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Effectiveness of Virtual Reality on Fatigue and Life Quality in Geriatric Patients at Kasih Nursing Home Cirebon, Indonesia

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ABSTRACT

Background: Fatigue is a significant challenge for geriatric patients, often leading to vulnerability and a poor quality of life. Virtual reality can potentially serve as a therapeutic intervention for fatigue and quality of life by positively influencing geriatric patients' motor and cognitive functions.

Aims: To analyze the effectiveness of virtual reality training on fatigue and quality of life in geriatric patients at Kasih Nursing Home Cirebon, Indonesia.

Methods: The research type was a quasi-experimental design with a pre-test, post-test, and nonequivalent group design. Sampling utilized non-probability sampling techniques, specifically total sampling divided into two groups. The intervention group received five treatment sessions over five weeks, each session lasting 15 minutes and conducted on the same days apart. Data was collected using the Fatigue Severity Scale and the World Health Organization Quality of Life-BREF. Data analysis employed paired t-tests, independent t-tests, and N-Gain scores.

Results: The results of the paired t-test for the control group showed a non-significant difference in fatigue ($p = 0.363 > 0.05$). In contrast, the intervention group showed significant improvements in fatigue ($p < 0.001$) and quality of life ($p = 0.049$). The independent t-test revealed no significant differences between groups in pre-test scores. However, post-test scores showed significant differences between groups for fatigue ($p = 0.048$) and quality of life ($p = 0.004$). The N-Gain Score test indicated that the virtual reality motor cognitive intervention was effective in reducing fatigue (83.96%) but had a limited impact on quality of life (28.32%).

Conclusion: Virtual reality training is effective against fatigue, however, while there was a significant increase in quality of life after the virtual reality intervention; virtual reality was not significantly effective in improving the overall quality of life of geriatric patients.

Keywords: *Virtual reality, Fatigue, Quality of life, Geriatric patients.*
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1. Introduction

Elderly individuals are defined as individuals aged 60 years and older. Geriatric patients are elderly individuals with multiple diseases and/or disorders stemming from declining organ function, psychological, social, economic, and environmental factors. These individuals require integrated healthcare with a multidisciplinary approach that works interdisciplinarily (Kemenkes R.I., 2015).

According to the Badan Pusat Statistik (BPS), the percentage of the elderly population in Indonesia was 10.48% in 2022 (Direktorat Statistik Kesejahteraan Rakyat, 2022). In Cirebon City, there are 37,305 individuals aged 60 and older out of a total population of 341,235 (10.93%), and in Cirebon Regency, there are 214,078 individuals aged 60 and older out of a total population of 2,315,417 (9.24%) (Badan Pusat Statistika Kota Cirebon, 2023).

Geriatric patients often face challenges such as geriatric syndromes. Geriatric syndrome is a collection of symptoms commonly found in the elderly population. Additionally, geriatric patients are prone to experiencing frailty syndrome, a syndrome characterized by reduced functional capacity and adaptive function, which can be exacerbated by fatigue. The occurrence of fatigue and geriatric syndrome can significantly impact the quality of life (QoL) of geriatric patients (Kemenkes R.I., 2015).

With advancements in science and technology, various medical therapies now utilize assistive devices such as virtual reality (VR) technology. VR involves human interaction with a simulated environment created using computer technology, primarily employing computer graphics and artificial intelligence (Communications & Mittal, 2020). The application of VR in healthcare plays a crucial role in disease prevention and treatment. VR can be applied to various health domains, including physical and cognitive rehabilitation, surgical planning, and distraction therapy. The advantages of VR include its accessibility for home use via the internet, its ability to mitigate feelings of threat and discomfort, and its consistent, easily manipulated, and interactive nature (Communications & Mittal, 2020). A study conducted by Maulani ZN, et al., demonstrated that VR training can improve the quality of life of the elderly by enhancing cognitive and motor function (Maulani et al., 2021).

This research focused on the objective of examining the effectiveness of virtual reality on fatigue and quality of life in the elderly at Kasih Cirebon Nursing Home.

2. Methods

Study design/ Research procedures

This research was conducted at Kasih Nursing Home Cirebon for three months, from May to July 2024. A quasi-experimental study with a pre-test, post-test, unequivalent groups design was employed. Both pre-test and post-test measurements were conducted without blinding. The subject was selected using non-probability sampling, specifically total sampling. Twelve participants were included and divided into two groups: the intervention group and the control group. These participants met the inclusion criterion of willingness to participate in the study. Individuals with stroke, dementia, hearing impairment, or blindness were excluded.

