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Virtual Reality as Non-Pharmacological Therapy for Managing Chemotherapy Complications in Cancer: a Systematic Review

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ABSTRACT

Introduction: Cancer patients undergoing chemotherapy often experience physical and psychological side effects from treatment. Virtual Reality (VR) is emerging as a non-pharmacological therapy to alleviate these complaints. **Objective:** This systematic review evaluates the impact of VR interventions on physical and psychological complaints in cancer patients undergoing chemotherapy. **Methods:** A systematic review was conducted using the PRISMA guidelines. Articles were sourced from ProQuest, Cochrane Library, and PubMed, limited to studies published between 2013 and 2023, in English, and containing original research findings. **Results:** Ten studies were reviewed, revealing that VR interventions reduce depression, pain, and anxiety, enhance comfort, and improve patients' quality of life. **Conclusion:** VR technology offers a promising non-pharmacological intervention for managing chemotherapy-related side effects. It supports reducing anxiety, depression, pain, and fatigue while enhancing comfort and quality of life for cancer patients undergoing treatment. Further research is recommended to optimize VR applications in healthcare.

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1. INTRODUCTION

Cancer patients undergoing chemotherapy treatment programs typically experience various symptoms due to the side effects of the administered drugs (Thiagarajan et al., 2014). Additionally, they also face physical and psychological discomfort caused by the environment where they undergo chemotherapy and the invasive procedures they undergo. Based on research findings, around 86% of cancer patients undergoing chemotherapy procedures report physical complaints such as pain, nausea, vomiting, mucositis, diarrhea, and alopecia (Pearce et al., 2017; Sahin, 2016). Furthermore, they also experience psychological issues, including anxiety, feelings of despair, anger, depression, fear, vulnerability, and sometimes loss of control (American Cancer Society, 2023).

Essentially, all patients undergoing chemotherapy receive management for side effects through medications, both pre-medication and post-medication. However, this approach is ineffective in eliminating or reducing the symptoms experienced by patients and can even lead to new complaints such as discomfort (Keim et al., 2016; Bilgic, 2017). Discomfort is when patients undergo negative physical or emotional states, causing unpleasant feelings or sensations. Therefore, this aspect should rightfully be the focus of a nurse's attention in providing holistic care to patients, encompassing bio, psycho, social, spiritual, and cultural aspects.

Kolcaba (1995) explains that in addition to providing primary care for patients, nurses should also provide specific and unique nursing care for each patient to enhance their comfort, especially for cancer patients undergoing chemotherapy. This can improve satisfaction and compliance with their treatment programs, ultimately enhancing their overall quality of life. There are many non-pharmacological therapy options as alternative approaches to managing chemotherapy side effects, including music therapy, massage, acupuncture, guided imagery, hypnotherapy, acupressure, and virtual reality therapy (VR), all of which are believed to help patients reduce various complaints arising from chemotherapy. However, most mentioned techniques use conventional procedures, with VR being a rare inclusion.

Virtual reality (VR) technology is considered a new technology that, in its development phase, utilizes visual-based foundations to create a digital environment resembling the original or what is commonly known as immersion. The application of VR extends beyond information technology into various sectors, including healthcare (Arif et al., 2019). The use of VR in cancer patients to alleviate complaints resulting from chemotherapy procedures is still infrequent. However, VR can provide an immersive experience that can create therapeutic effects explicitly tailored to the patient's preferences.

The slow development of VR technology in the healthcare sector is due to the limited production of devices and the relatively high cost. Nevertheless, this is no longer a significant obstacle as the cost of these devices has decreased, opening opportunities to increase their use in managing chemotherapy side effects for cancer patients as an alternative therapy. However, current studies on its usage are still limited. This systematic review aims to examine the impact of VR on the complaints arising in cancer patients undergoing chemotherapy, including both physical and psychological complaints.

The phenomenon of chemotherapy-related side effects, coupled with the growing availability of VR technology, underscores the need to explore this innovative intervention further.

