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THE EFFECT OF BRAIN GYM ON SLEEP QUALITY AMONG ELDERLY RESIDENTS OF TRESNA WERDHA INA-KAKA SOCIAL WELFARE INSTITUTION IN AMBON, INDONESIA

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Abstract

Background: Sleep disorders are common among the elderly and can negatively affect physical and psychological well-being and quality of life. Brain gym is a non-pharmacological intervention that may promote relaxation, reduce stress, and improve sleep quality. **Purpose:** This study aimed to determine the effect of brain gym on sleep quality among elderly residents of the Ina Kaka Social Welfare Institution in Ambon. **Method:** This study employed a quasi-experimental one-group pre-test-post-test design. The sample consisted of 20 elderly residents selected through consecutive sampling based on predetermined inclusion criteria. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) before and after the intervention. Brain gym was conducted for four weeks, three times per week, with each session lasting 15–20 minutes. Data were analyzed using a paired t-test. **Results:** Before the intervention, 95.2% of respondents had poor sleep quality. Following the intervention, 85% of respondents demonstrated improved sleep quality. The paired t-test showed a significant difference in PSQI scores before and after the intervention ($p = 0.000$; $p < 0.05$). **Conclusion:** Brain gym significantly improved sleep quality among elderly residents of PSTW Ina Kaka Ambon. Brain gym may be incorporated into routine activities in elderly social care institutions as a simple, safe, and accessible non-pharmacological intervention to support sleep quality and overall well-being.

Keywords: brain gym, elderly, non-pharmacological intervention, sleep quality

Abstrak

Latar Belakang: *Gangguan tidur sering terjadi pada lansia dan dapat berdampak negatif terhadap kesejahteraan fisik maupun psikologis serta kualitas hidup. Brain Gym merupakan intervensi nonfarmakologis yang dapat meningkatkan relaksasi, mengurangi stres, dan memperbaiki kualitas tidur.* ***Tujuan:*** *Penelitian ini bertujuan untuk mengetahui pengaruh Brain gym terhadap kualitas tidur lansia penghuni Panti Sosial Ina Kaka di Ambon.* ***Metode:*** *Penelitian ini menggunakan desain kuasi-eksperimental dengan rancangan one-group pretest-posttest. Sampel terdiri dari 20 lansia yang dipilih melalui teknik consecutive sampling berdasarkan kriteria inklusi yang telah ditetapkan. Kualitas tidur dinilai menggunakan Pittsburgh Sleep Quality Index (PSQI) sebelum dan sesudah intervensi. Brain Gym dilakukan selama empat minggu, tiga kali seminggu, dengan durasi 15–20 menit per sesi. Data dianalisis menggunakan uji paired t-test.* ***Hasil:*** *Sebelum intervensi, 95,2% responden memiliki kualitas tidur yang buruk. Setelah intervensi, 85% responden menunjukkan peningkatan kualitas tidur. Uji paired t-test menunjukkan adanya perbedaan signifikan pada skor PSQI sebelum dan sesudah intervensi ($p = 0,000$; $p < 0,05$).* ***Kesimpulan:*** *Brain Gym secara signifikan meningkatkan kualitas tidur lansia penghuni PSTW Ina Kaka Ambon. Brain gym dapat diintegrasikan ke dalam kegiatan rutin di panti sosial lansia sebagai intervensi nonfarmakologis yang sederhana, aman, dan mudah diakses untuk mendukung kualitas tidur serta kesejahteraan secara menyeluruh.*

Kata Kunci: *senam otak, lansia, terapi non-farmakologis, kualitas tidur*

INTRODUCTION

Older adults are a category of individuals or groups considered vulnerable to various physiological and psychological changes that impact their overall quality of life.[1] Law No. 13 of 1998 defines older adults as individuals aged 60 years and above. Data from the Ministry of Health in 2022 indicates that older adults in Indonesia reached 11.0% of the total population of 273.88 million, with the largest category falling within the 60–64 age range at 37.48%, and this number is projected to continue increasing alongside rising life expectancy and declining fertility rates in Indonesia.[2] Additionally, data from the Central Statistics Agency (BPS) in 2022 recorded that the total number of older adults reached 21 million people, or about 7.7% of the total national population.[3]

