



POTENTIAL USE OF VIRTUAL REALITY IN OVERCOMING NEEDLE PHOBIA IN COVID-19 VACCINATION

Penggalih Mahardika Herlambang¹, Nanang Wiyono², Hendry Gunawan³, Rani Tiyas Budiyantri^{4*}

¹Faculty of Medicine, Wahid Hasyim University, Semarang, Indonesia

²Faculty of Medicine, Sebelas Maret University, Surakarta, Indonesia

³Faculty of Medicine, Swadaya Gunung Jati University, Cirebon, Indonesia

⁴Faculty of Public Health, Diponegoro University, Semarang, Indonesia

*Correspondence Author : E-mail : ranitiyas@lecturer.undip.ac.id

ABSTRACT

Background: Vaccination is very important because it can help prevent diseases that can be prevented by immunization (PD3I) such as polio, tetanus, diphtheria, measles, mumps, and rubella. During the Coronavirus Disease -19 (COVID-19) pandemic, the role of vaccination is very crucial, especially to reach herd immunity. However, there are many problems related to the implementation of vaccination, including needle phobia, which is a phobia of needles because it is considered painful. Virtual reality is a technology that develops in the form of a virtual image that can be used in vaccination services. This study aims to determine the potency of virtual reality to solve the needle phobia in vaccination services. **Methods:** The method used in this study is a literature review with sources from journals in the Scopus, ProQuest, and ScienceDirect database that was published in 2000 until 2020, and also books and articles with the keywords "virtual reality" "AND" "immunization," virtual reality " AND " vaccination " , "Needle phobia" "AND" "vaccination". This research was conducted from January to February 2021. **Results:** Based on the results obtained, virtual reality can be used in vaccination services, especially in the treatment of needle phobia. Virtual reality can become a distraction so that the patient will be distracted from fear and can lower the pain threshold. In addition, virtual reality can also be used as a means of education about immunization. **Conclusion:** Product development and clinical research need to be developed to assess the use of virtual reality in vaccination services during the COVID-19 pandemic. The use of virtual reality for other medical procedures that use needles can also be further investigated

Keywords: *virtual reality, needle phobia, vaccination, COVID-19*

INTRODUCTION

Coronavirus Disease 2019 (COVID-19) has been pandemic and spread all over the world. This disease has been caused by the SARS-COV-2 virus and the first case has been found in Wuhan in December 2019.¹ The positive cases have increased day by day so that in February 2020, World Health Organization has declared COVID-19 as Public Health Emergency of International Concern (PHEIC).²

On 17th February 2021, the number of COVID-19's positive cases in Indonesia reach 1,243,646 cases, 33,788 death cases, and 1,047,676 recovered cases.³ Many strategies have been implemented to decrease morbidity and mortality such as strict health protocol and making herd immunity using vaccination. Many health authorities compete to discover the appropriate vaccine. At the end of 2020, many vaccines have passed the 2nd phase of clinical trial and entered the 3rd phase.⁴ World Health Organization (WHO) also has

regulated about Emergency Authority in the use of COVID-19 vaccination.⁵

In January 2021, Indonesia has done the first COVID-19 vaccination with twice the dose administration.⁶ That vaccine has been prioritized to health professionals that work in health care. Future, the COVID-19 vaccine will distribute to all Indonesian people with a minimum coverage target of 70% to make herd immunity. Nevertheless, there are many challenges in vaccination program implementation such as anti-vaccine movement, disinformation, hoax, fear of adverse event after immunization, and needle phobia.

Needle phobia or trypanophobia is one of the specific phobias that was recognized by Diagnostic and Statistic Manual Mental Disorder 4th Edition (DSM-IV) in 1994.⁷ Someone that has needle phobia will worry or fear with injection or injury. In higher response, the patient will avoid needle injection, even though avoiding the medical care.⁷ The fear of needles can make negative



perceptions and imagination. This perception will lead to anxiety and can sensitize the nerve and improve the pain threshold. In America, at least 10% of adult people have a needle phobia and possibly a larger number.⁸

Virtual reality is the virtual graphic technology that can be utilized in healthcare facilities.⁹ In healthcare, virtual reality can be used as medical tools, translational research equipment, strengthening of exposure therapy, strengthening of distraction therapy, cognitive and physical rehabilitation support, planning and performance support in surgery, tools for preventing physical and emotional disorders, diagnostic tools, and supporting the development of an efficient health system.¹⁰ This research aims to determine the use of virtual reality in overcoming needle phobia during COVID-19 vaccination.

