Jurnal Ners Volume 9 Nomor 3 Tahun 2025 Halaman 3505 - 3512
JURNAL NERS
Research & Learning in Nursing Science
http://journal.universitaspahlawan.ac.id/index.php/ners

THE EFFECTIVENESS OF DIGITAL VIRTUAL REALITY-BASED THERAPY IN REDUCING ANXIETY AMONG PATIENTS UNDERGOING GASTROINTESTINAL ENDOSCOPY

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Abstract

Psychological responses such as anxiety often arise from negative perceptions in situations perceived as threatening, even when they should not induce fear. These anxiety-induced responses can lead to increased hemodynamic parameters such as elevated blood pressure, heart rate, and respiratory rate—particularly prior to medical procedures. This study aimed to evaluate the effectiveness of a digital virtual reality (VR)-based therapeutic intervention in reducing patient anxiety before undergoing gastrointestinal endoscopy. A quasi-experimental design was employed, involving both an experimental group and a control group using a pretest-posttest control group approach. Anxiety levels were measured using the State-Trait Anxiety Inventory (STAI). The intervention consisted of a 6-minute immersive VR video featuring calming mountain and beach scenery. A total of 50 respondents participated, with 25 in each group. Data were analyzed using paired and independent t-tests. Results showed no statistically significant difference in mean anxiety scores between the intervention and control groups (MD = 0.23, df = 48, t = 0.59, 95% CI: -0.56 to 1.03, p > 0.001). These findings suggest that the digital VR-based therapy was not statistically effective in reducing pre-endoscopy anxiety. Future interventions may require more immersive and interactive VR experiences—such as 360-degree simulations of endoscopic procedures—to achieve more substantial effects.

Keywords: *Digital Virtual Reality Therapy; Anxiety; Endoscopy; Pre-procedural Stress, Immersive Technology*

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INTRODUCTION

Gastrointestinal diseases often require endoscopic examinations as part of the diagnostic and therapeutic process during patient care (Simadibrata, 2016). Many patients perceive colonoscopy as a painful and uncomfortable procedure, which can lead to moderate levels of worry or anxiety during the procedure (Xiaolian J, 2015). Endoscopic procedures demand thorough and careful preparation. Providing clear and comprehensive pre-procedural education is a key strategy in preparing patients. Inadequate or unclear information is one of the main factors contributing to patient anxiety. Therefore, the education provided must be tailored to the patient's condition—for instance, using simple, patient-friendly language while minimizing the use of medical jargon (Slamet, 2023).

Anxiety experienced by patients can lead to discomfort during the procedure and may hinder its completion. This psychological response is often triggered by perceived threats before the endoscopy. Such perceived threats—although not always based on the actual risk—may arise from patients' negative perceptions, leading them to view endoscopy as an undesirable procedure (Kim et al., 2023). Anxiety-related physiological responses may manifest as increased hemodynamic parameters such as elevated blood pressure, heart rate, and respiratory rate (Irawati, D., et al., 2023). Unstable hemodynamics often reflect heightened anxiety stemming from negative perceptions. Therefore, effective communication is essential to prevent misperceptions that may result in anxiety (Wiratmo et al., 2022).

Virtual Reality (VR) is increasingly being utilized in healthcare settings (Haowen J. et al., 2021). With technological advancements, VR applications have shown potential in reducing anxiety by engaging patients' cognitive processes (Karaveli Çakır S. et al., 2021). Nurses play a critical role in helping patients manage anxiety. Pre-procedural anxiety is common, with patients often expressing fear and unease regarding upcoming medical procedures. Considering the frequent occurrence of anxiety-induced hemodynamic changes, it is important to explore alternative interventions. The use of Virtual Reality in hospitals may serve as an effective method for reducing pre-procedural anxiety (Slamet, 2023).

METHOD

Design:

This study employed a quasi-experimental design with an experimental group and a control group, using a pretest-posttest control group approach.

Population, Sampling & Sample Size:

The population in this study were all patients who were planned for endoscopy by gastroenterohepatology doctors, and for sampling using simple random sampling, with a total of 50 respondents divided equally into two groups. Inclusion criteria were: all patients who were scheduled to undergo gastrointestinal endoscopy, without age restriction, had no visual or hearing impairment, and had signed informed consent to participate in this study.

***Instrument*:**

Demographic questionnaire was used to collect information on the respondents' characteristics, including gender, education level, marital status, and previous endoscopy experience. Anxiety levels were measured using the State-Trait Anxiety Inventory (STAI), which consists of 40 items rated on a 4-point Likert scale. The instrument includes 20 positively worded and 20 negatively worded statements to assess both state and trait anxiety (Spielberger, 1983)

Intervention Description:

The control group received standard education in accordance with the hospital's Standard Operating Procedures (SOP). This included verbal explanations about the upcoming procedure, the medical equipment to be used, the required patient positioning, and the premedication to be administered. This information was conveyed using booklets and posters prior to the procedure.