Measurements

In this study, data was collected through pre-test and post-test questionnaires administered to geriatric patients at Kasih Nursing Home, Cirebon, before and after a virtual reality motor cognitive training intervention. The intervention group received five sessions of virtual reality training over five weeks, each session lasting 15 minutes and conducted on the same day of the week. The intervention involved virtual world commands such as picking up a ball, placing a ball in a basket, squeezing a ball, painting with the index finger, and pressing a button. The control group received a placebo intervention in the form of a 5-minute upper extremity motor exercise video.

The questionnaire was administered through interviews using the Fatigue Severity Scale (FSS) to assess fatigue and the World Health Organization Quality of Life-BREF (WHOQOL-BREF) to assess quality of life. The FSS consists of nine statements that describe the severity of fatigue symptoms. For the purpose of interpretation, the scores were categorized into two groups: those who had not experienced fatigue, with scores ranging from 9 to 31,

and those who had experienced fatigue, with scores ranging from 32 to 63. This questionnaire has been validated and tested for reliability and has also been adapted into the Indonesian language. (Butarbutar, 2014). For World Health Organization Quality of Life-BREF questionnaire consists of 26 questions covering 4 domains. The four domains are: physical health consists of seven questions, psychological six questions, social relationships three questions, environment eight questions and also the World Health Organization Quality of Life-BREF assesses overall quality of life and general health. For the interpretation of the WHOQOL-BREF, it was divided into 2 categories: good quality of life (65-130) and poor quality of life (26-64). This questionnaire has been validated and tested for reliability and has also been adapted into the Indonesian language (Ch Salim et al., 2007).

Statistical techniques

This study used univariate and bivariate analyses. Univariate analysis was conducted to observe the frequency distribution of the independent variable (virtual reality) and the dependent variables (fatigue and quality of life). Bivariate analysis was conducted to determine the effectiveness of the independent variable (virtual reality) on the dependent variables (fatigue and quality of life). The data was analyzed using parametric statistical tests due to the operational definition of both the independent and dependent variables being numerical data. Computer software was used for the analysis. The statistical tests used were the paired t-test, independent samples t-test, and N-Gain Score.

Ethical Clearance

This research was conducted by the research procedure, following the approval of the research permit which was obtained after passing the thesis proposal examination and ethical review by the Faculty of Medicine, Universitas Swadaya Gunung Jati Ethics Committee, with the number 39/EC/FKUGJ/V/2024.

3. Results

The result data was obtained through a pre-test before the intervention and a post-test after the intervention using a Fatigue Severity Scale and World Health Organization Quality of Life-BREF questionnaire that had been adapted into the Indonesian version.

Univariate analysis

Table 1 shows that the majority of respondents were ≤ 75 years old (58.3%). When viewed by gender, the majority of respondents were male, with 11 people (91.7%). The subject was divided into two groups: the intervention group, consisting of 6 respondents who received virtual reality training, and the control group, consisting of 6 respondents who did not receive virtual reality training.

Table 1. Frequency Distribution of Respondent Characteristics

	Frequency (n)	Percentage (%)
Age		
≤75 years old	7	58.3
>75 years old	5	41.7
Gender		
Male	11	91.7
Female	1	8.3
Group		
Intervention	6	50.0
Control	6	50.0

Based on Table 2, the control group's pre-test fatigue score exhibited a mean of 33.50, a standard deviation of 16.754, a median of 29.50, a minimum of 15, and a maximum of 59. Post-test scores showed a slight decrease, with a mean of 33.33, a standard deviation of 16.860, a median of 29.00, a minimum of 15, and a maximum of 59.

