according to clinical standards. Many studies lack methodological rigour or control groups. The available original works, including those of very high quality, are so numerous that it takes a lot of time and effort to extract all the information they contain.

Recently, two meta-reviews discussing the use of VR in various psychiatric disorders have been published, in 2016 and 2019, containing 28 and 25 systematic reviews and meta-analyses, respectively.[16,17] Both publications accurately described the mechanisms by which VR can be useful in supporting psychiatric disorders but did not quantify the scientific quality of the included studies and, due to inclusion criteria, did not cover fields related to psychiatry and psychology. Therefore, the aims of this study were to: (1) broadly characterize the literature to date on the application of VR in psychiatric disorders by conducting a systematic review of reviews, (2) describe the limitations of existing research, (3) suggest avenues for future research to address gaps in the current literature and (4) provide practical recommendations for incorporating VR into various treatments for psychiatric disorders.

2. Methods

2.1. Design and registration

The study design was set as a systematic review of reviews and followed a methodology guide for systematic review of systematic reviews created by Smith et al. (2011).[18] The protocol has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) under number CRD42020136632 and was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

2.2. Search strategy

Publications (up to 30 April 2020) were searched in PubMed and Web of Science. After analysis, the references of the selected publications were also searched. A preliminary division of the existing psychiatric and psychological diseases into groups was carried out. The following were distinguished: anxiety/phobias, other mental disorders, pain perception, neurodevelopmental disorders and post-traumatic stress disorder (PTSD, which was also included in anxiety/phobias). Then, additional keywords were specified within each group in order to broaden the spectrum of the searched conditions. 'Fear', 'phobias', 'agoraphobia', 'aviophobia', 'claustrophobia', 'panic', 'social phobia' and 'spiders' were added for anxiety/phobias. 'Eating disorder', 'depression', 'mental disorder', 'developmental disability', 'psychosis' and 'schizophrenia' were added for other mental disorders. For pain perception we added 'burn pain' and 'phantom limb pain'; for neurodevelopmental disorders we added 'paediatric psychology' 'children', 'autism' and 'cerebral palsy'. All these keywords were combined with 'virtual reality', 'augmented reality', 'exergaming' and 'review' or 'meta-analysis'.

2.3. Selection criteria

The review included only peer-reviewed publications in English. The following inclusion criteria were used:

1 Publication defined as a systematic review and/or meta-analysis or as a review with systematic search strategy
2 Application of VR as computer-generated schemes
3 Presence of at least one psychophysiological factor

In each literature review the following were defined: publication year, databases searched, study population, number of publications included in the review, the type of VR used and the main outcome of the study. In addition, the methodological quality of each literature review was assessed using AMSTAR (A MeaSurement Tool to Assess Reviews),[19] a questionnaire containing 9 questions for systematic review and 11 questions for meta-analysis. Each question allows four possible answers: *yes*, *no*, *can't answer* and *not applicable*. Points are awarded for *yes* answers. The tool enables a quantitative assessment of the quality of a literature review, presenting the overall quality result as *high* (score ≥ 8), *medium* (score = 4–7) or *low* (score ≤ 3). Publications whose study design was not defined as systematic review were also

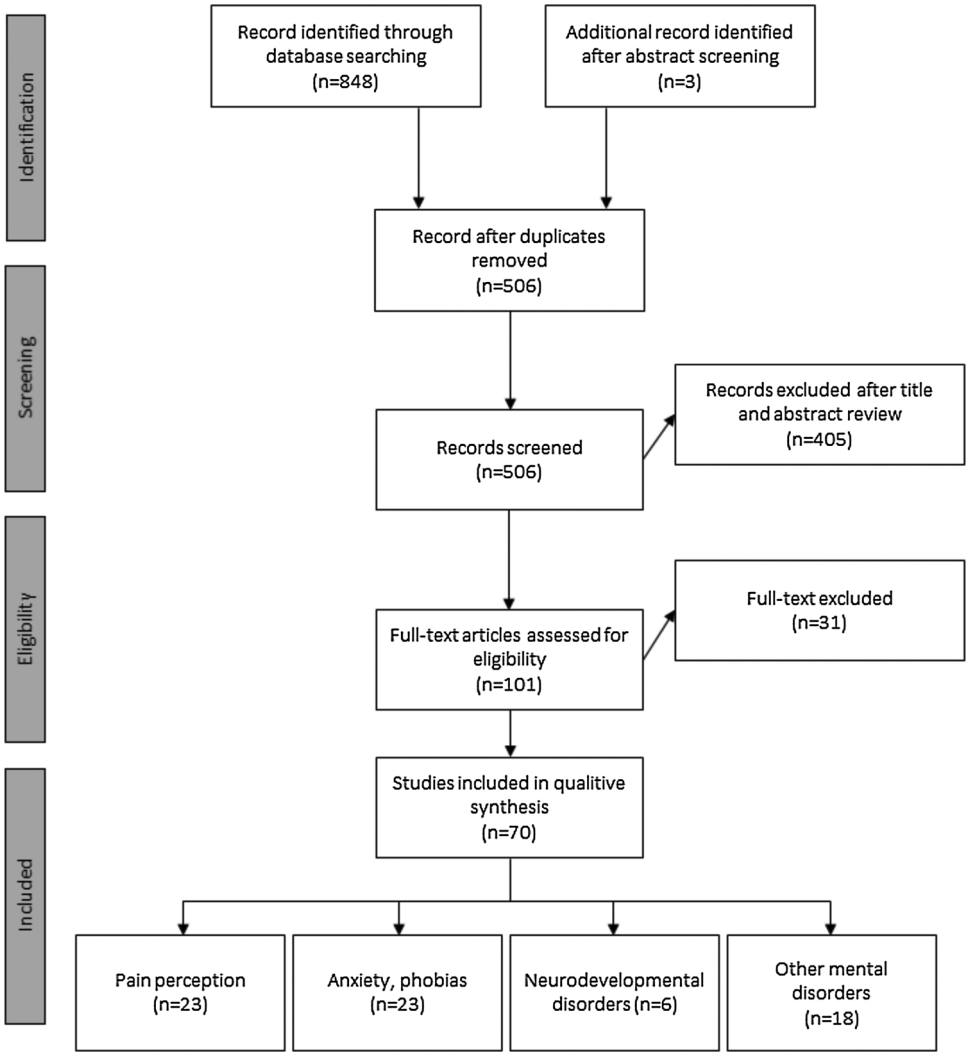

Fig. 1. Study flowchart.

evaluated, but the following annotation was added to the AMSTAR result: *'*-publication not defined by the author as systematic review*'. The database searches were carried out by two independent reviewers and any discrepancies were resolved via discussion. The reviews to be included in the study were assessed for methodological quality by one reviewer.

