Prosiding Seminar Nasional Indonesia
Vol. 3 No. 2 Juni 2025, hal., 107-120
e-ISSN: 3026-5169

THE EFFECTIVENESS OF VIRTUAL REALITY IN REDUCING ANXIETY IN HEMODIALYSIS PATIENTS: NARRATIVE REVIEW

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Abstract

Chronic Kidney Disease (CKD) requires regular hemodialysis therapy to replace impaired kidney function. However, this procedure often causes anxiety that impacts psychological well-being and patient compliance with treatment. One of the developing non-pharmacological interventions is Virtual Reality (VR), which is used as a distraction technique to reduce anxiety during hemodialysis. This review aims to evaluate the effectiveness of using VR in reducing anxiety in patients undergoing hemodialysis therapy. This study is a systematic review with a literature search from the Google Scholar, ProQuest, and PubMed databases for the period 2020–2025. The keywords "Virtual Reality," "Anxiety," and "Hemodialysis" were used with Boolean operators to filter the search results. Studies were selected based on the PICOS framework, and their quality was assessed using the Joanna Briggs Institute (JBI). Of the 1,414 studies found (960 from Google Scholar, 129 from ProQuest, and 325 from PubMed), four relevant studies were identified and further analyzed. The review results showed that VR is effective in reducing anxiety in hemodialysis patients. VR serves as a cognitive distraction, relaxation method, and parasympathetic response stimulant that helps reduce stress hormone levels and increase patient comfort during procedures. The implementation of VR has the potential to improve patient comfort, minimize dependence on anti-anxiety medications, and support technological innovation in healthcare. Further research is needed to explore the duration, frequency, and type of VR content that is most effective in reducing anxiety in hemodialysis patients and its impact on other psychological aspects, such as quality of life and adherence to therapy.

Keywords: Virtual Reality, Anxiety, Hemodialysis, Non-Pharmacological Interventions

Introduction

Chronic Kidney Failure (CKF) is defined as a glomerular filtration rate of less than 60 mL/min/1.73 m2, albuminuria of at least 30 mg per 24 hours, or signs of kidney damage (e.g., hematuria or structural abnormalities such as polycystic or dysplastic kidneys) persisting for more than three months (Chen et al., 2019). Ten percent of the world's population suffers from chronic kidney disease, with 2.6 million people undergoing hemodialysis (HD), which will reach around 5.4 million by 2030 (Bikbov et al., 2020; Campo et al., 2022). According to the Basic Health Research of the Republic of Indonesia (2018), the prevalence of chronic kidney failure in Indonesia increased from 2% in 2013 to 3.8% in 2018, with a total of 713,783 patients, indicating an increase of 1.8% (Riskesdas, 2018).

In Indonesia, the number of patients undergoing hemodialysis continues to increase along with the increasing number of CKD cases. In 2018, as many as 66,433 new patients underwent hemodialysis, while active patients undergoing this procedure reached 132,142 people (Indonesian Renal Registry, 2018). Hemodialysis is a kidney replacement therapy that functions to remove toxic substances such as urea, creatinine, and electrolytes through the process of diffusion, osmosis, and filtration using a semipermeable membrane (Crisanto et al., 2022; Purnawinadi, 2021; Situmurang et al., 2022; Siwi & Budiman, 2021). Globally, patients undergo hemodialysis with a frequency of 2–3 times per week for 4–5 hours per session or a total of 10–15 hours per week (Angfakh, Moh et al., 2024).

In Indonesia, hemodialysis is performed twice a week for 4 to 5 hours according to the needs of each individual and the dose given (Syahputra et al., 2022). Although effective, this therapy can cause physical and psychological impacts. The physical changes that occur can affect various body systems, including respiratory, cardiovascular, integumentary, digestive, hematological, and nervous, which have an impact on the patient's psychosocial well-being (Irawati et al., 2023). One of the psychosocial problems often experienced by hemodialysis patients is anxiety, especially during therapy (KK & Akbar, 2023; Tiwouw et al., 2024).