METHODS

The method used in this study is a literature review with sources from journals in the Scopus, ProQuest, and ScienceDirect database that was published in 2000 until 2020, and also books and articles with the keywords "virtual reality" "AND" "immunization," virtual reality "" AND "" vaccination " , "Needle phobia" "AND" "vaccination". This research was conducted from January to Mei 2021.

RESULTS

a. Needle Phobia

The phobia of needles or known as needle phobia or trypanophobia is one of the challenges in implementing vaccinations, especially during the COVID-19 pandemic. Trypanophobia is not just an ordinary fear but is an extreme fear of medical procedures involving needles.¹¹ This phobia often occurs in children and can even persist into adulthood. At least about 10% of citizens in the United States experience this phobia.⁸

Needle phobia can be caused by genetics, environment, and our experiences.¹² However, the sufferer has a great chance of survival. As many as four in five adults with a phobia of needles stated that they also have a close family member who has a similar phobia.

People with trypanophobia often feel afraid if they have to get medical treatment, especially those related to injections. If they continue to undergo the medical procedure, they often experience anxiety, high blood pressure, and an increased heart rate.¹³ Even at the time of medical treatment, they can experience syncope. Syncope may be a defense mechanism to protect the heart and brain with vasovagal reflexes and bradycardia.¹⁴ Bucci et al suggested that negative experiences when receiving vaccines may lead to vaccine rejection in the future.¹⁵

Unlike other anxiety disorders, there are no psychotropic interventions that are effective in the treatment of specific phobias.¹⁶ To overcome this phobia, several things can be done such as cognitive therapy, exposure therapy, and the use of technology such as virtual reality.^{17,18}

b. Virtual Reality

Virtual reality (VR) has been known since 1960. This technology-related with artificial environment, cyberspace, simulator technology, and so on.¹⁹ Virtual reality is defined as an interactive digital-based multimedia technology in which the user can ostensibly participate in the world displayed.²⁰

The environment that was displayed in VR is a simulation of a real or imaginary environment that is presented visually in three dimensions to provide an interactive experience through movement, sound, touch, or other forms. Humans can visualize, manipulate, and interact with computers and highly complex data because VR creates simulations of real-life simulations.²¹

Virtual reality divides into 2 components i.e. hardware and software components. Hardware components contain sub-component i.e. computer workstations, sensory displays, process acceleration cards, tracking systems, and input devices. While, the software component contains 3D modeling software, digital sound editing software, and VR simulation software.²²

Sensory display developed and still widely used today is the Head Mounted Display (HMD) which is hardware and is influenced by head movement. HMD is supported with sound and display that will change according to the head movement and position.²³



Virtual reality starts working when the eye sees an image or video in a virtual reality display. The perception of spatial reality can emerge from the binocular form in virtual reality so that the user can enter the environment or world that exists in virtual reality.²⁴

c. Virtual Reality Potency in COVID-19 Vaccination

Many intervention strategies in preventing COVID-19 have been implemented, one of which is the implementation of COVID vaccination. To achieve herd immunity quickly, the minimum number of people who must be vaccinated is approximately 70%. Due to mutations in the SARS-CoV-2 strain, a large proportion of the population will likely need to receive an annual COVID-19 vaccination once herd immunity is achieved.²⁵

During the COVID-19 pandemic, identification and treatment of needle phobia are expected to be a priority, especially regarding the implementation of the vaccination program. Therefore, treatment of targets with needle phobia needs to be considered because mass vaccination programs are increasingly being implemented to achieve and maintain herd immunity.

Virtual reality has the potency to be utilized as a pain and fear distractor. Moreover, VR also can be used for education media in vaccination.

Fear Distractor

The fear of needles is a phobia that often occurs in both children and adults. In some cases, needle phobia can cause parents to postpone schedules or even not bring their children to the doctor for immunization. In adult people, needle phobia can make the patient reject the injection or medical services. The fear and anxiety of the pain that was caused by needle injection can make them not cooperative.²⁶

Virtual reality (VR) began to be used and researched by a pediatrician named Chad Rudnick as a distractor in child vaccination services. This started with an 8-year-old child who came to his practice using a virtual reality headset.²⁷ When the injection was done, the child felt neither pain nor fear. In 2018, Chad Rudnick conducted a trial using VR on 17 children and 17 parents during vaccination services, and the results showed that the

fear of 94.1 % of children decreased when they received vaccination services accompanied by virtual reality.²⁷ Children become distracted and more focused on the VR content than needle injection.