3. Results

During the database screening, 848 potentially relevant articles were found. After removing duplicates, 506 articles qualified for analysis. On the basis of the available abstracts, 405 publications were rejected and 101 were accepted for full-text analysis. At this point, an additional manual search was made, during which the literature contained in the selected articles was analysed. Finally, having taken into account the eligibility criteria, 70 articles were accepted for review. Fig. 1 shows the study screening process.

Of the 70 included literature reviews, 20 had additionally carried out a meta-analysis. To search for available studies, 8 reviews used one database (11 %), another 8 reviews used two databases (11 %) and the remaining 54 used three or more databases (78 %). The most frequently used databases were PubMed (52 articles, 74 %) and Web of Science (32 articles, 46 %). In 25 studies a head-mounted display (HMD) was used as the VR therapy tool, with 17 studies referring to the tool as VR games. Other studies did not specify the VR tool used, referring to immersive VR, non-immersive VR, VR exposure therapy or VR tasks.

3.1. Quality assessment

The mean score of the quality assessment of literature reviews was 6.1 (SD = 2.0; range = 2–9) out of 9, and for meta-analyses the score was 8.8 (SD = 1.5; range = 6–11) out of 11. Of the 70 analysed publications, 31 (44 %) obtained a score classifying the quality of the publication as 'high', 34 (49 %) as 'medium' and 5 (7%) as 'low'. Taking into account the individual questions in AMSTAR, the analysed publications most often lost points for lack of assessment of research quality (46 %) and lack of reference to the quality of research in the conclusion (59 %). Further points were lost for failure to meet the criterion of at least two people involved in the data extraction (37 %) and not listing the included and excluded studies (37 %). Failure to meet the criterion referring to a description of conflicts of interest (16 %) was moderate.

3.2. Pain perception

According to the American Board of Psychiatry and Neurology, pain medicine is the medical discipline concerned with the diagnosis and treatment of the entire range of painful disorders. This group included 23 articles, with a total of 10,066 participants. The included publications concerned burn pain, cancer-related pain, dental pain, experimentally induced pain, acute and chronic pain, musculoskeletal pain,

phantom limb pain and spinal cord injury pain. The most frequently used VR tool was the HMD with motion capture VR games. In the case of burn pain, dental pain, cancer-related pain, acute and chronic pain and musculoskeletal pain, the authors all agreed that VR may be an effective non-pharmacological, non-invasive adjunct analgesic technique for current pain perception. However, in the case of phantom limb pain, the authors found that despite positive reports on the effect of VR on this type of pain, the publications were mostly limited to case studies and case reports, which made it difficult to draw broader conclusions.

3.3. Anxiety/phobias

Anxiety/phobias are diseases in which the effects of VR therapy were studied most frequently. This group included 23 reviews that analysed studies with a total of 12,991 subjects. The reviews mostly covered a few types of anxiety/phobias, notably PTSD, fear of driving, fear of flying, arachnophobia, agoraphobia and claustrophobia. The positive effect of VR therapy was identified in all the analysed reviews but for this group the use of VR tools was emphasized as add-on therapy, not as replacement therapy. On the other hand, despite a large number of included studies, many authors suggested the need for further research in this area due to the ambiguity of the conclusions obtained.

3.4. Neurodevelopmental disorders

The group of articles on neurodevelopmental disorders included six publications (4033 participants) concerning children with attention deficit hyperactivity disorder (ADHD), autism and cerebral palsy, fetal alcohol syndrome and perceptual auditory impairments. Four of the reviews included studies using VR games and one referred to a study using various VR systems, including a Cave Automatic Virtual Environment (CAVE). Each of the studies pointed out a positive effect of VR on neurodevelopmental disorders, although Parsons et al. stated that there is much more to be determined regarding the application of VR to specific rehabilitation scenarios and its efficacy.[20]

3.5. Other mental disorders

The articles on other mental disorders included 18 reviews, with a total of 7740 participants, covering conditions such as psychosis, depression, substance disorders, eating disorders, schizophrenia, spatial neglect cognitive impairment and dementia. Välimäki et al. were the only authors to state in their review that there is no clear good quality evidence for or against using VR for treatment compliance among people with serious mental illness.[21] The remaining reviewed studies confirm the effectiveness of VR therapy compared to treatment as usual and show similar effectiveness when VR therapy is compared to conventional treatments (Table 1).

4. Discussion

The aim of this study was to characterize the literature, describe the limitations of existing research, highlight important areas to address in future research and bring practical recommendations of VR use to the treatment of psychiatric disorders. Despite certain methodological concerns that have emerged across this literature, this overview addresses the evidence supporting the efficacy of VR interventions in psychiatric disorders. However, in order to summarize the results of this review we should refer separately to matter related to the included reviews and separately to matter related to the use of VR in psychiatric disorders.

4.1. Limitations of included reviews

Significant inconsistencies are apparent with regard to the hardware/software used in the analysed literature reviews. Firstly, in many instances, the analysed publications referred to VR as a device/equipment. Descriptions concerned the medium used and not the actual stimulus (the therapeutic process contained within the virtual world). For example, descriptions included the HMD, the PC or Xbox Kinect as the VR system used. However, the therapeutic factor involves combining both hardware and software. The software was most often described in cases where the study used console equipment for exergaming, e.g. Xbox Kinect or Nintendo Wii, as they were mostly console games. Secondly, a number of reviews did not specify the hardware or software used in the included studies. Most often, the VR environment was described as immersive or non-immersive VR, VR exposure therapy or multi-sensory VR. This could be a particular limitation of systematic reviews but also of the primary research that the reviews describe. An answer could be to provide the exact names of the hardware and software used in the study, although this may be problematic for clinical trials that are testing new solutions. Some of the authors were aware of the above issues but, although the lack of standardization of hardware and software used in VR was pointed out 10 years ago, we can still see inaccuracies in this area.[63]

With AMSTAR evaluation, it is possible to identify the areas that raise major methodological concerns. The most common shortcoming was lack of assessment of the scientific quality of the publications included in the review. However, given the large number of available tools, the choice of an appropriate method is problematic. The Cochrane Collaboration tool is most frequently used to assess the risk of bias in randomized trials,[87] whereas for non-randomized studies it is worth paying attention to the GRADE approach.[88] An equally common limitation is when data extraction is conducted by only one person because it is recommended that there should be at least two independent data extractors and that a consensus procedure for disagreements should be in place. Such an approach reduces the risk of bias at the stage of qualification of publications for a systematic review. Paying attention to these shortcomings is important in order to draw objective conclusions in this area of research.