As they age, older adults experience changes in their sleep patterns that differ from those of younger individuals and face various sleep disorders. Age is undoubtedly a major factor affecting sleep quality. The older a person gets, the shorter their sleep duration becomes.[4] Sleep quality issues are among the most common complaints among older adults, warranting special attention as they directly impact their health and quality of life.[5,6]

Indonesian Ministry of Health's Data and Information Center in 2017 indicates that 67% of older adults aged 65 and older in Indonesia experience sleep disorders that directly result in a decline in their sleep quality.[7] Additionally, sleep disorder issues. It can also affect the physical and mental health of older adults, as it has a significant impact on their overall quality of life. Zhao and Gooneratne note that older adults with insomnia experience a significant decline in quality of life and increased morbidity.[8] Chronic sleep disorders are also associated with an increased risk of degenerative diseases such as stroke, hypertension, and heart disease, as well as psychological disorders such as anxiety and depression.

In addressing this issue, various non-pharmacological approaches have been developed to treat sleep disorders in the elderly, such as cognitive behavioral therapy, relaxation techniques, yoga, and light physical activity. One intervention that has shown positive results is brain exercises. Brain exercises can be used as an effective method to help address sleep disorders experienced by the elderly, in addition to other interventions such as therapeutic touch, cognitive training, foot bath therapy, and aromatherapy.[9] These interventions are particularly suitable for implementation in nursing homes, as they are not only safe and easy to perform but also do not require special equipment and can be conducted in group settings.

A study by Chen et al. demonstrated the positive effects of brain exercises on sleep quality in older adults, as evidenced by increased sleep duration and reduced insomnia scores.[10] This is attributed to increased blood flow to the brain, improved body temperature regulation, and reduced levels of cortisol, the stress hormone. Similar findings from the study by Lee et al. indicate that brain exercises benefit the elderly by improving cognitive function and promoting physical relaxation, which contributes to better sleep quality.[11]

Additionally, other studies support this intervention, such as the one conducted by Lasmini et al. shows brain exercise interventions have been shown to improve cognitive function and reduce stress in the elderly. These conditions strongly support the attainment of quality sleep, as older adults who are more relaxed and have good cognitive function tend to fall asleep more easily. [12]

In 2025, preliminary data from the Tresna Werdha Ina-Kaka Ambon Social Care Home indicated that 9 out of 33 older adults experienced sleep disorders. In this context, the care home has conducted regular health checkups and collaborated with local community health centers and medical staff; however, there is currently no specialized program to address sleep disorders in older adults, and the issue is considered to receive insufficient attention, despite its significant impact on the health of older adults.[13] Therefore, given the limitations on the use of pharmacological therapy in the elderly due to the risk of side effects, there is a need for safe, practical, and beneficial non-pharmacological interventions, one of which is brain exercises.

Several studies have demonstrated that brain exercises are an effective non-pharmacological intervention for improving sleep quality and reducing anxiety in the elderly; however, most of these studies employed interventions of varying durations ranging from 2 weeks to 12 weeks with inconsistent results. In this context, a 2-week intervention duration has not shown a significant impact on sleep quality. On the other hand, longer-duration studies, such as those lasting 8 or 12 weeks, are considered more effective but often carry the risk of causing boredom and participant dropout, whereas interventions conducted consistently over 3–4 weeks are considered capable of producing significant changes in circadian rhythm, stress, and sleep quality; thus, a 4-week duration is deemed scientifically sound and measurable enough to have an impact on addressing these issues.

Previous studies have not specifically assessed the effectiveness of brain exercises alone with an intensive duration (3 times per week for 4 weeks, 15–20 minutes per session) on sleep quality. The selection of this duration also takes into account the condition of the elderly in social care facilities, who require an intervention that is sufficiently intensive yet still realistic to implement consistently. Therefore, this study is important to address this gap, while also contributing to structured, community-based non-pharmacological interventions that are easily implemented in institutional settings.