Table 2. Total Questionnaire Score

	Variable	n	$\bar{x} \pm SD$	*Me (Min-Max)*
Control Group	Pre-Test Score of Fatigue	6	33.50±16.75	29.50(15-59)
	Post-Test Score of Fatigue	6	33.33±16.86	29.00(15-59)
	Pre-Test Score of Life Quality	6	79.83±6.43	78.00(72-89)
	Post-Test Score of Life Quality	6	80.00±6.42	78.50(72-89)
Intervention Group	Pre-Test Score of Fatigue	6	50.83±10.12	53.00(34-59)
	Post-Test Score of Fatigue	6	16.33±7.47	15.50(9-27)
	Pre-Test Score of Life Quality	6	78.50±15.90	80.50(49-95)
	Post-Test Score of Life Quality	6	93.50±8.59	95.00(80-101)

In contrast, the intervention group's pre-test fatigue score averaged 50.83, with a standard deviation of 10.128, a median of 53.00, a minimum of 34, and a maximum of 59. Post-test scores indicated a substantial reduction, with a mean of 16.33, a standard deviation of 7.474, a median of 15.50, a minimum of 9, and a maximum of 27. Regarding life quality, the control group's pre-test score averaged 79.83, with a standard deviation of 6.432, a median of 78.00, a minimum of 72, and a maximum of 89. Post-test scores showed a slight improvement, with a mean of 80.00, a standard deviation of 6.419, a median of 78.50, a minimum of 72, and a maximum of 89. Conversely, the intervention group's pre-test life quality score averaged 78.50, with a standard deviation of 15.897, a median of 80.50, a minimum of 49, and a maximum of 95. Post-test scores revealed a significant increase, with a mean of 93.50, a standard deviation of 8.597, a median of 95.00, a minimum of 80, and a maximum of 101.

Table 3 indicates that, among geriatric patients at Kasih Cirebon Nursing Home, both pre-and post-intervention, fatigue incidence was divided into two categories: 3 patients (50%) did not experience fatigue, while 3 patients (50%) did. Conversely, before the intervention, 100% of the intervention group reported experiencing fatigue. However, post-intervention, none of the respondents in this group reported fatigue. Furthermore, regarding the life quality assessment of geriatric patients at Kasih Cirebon Nursing Home, both before and after the intervention, the results indicated that all participants in the control group reported a high level of life quality (100%). In contrast, before the intervention, the intervention group comprised 5 individuals (83.3%) with good life quality and 1 individual (17.7%) with poor life quality. Following the intervention, all participants in the intervention group reported good life quality.

Table 3. Frequency Distribution of Categorized Fatigue and Life Quality

Category	Control Group				Intervention Group			
	Pre-test		Post-test		Pre-test		Post-test	
	n	%	n	%	n	%	n	%
Not Experiencing Fatigue (9-31)	3	50.0	0	0.0	6	100.0	6	100.0
Experiencing Fatigue (31-63)	3	50.0	6	100.0	0	0.0	0	0.0
Good Life Quality (65-130)	6	100.0	6	100.0	5	83.3	6	100.0
Poor Life Quality (26-64)	0	0.0	0	0.0	1	17.7	0	0.0

Bivariate analysis

For the bivariate analysis, the researcher employed a paired t-test to compare pre-and post-test scores within each group, an independent t-test to compare pre-and post-test scores between the control and intervention groups, and calculated the effect size using the N-Gain score to assess the efficacy of virtual reality in reducing fatigue and improving the quality of life in geriatric patients.

Paired T-Test

Based on Table 4, the mean pre-test fatigue score for the control group was 33.50, while the mean post-test fatigue score was 33.33. This indicates a slight decrease in perceived fatigue in the control group from the pre-test to the post-test. Additionally, Table 4 shows that the mean pre-test quality of life score for the control group was 79.83, and the mean post-test quality of life score was 80.00. This suggests a minimal change in perceived quality of life in the control group at the post-test. Furthermore, a highly significant difference ($p < 0.001$) was observed between the pre-test and post-test scores, suggesting a strong relationship between the two. The significance value for both pre-test and post-test was 0.363, which is ≥0.05. This indicates that there was no significant difference between the pre-test and post-test scores in the control group.