4.2. Clinical implications

In each studied area, the reviews indicated the need for further research, particularly for high-quality randomized controlled trials (RCTs). Hence, this new technology has a long way to go in everyday clinical practice. Nevertheless, at this stage, some clinical implications can already be drawn.

Pain perception studies mainly deal with procedural and chronic pain. In this clinical condition, VR is mainly used as a distraction. Immersive VR effectively reduced pain for both paediatric and adult patients undergoing medical procedures.[25,31] VR used as an interactive virtual representation of limbs may reduce neuropathic and phantom limb pain but, in this syndrome, positive findings were limited mostly to case report series.[27,36] A meta-analysis of RCTs conducted in 2020 revealed that VR has the potential to improve clinical outcome (pain intensity or disability) for individuals with spinal cord pain but it also highlighted the need for more high-quality research on this topic.[23] Furthermore, both exergaming and immersive VR could have a beneficial effect by alleviating the pain intensity in patients with chronic pain.[26,34]

From the study analyses it can be observed that anxiety and phobias are well covered by the research. The use of VR in the form of simulators for PTSD has been present in research for a long time. A meta-analysis from 2019 showed that VR exposure therapy showed no significant difference between VR and active interventions in terms of reducing PTSD symptoms. However, the authors pointed out that, owing to methodological inaccuracies in the included studies, the

Table 1
Included study characteristics.

Author (year)	Database search	Included studies (n)	Population (total participants)	Virtual reality system	Conclusion	Quality score
Pain perception						
Ahmadpour et al. (2020)[22]	Scopus, Association for Computing Machinery, PsycINFO	18	Procedural pain in children (not specified)	Head-mounted display, exergaming	VR has been demonstrated to be a viable choice for managing pain and anxiety in a range of medical treatments.	4/9* (medium)
Ahern et al. (2020)[23]	PubMed, EMBASE, Scopus, CINAHL, PsycINFO, Clinical.Trials.gov	7	Patients with spinal pain (311)	Exergaming, Virtual reality simulators	Virtual reality potential for improvement in outcomes for spinal pain that demonstrated statistical clinical significance.	9/11 (high)
Iannicelli et al. (2019)[24]	EMBASE, MEDLINE, Cochrane Central	7	Pediatric patients (734)	Head-mounted display, mobile phone, Tripod-arm device	Virtual reality is a valid tool for non-pharmacological pain reduction and that this approach is to be preferred to the standard reduction techniques currently in use.	5/9 (medium)
Georgescu et al. (2019)[25]	PubMed, EMBASE, the Cochrane Library, PsycINFO	27	Subject with experimentally induced pain (1452)	Virtual reality distraction	Though VR-based interventions reduced pain for patients undergoing medical procedures, inferring clinical effectiveness is precluded by the predominance of small trials, with substantial risk of bias, and by incomplete reporting.	10/11 (high)
Mallari et al. (2019)[26]	PubMed, CINAHL, Trip	3	Adults with chronic pain (601)	Head-mounted display	VR is an effective treatment for reducing acute pain.	8/11 (high)
Wittkopf et al. (2019)[27]	MEDLINE, PsycINFO, CINAHL, Web of Science	25	Subject with experimentally induced pain (354)	Virtual representation of any body part	The use of virtual representations of body parts to reduce pain is promising. However, due to the poor methodological quality and limitations of primary studies, we could not find conclusive evidence.	9/9 (high)
Chi et al. (2019)[28]	PubMed, CINAHL, Embase, PsycINFO	9	Subject with spinal cord injury-associated neuropathic pain (150)	Virtual walking, virtual illusion, Virtual reality hypnosis	VR therapies are an attractive alternative for treating spinal cord injury-associated neuropathic pain, with potential for clinically significant analgesic effects.	7/9 (medium)
Luo et al. (2019)[29]	PubMed, Embase, Cochrane Library	13	Procedural pain management of burn patients (362)	Virtual reality exposure therapy	Virtual reality is an effective pain reduction measurement added to analgesics for burn patients undergoing dressing change or physical therapy.	10/11 (high)
Austin et al. (2019)[30]	PubMed, Embase, Web of Science	9	Subject with neuropathic spinal cord injury pain (207)	Head-mounted display	Given the limited options available for the effective treatment of neuropathic spinal cord injury pain and early evidence of efficacy, they provide valuable incentive for further research.	5/9 (medium)*
Eijlers et al. (2019)[31]	EMBASE, MEDLINE, CENTRAL, PubMed, Web of Science, PsycINFO	17	Pediatric patients undergoing medical procedures (859)	Head-mounted display	Large effect sizes indicate that VR is an effective distraction intervention to reduce pain and anxiety in pediatric patients undergoing a wide variety of medical procedures.	9/11 (high)
Wittkopf et al. (2018)[32]	MEDLINE, PsycINFO, CINAHL, Cochrane Library, Web of Science	13	Subject with chronic musculoskeletal pain, phantom limb pain (469)	Head-mounted display, VR games, screen	Interactive virtual reality using exergames may promote distraction from painful exercises and reduce pain post-mastectomy and in patients with ankylosing spondylitis. Interactive virtual representation of limbs may reduce neuropathic and phantom limb pain.	9/9 (high)
Chan et al. (2018)[33]		36	Subject with procedural pain (1432)	Immersive VR		11/11 (high)

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Table 1 (*continued*)

