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Literature Review: VR Games for Breathe Helping

Attila Tóth, Cecília Sik-Lanyi and Patricia Szabó

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Attila Tóth
University of Pannonia,
Egyetem u. 10,
8200 Veszprém
atoth.german@gmail.com

Cecilia Sik-Lanyi
University of Pannonia,
Egyetem u. 10, 8200 Veszprem
Eötvös Loránd Research Network,
Piarista u. 4, H-1052 Budapest,
Hungary
lanyi.cecilia@mik.uni-pannon.hu

Patrícia Szabó
University of Pannonia,
Egyetem u. 10, 8200 Veszprem
Eötvös Loránd Research Network,
Piarista u. 4, H-1052 Budapest,
Hungary
szabo.patricia@phd.mik.uni-pannon.hu

Abstract*—The main aim of the study is to showcase the poten tial of virtual reality (VR) technology in supporting breathing, particularly focusing on those grappling with functional respiratory disorders. The paper provides an overview of the anatomy and function of breathing, as well as possible psychological causes of respiratory disorders. It introduces various breathing techniques that can aid in improving respiration and reducing stress, such as the Buteyko method or Pranayama. Additionally, it presents therapeutic applications of VR technology in supporting breathing, which help from asthma to emotional balance. The study discusses two research endeavors demonstrating the effectiveness of VR breathing techniques in alleviating dyspnea, particularly among individuals recovering from COVID-19. One study focused on the physical effects of VR applications and the relief of dyspnea, while the other examined the impact of VR breathing therapies on mental health. Together, the studies suggest that VR technology holds promise as a tool for managing respiratory disorders and enhancing mental well-being.

Keywords*— Virtual Reality, breathing technique, functional breathing disorder

I. Introduction

The process of breathing is divided into two parts: the first one is called inspiracio where we inhalate oxygen from the atmosphere into the lungs and the second one is the so called expiration where we ehaling carbon diox into the air. In order to move air in and out of the lungs, the volume of the thoracic cavity is increased (or decreased). The lungs do not contract but increase or decrease in volume. Muscles like intercostals or diaphragm contract during inspiration. Normally, the expiration is passive, the inspiration is active (= contraction of muscles). By increasing the thoracic cavity, the pressure around the lungs decreases, the lungs expand, and air is sucked in.

Breathing controls the fundamental gaseous fuels of life's energy and assists in maintaining optimal conditions for the biochemical aspect of the internal milieu. If there is no severe pathology of the lungs, Oxygen concentrations are generally well maintained. In our study we focus on functional breathing disorders (PFBD) [1]

The term "functional breathing disorders" refers to respiratory problems that are not directly related to organic diseases or complications, but rather indicate dysfunctions in respiratory mechanisms. Functional breathing disorders may stem from psychological or stress-related causes, incorrect breathing techniques, or other factors. This is an area characterized by extensive research and treatment methods. The reasosns for PFBD can be the following (without claiming completeness):

Stress and Anxiety: Psychological stress and anxiety are common triggers for breathing problems. Elevated stress levels can lead to accelerated or disrupted breathing patterns.

Trauma or Excessive Physical Strain: Injuries, accidents, or overexertion can also result in breathing difficulties. These factors may affect respiratory function or chest movement necessary for proper breathing.

Incorrect Breathing Technique: Many individuals may not practice proper breathing techniques or may be unaware of their breathing patterns. Poor breathing habits, such as shallow or excessively deep breathing, can contribute to long-term respiratory issues.

Habitual Breathing Patterns: Certain lifestyle habits or occupational conditions, such as prolonged sedentary behavior, may contribute to the development of functional breathing disorders.

Neuromuscular Problems: Neuromuscular conditions, including muscle weakness or dysfunction of respiratory muscles, can impact breathing mechanics.[1]

Our main focus is on the pychological indicators behind functional breathing disorders. In study of R. Anbar & H. Hall [2] emphasize that from the beginnig of history berathing is in strickt connection: in Hebrew the spirit is ruach which means wind or breath. The Greek term of pneuma refers to breath, life and God and there is an equvivalence in India which is called prana.

In the early 1930s it was known that there is a connection between breathing disorder and psychological disorders as asthma was widly known, however they thought that a child's separation from his or her mother caused an emotional conflict leading to anxiety, which underlay the development of asthma. According to Selye János (1950) a hungarian professzor found no evidence for that [3] and nonspecific stress models were emerged thanks to professor Selye.

