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# Brain Gym Application and Brain Vitalization Exercises in Balinese Dance Movement Improves Cognitive Functions, Quality of Live and Decreasing BDNF Level in Elderly

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*life quality;*
*psychological health;*

**Abstract**

Decreased cognitive function often occurs in the elderly. Brain-Derived Neurotrophic Factor (BDNF) is one of the neurotrophins that plays in the maintenance of the function of a neuron and synaptic plasticity. This study aims to determine the effectiveness of the movements of the Balinese dance on cognitive function, quality of life, and BDNF levels in the elderly. This study used an experimental research design with Pretest Posttest One Group Design. The study sample was elderly, female, aged> 60 years with cognitive impairment in the Denpasar area. Subjects were given the treatment of the Balinese Dance movement 3 times a week, each session 11 minutes for 8 weeks. Before and after the treatment, subjects were taken for blood to measure BDNF levels, assessed cognitive scores with MoCa Ina, quality of life with WHOQOL BREF in the elderly. Statistical tests get an increase in cognitive scores and quality of life scores in psychological well-being domains, social relations domains, environmental domains, and decreasing in BDNF levels. This study shows that the application of Brain Gym and Brain Vitalization Exercises in the Balinese Dance movements have a positive impact on the handling of cognitive disorders in non-pharmacological treatment.



**Contents**



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## 1 Introduction

In almost five decades, the percentage of elderly Indonesians has doubled (1971-2017), which is 8.97 percent (23.4 million) where the elderly woman is about one percent more than the elderly (9.47 percent compared to 8.48 percent). Elderly people in Indonesia are dominated by the age group of 60-69 years (young elderly) whose percentage reaches 5.65 percent of the population of Indonesia and the rest is filled by the age group 70-79 years (middle-aged) and aged over 80 years ( elderly) (Martono & Pranarka, 2009)

The quality of life in the elderly often decreases along with the limitations possessed both physically and psychologically. This will have an impact on the family and the occurrence of swelling medical costs for the elderly. From the WHO data, it was found that the quality of life in poor elderly resulted in disabilities of around 11.9% and 16% resulting in increased medical costs for the elderly. The presence of cognitive impairments in the elderly affects the quality of life where there is a decline in all domains of quality of life including physical, psychological, social, and environmental relationships (Haris et al., 2014).

Increased age has the consequence of decreasing functions including cognitive function. In society, this decline in cognitive function is known as senility. In the medical world, it is called dementia. Aging is generally associated with the deterioration of the brain structure which causes a decrease in cognitive function including the speed of information processing, the ability to provide reason and memory (Chang et al., 2010; Keefe et al., 2005). Dementia is found in 10% of the age group above 65 years and 47% in the age group above 85 years. Reversible dementia is found in 10-20% of cases (Lumbantobing, 2020). In the world, there are 35 million elderly people experiencing dementia. In Indonesia, there are 606,100 people experiencing dementia (Haris et al., 2014; Greenwood & Winocur, 2005).

The prevalence of people with cognitive impairment is increasing every year, so promotive, preventive, curative, and rehabilitative measures need to be pursued for both those without problems and those who have problems. Two treatments can be done, the first is pharmacology and the second is non-pharmacological. Pharmacological treatments include treating diseases that aggravate and treat symptoms of mental disorders and behaviors in severe cognitive disorders. The concept of non-pharmacological treatment aims to improve and maintain self-confidence, motivation, mobility, social interaction, and fitness. Activities that have therapeutic effects include reality orientation, cognitive stimulation, sensory stimulation, and physical stimulation in the form of brain movement and exercise (Hernanta, 2013).

Several specific neurotropic pathways play an important role in improving cognitive function. These pathways include the Brain-Derived Neurotrophic Factor (BDNF), Vascular Endothelial Growth Factor (VEGF), and Irisin (a myokin). In this study, one pathway will be observed, namely the pathway that involves the role of the Brain-Derived Neurotrophic Factor (BDNF). Brain-Derived Neurotrophic Factor (BDNF) plays an important role in cognitive processes, affecting the development and activity of brain structures. Predominantly in the hippocampus and prefrontal cortex, by modulating neurotransmissions, affecting the plasticity and proliferation of neurons through regulation of migration processes such as differentiation, perseveration, neuron modification, and replacement of synapses (Notaras et al., 2015).