The intervention group received the same standard education as the control group, with the addition of virtual reality (VR) digital therapy. This therapy involved the use of a VR headset displaying immersive 360-degree videos of calming beach and mountain landscapes. Patients experienced the VR therapy while seated upright for 5–6 minutes in the preparation room, just before undergoing the endoscopy procedure.

Data Collection Procedure

Participants were selected based on predetermined inclusion criteria and subsequently assigned to either the control or intervention group. Upon

allocation, eligible participants were approached during their initial visit to the gastroenterohepatology outpatient clinic, where they were scheduled for an endoscopic procedure. At this time, written informed consent was obtained, signifying their voluntary participation in the study.

Following consent, baseline anxiety levels (pre-test) were assessed using the State-Trait Anxiety Inventory (STAI) for both groups.

The control group received standard education in accordance with the hospital's established protocols. This included verbal explanations covering the procedure's purpose, the planned steps, post-procedural monitoring, and visual aids in the form of posters that illustrated the gastrointestinal endoscopy process.

The intervention group received the same standard education as the control group, supplemented with a digital intervention using virtual reality (VR) therapy. This VR-based therapy involved exposure to immersive 360-degree videos depicting calming beach and mountain scenes via a VR device. The device was worn by the patient while seated in an upright position to promote relaxation.

Both groups received their respective interventions twice: first, during the initial outpatient consultation, and second, immediately prior to the endoscopic procedure in the preparation room.

A follow-up anxiety assessment (post-test) using the STAI was conducted on the day of the endoscopy, following the completion of the second intervention.

***Ethical Consideration*:**

This study received ethical approval from the Ethics Committee of the Faculty of Nursing, Universitas Muhammadiyah Jakarta, with approval number: 1493/F.9-UMJ/X/2024, dated October 11, 2024.

Data Analysis:

Data analysis was conducted using paired sample t-tests to assess within-group changes and independent sample t-tests to compare the mean differences between the intervention and control groups. The analysis was performed using IBM SPSS Statistics version 20.

RESULT AND DISCUSSION

The majority of respondents in this study were female (56%, n=28). A large proportion of participants had attained higher education, accounting for 74% (n=37) of the sample. Regarding marital status, most participants were married (84%, n=42). When asked about prior experience with gastrointestinal endoscopy, most participants had never undergone the procedure, with only 8 respondents (12%) reporting previous experience. Chi-square analysis revealed no significant differences between the control and intervention groups in terms of gender ($\chi^2 = 0.776$, $p = 0.388$), educational level ($\chi^2 = 1.000$, $p = 0.500$), marital status ($\chi^2 = 0.247$, $p = 0.123$), or prior endoscopy experience ($\chi^2 = 1.000$, $p = 0.649$), suggesting that the two groups were comparable in baseline characteristics (see Table 1).

Table 2 shows that respondents' anxiety scores ranged from a minimum of 37.50 to a maximum of 79.61. The mean anxiety score in the control group was 51.60 (± 11.253), while the intervention group had a slightly higher mean score of 55.71 (± 8.145). Regarding age, respondents ranged from 16 to 82 years. The average age in the control group was 47.04 years (± 12.272), while the mean age in the intervention group was 49.20 years (± 16.988) (see Table 2).

Anxiety Scores Before and After Intervention

In the intervention group, anxiety scores decreased from 55.71 to 54.08 after the first intervention. This reduction indicates a decrease in anxiety levels according to the STAI instrument. However, after the second intervention, the mean anxiety score increased from 54.08 to 56.32, suggesting a rise in anxiety among the respondents. These results indicate that digital virtual reality-based therapy did not effectively reduce anxiety in the respondents.

Paired T-Test Results for Pre-test and Post-test Anxiety Scores

Table 3 presents statistical analysis using the paired T-test for pre-test and post-test anxiety scores in both the control and intervention groups. In the intervention group, the mean anxiety score decreased by 1.63 after the first intervention and by 0.60 after the second intervention, both showing statistically significant differences ($p = 0.000$). In the control group, the mean anxiety score decreased by 1.65 after the first intervention, also yielding a significant result ($p = 0.000$). However, there was no significant difference between the control and intervention groups, indicating that both groups experienced similar changes in anxiety scores.

