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VIRTUAL REALITY APP (SI-VIGUR) TO IMPROVE SLEEP QUALITY AMONG OLDER ADULTS IN NURSING HOMES

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ABSTRACT
Sleep disturbances are common among older adults, especially those residing in nursing homes, and can significantly affect their quality of life and overall well-being. Non-pharmacological interventions, such as guided imagery and virtual reality (VR), have shown promise in improving sleep quality by promoting relaxation and reducing cognitive arousal. The SI-VIGUR (Virtual Reality Guided Imagery) app combines VR technology with guided imagery to offer a therapeutic solution for improving sleep in older adults. This study aimed to evaluate the effectiveness of the SI-VIGUR VR app in improving sleep quality among older adults in nursing homes. This study aimed to evaluate the effectiveness of the Virtual Reality Guided Imagery (SI-VIGUR) application in improving sleep quality among older adults in nursing homes in Palembang City, South Sumatra, Indonesia, in 2024. Using a quasi-experimental design with pre- and post-tests, 80 participants aged 60 or older with sleep disturbances were selected. They received 15-minute SI-VIGUR sessions three times a week for 1 months. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). Participants in the experimental group showed a significant improvement in sleep quality, as evidenced by a decrease in their PSQI scores (from 14.20 ± 1.86 to 7.31 ± 2.81). The intervention group demonstrated a marked reduction in poor sleep quality, with a higher percentage of individuals reporting fair or good sleep quality after the intervention compared to before. These findings were statistically significant ($p = 0.0001$), confirming the effectiveness of the SI-VIGUR app. The SI-VIGUR VR app proved to be an effective non-pharmacological intervention for improving sleep quality among older adults in nursing homes. The results suggest that VR-guided imagery can significantly reduce sleep disturbances, offering a promising solution for enhancing the well-being of older adults in institutional settings.

Keywords: guided imagery; older adults; PSQI; sleep quality; virtual reality

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INTRODUCTION

The population of individuals aged 60 years and older is projected to increase rapidly from 2015 to 2050 worldwide (WHO, 2017), marking a significant achievement in improving life expectancy (Kemenkes, 2017). However, aging is associated with progressive degenerative changes in organ function, physiological processes, and mental health issues (neurological disorders). Over 20% of older adults experience mental health disorders, with 7% suffering from depression, 5% from dementia, and 3.8% from anxiety. The remaining individuals face sleep disorders and other mental health issues, with 50%–60% of older adults affected by sleep disturbances (WHO, 2021).

Sleep disorders, anxiety, and depression form a complex and intertwined cycle in older adults, often compounded by other chronic conditions. Sleep disturbances in older adults double the risk of developing mental health problems such as anxiety and depression, and vice versa. Therefore, addressing these issues requires a combination of pharmacological and non-pharmacological treatment strategies to prevent exacerbating one of the three problems

(Dzierzewski & Dautovich, 2018; Kumar et al., 2019). The prolonged use of pharmaceutical medications often has adverse side effects in the elderly (Skinner, 2017), making non-pharmacological interventions essential. Complementary and alternative therapies, which focus on the holistic nature of humans and integrate biopsychosocial and spiritual aspects, have gained attention. One such intervention is guided imagery therapy (Stuart, 2016).

Guided imagery relaxation techniques are a well-regarded stress management tool, which can be practiced independently, making it particularly suitable for older adults with physical limitations. It is easier than exercises or yoga and has no side effects compared to medical or herbal therapies (Scott, 2020). Guided imagery induces a sense of relaxation, peace, and mental calm, reducing psychological tension by evoking pleasant visualizations in the subconscious, which in turn reduces anxiety, depression, and sleep disorders (Aprilyawan & Wibowo, 2021; Mahanani, 2020). With advancements in technology, VR-based interventions have become increasingly popular for mental health and wellness applications. Researchers have developed a VR-guided imagery technology, patented under the name SI-VIGUR, which has shown to be effective for older adults. It allows individuals to experience guided imagery therapy in a virtual reality setting, significantly improving sleep quality among elderly individuals (Martini et al., 2023).