In the 1980s asthma were categorised as a not simply a behavioral disease, but there have been major advances in our understanding of how behavioral and psychological factors can exacerbate or ameliorate this particular condition in a major way [4] . For example, stress may be mediated through the autonomic nervous system (ANS), hormonally, or through immune mechanisms, and thereby influence.

Still today there are two main categories of functional respiratory disorders:

The disorder arises isolated besides psychological stress.For instance: a teenager who has no asthma, develops vocal cord dysfunction due to he fact that having stess within competetive sports activite or someone who is angry to losing his/her job or income. In special cases these people were misdiagnosed. In such cases, exploration of possible psychological stressors should be carried out in conjunction with appropriate medical assessment. This may prompt reconsideration of the diagnosis and will allow development of a more effective treatment plan.

The disorder arises based on pervious diagnostised medical illnes or environmental exposure. The patient anticipating that he or she will have astma attack and from fear from that he or she commance hyperventilating. Another variation of this scenario involves patients whose psychological factors influence treatment of a respiratory condition. For example, a patient with asthma and underlying anxiety may develop dyspnea as the result of schoolrelated experiences such as test taking or bullying. However, in response to the dyspnea, a healthcare provider often assumes that the patient's asthma is the trigger, and treats accordingly by modifying the asthma medications.

According tot he research of Thomas [5] the most common case is the second one. In these patients, stress and anxiety can be associated with exacerbations of respiratory symptoms such as chest pain, cough, and dyspnea/hyperventilation.Case nummber 2 is also associated with situations where patients have asthma combined with vocal cord dysfunction.

At the beginning of the treatment of functional respiratory disorder, it is needed to classify in which category the patient fits. In case number 2 patients may require attention in tandem for both their psychological and underlying disease factors.

Misdiagnosing or lack of recognition of a functional component in the presentation of patients with respiratory symptoms can lead to an ineffective therapy.

It is important to konw that respiratory disorders can cause physical pathology. For instance tracheal petechiae (small bleeding spots or points on the inner wall of the trachea) can occur due to severe cough [6] . It is important that clinicians not confuse the secondary organic changes in such settings as the primary cause of the functional symptoms.

In some cases there is no psychological factor behind functional respiratory, but functional respiratory can led to psychological issues: anxiety can be developed from long term respiratory without identificable cause. [7]

A. Slow breathing with self control: the Buteyko method[8]

In the 1990s a Russion medical community was formed with the leadership of Konstantin Pavlovich Buteyko, which is known today as Buteyko method. Buteyko claimed that low carbon dioxide or hypocapnia and its consequences aggravated many medical conditions and produced as many as 150 symptoms and conditions [9]. His method rests on his theory of low carbone dioxid and therefore is the aim of rising this level. He claimed also that hidden hyperventiation is the hidden destabilizer of physiological systems and psychological states. In Buteyko stated that carbon dioxide was so vital, the body created a series of defense mechanisms to retain carbon dioxide.

B. Other methods

Pranayama is an ancient breath technique that originates from yogic practices in India. It involves controlling your breath in different styles and lengths. It has more recently gained popularity in the western world because of the many health benefits that come from a pranayama practice. Pranayama has been shown to improve the vagal tone and decrease sympathetic activity on patients. The procedure is the following:

Exhale slowly and deeply without closing the' nostrils but be ready to do so.

Inhale slowly and quietly through the left nostril while closing the right.

At the end of the inhalation close both nostrils. Hold the breath for not more than 1-2 seconds.

Keep the left nostril closed and exhale through the right as quietly as possible.

After exhaling completely, inhale slowly and quietly through the right nostril.

Close both nostril and wait for a second, then open the left nostril and exhale slowly and silently.

Inhale through the same nostril and continue. [10]

C. Belly Breathing or Diaphragmatic Breathing

At the end of the 19th century physicians commence with investigation the relationship between the movement of diaphragm and chest during respiration. The diaphragm also responsible to vocalization and swallowing, as well as respiration. The diaphragm has multiple physiological roles: Diaphragmatic motion in breathing directly and indirectly affects the sympathetic and parasympathetic nervous systems and also influences motor nerve activities and brain mass. [11]. The process is the following: Breathing in slowly and deeply through the nose with a minimum movement of the chest in a supine position with one hand placed on the chest and the other on the belly. Diaphragmatic breathing has an impact on the brain and cardiovascular, respiratory, and gastrointestinal systems through the modulation of the autonomic nervous function.