Current studies provide fragmented evidence, lacking comprehensive insights into its impact on both physical and psychological complaints. Therefore, this systematic review seeks to address this gap by critically analyzing the existing literature. The findings aim to justify the application of VR as a cost-effective, non-pharmacological solution for improving comfort, reducing distress, and enhancing the quality of life for cancer patients undergoing chemotherapy.

2. METHODS

Study Design

This research employs a systematic review methodology adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher et al., 2009).

Search Strategy

The systematic search involved secondary data obtained from ProQuest, Cochrane Library, and PubMed databases. Keywords used during the search included “cancer patient,” “virtual reality,” “chemotherapy complication,” and “comfort.” Articles were limited to those published between 2013 and 2023, written in English, and containing original study findings. The selected period aimed to ensure a comprehensive search of recent and relevant studies.

During the initial search on November 20, 2023, 87 journal articles were retrieved from ProQuest. Additional searches in the Cochrane Library yielded six journals, and PubMed contributed three journals, resulting in 96 articles prior to screening. Duplicate articles were removed before the inclusion and exclusion criteria were applied to refine the dataset.

Inclusion and Exclusion Criteria

Inclusion Criteria:

1. Population: Cancer patients undergoing chemotherapy.
2. Study Type: Clinical trials or randomized controlled trials (RCT).
3. Outcome Type: Addressing comfort or chemotherapy side effects.

Exclusion Criteria:

1. Studies conducted on cancer patients not receiving chemotherapy.
2. Studies not focused on VR interventions or lacking relevant outcomes.

Study Selection

The selection process involved two stages:

1. Screening for duplicates: Articles were reviewed, and duplicates were removed.
2. Eligibility assessment: Articles were assessed based on the inclusion and exclusion criteria.

The process is summarized in Figure 1, which outlines the PRISMA flow diagram.

Quality Assessment

The quality of included randomized controlled trials was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tool. This tool evaluates the risk of bias and ensures the reliability and validity of the selected studies. Studies were assessed on factors such as randomization

process, allocation concealment, blinding of participants, outcome measurement, and statistical analysis.

Data Extraction

All included articles were coded with unique identifiers. Data extraction followed a structured form developed by the researcher, capturing the following details for each study:

1. Author and publication year.
2. Study design and methodology.
3. Sample size and population characteristics.
4. Intervention details (VR application).
5. Outcome measures (comfort or chemotherapy side effects).

Data Synthesis

Studies were grouped for synthesis based on the following categories:

1. Physical Outcomes: Pain, nausea, fatigue, or other chemotherapy-related symptoms.
2. Psychological Outcomes: Anxiety, depression, and emotional well-being.
3. Comfort Measures: Holistic comfort indicators as defined by patient-reported outcomes.