METHODS

This study was conducted from August to September 2025 at the Tresna Werdha Ina-Kaka Ambon Social Welfare Home, located in Passo Village, Teluk Ambon Baguala Subdistrict, Ambon City, Maluku Province. The study employed a quasi-experimental method using a one-group pre-test and post-test design, specifically an experiment conducted on a single (1) group to which a treatment consisting of brain exercises was administered consistently three (3) times per week for 15–20 minutes in the morning over a period of 4 weeks. [14,15]

The study used the final sample size of older adults from the PSTW Ina Kaka Ambon to be re-determined based on the results of the Pittsburgh Sleep Quality Index (PSQI) questionnaire to ensure that only respondents who met the inclusion criteria would be included in the intervention process. Study participants were selected based on established inclusion criteria, namely older adults aged ≥65 years, experiencing poor sleep quality, and willing to participate in the entire series of research activities and brain exercise interventions conducted at PSTW Ina-Kaka Ambon. Additionally, data distribution will be tested using a paired t-test to compare the two means of the same group at two different time points, namely before and after the brain exercise intervention for sleep disorders in the elderly.

This study has obtained ethical approval from the Research Ethics Committee of the Faculty of Medicine, Pattimura University, under Number 157/FK-KOM.ETIK/VIII/2025. All research procedures were conducted in accordance with the ethical principles of research involving human subjects, and each participant provided informed consent to participate after receiving an explanation of the study's objectives and procedures.

RESULTS

Respondent Characteristics

Table 1. Distribution of Respondents by Gender

Gender	Frequencies	%
Men	7	35
Women	13	65
Total	20	100

Table 1 shows the distribution of respondents by gender. The results indicate that of the 20 older adults who participated in the study, the majority were women, namely 13 individuals (65%), while men accounted for only 7 individuals (35%). This disparity in numbers is important to note as it may influence the study's findings. Older women and men naturally differ in terms of physical condition, lifestyle habits, and psychological issues, so the way they experience sleep disturbances or respond to brain exercises may vary.

Given the total sample size of 20 participants, the statistical analysis is more limited, and the results may be less robust compared to studies involving larger and more balanced samples. Therefore, the data is supported by a recent study titled "Sex differences in elderly people's sleep: a cross-sectional study," which involved 226 older adults aged 65 and older (69.5% women) and found that women reported poorer sleep quality more frequently than men. 16 Additionally, another longitudinal study, Sex differences in deterioration of sleep properties associated with aging, reported that the decline in sleep quality (sleep efficiency, duration, sleep latency) with advancing age is more pronounced in women, particularly during the perimenopausal period, compared to men ($P<0.001$).[1]

Table 2. Distribution of Respondents by Age

Table 2 shows the distribution of respondents by age. In this case, the majority of respondents were aged 69–75, totaling 13 people (65%), while only 2 people (10%) were aged 65–68 and 5 people (25%) were aged 76–83. This difference in numbers is significant because age greatly influences the physical condition and sleep patterns of older adults; for instance, older adults aged 69–75 generally still possess fairly good physical ability and cognitive function, so those in this age range are considered better able to follow brain exercise movements and experience the benefits of the intervention on sleep quality.

Based on the findings of Li et al., engaging in physical activity or exercise among the elderly has been shown to improve sleep quality significantly. Meanwhile, older adults who are much older, particularly those over 76 years of age, usually have more health complaints such as pain, muscle weakness, and balance disorders. These conditions can make it difficult for them to perform the exercises optimally and ultimately impact the resulting sleep quality. [18]

Proportion of Sleep Quality Outcomes Among the Elderly

Brain exercises were one of the independent variables used to assess sleep quality among the elderly at the Ina-Kaka Ambon Elderly Care Center in 2025. The results of the data collection are described as follows:

Age	Frequencies	%
≥65-68	2	10
69-75	13	65
76-83	5	25
Total	20	100

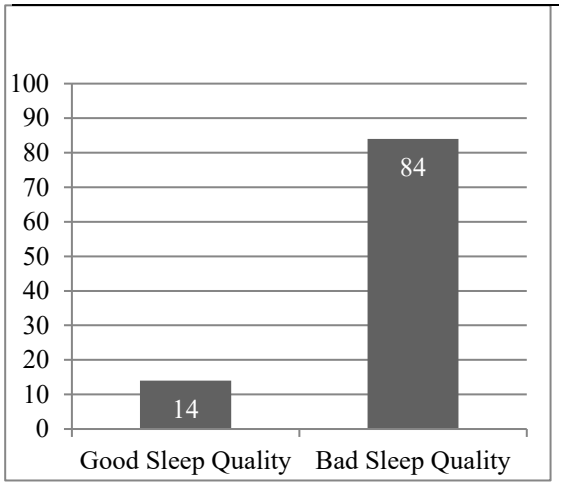

Figure 1. Proportion of Sleep Quality Outcomes Among Older Adults Before the Brain Exercise Intervention

Based on the results of a study of 25 respondents, it was found that 21 elderly respondents (84%) experienced sleep disturbances and had poor sleep quality, while 4 respondents (14%) had good sleep quality.