D. Pursed Lips Breathing

During this technique the patient have to exhaling slowly through nose and then exhaling against pursed lips; to eases breathing and to prevent small airway collapse. First of all Pursed lip breathing is a breathing technique used as part of treatment for Chronic obstructive pulmonary disease, called COPD, but it is also help reducing respiratory rate. According to Zwerink [12] nurses have an important role in enhancing the care of patients through education and training approaches, which will help them to improve the practices and knowledge about disease and management, teaching the correct way of using of the technique.

E. 4-7-8 Breathing

According to WHO COPD will become the third most common casue of death by 2030 [13]. By now very few method were developed to decrease the number of

psychiatric morbidity. Anxiety and depression affect a number of patients with COPD. Mothds before 4-7-8 Breathing: Nebulization-In this, the drug is administered in the form of mist, inhaled into the lungs. This type of drug treatment reduces the severity and number of attacks in COPD patients. The process of using 4-7-8 technique [14]: the patient have to sit in confortable position, hands on lap, press the tip of the tongue on the ridge of tissue behind the top, front teeth and keep it there throughout the breathing cycle, breath in deeply through the nose for 4 counts, hold the breath for 7 counts and then breath out slowly through the mouth for 8 counts and repeat the breathing cycle. Effets of using the technique: there will be increased dyspnea, resulting in respiratory muscle weakness, which increases dyspnea, reduces physical activity and increases anxiety and depression.

In order to present this study, this article is structured as follows. The methods are shown in section II. The results are detailed in section III. Section IV presents Conclusions.

II. METHOD

A systematic search of GOOGLE SCHOLAR and SCOPUS databases, using keywords related to both breathing techniques and to their psychophysiological outcomes and their circumstances. It must be mentioned that very few of them included or handled the definition of VR. During a period of the last ten years a pool of 270 abstracts only 14 articles met eligibility criteria and were included in the review. Most of the articles were infeasibel due to leaving out psycholgical aspects or reasons of breathing disorders. 32 articles were excluded because the title missed the topic. 130 articles had a feasible title but only the abstract was available.

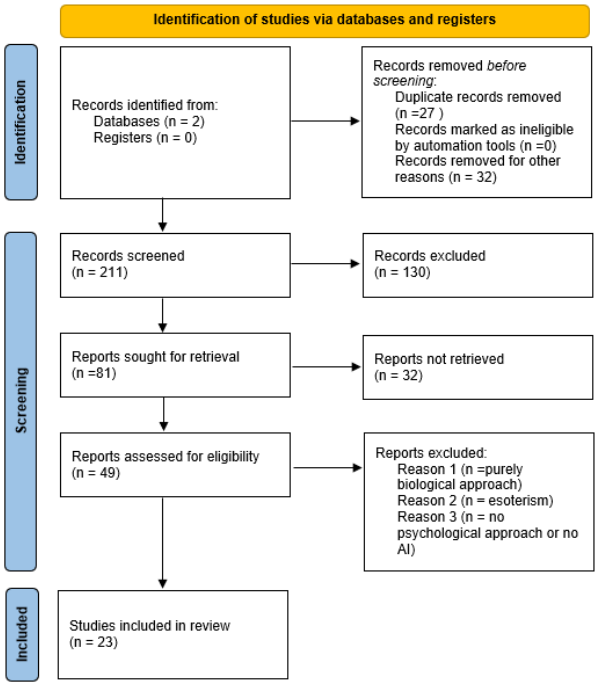

Fig.1. Search results presented with the PRISMA flow chart

Additional 32 articles had a feasible abstract but without AI topic. 12 articles had a purely biological approach, 8 articles were not science but esoterism, 5 articles had no psychological aspects The present systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

III. RESULTS

Virtual Reality (VR) technology serves as a transformative force, extending far beyond its origins in gaming, to offer profound advancements in the medical field. Its potential is particularly evident in the realm of diagnostics, where it enables doctors to delve deep into the psyche of patients and uncover the root causes of various illnesses. Through meticulously crafted simulations within virtual environments, clinicians can induce and observe phobic reactions, shedding light on underlying conditions that may otherwise remain elusive. This diagnostic capability not only enhances the accuracy of medical assessments but also empowers healthcare professionals to tailor treatments with unprecedented precision.