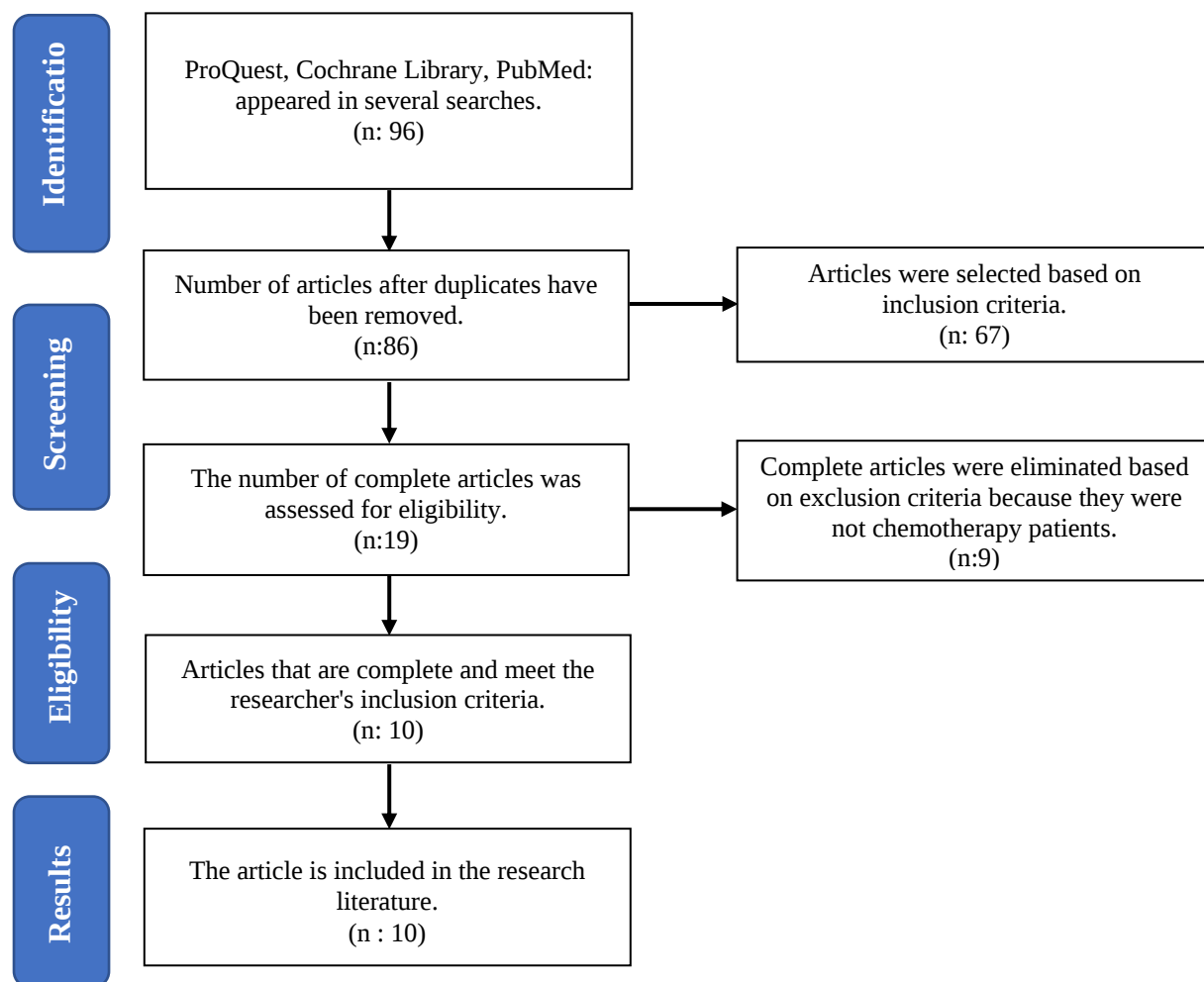


Figure 1. Research Article Selection Process with PRISMA

3. RESULTS

The psychological impact of Virtual Reality (VR) interventions in cancer care has shown promising results, particularly in reducing anxiety and psychological distress. Studies focusing on breast cancer (Zhang et al., 2022), leukemia (Zang et al., 2023), and metastatic breast cancer patients (Chin et al., 2022) demonstrate that VR can significantly alleviate anxiety and help manage psychological distress. However, the impact of VR on depression is less consistent. While some studies report no significant changes in depression levels (Fabi et al., 2022; Ioannou et al., 2022), others, such as Chin et al. (2022), have found improvement in depressive symptoms after VR interventions.

Regarding quality of life, VR has been shown to positively affect several psychological variables, including mood, fatigue, and sleep disturbances, particularly in breast cancer and leukemia patients (Zhang et al., 2022; Chin et al., 2022). However, Fabi et al. (2022) did not find a significant impact on the quality of life for patients with breast and ovarian cancers, suggesting that the benefits of VR on quality of life may vary depending on the type of cancer or individual patient factors.

When it comes to physical symptoms, the impact of VR on pain and nausea is less clear. While some studies, such as Jansen et al. (2022) and Chiu et al. (2023), report that VR can help reduce discomfort and improve physical comfort during chemotherapy, its effects on pain and nausea remain minimal. Additionally, studies like those by Ioannou et al. (2022) suggest that VR interventions may help alleviate fatigue, although these benefits are not always universally observed.