Table 4. Paired T-Test for Control Group

	Mean	N	Std. Deviation	Correlation	Sig.	Sig. (2-tailed)
Pre-test fatigue	33.50	6	16.75			
Post-test fatigue	33.33	6	16.86			
Pre-test life quality	79.83	6	6.43			
Post-test life quality	80.00	6	6.42			
Pre-test & Post-test fatigue	0.16	6	0.40	1.000	<0.001	0.363
Pre-test & Post-test life quality	-0.16	6	0.40	0.998	<0.001	0.363

Table 5 reveals that the mean pre-test fatigue score for the intervention group was 50.83, while the mean post-test fatigue score was 16.33. This indicates a significant decrease in fatigue occurrence in the intervention group from the pre-test to the post-test. Additionally, Table 5 shows that the mean pre-test life quality score for the intervention group was 78.50, and the mean post-test quality of life score was 93.50. This suggests a significant improvement in perceived life quality in the intervention group at the post-test. The results presented in Table 5 also indicate that there was no statistically significant relationship between the pre-test and post-test scores for both fatigue and life quality. However, the paired t-test results show that there was a significant difference between the pre-test and post-test scores for both fatigue ($p < 0.001$) and life quality ($p = 0.049$) after the virtual reality training intervention.

Table 5. Paired T-Test for Intervention Group

	Mean	N	Std. Deviation	Correlation	Sig.	Sig. (2-tailed)
Pre-test fatigue	50.83	6	10.12			
Post-test fatigue	16.33	6	7.47			
Pre-test life quality	78.50	6	15.89			
Post-test life quality	93.50	6	8.59			
Pre-test & Post-test fatigue	34.50	6	8.78	0.537	0.272	<0.001
Pre-test & Post-test life quality	-15.00	6	14.15	0.462	<0.357	0.049

Independent T-Test

Table 6's show the Levene's Test for Equality of Variances yielded a significance value greater than or equal to 0.05. This indicates homogeneity of variances between the control and intervention groups. Given this homogeneity, an independent samples t-test assuming equal variances was employed. The significance value (Sig. (2-tailed)) for the fatigue variable was 0.055 for the pre-test and 0.048 for the post-test. For the quality of life variable, the significance values were 0.853 for the pre-test and 0.004 for the post-test. These findings suggest no

significant difference (≥0.05) between the pre-test scores of the control and intervention groups. However, a significant difference (<0.05) was observed between the post-test scores of the two groups.

Table 6. Independent T-Test Result

	Levene's Test for Equality of Variances	T–test for Equality of Means
	F	**Sig.**	**Sig. (2 tailed)**
Pre-test *Fatigue*	1.57	0.238	0.055
Post-test *Fatigue*	3.73	0.082	0.048
Pre-test Life Quality	1.21	0.296	0.853
Post-test Life Quality	0.62	0.448	0.004

N-Gain Score Test

The Normalized Gain (N-Gain) Score was used in this study to assess the effectiveness of virtual reality motor cognitive training on fatigue and quality of life in geriatric patients.

The criteria for determining the level of effectiveness are as follows (Sukarelawan et al., 2024):

1) < 40% = Ineffective
2) 40 – 50% = Less Effective
3) 56 – 75% = Moderately Effective
4) 76% = Effective

Table 7. N-Gain Score

No.	*Fatigue*		Life Quality	
	Control	**Intervention**	**Control**	**Intervention**
	***N-Gain Score* (%)**	***N-Gain Score* (%)**	***N-Gain Score* (%)**	***N-Gain Score* (%)**
1.	0	100	2	42
2.	0	100	0	27
3.	0	74	0	51
4.	6	64	0	17
5.	0	92	0	17
6.	0	74	0	16
Mean	1.04	83.96	0.33	28.32
Minimum	0	64	0	16
Maximum	6	100	2	51

Based on the results of the N-Gain Score test in Table 7, it was found that the virtual reality motor cognitive intervention was effective in reducing fatigue, with an average N-Gain score of 83.96% in the intervention group. However, it was ineffective in improving quality of life, as the intervention group had an average N-Gain score of 28.32%.

4. Discussion

Fatigue profile in geriatric patients

The research results from the pre-test on fatigue incidents in the control group showed a mean score of 33.50, while the intervention group showed a mean score of 50.83. Furthermore, in the control group, 3 respondents were categorized as suffering from fatigue, and 3 respondents were categorized as not suffering from fatigue. For the intervention group, 6 respondents were categorized as suffering from fatigue. This indicates that 9 out of 12 geriatric patients suffered from fatigue. Therefore, it can be concluded that the majority of geriatric patients at Kasih Nursing Home Cirebon suffer from fatigue.