Author (year)	Database search	Included studies (n)	Population (total participants)	Virtual reality system	Conclusion	Quality score
	Cochrane Library, MEDLINE, Embase, CINAHL, ERIC, ProQuest				These data suggest that VR may have a role in acutely painful procedures, however included studies were clinically and statistically heterogenous.	
Collado-Mateo et al. (2018)[34]	CINAHL, Cochrane Library, PubMed, Web of Science	7	Subject with musculoskeletal pain (119)	Exergaming	Exergames may be a relevant and useful tool for rehabilitation in the next few years. The effect sizes for musculoskeletal pain of six articles have been analyzed and the overall effect sizes were large for chronic pain, small for non-chronic pain and medium when the six articles were analyzed together.	10/11 (high)
Scapin et al. (2018)[35]	LILACS, BDENF, SciELO, CINAHL, Web of Science, PubMed, Scopus, Academic Search Complete, PsycINFO, Google Scholar	34	Subject with burn pain (not specified)	Head-mounted display, VR games, tablets	Virtual Reality is a non-pharmacological complementary strategy which has proven beneficial results in the treatment of burn patients.	6/9 (medium)
Dunn et al. (2017)[36]	PubMed, Google Scholar	8	Subject with phantom limp pain (41)	VR games, VR tasks	Despite the positive findings, all of the studies were confined purely to case studies and case report series. No studies of higher evidence have been conducted, thus considerably limiting the strength of the findings.	5/9 (medium)*
Won et al. (2017)[37]	PubMed	55	Subjects with procedural pain and anxiety, acute and chronic pain (not specified)	Head-mounted display, hand tracking	VR is a promising new technology that offers unique opportunities to modulate the experience of pain.	3/9 (low)*
Chirico et al. (2016)[38]	Scopus	19	Cancer-related pain (720)	Immersive VR, not immersive VR	Results found that VR improved patients emotional well-being, and diminished cancer-related psychological symptoms. They point to the need of a global and multi-disciplinary approach aimed at analyzing the effects of VR taking advantage of the new technology systems like biosensors as well as electroencephalogram monitoring pre, during, and after intervention.	5/9 (medium)*
Garrett (2014)[39]	CINAHL, MEDLINE, Web of Science, IEEE Xplore Digital Library, Cochrane Library	17	Subjects with burn and wound pain, dental pain (337)	3D immersive environments; 3D motion tracking; and stereo audio representation, VR games	This review found moderate evidence for the reduction of pain and functional impairment after immersive VR in patients with acute pain.	9/9 (high)*
Triberti et al. (2014)[40]	PubMed, Scopus	11	Subjects with experimentally induced pain, burn pain (381)	Head-mounted display	The results suggest the importance of different psychological factors in the effectiveness of the analgesic distraction. While sense of presence influences the effectiveness of VR as a distraction tool, anxiety as well as positive emotions directly affect the experience of pain.	6/9 (medium)
Malloy et al. (2010)[41]	PsycINFO, PubMed	11	Subjects with experimentally induced pain, burn pain (479)	Head-mounted display, VR games	VR distraction was shown to be effective for reducing experimental pain, as well as the discomfort associated with burn injury care.	4/9 (medium)
Mahrer et al. (2009)[42]	PubMed, Computer Retrieval of Information on Scientific Projects	19	Subject with burn pain, cancer-related pain (439)	Head-mounted display, augmented reality	Investigations have demonstrated initial promise with specific populations and acute medical procedures.	7/9 (medium)*
Morris et al. (2009)[43]		9	Subject with burn pain, cancer-related pain (152)	Head-mounted display, VR games		9/9 (high)

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Table 1 (*continued*)

Author (year)	Database search	Included studies (n)	Population (total participants)	Virtual reality system	Conclusion	Quality score
	PubMed, CINAHL, Cochrane Library, PEDro, Science Direct, PsycINFO, ProQuest, SPORTDiscus				VR may be an effective nonpharmacologic, noninvasive adjunct analgesic technique to current pain management.	
Wismeijer et al. (2005)[44]	PubMed, PsycINFO, Web of Science	20	Subject with burn pain, dental pain, cancer-related pain (467)	Head-mounted display, LCD glasses, Motion sensing system, Sound effects, SpiderWorld VE	The reviewed studies strongly support that VR and audiovisual distraction are clinically viable techniques with a high potential to alleviate pain associated with different medical diagnostic and therapeutic procedure.	5/9 (medium)*
Anxiety, phobias						
Lin-Stephens (2020)[45]	CINAHL, Cochrane Library, Embase, Medline, PsycINFO, Scopus and three more	13	Social, travel, general anxiety (737)	Virtual reality exposure therapy	Future visual narrative studies addressing adult anxiety are recommended to strengthen the current body of knowledge.	6/9 (medium)
Custódio et al. (2020)[46]	PubMed (via Medline), Scopus, Web of Science, Lilacs	9	Dental anxiety in children (579)	Head-mounted display	The use of virtual reality glasses is an effective tool for improving behavior and reducing pain perception during the dental treatment of children.	9/11 (high)
Viana et al. (2020)[47]	PubMed, Scopus, Cochrane	17	Anxiety patients (662)	Exergaming	Existing evidence is insufficient to support the advantages of usual care supplemented by exergame intervention over usual care standalone in anxiety levels reduction.	9/11* (high)
Gohari et al. (2019)[48]	PubMed	52	Panic, aviophobia, agoraphobia, acrophobia, cockroach phobia (703)	Head-mounted display, exergaming, PTSD	VR technology has been increasingly used in recent years for treatment and rehabilitation purposes among patients affected by chronic conditions in order to motivate them for more successful management.	4/9* (medium)
Deng et al. (2019)[49]	PubMed, Embase, Web of Science, Cochrane, PsycInfo, Science Direct, MEDLINE	15	PTSD (699)	Virtual reality exposure therapy	Virtual reality exposure therapy could produce significant PTSD symptoms reduction and supported its application in treating PTSD.	9/11 (high)
Gujjar et al. (2019) [50]	PubMed, MEDLINE, EMBASE, PsycINFO, CINAHL, Scopus, Cochrane Library	7	Dental anxiety in children (794)	Computerized-Cognitive Behavioral Therapy, Virtual reality exposure therapy	A limited number of studies supported the effectiveness of technology-based interventions in the treatment of dental anxiety in children and adults.	6/9 (medium)
Kothgassner et al. (2019)[51]	MEDLINE, PSYNDEX, Scopus, Web of Science	9	PTSD (296)	Virtual reality exposure therapy	VRET may be as effective as active comparators for PTSD patients.	6/9 (medium)
Wechsler et al. (2019)[52]	PubMed, PsychInfo, Web of Science	9	Specific Phobia, Social Phobia, or Agoraphobia (371)	Virtual reality exposure therapy	The study found no evidence that VR exposure is significantly less efficacious than in vivo exposure in Specific Phobia and Agoraphobia.	9/11 (high)
Park et al. (2019) [53]*	PubMed	36	Various psychiatric patients (1869)	Virtual reality exposure therapy	VR environments show the possibility of changing their anxiety, depression, cognition, and social functions in various psychiatric patients.	3/9* (low)
Zeng et al. (2018)[2]	Academic Search Complete, Google Scholar, MEDLINE, PsycINFO, PubMed, Scopus, SPORTDiscus, Web of Science	5	Anxiety, depression (396)	Virtual reality exposure therapy	Findings favor VR exercise in alleviating anxiety and depression symptomology. However, existing evidence is insufficient to support the advantages of VR exercise as a standalone treatment over traditional therapy.	9/9 (high)*