T-Test Analysis of Pre-test and Post-test Anxiety Scores

Table 4 provides the T-test analysis for pre-test and post-test anxiety scores in both groups. The average scores between the control and intervention groups were nearly identical. There was no significant change in anxiety levels between the two groups (MD = 0.23, df = 48, t = 0.59, 95% CI -0.56; 1.03, p > 0.001), further confirming the absence of meaningful differences in anxiety reduction between the two groups.

Table 1. Demographic and Respondents Characteristics of Respondents

Characteristics	Group		Total n(%)	X^2 Chi Square	p-value
	Control n(%)	Intervention n(%)			
Gender					
Male	10(45,5)	12(54,5)	22(44)	0,776	0,388
Female	15(53,6)	13(46,4)	28(56)		
Marital Status					
Married	23(54,8)	19(45,2)	42(84)	0,247	0,123
Single	2(25,0)	6(75,0)	8(12)		
Education					
Senior High School dan College	18(48,6)	19(51,4)	37(74)	1,000	0,500
Elementary and Junior High School	7(53,8)	6(46,2)	13(26)		
Work Status					
Work	21(52,5)	19(47,5)	40(80)	0,725	0,363
Don't Work	4(40,0)	6(60,0)	10(20)		
Previous Endoscopy Experience					
Ever	4(50)	4(50)	8(12)	1,000	0,649
Never	21(50)	21(50)	42(84)		

Table 2. Distribution of Respondent Characteristics Based on Anxiety Scores and Age by Group (Control n = 25 and Intervention n = 25)

Treatment group characteristics		n	mean	min-max	SD	t	p-value
Anxiety	Control	25	51,60	37,50-79,61	11,253	-1,478	0,015
	Intervention	25	55,71	39,47-72,37	8,145		
Age	Control	25	47,04	25-74	12,272	-0,509	0,613
	Intervention	25	49,20	16-82	16,988		

Figure 1. Mean Anxiety Scores Before and After Digital Virtual Reality-Based Therapy Intervention in Each Group.

Table 3. Statistical Analysis of Paired T-Test for Pre-test and Post-test Anxiety Scores in the Control and Intervention Groups for Digital Virtual Reality-Based Therapy

Group	Treatment group	*N*	*Mean (±S)*	*95% CI (lower;upper)*	*Selisih Mean (±SD)*	*df*	*t*	*p-value*
Control	T0	25	51,61 (11,25)	1,49 ; 1,81	1,65 (±0,38)	24	21,50	0,000
	T1		49,95 (11,02)					
	T0		51,61 (11,25)	-0,78 ; 0,04	-0,36 (±1,00)	24	-1,83	0,080
	T2		51,97 (10,57)					
	T1		49,95 (11,02)	-2,40 ; -1,65	-2,02 (±0,18)	24	-11,14	0,000
	T2		51,97 (10,57)					
Intervention	T0	25	55,71 (8,15)	1,45 ; 1,80	1,63 (±0,42)	24	18,98	0,000
	T1		54,08 (8,03)					
	T0		55,71 (8,15)	-1,31 ; 0,10	-0,60 (±1,71)	24	-1,76	0,091
	T2		56,32 (7,08)					
	T1		54,08 (8,03)	-2,92 ; -1,55	-2,23 (±1,65)	24	-6,75	0,000
	T2		56,32 (7,08)					

Table 4. Statistical Analysis of T-Test for Pre-test and Post-test Anxiety Scores in the Control and Intervention Groups for Digital Virtual Reality-Based Therapy.

Treatment group	Group	*N*	*Mean (±S)*	*Mean Difference*	*df*	*t*	*95% CI (lower;upper)*	*p-value*
T0-T1	Control	48	1,65 (0,38)	0,02	48	0,22	-0,20 ; 0,25	0,821
	Intervention	48	1,63 (0,42)					
T0-T2	Control	48	-0,36 (1,00)	0,23	48	0,59	-0,56 ; 1,03	0,555
	Intervention	48	-0,60 (1,71)					
T1-T2	Control	48	-2,02 (0,90)	0,21	48	0,55	-0,54 ; 0,97	0,580
	Intervention	48	-2,23 (1,65)					

Discussion

Responden Characteristic

The analysis of respondent characteristics revealed that age did not significantly differ between the control and intervention groups. This is consistent with prior studies such as Wiratmo (2022), which found that respondents in the early to late adulthood stages generally experience moderate levels of anxiety. However, the study by Paniyadi et al. (2019) contradicts this, indicating that demographic factors such as age, marital status, gender, employment, education, living conditions, and family income do not significantly correlate with anxiety levels.