Figure 2. Proportion of Sleep Quality Outcomes Among Older Adults After the Brain Exercise Intervention

The study found that approximately 85% of older adults slept better after participating in a brain exercise program, which was found to help the body relax. Paiva and Prudente et al. noted that, physiologically, brain exercises increase blood flow to the brain, so that brain cells function more stably and are less likely to cause feelings of tension or anxiety.[19]

Rhythmic and coordinated movements are believed to help reduce the activity of the sympathetic nervous system—the system that is typically active when the body is under stress or anxiety. When the sympathetic system subsides, the body activates the parasympathetic system, which is responsible for calming the body. It is this activation of the parasympathetic system that stabilizes the heart rate, calms breathing, and relaxes the body's muscles, making it easier to fall asleep. Light physical activity, such as brain exercises, can increase the release of endorphins and neurotransmitters, such as GABA, which play a role in making the body feel comfortable and reducing anxiety. All these physiological changes help many older adults achieve a more restful sleep.[20]

However, about 15% of elderly respondents have poor sleep quality because their bodies have other factors that physiologically disrupt the sleep process. Unal et al. note that in some elderly individuals with chronic conditions, such as joint pain, hypertension, or diabetes, the body remains in a "state of alert," causing the sympathetic nervous system to remain more active than it should be. This condition makes it difficult for them to enter the relaxation phase even after doing brain exercises. Additionally, some older adults take medications that can disrupt sleep patterns, such as diuretics that cause frequent urination at night. Physiologically, older adults also experience a decrease in melatonin production—the hormone that regulates sleep timing—so their sleep rhythms are indeed more easily disrupted. These factors are what prevent some older adults from achieving optimal improvement even after participating in the same intervention.[21] In this context, based on the research results, 85% of the elderly responded well because their bodies were able to reduce physiological stress and enhance relaxation following the brain exercise, while the remaining 15% continued to experience disturbances due to stronger physiological conditions that are not easily resolved by a single type of intervention. These results indicate an improvement in sleep quality among the elderly when compared to their condition prior to the brain exercise intervention; specifically, in the pre-test phase, the majority of respondents were classified as having poor sleep quality. This improvement is consistent with the results of the paired t-test, which showed a significant difference ($p < 0.05$).

The Effect of Brain Exercises on Sleep Quality in Older Adults

Table 3. Normality Test of Sleep Quality Scores Before and After the Brain Exercise Intervention

Variable	*N*	*Shapiro–Wilk Statistic*	*p-value*	*Normality*
Pre-test PSQI	20	0.955	0.449	Normal
Post-test PSQI	20	0.892	0.029	Not Normal

Variable	*N*	*Shapiro–Wilk Statistic*	*p-value*	*Normality*
Difference (Pre–Post) PSQI	20	0.913	0.072	Normal

To determine the effect of brain exercises on sleep quality in the elderly based on the results of normality tests conducted before and after the brain exercise intervention on 20 respondents, it was found that the pre-test data (before the intervention) met the assumption of normality, whereas the post-test data (after the intervention) did not meet this assumption or were not normally distributed, as shown in Table 3. The pre-intervention PSQI score had a Shapiro-Wilk p-value of 0.449 ($p > 0.05$), the post-intervention PSQI score had a p-value of 0.029 ($p < 0.05$), and the pre-post PSQI score had a p-value of 0.072 ($p > 0.05$). These results indicate that the pre-test and difference data are normally distributed, whereas the post-test data are not normally distributed.