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Table 1 (*continued*)

Author (year)	Database search	Included studies (n)	Population (total participants)	Virtual reality system	Conclusion	Quality score
Oing et al. (2018)[54]	ProQuest, PsycINFO, PsycARTICLES	49	Claustrophobia, agoraphobia, arachnophobia, aviophobia, PTSD, social anxiety (1175)	Virtual reality exposure therapy	Although past studies have demonstrated promising and emerging efficacy for the use of VR as a treatment and diagnostic tool for anxiety-related disorders, it is clear that VR technology as a whole needs to improve to provide a completely immersive and interactive experience that is capable of blurring the lines between the real and virtual world.	6/9 (medium)
Botella et al. (2017)[55]	PsycNet, PubMed, Scopus, Web of Science	11	Arachnophobia, social anxiety disorder, agoraphobia, fear flying, acrophobia, fear of falling (715)	Head-mounted display, computerized automatic virtual environment	Results further confirm VR exposure therapy potential in treating these problems. Studies have demonstrated that VR used in conjunction with traditional evidence-based psychological treatments can provide innovative treatment strategies for this problem.	9/9 (high)
Maples-Keller et al. (2017)[12]	PsycINFO, PubMed, Embase, Google Scholar	80	Phobias, PTSD, Obsessive-Compulsive Disorder, Schizophrenia, Acute and Chronic Pain, Addiction, autism (not specified)	VR-based exposure therapy	Study indicated that VR is an efficacious tool, compares favorably to existing treatments, and has lasting effects that generalize to the real world.	4/9 (medium)*
Teo et al. (2016) [56]	PEDro	8	Anxiety, PTSD, Stroke, Parkinson's Disease, Celebral Palsy, Schizophrenia (not specified)	Nintendo Wii, Xbox Kinect, VR games	The current evidence suggest that a combination of VR and conventional therapies are safe and likely to be more efficacious compared to just traditional or VR therapy alone.	4/9 (medium)*
Botella et al. (2015)[57]	CINAHL, Google Scholar, Web of Science, PubMed, PsycNET, Scopus	12	PTSD (not specified)	Virtual reality exposure therapy	The literature review indicates that VR exposure-based therapy is an effective and promising alternative for the treatment of PTSD.	8/9 (high)*
Diemer et al. (2014)[58]	PubMed, PsycINFO, Academic Search Premier	39	Claustrophobia, social phobia, panic, Aviophobia, arachnophobia, agoraphobia (1274)	Head-mounted display	Review provides evidence that VR exposure elicits psychophysiological response patterns related to anxiety patients.	6/9 (medium)
McCann et al. (2014)[59]	PsycINFO, PubMed, Cochrane Library, Embase	27	Fear of flying, agoraphobia, PTSD, social anxiety, arachnophobia (431)	Multi-sensory virtual reality, Virtual reality exposure therapy	VR exposure therapy may be an effective method for anxiety therapy.	9/11 (high)
Motraghi et al. (2014)[60]	PsycINFO, PubMed, CINAHL, Google Scholar	9	PTSD (139)	Virtual reality exposure therapy	Although preliminary findings suggest some positive results for VR exposure therapy as a form of exposure treatment for PTSD, additional research using randomized controlled trials are needed.	8/9 (high)
Gonçalves et al. (2012)[61]	Web of Science, PubMed, PILOTS, PsycINFO	10	PTSD (155)	Virtual reality exposure therapy	Preliminary data suggest that VR exposure therapy is as efficacious as traditional exposure treatment and can be especially useful in the treatment of patients who are resistant to traditional exposure.	8/9 (high)
Meyerbröker et al. (2010)[62]	PsycINFO, PubMed, Web of Science, Academic Search Premier	20	Fear of flying, acrophobia, social phobia, panic disorder, PTSD (393)	Multi-sensory virtual reality, Virtual reality exposure therapy	Only in fear of flying and acrophobia is there considerable evidence that VR exposure therapy indeed is effective. In more complex anxiety disorders as panic disorder and social phobia, first results of VR exposure therapy are promising, but more and better controlled studies are needed before the status of empirically supported treatment is reached.	9/9 (high)

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Table 1 (*continued*)