Moreover, VR emerges as a powerful tool for healthcare education and outreach. In a world where access to quality medical information is often limited by geographical barriers, VR bridges the divide by providing immersive, interactive experiences that transcend physical distances. Whether it's training medical professionals in remote areas or educating patients about preventive care measures, VR facilitates the dissemination of crucial health-related knowledge in ways previously thought impossible.

Furthermore, the therapeutic potential of VR extends to respiratory support, offering innovative solutions for conditions ranging from asthma to anxiety disorders. By creating immersive environments that encourage proper breathing techniques and mindfulness practices, VR empowers individuals to take control of their respiratory health in engaging and effective ways. Whether it's through guided breathing exercises or virtual relaxation environments, VR offers a novel approach to respiratory care that complements traditional treatments and fosters holistic well-being.

In essence, VR technology represents a paradigm shift in the way we approach healthcare, offering unparalleled opportunities for diagnosis, education, and treatment. As its capabilities continue to evolve, so too will its impact on the medical landscape, ushering in a new era of personalized medicine and patient-centered care.

The following encapsulation delineates the pivotal facets of the research endeavor titled "Exploring the Utility of Virtual Reality (VR)-Based Digital Therapies in Mitigating Dyspnea among Patients Recovering from COVID-19 Pneumonia." [15] This study delves into the efficacy of employing VR technology as a therapeutic modality targeting dyspnea among individuals in the convalescent phase of COVID-19 pneumonia.

In elucidating the results and procedures, emphasis is placed on the meticulous setup, wherein eligible patients were positioned semi-seated in their hospital beds and equipped with a belt-mounted linear force sensor to accurately capture respiratory movements. Furthermore, they were outfitted with a head-mounted display housing a smartphone, which facilitated the execution of the VR application. Developed in collaboration between MindMaze SA and the Laboratory of Cognitive Neuroscience

at Ecole Polytechnique Federale de Lausanne, this application operates in real-time, processing respiratory data to generate a computer-simulated virtual environment.

The procedure segment delineates efficacy and feasibility as the primary outcomes of interest in evaluating the VR-based digital therapeutic intervention. Enhanced feasibility and perceived outcomes are indicated by concurrence with questionnaire items. Secondary outcome measures encompass respiratory parameters and subjective assessments of breathing awareness and control, evaluated utilizing a 7-point Likert scale.

In summation, these findings underscore the viability of VR-based digital therapy as a feasible and effective means of ameliorating dyspnea among patients recuperating from COVID-19 pneumonia. The study advocates for further exploration to deepen understanding of the intervention's efficacy and feasibility.

In a further study, entitled "Virtual Reality Breathing Interventions for Mental Health: a Systematic Review and Meta-Analysis of Randomized Controlled Trials" [16], Cortez-Vázquez and colleagues conducted a comprehensive study on the effects of virtual reality (VR) technology breathing interventions on mental health. The researchers conducted a systematic literature search and meta-analysis, analysing randomized controlled trials. The aim was to determine whether VR breathing interventions are more effective in improving mental health compared to non-VR breathing interventions.

In the study, the researchers focused on general and individual mental health outcomes, including stress, mood, and anxiety, as well as measures of physiological stress, such as heart rate (HR) and heart rate variability (HRV). Additionally, the evaluation considered participants' feedback on VR and non-VR breathing interventions.

The results indicated that there was no evidence that VR breathing interventions were more effective in improving mental health. These conclusions were reached with moderate certainty. The meta-analysis also concluded that there were no significant differences between VR and non-VR respiratory interventions in terms of heart rate variability. Furthermore, it was observed that participants did not demonstrate a marked preference for VR respiratory interventions and that there was no evidence that they would be more likely to use these interventions in the future. Overall, therefore, the study concluded that there are no significant differences between the effectiveness of VR and non-VR breathing interventions in improving mental health and reducing physiological distress.

A. BreathVR

BreathVR emerges as a groundbreaking innovation from the collaborative efforts of Neon, a dynamic duo comprising a seasoned medical professor and a tech-savvy IT specialist. Together, they have harnessed the power of technology to create an app that transcends conventional boundaries, offering profound benefits to a diverse range of users, particularly parents of children with autism.