Finally, the sample size and design of the studies are important considerations. Larger, well-designed randomized controlled trials (RCTs), such as those conducted by Zhang et al. (2022) and Lewandowski (2021), generally provide more reliable and generalizable results. In contrast, smaller studies, such as single-arm or mixed-method studies (Hoffman et al., 2014), may have limited generalizability due to their smaller sample sizes and methodological limitations.

Table 1. Characteristics of Results

No	Authors/ Years	Title of study	Publisher	Design	Sample	Results
1.	Stanley Chin, 2022	An Investigation of Virtual Reality Nature Experiences in Patients With Metastatic Breast Cancer: Secondary Analysis of a Randomized Controlled Trial	JMIR CANCER	secondary analysis of a previous randomized controlled crossover trial	n=46	VR has a significant influence on two aspects, namely depression and quality of life, while for pain, fatigue, anxiety, and spirituality, it does not have a considerable impact.
2.	Alessandra Fabi, et al, 2022	The immersive experience of virtual reality during chemotherapy in patients with early breast and ovarian cancers: The patient's dream study	Frontier In Oncology	study is a two-arm randomized controlled trial	n=44	VRE positively influenced anxiety levels and feelings about the duration of chemotherapy but did not show significance on depression and quality of life.
3.	Xiuqing Zhang, 2022	The Impact of VR-CALM Intervention Based on VR on Psychological Distress and Symptom Management in Breast Cancer Survivors	Hindawi Journal Of Oncology	nonblind, parallel assignment randomized controlled trial (RCT).	n=90	VR-CALM intervention is more effective than (Care as Usual) CAU in most Quality of Life (QOL) variables, psychological distress, anxiety,
4.	Konrad Lewandowski, 2021	The Use of Virtual Reality to Reduce Stress among Inflammatory Bowel Disease Patients Treated with Vedolizumab	Journal of Clinical Medicine	randomized, controlled, single-center clinical trial	n=90	depression, sleep disturbances, and fatigue.
5.	Amy J. Hoffman et al, 2014	Virtual Reality Bringing a New Reality to Postthoracotomy Lung Cancer Patients Via a Home-Based Exercise Intervention Targeting Fatigue While Undergoing Adjuvant Treatment	Wolters Kluwer Health	A single-arm design	n=7	VR positively affects stress reduction, improves QOL, improves comfort and relaxation associated with vedolizumab treatment, and may improve compliance.
6.	Ioanna Piskorz1 et al, 2023	Virtual Reality Use for Stress Reduction and Patient Comfort During Chemotherapy	Committee for Psychological Science of Polish Academy of Sciences	in the between-group design study	n=26	VR has been proven to reduce Cancer Related Fatigue (CRF) significantly.

7.	Zang et al, (2023).	Effects of a Virtual Reality-Based Meditation Intervention on Anxiety and Depression Among Patients With Acute Leukemia During Induction Chemotherapy A Randomized Controlled Trial	Cancer Nursing	randomized controlled trial	n=63	Throughout several sessions, individuals using VR applications feel more relaxed and experience greater physical comfort.
8.	Androniki Ioannou, et al, 2022	Effectiveness of Virtual Reality Vs Guided Imagery on mood changes in cancer patients receiving chemotherapy treatment: A crossover trial	Eur J Oncol Nurs	A randomized crossover trial	n=50	Compared with patients in the control group, those in the intervention group showed a significantly more significant anxiety reduction ($P = 0.04$) and improved quality of life ($P = 0.04$). However, no significant differences were noted in depression levels between groups ($P = 0.09$), although a decreasing trend was observed in the intervention group.
9.	Jansen et al. (2022)	Experiences of Patients Undergoing Chemotherapy With Virtual Reality: Mixed Methods Feasibility Study	JMIR Publication	a mixed methodology with observations	n=18	For all mood subscales, patients experienced better mood state effects after VR intervention compared with GI, regardless of order ($p < 0.05$). No effectiveness was found for the symptoms of Nausea, Pain, and Feeling Sickness. Statistically significant improvements were seen in Biophysical parameters for VR intervention ($p < 0.05$).
10.	Chiu et al. (2023)	Immersive Virtual Reality to Distract From Pain in Children Treated With L asparaginase by Intramuscular Injection	Cureus	mixed-methods study	n=14	VR can reduce pain and increase patient comfort when undergoing chemotherapy procedures.