Author (year)	Database search	Included studies (n)	Population (total participants)	Virtual reality system	Conclusion	Quality score
Gorini et al. (2008)[63]	PubMed, PsycLIT, Web of Science	47	Fear of driving, fear of flying, acrophobia, claustrophobia, arachnophobia, social phobia, agoraphobia, PTSD (455)	Head-mounted display, Virtual reality exposure therapy	A final critical issue related to the use of Virtual Reality Exposure Therapy in the treatment of anxiety-related disorders is the lack of availability of a VR system in the real-life context of the patient: both the cost and the setting of the system limit its use to the healthcare center/hospital/therapist's office.	5/9 (medium)*
da Costa et al. (2008)[64]	PubMed, Web of Science	16	Fear of flying (417)	Virtual reality exposure therapy	Study concludes that additional randomized clinical trials (in which VR exposure therapy is compared with standard exposure or as a stand-alone treatment) will be of use to establish which fear of flying patients may benefit best from this technology.	6/11 (medium)
Gregg et al. (2007)[65]	PsycINFO, PubMed	17	Fear of driving, fear of height, social phobia, arachnophobia, agoraphobia, body image disturbance, PTSD (731)	Head-mounted display	There is a lack of good quality research on the effectiveness of VR therapy. Before clinicians will be able to make effective use of this emerging technology greater emphasis must be placed on controlled trials with clinically identified populations.	7/11 (high)*
Neurodevelopmental disorders						
Zayeni et al. (2020)[66]	MEDLINE, Web of Sciences	22	Attention Deficit Hyperactivity Disorder, Children with impairments in Social communication (2498)	Exergaming	Serious games and commercially available video games can be an effective trajectory for psychotherapy in child and adolescent psychiatry.	5/9 (medium)
Fang et al. (2019)[67]	Google Scholar, PubMed, Web of Science, PsycINFO, Research Autism	10	Autism (248)	Exergaming	Exergaming interventions lead to improved physical and cognitive functions in individuals with autism spectrum disorder.	8/9 (high)
Bashiri et al. (2017)[68]	Web of Science, PubMed, Science Direct	20	Attention Deficit Hyperactivity Disorder (696)	Immersive VR, desktop VR, projective VR, and CAVE	The results indicated that VR technologies can support the rehabilitation of children with attention deficit hyperactivity disorder.	5/9 (medium)*
Krysta et al. (2017)[69]	PubMed	18	Patients with intellectual and developmental disabilities (not specified)	VR tasks	Virtual reality can be a safe and effective method of improving different skills in individuals with intellectual and developmental disabilities.	2/9 (low)*
Wang et al. (2011)[70]	Scholar's Portal, Embase, AMED, CINAHL, IEEE, Biosis, Scopus, Web of Science	20	Attention Deficit Hyperactivity Disorder, Autism, Cerebral Palsy (145)	VR games	The potential of using VR with children with disabilities will hopefully stimulate interest and discussion for continued use and research with virtual technology within the field of pediatric neurorehabilitation.	5/9 (medium)*
Parsons et al. (2009)[20]	PubMed, PsycINFO	34	Autism, Attention Deficit Hyperactivity Disorder, cerebral palsy, pain, fetal alcohol syndrome, Perceptual auditory impairments (446)	VR games	VR has been shown to be a novel and effective form of rehabilitation for children dealing with a number of disabilities. Also, there is much more to be determined regarding the application of VR to specific rehabilitation scenarios and its efficacy in comparison to other viable options.	5/9 (medium)*
Other mental disorders						
Butler et al. (2020)[71]	PsycINFO, PubMed, Google Scholar	60	Eating disorders (not specified)	Virtual reality exposure therapy		4/9 (medium)

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Table 1 (*continued*)

Author (year)	Database search	Included studies (n)	Population (total participants)	Virtual reality system	Conclusion	Quality score
					Exposure therapy for eating disorders has demonstrated some efficacy, but large RCTs isolating exposure therapy from other treatments are needed.	
Moreno et al. (2019)[72]	MEDLINE, PubMed, Cochrane, EMBASE, LILACS, SciELO, PEDro, CINAHL, Scopus	22	Individuals with neurocognitive disorders (564)	Virtual reality exposure therapy	VR interventions are useful to improve cognition and psychological symptoms in individuals with neurocognitive disorders.	7/9 (medium)
Dellazizzo et al. (2019)[73]	PubMed, PsycINFO, Google Scholar	4	Schizophrenia (225)	Avatar therapy, virtual reality cognitive therapy	The review shows that VR may also be used for the management of violence risk in youth with schizophrenia.	6/9* (medium)
Alashram et al. (2019)[74]	PubMed, Scopus, PEDro, REHABDAT, EMBASE, Web of Science, MEDLINE	9	Subjects with post traumatic brain injury (141)	Head-mounted display, simulators	Using different VR tools with following treatment protocol; 10–12 sessions, 20–40 min in duration with 2–4 sessions per week may improves cognitive function in patients with post traumatic brain injury.	7/9 (medium)
Andrade et al. (2019)[75]	PubMed, Scopus, Web of Science, SPORTDiscus, Science Direct, CINAHL, PsycINFO	9	Children and adolescents with obesity (336)	Exergaming	Exergames may be effective in improving psychological aspects of children and adolescents with overweight or obesity.	9/11 (high)
Rus-Calafell et al. (2018)[76]	Web of Science, PsycINFO, Embase, Scopus, ProQuest, PubMed	50	Psychosis (342)	Head-mounted displays	Virtual reality is a promising method to be used in the assessment of neurocognitive deficits and the study of relevant clinical symptoms. Furthermore, preliminary findings suggest that it can be applied to the delivery of cognitive rehabilitation, social skills training interventions and virtual reality-assisted therapies for psychosis.	9/9 (high)
Freeman et al. (2017)[11]	PubMed	285	Psychosis, depression, substance disorders, eating disorders, anxiety disorders (not specified)	Head-mounted displays, CAVE system, large projection screen	The capability of VR to simulate reality could greatly increase access to psychological therapies, while treatment outcomes could be enhanced by the technology's ability to create new realities.	3/9 (low)
Ogourtsova et al. (2017)[77]	MEDLINE, CINAHL, Embase, PEDro, AMED, PsycINFO	23	Subject with unilateral spatial neglect (329)	VR-based unilateral spatial neglect Assessment and Treatment Toolkit	VR-based Assessment and Treatment Toolkit could facilitate identification and decision-making as to the appropriateness of VR-based USN assessments and treatments across the continuum of stroke care, but more evidence is required on treatment effectiveness.	9/9 (high)
Cogné et al. (2017)[78]	PubMed, Scopus	63	Spatial navigation disorder, schizophrenia, dementia, cognitive impairment (322)	Vehicle simulator, virtual landscape, virtual maze	Virtual reality is useful to assess large-scale navigation strategies in patients with brain injury or schizophrenia, or in the context of ageing and dementia.	6/9 (medium)
de Carvalho et al. (2017)[79]	PubMed, Web of Science, Scopus	19	Bulimia Nervosa and Binge Eating Disorder (749)	VR-based environments	VR-based environments may be considered a promising strategy for the assessment and treatment of bulimia nervosa and binge eating disorder.	7/9 (medium)
Valmaggia et al. (2016)[80]	Web of Science, PsycINFO, Embase, PubMed	16	Psychosis (671)	CAVE system, Head-mounted display	The reviewed studies suggest that VR can be used to investigate psychological processes and mechanisms associated with psychosis.	7/9 (medium)
		24		Head-mounted display		6/9 (medium)