The higher prevalence of anxiety among women, as observed in this study, can be attributed to hormonal and gender-based differences. Women are more susceptible to psychological issues due to the complex interplay of biological and social determinants, including gender stereotypes, social roles, and inequalities (Vellyana et al., 2017; Hou et al., 2020). The association between gender and anxiety observed in this study aligns with the broader literature suggesting that women face higher psychological risks than men, partly due to these biological and sociocultural factors.

Regarding education, the results suggest that individuals with higher education levels experienced lower anxiety, which could be explained by a higher sense of control and knowledge about their health. In contrast, respondents with lower education levels experienced higher anxiety levels, which aligns with research indicating that lower education can lead to greater uncertainty and worry regarding medical procedures. The finding that education correlates with anxiety supports previous studies highlighting the role

of cognitive resources and knowledge in mitigating anxiety.

Employment status also plays a significant role in the anxiety levels of respondents. Employed individuals may perceive a higher sense of agency and financial security, reducing anxiety. In contrast, unemployed individuals may experience greater uncertainty and a sense of helplessness, which can contribute to heightened anxiety. This finding emphasizes the importance of psychological resources such as a sense of control and security in managing anxiety.

Anxiety Level

While the intervention of digital virtual reality (VR) therapy aimed to reduce anxiety, the results showed mixed outcomes. The initial decrease in anxiety following the first VR intervention followed by an increase after the second intervention suggests that while VR may have a temporary calming effect, its long-term efficacy is uncertain. This could be attributed to several factors, including the novelty of the VR technology, which may have initially captured the respondents' attention but later caused discomfort or apprehension, particularly for those unfamiliar with the technology (Mittal A, 2024).

The study's findings suggest that while VR has the potential to reduce anxiety, its effectiveness may be contingent on factors such as patient comfort, prior experience with technology, and the duration of the intervention. Previous research has demonstrated that patient response to innovative interventions can vary widely, and a one-size-fits-all approach may not always be effective (Yulianti, E, 2021). The use of VR as a tool for anxiety reduction in clinical settings warrants further investigation, particularly with a focus on optimizing user comfort and engagement with the technology.

Additionally, the increase in anxiety observed after the second VR intervention may be influenced by the short interval between the second session and the third, which took place on the day of the endoscopy. While the first intervention occurred at the time of scheduling—when the procedure still felt distant—the proximity of the second and especially the third session to the actual procedure may have heightened anticipatory anxiety. This highlights the importance of not only the content but also the timing of interventions, suggesting that anxiety management strategies should be carefully aligned with the patient's emotional trajectory and procedural timeline (Sulayman el Mathari, 2024).

Effectiveness of Digital-Based Virtual Reality Therapy on Anxiety

The comparison between the intervention and control groups revealed that both therapies (VR and routine care) resulted in some reduction in anxiety, but no significant difference was observed between the groups. This suggests that while both interventions provided some temporary relief, neither was more effective than the other in reducing anxiety. It also underscores the complexity of anxiety management, especially in patients undergoing medical procedures. Psychological interventions, including VR and routine care, may need to be combined with other strategies, such as pharmacological treatments or behavioral therapies, to produce more substantial and lasting effects (Slamet M, et.all. 2023).

One key consideration is the physiological mechanisms underlying VR's impact on anxiety. VR therapy is expected to influence brain activity by stimulating parasympathetic nervous responses and promoting the release of endorphins, which should theoretically reduce cortisol levels and alleviate anxiety. However, the lack of significant clinical improvement in this study raises questions about the extent to which VR can effectively activate these physiological processes in patients facing medical procedures such as endoscopy (Aldao A, et.all. 2014).

Another potential explanation for the lack of significant improvement in the intervention group is the type of VR experience provided. Music therapy, when incorporated into digital therapies, has shown more promising results in reducing anxiety compared to visual-audio combinations, as it allows for more direct and focused engagement with the patient (Xiaolian J, et.all, 2015). The respondents' discomfort with VR, coupled with their lack of familiarity with the technology, might have undermined the overall effectiveness of the intervention. This suggests that patient education and gradual acclimatization to the technology could be essential for enhancing its efficacy in future interventions (Maurice-Szamburski, 2017).

CONCLUSION

This study highlights the potential of digital VR therapy as an innovative tool for managing anxiety in patients undergoing endoscopic

procedures. However, the results suggest that its efficacy may be limited by factors such as patient comfort with the technology and the novelty of the intervention. Further research is needed to optimize VR interventions, taking into account patient preferences and technological familiarity, to better tailor anxiety-reducing therapies for medical procedures. Additionally, a multifaceted approach combining VR with other therapeutic modalities might be more effective in reducing anxiety and improving patient outcomes.

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