Currently, VR interventions are gaining popularity for mental health and wellness applications (Cinalioglu et al., 2023). According to Bouchard (2018), the use of VR meditation has demonstrated a reduction in anxiety (Bouchard et al., 2018). Moreover, VR approaches have also been found to decrease depression (Goyal et al., 2014). The virtual environment unintentionally provides distraction, effectively immersing users in a virtual world (Tarrant et al., 2018). VR meditation has the potential to offer multiple benefits for addressing depression in older adults, including stress reduction, anxiety management, alleviation of sleep disorders, and improvement in overall quality of life (Cinalioglu et al., 2023).

Traditionally, guided imagery is facilitated by professionals; however, with the SI-VIGUR app, older adults can independently practice guided imagery while still receiving professional guidance through the application (Martini et al., 2023). Specifically, the stress management approach that combines VR-based meditation practices has been proven effective in enhancing mental health and well-being (Goyal et al., 2014). Furthermore, recent studies on VR for sleep disorders highlight its growing efficacy in improving sleep quality in older adults. Research by (Chen et al., 2022), found that VR-based relaxation techniques significantly reduced sleep onset latency and improved sleep duration in older populations. Similarly, a study by Lee et al. (2018) showed that VR intervention effectively decreased sleep disturbances, leading to improved sleep quality and emotional well-being among elderly patients suffering from insomnia (Lee, 2018).

A user-centered design process identified specific needs related to sleep disturbances in nursing homes, leading to tailored technological solutions by Carey-Smith et al., (2013) by building prototypes developed through this process have shown promise in alleviating nocturnal anxiety, a common barrier to restful sleep (Carey-Smith et al., 2013). VR interventions have been shown to enhance mental health and well-being among older adults, which can, in turn, improve sleep quality, by promoting social interaction and physical activity, both of which are linked to better sleep outcomes (Peng et al., 2024). VR can fulfill psycho-spiritual needs, such as enhancing self-esteem and fostering a sense of community, which are crucial for emotional well-being and can lead to improved sleep (Suchomelová et

al., 2023). The aim of this study is to evaluate the effectiveness of the Virtual Reality App (SI-VIGUR) in improving sleep quality among older adults residing in nursing homes.

METHOD

The study aimed to construct and test the effect of the Virtual Reality Guided Imagery (SI-VIGUR) Application on the improvement of sleep quality for older adults in nursing homes in Palembang City, South Sumatra, Indonesia, 2024. This study employs a quasi-experimental research design with a pre and post-test control group. Conducted in August 2024, this study targeted a population of 80 older adults with sleep disturbances in a nursing home in Palembang City. The purposive sampling technique was used, with inclusion criteria: 1) residing in the nursing home, 2) aged 60 years or older, 3) willing to participate, 4) experiencing sleep disturbances by PSQI score up to 11, and 5) able to attend the full duration of the study. The sample size consisted of 80 respondents. The participants received guided imagery therapy using the SI-VIGUR application three times a week in 1 mounth, each session lasting 15 minutes. Sleep quality was measured before and after the intervention using the Pittsburgh Sleep Quality Index (PSQI). The Pittsburgh Sleep Quality Index (PSQI) in Bahasa by (Made et al., 2021) was used to measure sleep quality. This questionnaire is widely validated with a Cronbach's alpha 0.742, assessing various dimensions of sleep quality such as duration, disturbances, and overall sleep satisfaction. The analysis of the data was performed univariately to describe each variable. A dependent T-test was conducted to achieve bivariate analysis pre and post-test, a logistic regression test with 95% confidence level.

RESULT

Table 1.
Respondents Characteristics (n=80)

Characteristics	f	%
Sex		
Male	24	70%
Female	56	30%
Age		
60 – 70	52	65%
71 – 80	17	21.25%
> 89	11	13.75%
Length of Stay		
< 6 Months	27	33.75
6 – 1 Year Old	29	36.25
> 1 Year Old	24	30

Table 1 shows the sociodemographic characteristics of respondents. Eighty respondents, older adults from Nursing Home, contributed to this study. Most of the respondents are female (70%), Age 60-70 years old (65%), and most length of stay 6- 1 Year Old (36.25%).