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Table 1 (*continued*)

Author (year)	Database search	Included studies (n)	Population (total participants)	Virtual reality system	Conclusion	Quality score
Valmaggia et al. (2016)[81]	MEDLINE, PsycINFO, Embase, Web of Science		Mood disorders, depression, bipolar, mania, paranoia, psychosis, schizophrenia, phobias, obsessive compulsive disorder (1305)		The reviewed studies confirm the effectiveness of VR therapy compared to treatment as usual and show similar effectiveness when VR therapy is compared to conventional treatments.	
Neguț et al. (2016)[82]	PubMed, PsycINFO, ScienceDirect	18	Cognitive impairment (668)	Head-mounted display, video capture systems, data gloves	Findings support the sensitivity of virtual reality-based measures in detecting cognitive impairment. They highlight the possibility of using virtual reality measures for neuropsychological assessment in research applications, as well as in clinical practice.	8/11 (high)
Pedroli et al. (2015)[83]	PsycINFO, Web of Science, PubMed, MEDLINE	13	Subject with spatial neglect (not specified)	Head-mounted display, immersive VR program	VR technologies offer impressive opportunities both for the rehabilitation and assessment of different cognitive deficits, including unilateral spatial neglect.	8/9 (high)
Coyle (2015) et al [84]	CINHAL, PsycINFO, Web of Science	16	Individuals with mild cognitive impairment, dementia (458)	Virtual reality cognitive training	Review suggested that computerized cognitive training and virtual reality cognitive training are feasible, worthwhile and effective cognitive training for populations at high risk of continued cognitive decline. Improved cognition across multiple domains was demonstrated, with some transfer and maintenance of improvements on psychological measures.	10/11 (high)
Välimäki et al. (2014)[21]	Cochrane Library	3	Schizophrenia (156)	Virtual reality exposure therapy	There is no clear good quality evidence for or against using virtual reality for treatment compliance among people with serious mental illness. If virtual reality is used, the experimental nature of the intervention should be clearly explained.	11/11 (high)
Li et al. (2014) [85]	PubMed, Embase, CINHAL, Web of Science, Cochrane Library, ACM Digital Library	19	Depression (1474)	VR games	The review supports the effectiveness of game-based digital interventions for depression.	9/11 (high)
Gutiérrez-Maldonado et al. (2013)[86]	PsycINFO, MEDLINE, PsycArticles	25	Bulimia Nervosa (not specified)	VR exposure treatment	The review explores the possibility of developing a new, empirically validated procedure for the treatment of bulimia nervosa that involves cue exposure via virtual reality.	3/9 (low)*

results should be interpreted with caution.[51] In the case of anxiety, both exergaming and VR exposure therapy showed some effectiveness in reducing symptoms. However, the available evidence is insufficient to support the advantages of VR exercise as a stand-alone treatment over traditional therapy.[2,47] There is also a need for high-quality research from narrative-based VR interventions in individuals with anxiety.[45] Nevertheless, in agoraphobia and specific phobia, both VR and in vivo exposure showed similar effectiveness in lowering anxiety symptoms.[52]By contrast, the results obtained in social phobia therapy are still ambiguous and require further, deeper investigation.[52]

Neurodevelopmental disorders cover mainly ADHD and autism spectrum disorders (ASD). In this clinical condition, most of the included studies used VR games as a therapeutic medium. Both serious games and exergames could have a positive effect on ADHD and ASD. However, exergames increase the range of psychiatric disorders treated by targeting symptoms that are not addressed by sedentary games.[66,67] Besides VR games, VR simulations provide appropriate conditions for children undergoing ADHD therapy.[68]

In other mental disorders, VR intervention may be useful for the assessment and treatment of bulimia nervosa and binge eating disorder.[79,86] According to the research cited here, VR showed some promise in identifying how those patients experienced their body image. On the other hand, it can help in identifying specific kinds of foods that may trigger the binge–purging cycle. Moreover, the study from 2019 stated that VR games may be effective in improving the psychological aspects of children with overweight or obesity.[75] In the above cases, the mechanism of action can be associated with an improvement in self-esteem, self-efficacy and motivation for change.

VR interventions may also be beneficial for patients with neurocognitive disorders.[72,78,84] VR used as cognitive rehabilitation is suggested to improve memory, dual tasking and visual attention. Moreover, with its sensitivity in detecting abnormal cognitive functioning, VR measures could be an effective neuropsychological assessment tool for cognitive impairment screening.[82]

Four studies considered various forms of VR in individuals with psychosis and schizophrenia. By measuring real-time physiological activation in social situations, VR offers several possibilities for psychosis clinical assessment.[80] So far, the majority of studies have focused on paranoid thinking assessment.[76] There are also preliminary reports that, in individuals with schizophrenia, VR enhances motivation towards treatment and is more interesting and useful than conventional training.[76] In the case of schizophrenia, a Cochrane review from 2014 concluded: 'there is no clear evidence for or against using VR for encouraging people with schizophrenia to take their medication'.[21] In contrast, Dellazizzo et al. (2019) stated that VR may be used for the management of violence risk in youths with schizophrenia.[73] VR intervention can be highly engaging and thus could facilitate identification and decision-making, making VR seem promising for post-stroke unilateral spatial neglect.[77,83] However, it is worth noting that the subject-related evidence is limited and there is still a need for research in this group. Included reviews support the effectiveness of VR and VR games for depression. A meta-analysis from 2014 suggested that game-based digital applications, in general, have a moderate effect size as depression therapy.[85] Besides VR games, depression has received minor VR research attention.[11] The latest review (2018) on depression has included only six studies[2] but these have shown that applying VR to depressed patients can reduce the severity of their depression.[9,11,80]

4.3. Accessibility of VR

An increase in the popularity of new technologies is inevitable, especially in the areas of health and education sciences. From year to year, the need to confirm the efficacy and usefulness of VR in different areas grows at an extraordinary pace. Analysis of the dynamics of the increase in number of publications on VR in the PubMed database shows that approximately half of all the articles (5589 out of 10,914) have been published within the last 5 years (2015–2019). The results of this literature review create a positive image regarding the usefulness of VR in supporting therapy for psychiatric disorders. The question, however, is how much time must pass before it can be implemented for the general use of psychiatrists and therapists.