Anxiety is a subjective experience involving mental tension, restlessness, and fear due to the inability to face a situation or feelings of insecurity (Fatmala et al., 2023). The results of a study by Tusi et al., (2023) showed that the psychological conditions of hemodialysis patients were moderate depression (16.58), severe stress (20.43), and severe anxiety (21.33). When experiencing anxiety, the autonomic nervous system responds by stimulating the adrenal glands to release adrenaline (epinephrine), which causes increased blood pressure and heart rate. In addition, the narrowing of peripheral blood vessels diverts blood flow from the digestive system to the muscles, accelerates glucose breakdown, and accelerates body fatigue (Aini et al., 2023).

The results of the study by Dame et al., (2022) showed that factors that influence anxiety include education level, duration of hemodialysis, and patient knowledge level, with duration of therapy as the most influential factor. Other factors that increase anxiety in hemodialysis patients are the need for long-term care, high costs, and strict fluid restrictions (Auliasari et al., 2025). Anxiety in hemodialysis patients can trigger physical, psychological, and behavioral changes, as well as limit social activities, which risk causing family conflict and worsening health conditions (Taha et al., 2023). Hemodialysis patients who do not experience anxiety are usually characterized by the ability to accept their health condition, maintain daily routines calmly, and have high self-confidence in facing the treatment process and daily life (Nurhaeda et al., 2023). One of the non-pharmacological interventions that has emerged as an innovative solution for hemodialysis patients is Virtual Reality (VR).

Virtual Reality plays a role in relaxation interventions by creating a calm atmosphere and a comfortable environment. This technology provides an immersive visual experience

combined with music to help users feel calm (Jawed et al., 2021). VR is a technology that allows users to experience a realistic digital environment through a head-mounted display device (HMD), which supports eye or head movement tracking systems to navigate the virtual world. This environment can be a 360° video of a natural location such as a park or beach, or a more complex science fiction setting (Wahyuni et al., 2025). With this technology, patients can feel like they are in another place without having to leave their bed (Sitopu et al., 2022).

This review aims to evaluate the effectiveness of using VR in reducing anxiety in patients undergoing hemodialysis therapy.

Research Methods

This study is a narative review that analyzes the effectiveness of Virtual Reality (VR) in reducing anxiety in hemodialysis patients. We adopted a systematic narrative review approach to integrate findings from various quantitative research designs; data were obtained from electronic databases to collect all relevant literature. The literature review process was carried out with a selection method and procedure using a modified PICOS framework. In this method, P (Population) refers to hemodialysis patients, I (Intervention) is the Virtual Reality intervention in reducing anxiety, C (Comparison) refers to the comparison factor in the intervention group, O (Outcome) assesses the impact of Virtual Reality on patient anxiety, and S (Study Design) focuses on the research model used.

The selection process uses inclusion criteria, including journals published in 2020-2025, hemodialysis patients who experience anxiety receiving virtual reality interventions, and articles published in English and Indonesian. Meanwhile, exclusion criteria included articles that did not discuss hemodialysis patients experiencing anxiety and receiving virtual reality interventions, articles published before 2020, and literature that was not included in the analysis. The methodological quality of the selected studies was assessed using the Joanna Briggs Institute (JBI) critical appraisal tool. This narrative review does not require formal ethical approval because all data used comes from published materials. Articles that are reviewed and have gone through the peer review process will be used to distribute the findings. Researchers assessed the quality and relevance of the review topic and literature review questions through a screening process. Researchers used Mendeley software to organize the search results. Researchers created a special folder and named the folder according to the database used to store the articles.

Furthermore, researchers conducted a screening to check for duplicate articles; then, the duplicate articles were removed and stored in a separate folder. After that, researchers screened articles based on titles and abstracts to determine appropriate articles, and in the next stage, researchers read the full text of articles that met the inclusion and exclusion criteria. Articles that did not have full text were excluded from the review. Eligible articles were put into a separate folder for further quality review.