Thus, the analysis of pre-post differences can be conducted using the normally distributed difference data for a parametric test (paired t-test) to assess the difference in pre-post PSQI scores. The results of the data analysis using SPSS are presented in the following table:

Table 4. Paired t-test of Sleep Quality in Older Adults Before and After the Brain Exercise Intervention

	Mean Difference	95% CI	t	df	p-value
Pre-test - Post-test PSQI	6,90 ± 2,75	5,61-8,19	11,217	19	0,000

The results of the paired t-test analysis of 20 respondents showed that the mean pre-test PSQI score was 6.90 points higher than the post-test score (Mean Difference = 6.90; SD = 2.75), t-value (19) = 11.217 with $p = 0.000$ ($p < 0.05$). This indicates a statistically significant difference between sleep quality scores before and after the brain exercise intervention. Thus, the brain exercise intervention significantly reduced the PSQI score, which means it improved the sleep quality of the elderly residents at PSTW Ina Kaka Ambon.

DISSCUSION

Sleep Quality in Older Adults Before the Brain Exercise Intervention

This study was conducted at the Ina-Kaka Ambon Elderly Care Center on September 5, 2025. Before the intervention was administered, the researchers first selected the sample using consecutive sampling. Of the total 25 older adults who were initial respondents, only 20 met the inclusion criteria and were selected as the study sample. The respondents' sleep quality was then assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire, which was administered twice: before the intervention (pre-test) and after the intervention (post-test). Initial measurement results showed that 20 respondents (80%) fell into the poor sleep quality category, while 4 respondents (20%) had good sleep quality, and 1 respondent had returned to their family. Therefore, the researchers used only the 20 respondents who met the inclusion criteria as the sample for this study.

The PSQI questionnaire consists of 7 components: sleep quality, sleep latency, sleep duration, sleep efficiency,

disturbances during nighttime sleep, use of sleep medications, and disruption of daytime activities. A majority of respondents (3 respondents, 15%) experienced disturbances during nighttime sleep, and the majority (19 respondents, 95%) had never used sleep medications.

Based on the results of the pre-test conducted prior to the brain exercise intervention, it was found that the majority of respondents had an average sleep latency of approximately 30 minutes to about 1 hour, namely 15 respondents (75%). Sleep disturbances at night generally occurred due to waking up in the middle of the night, with 7 respondents (35%) citing the need to use the restroom as the cause. Additionally, 11 respondents (55%) reported that their sleep duration ranged from about 5–6 hours or even less than 5 hours, and 1 respondent admitted to using sleeping pills at night. Nevertheless, nearly all respondents did not use sleeping pills, so the sleep disturbances they experienced reflected natural physiological conditions without the influence of medication.

As they age, older adults experience physical, psychological, and spiritual changes in their bodies. One key factor in efforts to improve the health of older adults is maintaining their sleep quality. Sleep plays a role in restoring bodily functions to achieve optimal functional condition, while also supporting daytime alertness so that older adults can carry out activities and enjoy life well and comfortably. According to Sumedi et al., who note that in older adults, the effectiveness of nighttime sleep tends to decrease to approximately 70–80% compared to adulthood.[22]

Sleep disorders in older adults are actually consistent with physiological theories of aging, namely that sleep effectiveness decreases to about 70–80% due to changes in the nervous system, hormones, and circadian rhythms.[22] This explains why most participants in this study experienced poor sleep quality during the pre-test.

When the brain exercise intervention was administered over 4 weeks, the elderly participants' bodies began to respond to the physical and cognitive stimuli provided by the exercises. Brain exercises increase blood flow to the brain, improve tissue oxygenation, and reduce the activity of the parasympathetic nervous system, which keeps the body in a state of "alertness" and makes it difficult to sleep. Conversely, the parasympathetic nervous system becomes more dominant, causing muscles to relax, breathing to become more regular, and relaxation hormones such as serotonin, endorphins, and GABA to increase. This increase in neurotransmitters physiologically reduces mental tension and facilitates the sleep process, explaining why approximately 80% of participants experienced improved sleep quality following the intervention.