This distraction is following the existing human theory that humans have a limited capacity to focus attention so that if someone gets another stimulus, the attention to the fear of needles will decrease.²⁸

Pain Distractor

Pain is a complex experience involving sensory, cognitive, behavioral, and psychological components.²⁹ Health procedures such as vaccination, intravenous injection, wound healing, or treatment is often traumatic for children. Sometimes pediatricians recommend analgesics such as opioids. However, opioids have many side effects such as vomiting and constipation, which can lead to cognitive impairment and respiratory depression.³⁰

Virtual reality can be used as a distractor in reducing pain during vaccination. Pain is associated with attention, and if the attention is distracted by VR, the patient's response to the pain signal will be slower. Many studies have shown that VR can reduce acute and chronic pain in children. In the research that conducted 244 children age 2 until 16 years old in California who received influenza vaccination and VR support, it was found that using VR for 30 seconds before, during, and after vaccination can reduce pain by 45 to 74%.³¹ This study was evaluated using a questionnaire that has filled out my parent's child and health worker immediately after vaccination.

Education Media

Apart from being a medium for distracting fear and pain during vaccination, VR can also be used as education or communication media about vaccination. In a study that was conducted by ORAU and the University of Georgia (UGA) from 2017 to 2018, it was found that VR helps improve parent's knowledge about vaccination.³²

Research conducted by Nowak *et al* (2019) on adults age 18-49 years old regarding the use of immersive VR in vaccination education shows that VR has the potency to increase knowledge about vaccination concepts such as immunity in the



community.³³ By increasing knowledge about the concept of vaccination, it is hoped that VR can help increase vaccination coverage.

In a study conducted by the University of Copenhagen on 234 random people who had the opportunity to try a virtual reality game about COVID-19 vaccination, it was stated that VR can be used in disseminating vaccine information.³⁴

CONCLUSION

Virtual reality (VR) can be used in vaccination services especially in a pandemic era. It can be used for distracted from pain, fear, and also can be used for vaccination education media. To develop the use of virtual reality in vaccination services, clinical research support in Indonesia was needed. The development of content that is suitable needs to involve various parties such as psychologists, pediatricians, and content creators.

REFERENCES

1. Lau, Hien, et al. "The positive impact of lockdown in Wuhan on containing the COVID-19 outbreak in China." *Journal of travel medicine* 27.3 (2020): taaa037.
2. World Health Organization. Covid-19 *Public Health Emergency of International Concern* (PHEIC) Global Research and Innovation Forum. 12 February 2020. Available from: [https://www.who.int/publications/m/item/covid-19-public-health-emergency-of-international-concern-\(pheic\)-global-research-and-innovation-forum](https://www.who.int/publications/m/item/covid-19-public-health-emergency-of-international-concern-(pheic)-global-research-and-innovation-forum) (Accessed : 18th February 2021)
3. Committee for Handling COVID-19 and National Economic Recovery. Available from : <https://covid19.go.id/>
4. Li, Yingzhu, et al. "A comprehensive review of the global efforts on COVID-19 vaccine development." *ACS Central Science* 7.4 (2021): 512-533.
5. Smith, Maxwell J., et al. "Should COVID-19 Vaccines Authorized for Emergency Use Be Considered "Essential" Medicines?." *Health and Human Rights* 23.1 (2021): 145.
6. Aldila, Dipo, et al. "Impact of early detection and vaccination strategy in COVID-19 eradication program in Jakarta, Indonesia." *BMC Research Notes* 14.1 (2021): 1-7.
7. Cook, Lynda S. "Needle phobia." *Journal of Infusion Nursing* 39.5 (2016): 273-279.
8. Love, Ashley S., and Robert J. Love. "Considering Needle Phobia among Adult Patients During Mass COVID-19 Vaccinations." *Journal of Primary Care & Community Health* 12 (2021): 21501327211007393.
9. de Bruin, Eling D., et al. "Use of virtual reality technique for the training of motor control in the elderly." *Zeitschrift für Gerontologie und Geriatrie* 43.4 (2010): 229-234.
10. Moline, Judi. "Virtual reality for health care: a survey." *Virtual reality in neuro-psycho-physiology* (1997): 3-34.
11. Hempel, Eliana. "Trypanophobia." *Family Medicine* 52.10 (2020): 759-759.
12. Loken, E. K., et al. "The structure of genetic and environmental risk factors for fears and phobias." *Psychological medicine* 44.11 (2014): 2375-2384.
13. Sokolowski, Chester J., Joseph A. Giovannitti, and Sean G. Boynes. "Needle phobia: etiology, adverse consequences, and patient management." *Dental Clinics* 54.4 (2010): 731-744.
14. Mimura, Tatsuya, et al. "Vasovagal syncope evoked by needle phobia when inserting a contact lens." *Ophthalmic and Physiological Optics* 25.2 (2005): 171-173.
15. Bucci, Lucie Marisa, et al. "Taking the sting out of school-based immunizations." *Paediatrics & child health* 22.1 (2017): 41-42.
16. Wolitzky-Taylor, Kate B., et al. "Psychological approaches in the treatment of specific phobias: A meta-analysis." *Clinical psychology review* 28.6 (2008): 1021-1037.
17. Ruiz García, Antonio, and Luis Valero Aguayo. "Multimedia intervention for specific phobias: A clinical and experimental study." *Psicothema* (2020).
18. Parsons, Thomas D., and Albert A. Rizzo. "Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: A