Geriatric patients are more likely to experience fatigue compared to younger individuals. This can occur due to various changes in geriatric patients that affect their physical strength, causing it to weaken. Furthermore, limitations in physical activity also lead to geriatric patients experiencing fatigue more easily due to a lack of physical function training. Sleep disturbances also contribute to fatigue in geriatric patients, ultimately resulting in

insufficient rest (Ismahmudi & Fakhrurizal, 2020).

However, based on the results of the post-test on fatigue incidents, both the control group and the intervention group experienced a change with a decrease in the mean score. The post-test mean score in the control group was 33.33, indicating a change in the post-test mean score. However, in the bivariate analysis using the paired t-test, a significance value of 0.363 or ≥0.05 was obtained, meaning that the pre-test and post-test values for the control group did not have a significant difference. For the intervention group, there was also a decrease, especially after receiving virtual reality motor cognitive training. The average post-test score in the intervention group was 16.33, with a significance value in the paired t-test of <0.001 or <0.05, meaning that the pre-test and post-test values for the intervention group had a significant difference. Therefore, it can be concluded that both the control and the intervention group experienced a decrease in post-test scores, but the difference in pre-test and post-test scores in the intervention group was more significant compared to the control group.

The results of this study are in line with the research conducted by Al-Sharman, et al. (2019), which stated that the provision of virtual reality intervention affected the occurrence of fatigue ($p < .001$) (Al-Sharman et al., 2019). This can be interpreted as virtual reality intervention having a positive impact on addressing fatigue.

Life quality profile in geriatric patients

The results of the pre-test on quality of life in the control group showed a mean score of 79.83, while the intervention group showed a mean score of 78.50. Subsequently, all respondents in the control group had a good quality of life, while in the intervention group, there was 1 respondent who had a poor quality of life. This means that 11 out of 12 geriatric patients had a good quality of life. Therefore, it can be concluded that the majority of geriatric patients at Kasih Nursing Home Cirebon have a good quality of life.

The quality of life of geriatric patients is susceptible to decline due to various factors that influence quality of life, such as physical well-being, psychological health, social relationships, and environmental aspects. However, in this study, the majority of geriatric patients at Kasih Nursing Home Cirebon have a good quality of life. Based on the results of the post-test on quality of life, both the control and intervention groups experienced a change with an increase in the mean score. The post-test mean score in the control group was 80.00. However, in the bivariate analysis using the paired t-test, a significance value of 0.363 or ≥0.05 was obtained, meaning that the pre-test and post-test values for the control group did not have a significant difference.

For the intervention group, there was also an increase, especially after receiving virtual reality motor cognitive training. The average post-test score in the intervention group was 93.50, with a significance value in the paired t-test of 0.049 or <0.05, meaning that the pre-test and post-test values for the intervention group had a significant difference. Therefore, it can be concluded that both the control and intervention groups experienced an increase in post-test scores, but the difference in pre-test and post-test scores in the intervention group was more significant compared to the control group (Kemenkes R.I., 2015; Rohmah et al., 2012).

The results of this study are in line with the research conducted by Maulani ZN, et al. (2021), which stated that the application of virtual reality technology has a positive impact on the elderly with cognitive and motor impairments, thus improving the life quality of the elderly. This means that virtual reality can improve the life quality of the elderly (Maulani et al., 2021).

The effectiveness of virtual reality motor cognitive training

Based on the results of the paired t-test comparative analysis, it was found that both the control and intervention groups had differences in the mean scores between the pre-test and post-test for both variables. In the control group, the mean score for pre-test fatigue events was 33.50 and decreased to 33.33 at the post-test, similarly for the mean quality of life score where the pre-test mean score was 79.83 and increased at the post-test with a mean score of 80.00. Although there were changes in the scores, no changes were found in the frequency distribution of categorization in the control group, where at pre-test 3 people experienced fatigue and at post-test, there were still 3 people who experienced fatigue. Meanwhile, for the quality of life variable, both at pre-test and post-test, all geriatric patients in the control group had a good life quality.

In the intervention group, a similar occurrence happened where there was a change in the mean scores between the pre-test and post-test. For the pre-test mean score for fatigue events, it was 50.83 and decreased to 16.33 at the post-test, similarly for the mean quality of life score where the pre-test mean score for the intervention group was 78.50 and the post-test mean score increased to 93.50. This change in the mean score was followed by a change in the frequency distribution of categorization where at pre-test 6 geriatric patients suffered from fatigue and at post-test 6 geriatric patients did not suffer from fatigue or no geriatric patients were found to suffer from fatigue. Similarly, for the quality of life variable, there was a change in the frequency distribution of categorization where at pre-test 1 geriatric patient had a poor quality of life and at post-test 6 geriatric patients had a good quality of life or no geriatric patients were found to have a poor quality of life. The change in values in the intervention group was more significant compared to the change in values in the control group.