The vitalization exercise of the brain is a harmonization of motion, breathing, and the center of thought (memory, imagination). The Brain Gym movement application uses the term lateral dimension for the left-right brain hemisphere, focusing dimensions for the back of the brain (brainstem) and the front of the brain (frontal lobes), and concentration dimensions for the limbic and cerebral system (Dennison & Dennison, 2008).

The Balinese dance movements that match the movements in the brain and brain gym vitalization exercises such as Ngegol (moving the hips), right agem (basic attitude of Balinese dance), and several other

movements, are slow and slow movements, from the bottom up and repeatedly. Mekilid, stretchy hands and several other movements are full joint movements (Astuti, 2000).

Cognitive disorders that occur in the elderly are influenced by various factors, such as age, education, marital status, employment status, genetic status, and disease processes. Diseases that play a role are brain trauma, physical illness, mental disorders, metabolic diseases, cardiovascular disease, and drugs (Antunes et al., 2006). The cause of cognitive impairment is multifactorial. The theories that are widely adopted are neuroplasticity, degeneration, stress, aging processes, and others. all of which can influence regulation of specific factors such as Nerve Growth Factor (NGF), Brain-Derived Neurotrophic Factor (BDNF), Vascular Endothelial Growth Factor (VEGF), or Irisin, a myokin. The imbalance in the levels of the above factors including BDNF causes a disruption in neurogenesis, synaptic neurotransmission, and neuroplasticity which results in neurodegenerative diseases such as cognitive disorders. Increased cognitive abilities will affect the improvement of quality of life such as physical, psychological, social, and environmental relations (Notaras et al., 2015; Bourassa et al., 2016). Brain Gym and Brain Vitalization Exercises are non-pharmacological interventions that contribute to brain health and protect and fight the aging process (Dennison & Dennison, 2008; Cotman & Berchtold, 2002).

In the last decade, several non-pharmacological interventions such as brain gym, brain vitalization exercises, and neurobic exercise have been developed, examined, and analyzed for their effectiveness in treating cognitive disorders in the elderly. No one has examined the relationship between brain gym applications and brain vitalization exercises in Balinese dance movements with BDNF levels, increased cognitive function, and quality of life in the elderly in Bali. The importance of non-pharmacological treatment in elderly people with cognitive impairment is a consideration for research. Based on the data above, this research needs to be done. In this study, a Balinese dance was created which represented the characteristics of the brain gym aspect and brain vitalization exercises (Kusumajaya, 2021; Carchi et al., 2021). Brain gym applications and brain vitalization exercises in Balinese dance movements are danced by the elderly who experience cognitive function disorders, and their effects on BDNF levels, cognitive function, and quality of life of the elderly are analyzed. In this study, a new dance was created containing the basic movements of Balinese Dance which symbolized the application of Brain Gym and Brain Vitalization Exercises where this dance will be used as a treatment for a group of elderly people with cognitive impairment (Bressler & Bahl, 2003; Hajjar et al., 2007).

Risk factors that influence the cognitive and quality of life of the elderly include individual characteristics such as age, gender, race, education, marital status, employment, and other factors such as genetics, trauma, aging, adaptation, family history, physical illness, drugs, psychoactive substances, nutrition, obesity, and psychosocial factors, as well as physical disability.

Based on the description of the background, the problem statement can be made as follows: Does the application of Brain Gym and Brain Vitalization Exercises in the Balinese Dance movement improve cognitive function in the elderly? Does the application of Brain Gym and Brain Vitalization Exercises in the Balinese Dance movement improve the quality of life in the elderly? Can the Brain Gym and Brain Vitalization Exercises in the Balinese Dance movement increase BDNF levels in the elderly?