4. DISCUSSION

The findings of this systematic review shed light on the opportunities and challenges associated with Virtual Reality (VR) interventions for cancer patients undergoing chemotherapy, emphasizing both the potential benefits and limitations. It has been shown that VR can significantly reduce anxiety, depression, pain, and fatigue, while also improving patients' quality of life (Iaonnou et al., 2022; Chiu et al., 2023; Jansen et al., 2022). These effects align with the growing body of evidence supporting VR as an effective non-pharmacological intervention for alleviating the physical and psychological burdens associated with chemotherapy. However, conflicting results in some studies highlight the need for a nuanced interpretation of these findings.

One of the key challenges identified in the review is the variability in sample sizes across studies. Some studies had small sample sizes, which limit the generalizability of their findings to the broader cancer patient population. It is essential to be cautious when interpreting the results of studies with inadequate sample sizes, as they may not provide a reliable representation of the larger population of patients undergoing chemotherapy. Larger sample sizes in future studies could help address this limitation and provide more robust data on the effectiveness of VR interventions.

Additionally, the duration of VR interventions varied between studies, which may have contributed to discrepancies in reported outcomes. Standardizing the duration of VR interventions in future research would enable more consistent results and facilitate better comparisons between different VR applications. This could help identify the optimal duration for VR interventions and improve the reliability of findings.

Despite these challenges, the overall feasibility of VR interventions in cancer care is evident. The positive impact on both the physical and psychological well-being of patients undergoing chemotherapy suggests that VR could be a valuable adjunct to traditional cancer treatments. Integrating VR interventions into comprehensive care plans could provide an effective means of improving the overall patient experience during chemotherapy. Healthcare providers may consider offering VR as part of their supportive care strategies, especially for patients experiencing significant distress.

Future research should focus on addressing the identified challenges, particularly by increasing sample sizes, standardizing intervention durations, and improving methodological rigor. This approach would help clarify the potential benefits and limitations of VR interventions for cancer patients undergoing chemotherapy. Moreover, exploring the potential negative impacts of VR interventions is essential for a balanced evaluation of their safety and effectiveness.

In conclusion, this systematic review underscores the potential of VR as a non-pharmacological therapy for cancer patients undergoing chemotherapy. While challenges such as sample size variability and intervention duration remain, the positive outcomes observed in reducing complications suggest that VR interventions hold promise for improving the well-being of cancer patients. Continued research, using rigorous methodologies, is essential to optimize the use of VR in cancer care and ensure its safe and effective implementation. The discussion, however, remains underdeveloped, as there is insufficient emphasis on the urgency of adopting VR in cancer care, given the compelling evidence supporting its potential benefits.

This review links research findings with relevant theoretical frameworks, supporting the idea that VR has a role to play in managing the psychological and physical complications of

chemotherapy. The author's opinion seems to be cautiously optimistic about VR's promise but calls for more rigorous research to solidify its position as an integral part of cancer care practices.

The challenges and limitations of this study can be categorized into several factors. (1) VR Equipment: The weight of the headset and helmet, User resistance due to initial exposure to VR, Visual image quality, learning curve weaknesses, an introduction stage to use VR, Equipment costs, and limited availability of video content. (2) In some studies, the sample size is minimal, and there are instances of participants needing to complete the research process. Additionally, some research methods employed are single-arm studies.