Physical activity can enhance the release of neurotransmitters in the brain. This activity increases levels of norepinephrine, dopamine, and serotonin, thereby reducing depression and promoting a sense of calm.[23] Additionally, exercise is believed to play a role in optimizing melatonin secretion and triggering the effects of beta-endorphins, both of which help meet the sleep needs of older adults.[24]

Sleep Quality in Older Adults Following Brain Exercise Intervention

The implementation of brain exercises over approximately 4 weeks showed that the majority of respondents achieved good sleep quality, namely 17 (85%) older adults, while 3 respondents (15%) reported poor sleep quality or no change following the intervention. This condition can be physiologically explained by the physical and cognitive stimulation provided by brain exercises. This exercise increases blood flow to the brain, improves tissue oxygenation, and reduces the activity of the sympathetic nervous system, which typically keeps the body tense and makes it difficult to sleep.[25] When the sympathetic nervous system is reduced and the parasympathetic system becomes more dominant, the body enters a state of relaxation, heart rate becomes more stable, muscles relax, and relaxation hormones—such as serotonin, endorphins, and GABA—increase.[26] This combination makes the body better prepared for sleep, helping to shorten sleep latency, reduce the frequency of awakenings in older adults, and increase sleep depth. This is what allows older adults to experience better sleep quality after participating in brain exercises. These findings demonstrate an increase in the number of older adults with good sleep quality and indicate that brain exercises are effective in helping to restore sleep needs in older adults.

In Borbely's theory of sleep homeostasis, regular brain exercises increase energy expenditure and trigger a greater accumulation of adenosine in the brain. Adenosine is a chemical that increases sleep pressure, or the body's urge to sleep. Increased sleep pressure leads to a greater tendency for the body to enter deep sleep.[26] Additionally, daily brain exercises performed at consistent times also act as a zeitgeber—a time signal that helps stabilize the circadian rhythm, as per Carskadon and Dement's sleep-wake cycle theory. A stabilized circadian rhythm makes it easier for the brain to distinguish between wakefulness and rest, resulting in more regular sleep.[27] Consequently, the majority of participants showed significant improvement following the intervention.

Nevertheless, 15% of older adults continued to experience poor sleep quality and showed no significant improvement following the intervention. This is quite common and can be explained by several physiological and clinical factors. In some older adults, the aging process leads to more severe biological changes, such as a drastic decrease in melatonin production, a reduction in deep sleep (N3), neuropathic disorders, or chronic pain in joints and muscles. These conditions cannot be fully resolved by light exercises like brain exercises. In addition, from a psychological perspective, anxiety, loneliness, or emotional stress can also hinder the relaxation mechanisms that should be achieved through brain exercises.

Based on the sleep-wake cycle theory, unstable emotional and metabolic factors can maintain activation of the parasympathetic nervous system at night, making it difficult for the brain to enter deep sleep even when stimulated by physical intervention. Additionally, the theory of sleep architecture in older adults

suggests that not all sleep disorders respond to moderate exercise; some require additional interventions such as pain management, psychological counseling, or mild pharmacological therapy. Thus, 15% of respondents who did not improve reflect the presence of strong biological and psychological factors compared to the effects of brain exercises.[27]

Based on the PSQI questionnaire, which assesses seven (7) components, namely sleep quality, sleep latency, sleep duration, nighttime sleep disturbances, use of sleep medications, and daytime activity disturbances, it was found that the majority of respondents experienced sleep latency, specifically 12 respondents (60%). Additionally, nearly all respondents (19 people; 95%) reported never using sleep medications.

The other group, consisting of 4 people (20%), reported experiencing disruptions to their daytime activities. The results of the post-test conducted by the researchers following the intervention indicated that the sleep quality of the elderly improved after the intervention. There was an improvement in the respondents' sleep quality, specifically regarding sleep latency: 9 respondents (45%) reported taking approximately 16–30 minutes to fall asleep, while 11 respondents (55.9%) required less than 15 minutes to fall asleep, indicating a significant improvement in sleep latency. The duration of nightly sleep also improved, with 13 respondents (65%) sleeping more than 7 hours, 3 respondents (15%) sleeping for 6–7 hours, and 4 respondents (20%) sleeping for 5–6 hours, and no respondents slept less than 5 hours. Meanwhile, one respondent who previously used sleeping pills continued to take them because they found it difficult to sleep without medication, even after participating in the brain exercises. The results of this study are not merely based on the researcher's theories and assumptions but are also supported by evidence from previous studies yielding results consistent with this research.