Table 2.
The Depression Level By Catagories And Sex Of Respondents Before Intervention

(Psqi) Scoring Categories	f	%	Sex	
			Male	Female
Poor Sleep Quality	62	77.50	21	41
Very Poor Sleep Quality	18	22.50	3	15

Table 2 presents the depression levels of respondents before the intervention, categorized by severity (high, mild, and low) and broken down by sex. Before the intervention, 25% of participants were classified as having high depression, with a higher proportion of females (40%) compared to males (16%). The mild depression category included 56.25% of respondents, with a slightly higher

percentage of females (54.54%) compared to males (29%). Lastly, 18.75% of respondents were classified as having low depression, with more females (27.27%) than males (11%) in this category.

Table 3.
The Depression Level By Catagories And Sex Of Respondents After Intervention

(PSQI) scoring categories	Number	Percentage (%)	SEX	
			MALE	FEMALE
Good Sleep Quality	21	26.25	10	32
Fair Sleep Quality	42	52.5	7	15
Poor Sleep Quality	12	15	6	5
Very Poor Sleep Quality	5	6.25	1	4

Table 3 shows the depression levels after the intervention. The number of respondents in the high depression category dropped significantly to 6.25%, with only 9.09% of females and 9% of males still falling into this category. The mild depression category decreased to 31.25%, with a relatively balanced distribution between males (28%) and females (27.27%). The most notable change is in the low depression category, which increased to 62.5%, with a higher percentage of both males (60%) and females (63.63%) now in this category. This suggests a significant improvement in depression levels after the intervention.

Table 4.
Total PSQI Score Before and After Giving Therapies

Variable	Before	After	Difference	t	p*
	M ± SD	M ± SD	M ± SD		
GDS	14.20 ± 2.77	7.31 ± 4.06	3.68 ± 1.70	8.68	.0001

*Paired t-Test *

Table 4 presents the results of a paired t-test comparing the PSQI scores before and after the intervention. The table shows the following data; Before the intervention, the mean PSQI score was 14.20 with a standard deviation (SD) of 1.86, indicating poor sleep quality. After the intervention, the mean PSQI score decreased to 7.31 with a standard deviation of 2.81, reflecting a significant improvement in sleep quality. The difference in scores between before and after the intervention was 6.88 with a standard deviation of 1.84. The t-value of 33.32 and the p-value of 0.0001 (p-value < 0.05) indicate a statistically significant difference, confirming that the intervention had a meaningful impact on improving sleep quality among the participants. This result suggests that the intervention effectively reduced sleep disturbances in the older adult population.

DISCUSSION

Table 2 presents the PSQI score of respondents before the intervention, categorized by sleep quality and broken down by sex. Prior to the intervention, 77.5% of participants reported poor sleep quality, with a significantly higher number of females (56%) compared to males (24%). Additionally, 22.5% of respondents reported very poor sleep quality, with more males (15%) than females (5%) in this category. This distribution aligns with studies that show sleep disturbances are prevalent among older adults, with a higher rate of sleep problems among females (Ancoli-Israel et al., 2015). These results suggest that most respondents had poor sleep quality before the intervention, with a greater proportion of females affected by these disturbances.

Table 3 shows the sleep quality of respondents after the intervention. Following the intervention, 26.25% of respondents reported good sleep quality, with a higher percentage of females (32%) than males (10%) in this category. A larger portion, 52.5%, reported fair sleep quality, with a relatively balanced distribution between males (28%) and females (27.27%). Meanwhile, only 6.25% of respondents reported very poor sleep quality, a significant decrease from the pre-intervention period, with only a small percentage of females (4%) and

males (1%) in this category. These results suggest a substantial improvement in sleep quality after the intervention, consistent with findings from studies on the effectiveness of guided imagery and virtual reality-based interventions for improving sleep quality in older adults (Martini et al., 2023; Chen et al., 2022).

Table 4 provides the results of a paired t-test comparing the PSQI scores before and after the intervention. Before the intervention, the mean GDS score was 14.20 ± 2.77, indicating high levels of depression among participants. After the intervention, the mean GDS score decreased significantly to 7.31 ± 4.06, reflecting a notable reduction in depression. The difference between pre- and post-intervention GDS scores was 3.68 ± 1.70, with a t-value of 8.68 and a p-value of 0.0001, indicating a statistically significant reduction in depression. This result is in line with previous research showing that non-pharmacological interventions, such as guided imagery and virtual reality therapies, significantly reduce depression in older adults (Dzierzewski & Dautovich, 2018; Goyal et al., 2014).