The results of this systematic review indicate that using VR interventions for cancer patients undergoing chemotherapy programs can reduce anxiety, pain, depression, fatigue, time perception, improve quality of life, and alleviate discomfort. Additionally, VR can enhance relaxation and comfort. Based on these findings, it is recommended that healthcare providers incorporate VR interventions for cancer patients undergoing chemotherapy throughout their treatment process. Developing VR programs that empower patients to continue therapy at home can be beneficial, as care does not end when patients leave the oncology ward. Future research could have larger sample sizes, longer intervention durations, and higher methodological quality. Furthermore, it is also suggested that the negative impacts of VR interventions on patients be investigated.

5. CONCLUSION

This systematic review highlights the growing role of virtual reality (VR) as a non-pharmacological intervention for cancer patients undergoing chemotherapy. VR has been shown to reduce anxiety, depression, pain, and fatigue, while improving comfort and quality of life. However, challenges such as headset weight, visual quality, equipment costs, and limited video content need to be addressed.

Among the reviewed interventions, VR-CALM (Virtual Reality Cognitive, Affective, and Lifestyle Management) appears most effective, improving quality of life and psychological distress. Despite its potential, the practicality of VR in cancer care depends on overcoming technical and logistical barriers, ensuring accessibility, and making it cost-effective for broader use.

6. CONFLICT OF INTEREST

The authors have no competing interests to disclose.

7. REFERENCES

- Arif, L. S., Gunawan, H., & Herlambang, P. M. (2019). Peluang Penerapan Teknologi Virtual Reality pada Bidang Neurologi. *Seminar Nasional Informatika Medis (SNIMed)*, 40–44.
- Ashkenazy S, DeKeyser GF. Diferensiasi Antara Rasa Sakit dan Ketidaknyamanan: Analisis Konsep Ketidaknyamanan. *Penatalaksana Nyeri Nurs*. 2019; 20 :556–562.
- Barker TH, Stone JC, Sears K, Klugar M, Tufanaru C, Leonardi-Bee J, Aromataris E, Munn Z. The revised JBI critical appraisal tool for the assessment of risk of bias for randomized controlled trials. *JBIC Evidence Synthesis*. 2023;21(3):494-506.