Heri's study explains that after receiving exercise intervention, the respondents showed improved sleep quality, with improvements in sleep latency of 60.75%, sleep duration of 86.3%, and sleep efficiency of 86.2%, as well as a reduction in sleep disturbances of 21.6%. Meanwhile, Sumedi et al. reported that after performing brain exercises, 11 respondents (68.75%) no longer experienced insomnia, 3 respondents (18.75%) experienced mild insomnia, and 2 respondents (12.5%) remained in the moderate insomnia category.22 This is consistent with research also conducted by Effendy et al., who studied the effects of brain exercises on sleep quality and anxiety in the elderly, and found that brain exercises significantly improved sleep quality and reduced anxiety after eight weeks of intervention.[14] These findings are consistent with early research in this field conducted by Spaulding et al., who suggested that brain training exercises have great potential to enhance learning processes and scientific understanding. Nighttime sleep itself is divided into two (2) main phases: non-rapid eye movement (non-REM) and rapid eye movement (REM).

Much of the body's recovery occurs during the non-REM phase, while REM sleep plays a crucial role in processing memories and ideas from daily activities. The sleep cycle repeats itself, progressing from stages one through four, then continuing into the REM phase before returning to the initial stages. Several neurotransmitters, such as dopamine and serotonin, also play a role in regulating this sleep process. [28] It is through this mechanism that brain exercises are believed to provide an additional contribution to improving sleep quality, as demonstrated by improvements in sleep latency, sleep duration, sleep efficiency, and reduced levels of insomnia in various previous studies.

The part of the brain responsible for regulating sleep is the hypothalamus, which functions as a control center to regulate various bodily functions, including the sleep-wake cycle. It contains orexin or hypocretin neurons nerve cells responsible for keeping the body awake by stimulating the arousal center and activating the sympathetic nervous system. When orexin is active, the brain remains in a state of alertness, making it difficult for the body to enter the sleep phase. Sleep itself is physiologically crucial because it is during this time that the brain enters a recovery mode. Brain electrical activity decreases; energy is used to repair damaged nerve cells, balance neurotransmitters, and reduce neural stress and inflammation. During deep sleep, particularly in the non-REM stage, the glymphatic system operates at maximum capacity. This system functions like a "cleaning machine" in the brain, where the spaces between cells widen so that cerebrospinal fluid (CSF) can flow more freely to carry out metabolic waste, including beta-amyloid proteins and other neurotoxic substances. This process helps prevent the buildup of toxins that, if left unchecked, can damage nerve cells and accelerate brain aging. When a person is sleep-deprived, the glymphatic system does not function optimally, causing metabolic waste to accumulate and increasing the risk of memory impairment and neurodegenerative diseases.

The researchers Tri and Atikah explain that brain exercises using the Edu-K method—or kinesis movement training—are performed through a series of specific movements that engage all parts of the brain. This exercise aims to renew movement patterns so that areas of the brain that were previously not functioning optimally or were inhibited can be reactivated. In this way, brain exercises can help restore neural flexibility and improve blood circulation in the body.[30]

Brain exercises are a form of physical activity designed for older adults, whether individually or in groups. This activity helps restore neural flexibility and improve blood flow. In older adults, these exercises stimulate a reduction in sympathetic nervous system activity and enhance parasympathetic nervous system function, leading to decreased levels of adrenaline, norepinephrine, and catecholamines. This process triggers the dilation of blood vessels (vasodilation), which optimizes oxygen distribution throughout the body, particularly to the brain. This condition ultimately enhances a sense of relaxation in the elderly.[24]

Taking these various explanations into account, overall, the results of this study align with existing theories that light physical activity and cognitive-based exercises can improve sleep quality in older adults through mechanisms such as relaxation, stabilization of the circadian rhythm, and increased sleep pressure. However, individual responses still vary because they are influenced by health conditions, emotional state, and the degree of physiological changes due to aging.

Differences in Sleep Quality Among the Elderly After Brain Exercise Intervention

A study on the effects of brain exercise on sleep quality conducted at the Ina-Kaka Ambon Elderly Care Center in 2025 over 4 weeks, with exercise sessions lasting approximately ±15 minutes in the morning three times a week, yielded interesting results.