## 2 Materials and Methods

This study was an experimental study with Pre-test & Post-test Group Design. The place of research was conducted in the Bumi Santhi Banjar Hall Jl. Bawean Island Denpasar. The research was conducted from December 2018-February 2019. The target population in this study was all elderly with cognitive impairment in Bali.

*Sampling and participant*

The affordable population of this study was the elderly with cognitive impairment in Denpasar. Samples are affordable populations that meet inclusion and exclusion criteria by consecutive sampling. Inclusion criteria are women, age> 60 years, having to experience cognitive impairment, and willing to cooperate in following a research program. Exclusion criteria are having neuromuscular disorders (balance and or coordination and or

walking style), having severe physical illness and mental disorder, and a history of head trauma. Of the two calculations, the sample size taken is the largest, which is 36 samples. To prevent sample shortages due to fall, the number of samples was added to 40 samples.

*Procedure and analysis*

The independent variable in this study is the Brain Gym Application and Brain Vitalization Exercises in the Balinese Dance Movement. Variables depending on this study are cognitive scores, quality of life scores, and BDNF levels. Control variables in this study were age, sex, ethnicity, education status, marital status, and employment status. We collect data with interviews and laboratory tests (using the ELISA method to obtain BDNF levels). The questionnaire used was the characteristic questionnaire, the Elderly Health Examination Form, MoCA Ina, and WHOQOL-BREF (Inoue et al., 2009; Ladwig et al., 2001).

The creation of Balinese dance movements was carried out by researchers in collaboration with dance creators, Balinese dance artists and also based on input from physiologists. Balinese dance movements are selected. Movements that have Brain Gym elements are collected and then selected again to be arranged systematically, given intensity, duration, and frequency. The Brain Gym and Brain Vitalization Exercises in the Balinese Dance Movement are set to take 11 minutes, performed by the subject 3 times a week for 8 weeks. This Balinese dance movement is carried out according to the rules of brain vitalization training, which are slow, from the bottom up, repeatedly, involving eyesight, full joint movement, involving breathing, and being experienced. Balinese dance movements that have Brain Gym and Brain Vitalization Exercises are tested on 10 elderly women within 11 minutes in Preliminary Research conducted by researchers. This research was conducted at the Wana Sraya Nursing Home in September 2018. Based on an increase in post-workout pulse rate of 60-80% of the maximum pulse rate, it was concluded that the dance was safe for the elderly (Silakarma, 2018).

The series of Balinese dance movements that contain Brain Gym and Brain Vitalization Exercises are then used as a treatment for 40 subjects of elderly women in the actual research. First, introductions were made to prospective subjects, providing information about the purpose and objectives of the study. The next step is to examine prospective subjects with MoCa Ina to see whether there is cognitive impairment. Prospective subjects who meet the inclusion and exclusion criteria then are given informed consent to be signed as approval as the subject of the study. In the sample group that has fulfilled the requirements, the introduction of Brain Gym and Brain Vitalization Exercise in the motion of Balinese Dance is given in the form of 2 weeks of exercise.

The subjects were taken blood to measure BDNF levels and calculated cognitive scores with MoCa Ina and quality of life scores with WHOQOL-BREF before intervention. The measurement of cognitive function in this study used the Montreal Cognitive Assessment (MoCA-Ina) which functions to determine cognitive impairment. The maximum value is 30. If the last total value of 26 or more is considered normal.[9] Measurement of the BDNF level of the subject in this study is the measurement of serum levels taken from the subject's blood using the ELISA method. Quality of life is measured using a measuring device developed by WHO namely WHOQOL - BREF. This tool is in the form of a questionnaire containing 26 questions from each dimension of quality of life.

Descriptive statistical tests were used to analyze data about characteristics obtained from research results such as age, education status, marital status, and employment status. Gender and ethnicity are controlled by design by excluding men, only using female subjects. Test the normality of the data with Saphiro Wilk Test, $p > 0.05$ said the data is normally distributed. Conversely, $p < 0.05$ data is not normally distributed. Analytical test data that is normally distributed, conducted a Dependent t-test to compare pre and post-test between groups. The magnitude of the change in the dependent variable before and after treatment is expressed in the difference in mean values before and after treatment. Data that is not normally distributed is performed in a non-parametric paired analysis (Wilcoxon test). ANCOVA is used as a multivariate analysis to control potential confounding variables that influence the dependent variable. The significance level is used p-value <0.05 with sample precision to the population using 95% confidence interval value.