Immersive experiences provided through virtual reality (VR) can significantly enhance relaxation by allowing users to engage with serene landscapes or guided meditations. These calming environments promote relaxation by reducing cognitive arousal, which is a common barrier to sleep onset (De Zambotti et al., 2020). By immersing users in peaceful virtual settings, VR helps quiet the mind, making it easier to transition into sleep. In addition to mental relaxation, VR experiences have been shown to promote physiological regulation, such as lowering heart rates, which are crucial for sleep initiation (Chitra & Eremita, 2023). This physiological response further supports the body's natural processes of winding down. Furthermore, the app may integrate elements of Cognitive Behavioral Therapy for Insomnia (CBT-I), equipping users with effective strategies to manage their thoughts and behaviors around sleep. Techniques from CBT-I, such as cognitive restructuring and stimulus control, help users address negative sleep patterns and develop healthier sleep habits, leading to improved sleep quality (Mousavi & Samadi, 2024).

Several previous studies have also identified various types of Virtual Reality (VR) that can be effective in reducing anxiety in patients before surgical procedures. Fully immersive VR, where patients are immersed in calming virtual environments such as natural landscapes, has been shown to divert patients' attention and reduce anxiety levels (Ariyanti et al., 2020). The use of VR plays a crucial role in creating a more comfortable and secure experience during medical procedures (Karujan et al., 2023). VR technology provides a calming experience, distracts attention, and gives patients a sense of control addressing your rilex and joy (Cinalioglu et al., 2023). VR as a distraction method has proven effective in reducing anxiety, pain, and sleep problems (Yulianti et al., 2021). One of VR's advantages is its ability to serve as an effective distraction tool, transforming patients' perceptions of medical experiences into more positive ones (Durán Anrique & Mosqueda Díaz, 2021). This method not only provides an innovative alternative but can also be tailored to the individual needs and preferences of each child. In addition to VR, this innovative approach can be implemented through other technologies, such as educational cartoons, offering a broader range of options to minimize the health impact during frightening medical experiences and procedures (Ariyanti et al., 2020).

A study demonstrated that VR-based meditation significantly improved subjective sleep quality, sleep efficiency, and deep sleep quality among nursing students compared to traditional meditation and control groups. Participants reported lower stress levels and better autonomic nervous system balance, which are essential for facilitating restful sleep (Kim et

al., 2024). In a study Chitra & Eremita (2023), participants exhibited significant improvements in sleep quality as measured by the Pittsburgh Sleep Quality Index after engaging in VRT sessions. VRT has been shown to effectively address sleep deprivation by providing immersive experiences that help individuals relax and disengage from stressors (Chitra & Eremita, 2023). Advanced systems combining VR with machine learning and multimedia have been developed to classify sleep stages and enhance sleep quality through tailored audio-visual stimuli, these systems have demonstrated superior performance in improving sleep quality compared to traditional methods, indicating the potential of VR in sleep therapy. While VR shows great promise in improving sleep quality, it is essential to consider potential drawbacks, such as the need for further research on long-term effects and the accessibility of VR technology for broader populations (Huang et al., 2022).

Virtual reality (VR) as a promising tool for enhancing sleep quality through various innovative approaches. Research indicates that VR-based interventions can significantly improve sleep metrics by reducing stress and promoting relaxation, which are critical for achieving restorative sleep. The following sections outline the key mechanisms through which VR contributes to better sleep quality. Despite the potential benefits, there are several considerations for the effective use of VR for sleep improvement. Individual variability in response to VR suggests that personalized experiences may be more effective. Additionally, VR should complement traditional sleep hygiene practices, such as maintaining a regular sleep schedule and optimizing the sleep environment. While initial findings are encouraging, further research is needed to understand the long-term effects of VR interventions on sleep quality. Ultimately, the SI-VIGUR app offers a promising solution for improving sleep among older adults in nursing homes, with continued research essential to refining and validating its efficacy.

CONCLUSION

In conclusion, the study highlights the effectiveness of the SI-VIGUR virtual reality app in improving sleep quality and reducing depression among older adults in nursing homes. The results show significant improvements in both sleep and depression levels post-intervention, with reductions in PSQI and GDS scores. This aligns with existing research that underscores the potential of VR to reduce cognitive arousal, promote relaxation, and regulate physiological responses critical for sleep.

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