Based on statistical analysis using a paired t-test, the data indicated that before the intervention, 4 elderly individuals (20%) out of 25 respondents had good sleep quality. However, in this study, the researchers used a sampling technique known as consecutive sampling, meaning that the sample had to be selected based on predetermined criteria. Consequently, 21 respondents met the inclusion criteria; however, one respondent dropped out during the intervention. After the brain exercise intervention, 17 older adults (85%) reported good sleep quality, while poor sleep quality post-intervention was noted in 3 older adults (15%). Meanwhile, the 20 elderly participants (100%) with poor sleep quality before the brain exercise—selected from the final sample defined by the researchers in this study—showed an improvement after the brain exercise intervention, with 17 elderly participants achieving good sleep quality, while 3 of them experienced no change in their sleep quality. Overall, sleep quality after brain exercises showed that 17 elderly participants (85%) were in the good category and 3 elderly participants (15%) remained in the poor category.

Furthermore, the results of the statistical test showed a p-value of 0.000 ($p < 0.05$), indicating a statistically significant difference in sleep quality among the elderly before and after the brain exercise intervention. Thus, the null hypothesis (Ho), which states that brain exercises do not affect the sleep quality of the elderly, is rejected, and the alternative hypothesis (Ha) is accepted, namely that brain exercises affect the sleep quality of the elderly at the PSTW Ina-Kaka Ambon in 2025.

This study aligns with the findings of a study conducted by Effendy et al. at the Karya Kasih Nursing Home in Medan, which supports the results of this study. Additionally, this study employed a pre-post test design with an eight-week brain exercise intervention and measured sleep quality using the Pittsburgh Sleep Quality Index (PSQI). Analysis results showed a decrease in PSQI scores from 16.39 ± 0.68 before the intervention to 8.99 ± 0.89 after the intervention ($p < 0.001$), indicating a significant difference.[14] Furthermore, research conducted by Dhokpatil et al. showed that brain exercises significantly

improved sleep quality in older adults with sleep disorders. In this quasi-experimental study, the intervention was administered over 4 weeks in 12 sessions, and the results of the analysis using the Wilcoxon Signed-Rank Test showed a decrease in PSQI scores from 8.47 ± 2.646 to 5.43 ± 2.403, with a p-value of <0.0001. These findings clearly demonstrate a highly significant improvement in sleep quality following the administration of brain exercises.[31]

Based on the results of the study, the researchers hypothesize that brain exercises are an effective non-pharmacological intervention for improving sleep quality in the elderly, consistent with the theory that regular physical activity can improve nervous system balance, enhance blood circulation, and stimulate the secretion of hormones that support sleep. These research findings are supported by the results of studies by Effendy et al. and Dhokpaktil et al., which both demonstrated a significant decrease in PSQI scores and an improvement in sleep quality among the elderly following brain exercise intervention. The consistency of these results reinforces the belief that adequate exercise duration and regular frequency can have a tangible impact on the sleep patterns of the elderly. Therefore, the researchers assume that the success of brain exercises in improving sleep quality depends heavily on the program's duration, the regularity of implementation, supportive health conditions, and an environment conducive to the sleep process of the elderly.

Limitations

This study has several limitations that should be considered when interpreting the findings. The intervention was conducted within a nursing home setting and required the involvement of several assistants to support the implementation process and ensure the safety, focus, and active participation of the elderly respondents throughout the study. In addition, the intervention schedule had to be adjusted to the readiness and willingness of participants, which may have affected the consistency of its implementation. The sample size was relatively small; although 33 elderly individuals met the inclusion criteria, only 21 respondents were successfully recruited, and one participant withdrew from the study after returning to live with their family, resulting in a final sample of 20 respondents. Furthermore, the absence of a control group and respondent randomization may have introduced selection bias, and therefore the causal relationship between the brain gym intervention and improvements in sleep quality should be interpreted with caution.

CONCLUSIONS

Brain gym exercises significantly improved sleep quality among older adults at the Ina-Kaka Ambon Nursing Care Center. After four weeks of intervention, 85% of participants achieved good sleep quality, with a significant improvement observed between pre- and post-intervention assessments (mean difference = 6.90; t = 11.217; p < 0.001). These findings support the use of brain gym as a simple and effective non-pharmacological intervention that may be incorporated into elderly health programs. Future studies should employ larger sample sizes, include control groups and randomization

procedures, and account for potential confounding factors to provide more robust evidence regarding the effectiveness of brain gym interventions.

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