- Chin, S., Cavadino, A., Akroyd, A., Tennant, G., Dobson, R., Gautier, A., & Reynolds, L. (2022). An investigation of virtual reality nature experiences in patients with metastatic breast cancer: Secondary analysis of a randomized controlled trial. *JMIR Cancer*, 8(3).
- Chin, S., Cavadino, A., Akroyd, A., Tennant, G., Dobson, R., Gautier, A., & Reynolds, L. (2022). An Investigation of Virtual Reality Nature Experiences in Patients With Metastatic Breast Cancer: Secondary Analysis of a Randomized Controlled Trial. *JMIR cancer*, 8(3), e38300.
- Chiu, C. C., Lin, Y. T., Wang, Y., Chang, T. Y., Wen, Y. C., Hsiao, Y. W., Chen, S. H., & Jaing, T. H. (2023). Immersive Virtual Reality to Distract From Pain in Children Treated With L-asparaginase by Intramuscular Injection. *Cureus*, 15(1), e34317.
- Fabi A, Fotia L, Giuseppini F, Gaeta A, Falcicchio C, Giuliani G, Savarese A, Taraborelli E, Rossi V, Malaguti P, Giannarelli D, Pugliese P and Cognetti F (2022) The immersive experience of virtual reality during chemotherapy in patients with early breast and ovarian cancers: The patient's dream study. *Front. Oncol.* 12:960387. doi:
- Hoffman, A. J., Brintnall, R. A., Brown, J. K., von Eye, A., Jones, L. W., Alderink, G., Ritz-Holland, D., Enter, M., Patzelt, L. H., & VanOtteren, G. M. (2014). Virtual reality bringing a new reality to postthoracotomy lung cancer patients via a home-based exercise intervention targeting fatigue while undergoing adjuvant treatment. *Cancer nursing*, 37(1), 23–33.
- Ioannou, A., Paikousis, L., PapastaVRou, E., AVRaamides, M. N., Astras, G., & Charalambous, A. (2022). Effectiveness of Virtual Reality Vs Guided Imagery on mood changes in cancer patients receiving chemotherapy treatment: A crossover trial. *European journal of oncology nursing : the official journal of European Oncology Nursing Society*, 61, 102188.
- Janssen, A., Fletcher, J., Keep, M., Ahmadpour, N., Rouf, A., Marthick, M., & Booth, R. (2022). Experiences of patients undergoing chemotherapy with virtual reality: Mixed methods feasibility study. *JMIR Serious Games*, 10(1).
- Kolcaba K. *Comfort Theory and Practice: A Vision for Holistic Health Care and Research*. New York, NY: Springer Publishing Company, 2003.
- Lewandowski K, Kaniowska M, Rosołowski M, Kucha P, Rydzewska G. The Use of Virtual Reality to Reduce Stress among Inflammatory Bowel Disease Patients Treated with Vedolizumab. *J Clin Med.* 2021 Jun 19;10(12):2709. doi: 10.3390/jcm10122709. PMID: 34205323; PMCID: PMC8235083.
- Made Satya, N. G., Haryani, H., & Tsai-Wei, H. (2023). Efficacy of smartphone-based virtual reality relaxation in providing comfort to patients with cancer undergoing chemotherapy in oncology outpatient setting in indonesia: Protocol for a randomised controlled trial. *BMJ Open*, 13(7).
- Pearce A, Haas M, Viney R, et al. Incidence and severity of self- reported chemotherapy side effects in routine care: A prospective cohort study. *PLoS One* 2017;12:e0184360.
- Piskorz, J., Czub, M., Mróz, M., & Drapała, J. (2023). Virtual reality use for stress reduction and patient comfort during chemotherapy. *Polish Psychological Bulletin*, 54(2), 136-155.
- Pourhoseingholi MA, Baghestani AR, Vahedi M. *How to control confounding effects by statistical analysis*. Gastroenterol Hepatol Bed Bench 2012;5:79–83.
- Sahin ZA, Ergüney S. Effect on symptom management education receiving patients of chemotherapy. *J Cancer Educ* 2016;31:101-7. 7 Society AC. Chemotherapy side effects | *American Cancer society*. 2023.

- Thiagarajan, M., Chan, C. M., Fuang, H. G., Beng, T. S., Atiliyana, M. A., & Yahaya, N. A. (2016). Symptom Prevalence and Related Distress in Cancer Patients Undergoing Chemotherapy. *Asian Pacific journal of cancer prevention : APJCP*, 17(1), 171–176.
- Yanyan Jing,^{1,2} and Huaidong ChengAshkenazy S, DeKeyser GF. Diferensiasi Antara Rasa Sakit dan Ketidaknyamanan: Analisis Konsep Ketidaknyamanan. *Penatalaksana Nyeri Nurs.* 2019; 20 :556–562.
- Zasadzka, E., Pieczyńska, A., Trzmiel, T., & Hojan, K. (2021). Virtual Reality as a Promising Tool Supporting Oncological Treatment in Breast Cancer. *International journal of environmental research and public health*, 18(16), 8768.
- Zhang, B., Jin, X., Kuang, X., Shen, B., Qiu, D., Peng, J., Chen, E., Dai, X., Chen, X., & Wong, C. L. (2023). Effects of a Virtual Reality-Based Meditation Intervention on Anxiety and Depression Among Patients With Acute Leukemia During Induction Chemotherapy: A Randomized Controlled Trial. *Cancer nursing*, 10.1097/NCC.0000000000001206. Advance online publication.
- Zhang.X, Yao.S, Wang.M, Yin. X, Bi.Z, 2022. The Impact of VR-CALM Intervention Based on VR on Psychological Distress and Symptom Management in Breast Cancer Survivors. *Hindawi Journal of Oncology*.