Penggalih Mahardika Herlambang, Nanang Wiyono,
Hendry Gunawan, Rani Tiyas Budiyantri

- meta-analysis." *Journal of behavior therapy and experimental psychiatry* 39.3 (2008): 250-261.
19. Onyesolu, Moses Okechukwu, and Felista Udoka Eze. "Understanding virtual reality technology: advances and applications." *Adv. Comput. Sci. Eng* (2011): 53-70.
 20. Bernardo, Antonio. "Virtual reality and simulation in neurosurgical training." *World neurosurgery* 106 (2017): 1015-1029.
 21. Kizil, M. S., and J. Joy. "What can virtual reality do for safety." *University of Queensland, St. Lucia QLD* (2001).
 22. Onyesolu, Moses Okechukwu, and Felista Udoka Eze. "Understanding virtual reality technology: advances and applications." *Adv. Comput. Sci. Eng* (2011): 53-70.
 23. Jain, Dhruv, et al. "Head-mounted display visualizations to support sound awareness for the deaf and hard of hearing." *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 2015.
 24. Guttentag, Daniel A. "Virtual reality: Applications and implications for tourism." *Tourism management* 31.5 (2010): 637-651.
 25. Fontanet, Arnaud, and Simon Cauchemez. "COVID-19 herd immunity: where are we?." *Nature Reviews Immunology* 20.10 (2020): 583-584.
 26. Won AS, Bailey J, Bailenson J, Tataru C, Yoon IA, Gloianu B. Immersive virtual reality for pediatric pain. *Children (Basel)*; 2017.4 (7):E52
 27. Chad, Rudnick, Sulaiman Emaan, and Orden Jillian. "Effect of virtual reality headset for pediatric fear and pain distraction during immunization." *Pain management* 8.3 (2018): 175-179.
 28. Willemsen, Hessel, Uttom Chowdhury, and Louise Briscall. "Needle phobia in children: A discussion of aetiology and treatment options." *Clinical Child Psychology and Psychiatry* 7.4 (2002): 609-619.
 29. Turk, Dennis C., and Donald Meichenbaum. "A cognitive-behavioral approach to pain management." *The Evolution of Cognitive Behavior Therapy*. Routledge, 2017. 132-154.
 30. Maxwell, Lynne G., et al. "The effects of a small-dose naloxone infusion on opioid-induced side effects and analgesia in children and adolescents treated with intravenous patient-controlled analgesia: a double-blind, prospective, randomized, controlled study." *Anesthesia & Analgesia* 100.4 (2005): 953-958.
 31. Mack H. Pilot study shows VR goggles reduce fear, pain in children during vaccination. *Mobile Health News*. 2017 Jan 25. Available from: www.mobihealthnews.com/content/pilot-study-shows-vr-goggles-reduce-fear-pain-children-during-vaccination
 32. ORAU. Improving adult vaccine communication, education with virtual reality. 2018. Available from: www.oraui.org
 33. Nowak GJ, Evans NJ, Wojdyski, Ahn SJG. 2019. Using immersive virtual reality to improve the beliefs and intentions of influenza vaccine avoidant 18-to-49-years-olds: Considerations, effects, and lessons learned.
 34. University of Copenhagen. Reserachers test virtual reality as a tool for promoting vaccination. Available from: https://news.ku.dk/all_news/2021/06/researcher-s-test-virtual-reality-as-a-tool-for-promoting-vaccination/