At its essence, BreathVR serves as a beacon of hope and understanding for parents navigating the unique challenges of raising children on the autism spectrum. Through an intricate tapestry of calming visuals and immersive soundscapes, the app guides users on a journey of self-discovery and relaxation. From tranquil melodies to the gentle rustle of leaves and birdsong, each element is meticulously designed to soothe the senses and evoke a sense of serenity.

Central to the app's therapeutic efficacy is its emphasis on deep breathing techniques, a cornerstone of mindfulness and stress reduction. Users are gently encouraged to inhale deeply through the nose and exhale through the mouth, with their breathing patterns monitored in real-time via the microphone. This practice not only promotes physical relaxation but also cultivates a deeper sense of emotional balance and resilience.

Originally conceived as a tool for managing chronic pain, BreathVR has transcended its initial purpose to offer solace to a broader audience, including individuals grappling with anxiety and stress. By providing a safe and accessible space for users to unwind and recharge, the app serves as a powerful antidote to the relentless pressures of modern life. Sra et. al [17] show in their study that participants report a higher sense of presence and find the gameplay more fun and challenging when using their breathing actions.

Moreover, BreathVR's impact extends beyond individual well-being, fostering a sense of community and connection among its users. Through online forums and support groups, individuals can share their experiences, offer encouragement, and find solidarity in their journey towards wellness. In this way, the app becomes not just a tool for personal growth but a catalyst for collective healing and empowerment.

In essence, BreathVR represents a paradigm shift in how we approach mental health and wellness in the digital age. By seamlessly blending cutting-edge technology with timeless healing practices,

B. DeepVR

In the immersive expanse of DeepVR, players are beckoned to traverse a realm imbued with ethereal beauty and poetic resonance. G. Xiao, M. Wu, Q [18]. chose a different way of approach in their study based on the fact that in recent times online panoramic video has gained enormous popularity. Herein lies a departure from conventional gaming interfaces, as the fluidity of movement is orchestrated by the deliberate modulation of diaphragmatic breathing. Through this harmonious integration, players are enveloped in a cocoon of tranquility, wherein the tumult of anxiety finds solace and reprieve. Crafted with meticulous attention to inclusivity, our bespoke wellness venture endeavors to extend its therapeutic allure to a broad spectrum of participants, ensuring accessibility to the restorative depths of Deep for all who seek refuge in its serene embrace.

C. Others

In addition to the aforementioned applications, there are numerous other VR-based breathing apps that serve similar purposes. One example is Prana Breath [19], which offers a variety of breathing techniques, including pranayama exercises. Calm VR is another option, offering a comprehensive range of relaxation and breathing techniques, including mindful breathing and

deep breathing. The Breethe [20] app also provides users with a diverse selection of breathing exercises and meditation programs to reduce stress and achieve a calm state.

It is also worth noting the MindBody [21] app, which assists users in understanding and improving their breathing technique through a variety of relaxation exercises. Oculus Relax [22]is an application developed specifically for the VR environment to assist users in relaxing and unwinding through various breathing and meditation techniques.

Finally, the Aura Breath [23] app is also worthy of mention, offering users personalised breathing exercises and meditations to help them find inner calm and relax in their daily lives. It is important to note that each app has its own benefits and limitations, and that it is therefore essential to consider individual needs and preferences before choosing.

IV. CONCLUSION

Most of the applications currently available are meditative in nature, with the main aim of achieving a state of relaxation, with proper breathing exercises as a key component. These methods can mainly address stress-related disorders, but it should be stressed that in many cases it is sufficient and promising that they can be carried out without human intervention using VR technology. All presented applications share the common feature that normally nonconscious mechanisms for perceiving circumambient space confront the incorporeality of the digital stimuli supplied by the virtual reality technology. VR environments are built upon these theses: the body's desire to (1) manipulate its environment affectively and (2) participate in roleplay. However, some VR games that control breathing are trying to create a new approach. According to auto-phenomenological studies, the feeling of being in a reality is enhanced by the body's privileging of those embodied movements that trigger the affective registers responsible for distal attribution in virtual environments. However, when it comes to breathing control, the approach differs, as most VR techniques adopt the breathing control method without integrating it into VR experiences. This study indicates that VR stimulation has indeed the potential to reduce psycho-physiological stress and to restore cognitive and attentional capacities in ill patients. Furthermore, the presented VR games are feasible and have great potential for cognitive stimulation in critically ill patients.

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