Results and Discussion

The article search was conducted using the scientific databases Google Scholar, ProQuest, and PubMed covering publications from 2020–2025 in full-text format, in English and Indonesian. Keywords such as Virtual Reality, Anxiety, and Renal Dialysis OR Hemodialysis were applied with Boolean operators to narrow the results. From the initial search, 960 studies were collected from Google Scholar, 129 from ProQuest, and 325 from PubMed, for a total of 1,414 studies. The data was organized in Mendeley in separate folders. After removing 10 duplicates, 1,404 studies remained to be screened. In the screening, 1309 studies were excluded because they did not meet the criteria: 59 did not match the research design, 735 were not relevant to the topic, and 515 were not in line with the target population. A total of 95 studies passed the selection, but 89 were inaccessible, leaving six reports for eligibility evaluation. Of the 6, 2 were excluded because the concept was not relevant. Finally, four studies met all criteria and were included in this systematic review. At this stage, the researchers reviewed the four eligibility assessments based on their inclusion and exclusion standards. The researchers evaluated and summarized the quality of the four research publications that met these criteria in the final report of the Literature review.

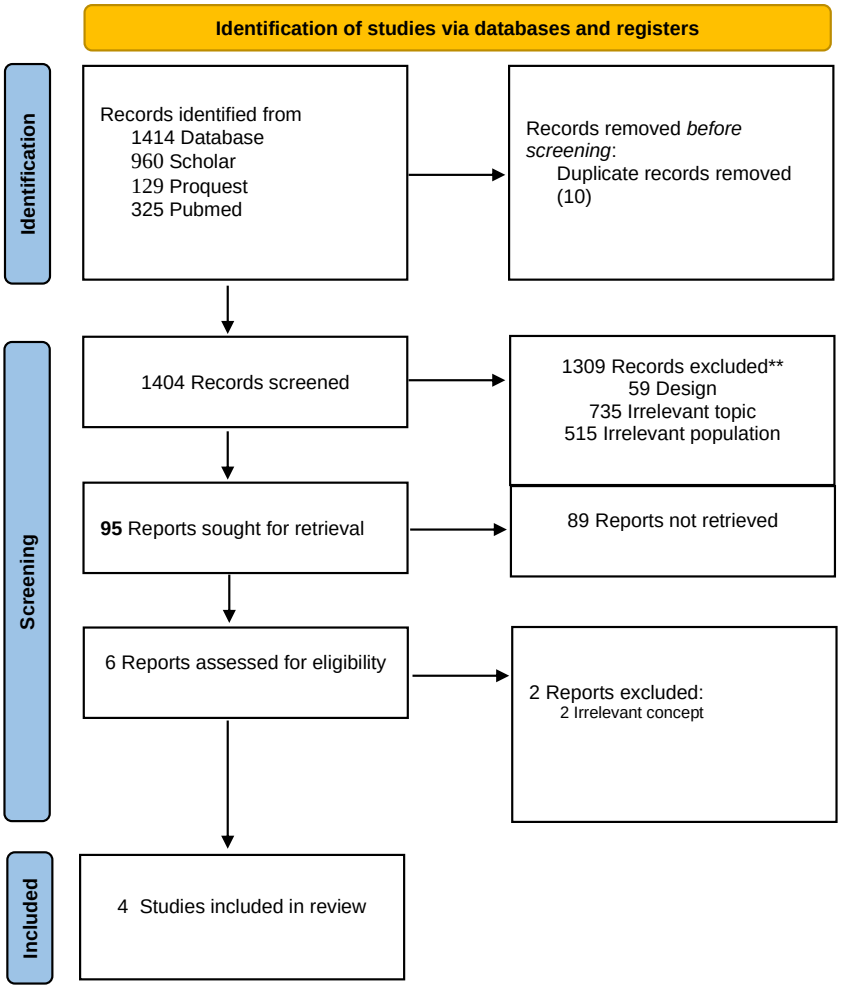

Figure 1. PRISMA flow diagram

Table 1. Data extraction

No	Title	Author and Year	Design and Number of Respondents	Country	Objective	Results	Measuring instrument
1	Virtual Reality Exposure Therapy to Decrease Anxiety Before Surgical Invasive Procedures in Hemodialysis Patients: an Interventional Study	(Hosseini et al., 2024)	Quasi-experimental (n=30) intervention group 15 and control 15 patients,	Iran	Assessing the effects of VR therapy on pre-invasive surgical anxiety.	Before the intervention, anxiety scores in the experimental and control groups did not show significant differences. However, after being given virtual reality intervention, state and trait anxiety in the experimental group decreased significantly compared to the control group ($p < 0.01$). Virtual reality has been shown to be effective in reducing anxiety in hemodialysis patients before invasive surgical procedures.	State-Trait Anxiety Inventory (STAI)
2	Effect of Virtual Reality compared to Guided Visualization on Arteriovenous Fistula Cannulation	(Dawood et al., 2021)	Quasi-experimental (n=30)	Egypt	To evaluate the effects of virtual reality compared with guided visualization on pain and anxiety following arteriovenous fistula cannulation	Showed a significant reduction in pain anxiety scores after intervention. Anxiety scores were significantly reduced with virtual reality (57±18 to 31±7.9) and guided visualization (57±18 to 41±16) ($P<0.001$). Before the intervention, there was a significant relationship between pain and anxiety scores	Pain Anxiety Symptom Scale Short Form