On the independent samples t-test, the significance value (Sig. (2-tailed)) on the row "equal variances assumed" for the fatigue variable was 0.055 for the pre-test and 0.048 for the post-test. Then, for the quality of life variable, it was 0.853 for the pre-test and 0.004 for the post-test. It can be interpreted that there is no significant difference between the pre-test values of the control group and the intervention group. However, there is a significant difference between the post-test values of the control group and the intervention group.

The N-Gain Score test conducted showed that the virtual reality motor cognitive intervention was effective for fatigue, with an average of 83.96% in the intervention group, but not effective for quality of life, as the intervention group had an average of 28.32%.

These research findings align with the experimental study conducted by Al-Sharman et al. (2019), which found that five sessions of virtual reality game intervention can help improve fatigue events and provide health benefits (Al-Sharman et al., 2019). Furthermore, in the research by Ranukusuma CM and Herawati T (2023), it was confirmed that virtual reality intervention can significantly improve upper extremity motor skills through the repetition of movements in virtual reality exercises that stimulate motor function. Additionally, the presence of virtual reality technology attracts patients due to the variation in exercises. (Ranukusuma & Herawati, 2023). Therefore, it can be concluded that the more significant difference in the intervention group compared to the control group is due to the influence of the intervention itself, which is virtual reality.

However, this research does not align with the study conducted by Maulani ZN, et al. (2021) which stated that the application of virtual reality technology has a positive impact on the elderly with cognitive and motor impairments, thus improving the quality of life of the elderly (Maulani et al., 2021). This is because the results of this study reveal that the provision of virtual reality motor cognitive training intervention was ineffective on the quality of life of geriatric patients at the Kasih Cirebon Nursing Home. Several factors may have influenced this occurrence, such as differences in the cognitive level of geriatric patients, social relationships between geriatric patients, and psychological factors in geriatric patients (Rohmah et al., 2012).

This research supports the hypothesis that virtual reality motor cognitive training is effective in reducing fatigue, and there was a significant improvement in the group that received the intervention. However, the research results are inconsistent with the hypothesis regarding improving life quality, although a significant increase was found after the intervention.

Virtual reality offers advantages in the healthcare field, one of which is by improving motor function. Motor function itself is closely related to the occurrence of fatigue, where in this study, the change in the average value of the intervention group was more significant compared to the control group that did not receive the intervention. Thus, the change in fatigue that occurred was also caused by the improvement in motor function of geriatric patients. Virtual reality motor cognitive training intervention also focuses on improving cognitive function, which will train the understanding and analysis of geriatric patients. Improvements in both motor and cognitive functions indirectly affect changes in the life quality of geriatric patients. It can be concluded that the provision of virtual reality motor cognitive training intervention has an effective impact on the occurrence of fatigue but has no effective impact on the quality of life of geriatric patients at Kasih Cirebon Nursing Home.

Limitation

The findings of this study should be interpreted with caution due to several limitations. Firstly, the study included only 12 geriatric patients. Secondly, the research did not use randomization to reduce bias or confounding variables. Thirdly, the research participants were predominantly male, making the research data too homogeneous. Fourthly, there was a difference in the procedure time between the intervention given to the intervention group and the placebo intervention given to the control group. Fifthly, the research time coincided with academic activities, resulting in several days when the researcher was unable to conduct the research. Lastly, time constraints during the research were due to the researcher have to adhere to the rules of the nursing home.

5. Conclusion

Virtual reality was effective in significantly improving fatigue. However, while there was a significant increase in quality of life after the virtual reality intervention, virtual reality was not significantly effective in improving the overall quality of life of geriatric patients. For future researchers or those interested in expanding research in this area, it was recommended to conduct studies with a larger sample size, to use randomization to minimize research bias, to implement interventions and placebo interventions with equal procedure durations, to conduct studies with a more heterogeneous sample, and to conduct longitudinal studies to observe more significant changes..

Conflict of Interest

There is no conflict of interest. Nothing to disclosure.

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