In 2008, Gorini and Riva drew attention to problems with the availability of this type of therapy, mainly due to the high cost of designing and testing a new clinical VR application and the expensive technical support.[63] After 10 years, their concerns are still valid. Even though, year on year, prices of the equipment decrease and quality increases, the cost of creating specialized software remains prohibitively high.[89] The question that arises at this point is why the market for therapeutic applications/games does not develop as dynamically as the video gaming industry. According to the 2016 Newzoo report, over 2 billion people worldwide play the broadly understood computer games.[90] The global gaming market is worth about 135 billion dollars, with annual growth of about 10 %, and is projected to reach 174 billion dollars in 2021.[90] With such profits, the earnings of game designers are very high, which makes it difficult to acquire IT specialists to cooperate in the development of projects without an impressive budget. In addition, the cost of such a venture is further increased by the necessity to involve psychiatrists and therapists familiar with the psychopathology of a given condition. Finally, clinical trials should be carried out to objectively assess the effectiveness of the treatment developed, which also generates very high costs. Therefore, it is impossible to produce a good quality, effective therapeutic application without a huge budget. One possible solution to this is to provide public grants.

However, in order for public bodies to be interested in investing large resources, it is necessary to provide clear, objective evidence of the benefits of using such therapeutic applications and to demonstrate the profits to be generated through greater availability of psychological therapies provided by VR. Therefore, it is important to develop a cost–efficiency ratio for the different types of VR used to treat psychiatric disorders. The solution might be to incorporate in each study, as good practice, an attempt to estimate the cost–efficiency (cost-effectiveness) ratio for each device and software used.

4.4. Recommendations for future research

VR could act as a non-invasive adjunct analgesic technique to current pain perception/management. Various reviews demonstrated the efficacy of this type of therapy in burn pain and procedural pain. However, an area that still needs further research is phantom limb pain, as the available reviews are mostly limited to case studies. Most of the literature reviews concerned anxiety/phobias. Despite extensive interest in the application of VR for anxiety/phobias, more attention should be focused on PTSD, as research in this area is largely related to case studies. It was also pointed out that one factor worth exploring with regard to anxiety/phobias is the possibility of using VR within a patient's home, with little to no therapist interaction. Neurodevelopmental disorders seem to be the least explored area so far. The most widely used therapy tools were VR games and it might be advisable to extend the therapy with other VR devices as no meta-analysis has been performed in this area yet. This group also lacks a high-quality RCT. Focusing on the broadly understood mental health issues, depression seems to be an important research direction to take, owing to the huge extent of the problem and the fact that the number of publications in this area is still relatively small. Nevertheless, in each of the above areas it is extremely important to investigate the adverse effects of VR therapy because, so far, few studies have touched upon this subject.

In view of the fact that safety and side effects of VR have rarely been raised in the reviews' conclusions, concerns regarding the possible side effects of VR are still justified. With the complexity of the VR issue, side effects may differ depending on the form of VR used (software, hardware)., In future VR interventional studies it may be worth considering

the use of a side-effect measuring method, such as the Simulator Sickness Questionnaire (SSQ), as a methodological standard.[91] The SSQ contains 16 items (in three components: nausea, oculomotor and disorientation) on a four-point scale (none, slight, moderate, severe). Another tool to be considered may be the Virtual Reality Sickness Questionnaire (VRSQ), created in 2018 on the basis of the SSQ.[92] The VRSQ was developed by eliminating the nausea component from the SSQ, thus reducing it from 16 items down to 9 items. An increased presence of one of the above tools in VR studies will allow for a future meta-analysis of the side effects of using various forms of VR. It seems necessary to resolve the above concern before we proceed from 'early adopters' to 'everyday users'. This is all the more important as the intended users are people of different ages suffering from various comorbidities (heart diseases, neurological diseases, visual impairments such as glaucoma, balance disorders, etc.).

4.5. Limitations

The limitations of the study have been complemented. One of the purposes of this publication was to gather all the previous reviews in one place. For this reason, the present publication has included articles labelled as 'systematic review', as well as those marked as 'meta-analysis' or 'review'. This resulted in the inclusion of a large number of various kinds of publications, which significantly hampered the meta-analysis of meta-analyses. A good direction seems to be the synthesis of meta-analyses in individual psychiatric disorders, which will enable objective determination of the efficacy of using VR in these areas. Another limitation of our study is the tool used to evaluate the scientific quality of the included reviews. AMSTAR is focused on systematic reviews of RCTs but with the wide scope of our research we included reviews of studies of all designs, therefore the quality assessment results should be interpreted with caution.

5. Conclusion

In conclusion, the above study provides evidence supporting the positive impact of VR therapy in psychiatric disorders. However, the impact is defined in a different way depending on the studied area. In pain perception, many authors emphasized using VR instead of traditional medication therapy, which is understandable as medication can be harmful. In anxiety/phobias, several authors mentioned the fact that VR can be used as a supportive therapy but not as a replacement for traditional treatments. It could also serve as therapy for patients resistant to conventional therapies. An important task is also an evaluation of the savings for the healthcare system resulting from wider use of VR in the treatment of psychiatric disorders and an accurate description of possible side effects that may occur in people of different ages with different concomitant diseases. Although the general methodological quality of the included reviews was reasonable, almost half of the reviews did not assess the scientific quality of the included studies and one in seven reviews did not provide a conflict of interest disclosure. Nevertheless, due to the continuous development of VR hardware and software, it is essential to conduct further research in the area of psychiatric disorders, especially as no review has concluded that VR does not work.

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Błażej Cieślik: Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing, Project administration, Investigation. **Justyna Mazurek:** Investigation, Writing - original draft, Writing - review & editing. **Sebastian Rutkowski:** Investigation, Formal analysis, Writing - original draft, Writing - review & editing. **Paweł Kiper:** Formal analysis, Validation, Writing - review & editing. **Andrea Turolla:** Methodology, Validation, Writing - review & editing, Supervision. **Joanna Szczepańska-Gieracha:** Conceptualization, Methodology, Validation, Writing - original draft, Writing - review & editing, Supervision, Project administration.

Declaration of Competing Interest

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