	pain and pain anxiety among hemodialysis children				in children undergoing hemodialysis.	(P=0.039), but after virtual reality, this relationship was not significant (P=0.251), while with guided visualization, it remained significant (P<0.001). Virtual reality is more effective than guided visualization in reducing pain and anxiety.	
3	Impact of virtual reality exercises on anxiety and depression in hemodialysis	(Turoń-Skrzypińska et al., 2023)	Analytical survey (n=85) intervention group 39 and control 46 patients.	Poland	This study aims to assess the relationship between regular physical activity with virtual reality and symptoms of anxiety and depression in hemodialysis patients.	There were no significant differences between groups in the scale evaluations in both examinations. However, the comparison between examinations I and II showed a significant decrease in scores in the study group on the Beck scale ($p < 0.001$) and GAD-7 ($p < 0.001$). Intragroup analysis of the GAD-7 scale showed that after the training cycle (examination II), the study group's scores decreased significantly ($p < 0.001$), while the control group actually experienced an increase in scores ($p = 0.002$). Showed a significant decrease in anxiety and depression symptoms.	Generalized Anxiety Disorder-7 (GAD-7) dan Beck Depression Inventory (BDI)

4	Teknik Distraksi Virtual Reality Dapat Mempengaruhi Tingkat Kecemasan Pada Pasien Hemodialisis	(Aprilia et al., 2022)	Pra-eksperimental (n=30)	Indonesia	This study aims to determine the effect of Virtual Reality distraction techniques on the anxiety levels of hemodialysis patients.	A significant value of 0.000 was obtained. Based on the Wilcoxon Signed Rank Test, because p <0.05, Ha is accepted, and H0 is rejected. Thus, the Virtual Reality distraction technique affects the anxiety level of hemodialysis patients at the Avio Prima Ciledug Hemodialysis Clinic.	Zung Self Rating Anxiety Scale

Table 2. Assessment Using Joanna Briggs Institute (JBI) Critical Appraisal Tools

No	Assessment criteria	Hosseini et al. (2024)	Dawood et al. (2021)	Aprilia et al. (2022)	Turoń-Skrzypińska et al. (2023)
	Study Design	Quasi-experimental	Quasi-experimental	Pre-experimental	Analytical survey
1	Clear control group	√	√	√	√
2	Baseline similarity	Not reported	Not reported	-	Not reported
3	Intervention description	√	√	√	√
4	Validity of measurement tools	STAI (valid)	Pain Anxiety Scale (valid)	Zung SAS (valid)	GAD-7, BDI (valid)
5	Completeness of follow-up	√	√	√	√
6	Appropriate statistical analysis	t-test	ANOVA	Wilcoxon test	Linear regression
7	Sample representativeness	Limited (n=30)	Limited (n=30)	Limited (n=30)	Good (n=85)
8	Control of confounding variables	×	×	×	×

	Risk of Bias Level	Moderate	Moderate	Tall	**Moderate**

Based on the results of the literature review of four studies that met the inclusion criteria, it can be concluded that Virtual Reality (VR) intervention is effective in reducing anxiety in hemodialysis patients. This finding is consistent across countries with different patient characteristics, including adults and children, and various clinical contexts, such as before surgical procedures, during arteriovenous fistula (AVF) cannulation, and routine hemodialysis sessions.

Virtual Reality (VR) is a computer-based technology that creates a three-dimensional environment, providing an immersive experience so that users feel as if they are in the real world with the support of special devices. Various devices such as head-mounted displays (HMDs), motion trackers, and controllers allow for more realistic interactions in the virtual world. In addition to being used in the entertainment industry, VR has also been applied in the medical field, including in physical rehabilitation, pain management, surgical training, anatomy education, and psychiatric disorder therapy (Arif et al., 2019; Saurik et al., 2019; Susilo & Febrianto, 2022). In hemodialysis patients, VR can be used as a distraction technique to reduce anxiety. The application of VR should be done after the needle insertion is complete so that the procedure runs smoothly without disturbing the nurse. The use of VR in this condition can help patients feel calmer and more comfortable during the hemodialysis process (Aprilia et al., 2022).

VR as a Distraction to Reduce Anxiety in Hemodialysis Patients

A study by Aprilia et al., (2022) showed that the use of VR with videos of natural scenery (sea and mountains) for 5-10 minutes significantly reduced the anxiety levels of hemodialysis patients. The distraction effect of VR helps patients divert their attention from stressful medical procedures, thereby reducing the stress response. This is in line with research by Jerdan et al., (2018) which states that VR can activate the parasympathetic nervous system, reduce cortisol levels, and reduce anxiety symptoms through calming visual and auditory stimulation. Dawood et al., (2021) also found that VR was more effective than guided visualization in reducing anxiety related to AVF cannulation pain in children. VR provides more immersive visual and auditory stimulation, making it more effective in diverting patients' focus from pain and discomfort. This finding is supported by Islamiyah et al., (2024) there was an effect after being given virtual reality intervention on the level of preoperative anxiety with spinal anesthesia.

VR for Stressful Medical Procedure Preparation in Hemodialysis Patients

A study conducted by Hosseini et al., (2024) evaluated the use of VR in preparing hemodialysis patients before invasive surgical procedures. VR simulations showing the stages of surgery (preoperative, surgical, recovery) helped reduce anxiety by increasing patient understanding and readiness. This study is supported by oleh Li et al., (2021) who found that VR exposure before a medical procedure can reduce anticipatory anxiety by providing a realistic picture of what the patient will face, thereby reducing uncertainty and fear.

VR in Improving Long-Term Mental Health in Hemodialysis Patients

A study conducted by Turoń-Skrzypińska et al., (2023) examined the impact of VR-based physical exercise on symptoms of anxiety and depression in hemodialysis patients. The results showed that VR activity not only reduced acute anxiety but also provided long-term psychological benefits, including reducing symptoms of depression. This finding is consistent with the study by Garcia et al., (2021), which stated that VR interventions that combine elements of relaxation and physical activity can improve the mental well-being of chronic patients through the mechanisms of neuroplasticity and endorphin release..

VR Mechanisms in Reducing Anxiety

Virtual Reality (VR) provides an immersive effect by creating a calming virtual environment, such as natural scenery or positive simulations, thereby helping to reduce patients' perceptions of stressful medical environments. Research by Riva et al., (2021) shows that this immersive virtual environment can induce relaxation through multisensory stimulation that includes visual, auditory, and even tactile when using haptic devices. In terms of cognitive distraction, VR works by focusing the patient's attention on the virtual content, which leads to reduced negative thoughts and worries related to the hemodialysis procedure. Hoffman et al., (2019) explain this mechanism as a diversion of cognitive resources from processing pain and anxiety to a more pleasant virtual experience.

For psychological relaxation, various studies have integrated VR with audiovisual stimulation, such as music or relaxation visualizations, to trigger a parasympathetic response that reduces stress hormone levels, such as cortisol. Findings by Tarrant et al., (2018) show that immersive VR environments can promote relaxation through reduced anxiety and increased alpha brain wave activity. Additionally, a study by Navarro-Haro et al., (2017) found that a VR-based intervention combining mindfulness elements and virtual nature scenes significantly reduced anxiety in participants.

Limitations of the Study

This study has limitations in English and Indonesian language publications.

Conclusion

Based on this literature review, Virtual Reality is an effective non-pharmacological intervention to reduce anxiety in hemodialysis patients, both in the context of specific medical procedures and routine therapy. The implementation of VR can be a holistic approach to improve patient psychological well-being, reduce dependence on anti-anxiety medications, and improve adherence to hemodialysis therapy. Further research is needed to optimize the use of VR in clinical practice, including the development of more personalized content and evaluation of long-term effects.

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