## 3 Results and Discussions

*3.1 Results*

The results of screening with the Moca Ina score were obtained by 40 elderly people who had a Moca Ina score <26. After that interviews were conducted in terms of characteristics and quality of life and blood sampling to see BDNF levels before intervention. The sample size was taken by 40 people, exceeding a sample of at least 36, to anticipate a dropout due to failure to take consecutive training. Of the 40 people sampled, 2 people dropped out because 3 consecutive times could not come for various reasons, so the number of samples used and analyzed was 38 people.

Table 1
Subject characteristic

| Variable | n=38 |
|---|---|
| Age (year), mean + SD | 68,3+4,3 |
| 60-74 year | 36 (94,7) |
| 75-90 year | 2 (5,3) |
| Education | |
| Elementary school | 3 (7,9) |
| Junior high school | 11 (28,9) |
| Senior high school | 14 (36,8) |
| University | 10 (26,3) |
| Marital status | |
| Married | 32 (84,2) |
| Divorced | 6 (15,8) |
| Job | |
| Housewife | 23 (60,5) |
| Pension | 12 (31,6) |
| Teacher | 1 (2,6) |
| Entrepreneur | 2 (5,3) |

Data on the subject characteristics of 38 people were all female and Balinese (100%). Subject education consisted of 3 people completing elementary school or not graduating from junior high school (7.9%), 11 people graduating from junior high school (28.9%) and 14 people graduating from high school (36.8%), and 10 people graduating from university (26.3% ) Marital status includes 32 married people (84.2%) and 6 divorced people (15.8%). The work of the elderly includes 23 housewives (60.5%), 12 people retired (31.6%), 1 teacher (2.6%), and 2 entrepreneurs (5.3%).

Table 2
Elderly BDNF levels before and after treatment

| Variable | Before Median (minimum-maximum) | After Median (minimum-maximum) | Z value | P value |
|---|---|---|---|---|
| BDNF Level (ng/ml) | 0,8750 (0,05-9,47) | 0,3600 (0,14 – 42,60) | -2,141 | 0,032* |

*significant p<0,05

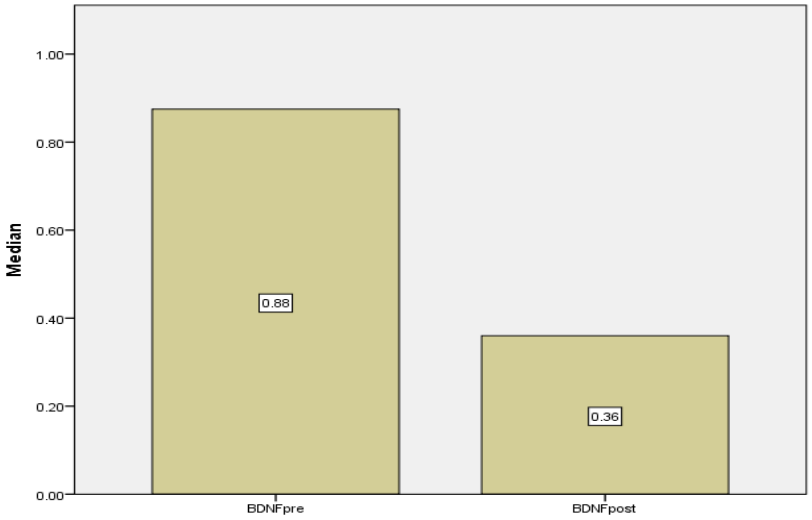


Figure 1. Comparison of BDNF levels before and after treatment

The results of the Wilcoxon test found a significant change in the decrease in BDNF levels p <0.001. This result is contrary to the hypothesis, which is expected to increase BDNF levels after exercise. ANCOVA is used as an analysis to control potential confounding variables such as age, education status, marital status, and employment status, which also influence the dependent variable. The following are the ANCOVA test results:

Table 3
Effect of brain gym application and brain vitalization exercises in the Balinese dance movement against DNF levels after controlled by age, education, marital status, and employment

| Variable | Koef B | 95% CI | p |
|---|---|---|---|
| Balinese dance movement | -0,825 | -3,345-1,695 | 0,516 |
| Age | -0,014 | -0,346-0,319 | 0,935 |
| Education | 0,850 | -0,663-2,362 | 0,267 |
| Marital status | -0,799 | -4,632-3,304 | 0,679 |
| Employment | -0,788 | -2,405-0,830 | 0,335 |

There was no significant relationship (Koef B: -0,825;95% CI: -3,345-1,695; p: 0,516) between the Balinese Dance Movement and BDNF levels afterbeing controlled by age, education, marital status, and employment.

Table 4
Comparison of Moca Ina results before and after treatment

| Variable | Before Median (minimum-maximum) | After Median (minimum-maximum) | Z value | P value |
|---|---|---|---|---|
| Moca Ina Score | 21 (4-29) | 26 (6-29) | -4,351 | <0,001* |

*significant

The Moca Ina score before and after treatment there was an increase in the median score with a significant result where p <0.001.

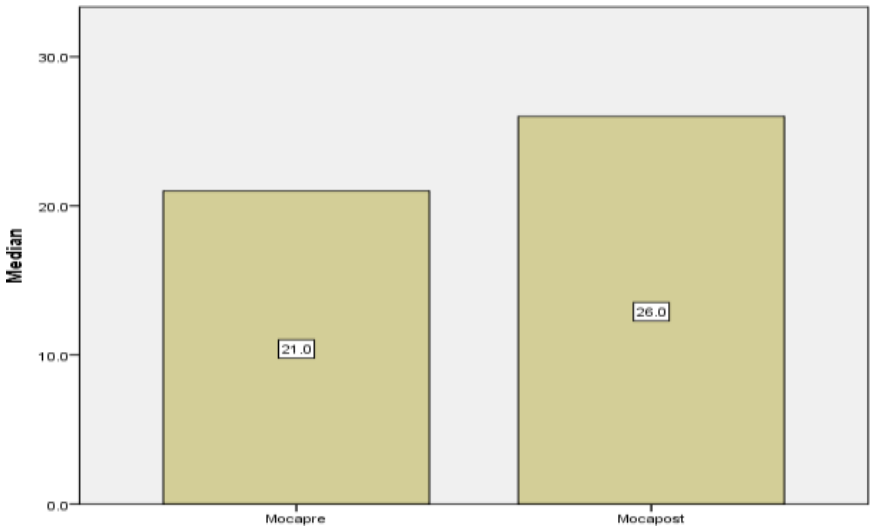


Figure 2. Comparison of Moca Ina scores before and aftertreatment

Table 5
Effect of brain gym application and brain vitalization exercises in Balinese dance motion on Moca Ina level after controlled by age variables, education, marriage, and employment status

| Variable | Koef B | 95% CI | p |
|---|---|---|---|
| Balinese dance | -4,000 | -5,888-(-2,112) | <0,001* |
| Age | -0,032 | -0,281-0,217 | 0,800 |
| Education | 2,255 | 1,121-3,389 | <0,001* |
| Marital status | -0,660 | -3,533-2,213 | 0,648 |
| Employment | 1,135 | -0,077-2,348 | 0,066 |

* Significant

There is a significant relationship (Koef B: -4,000; 95% CI: -5,888 - (-2,112); p: <0,001) between Brain Gym and Brain Vitalization Exercises in the Balinese Dance Movement against MoCa Ina after being controlled by age, education, status marriage and work. Besides thateducation has a significant relationship (Coefficient B: 2,255; 95% CI: 1,121-3,389; p value <0,001).

Table 6
Quality of life examination results before and after treatment

| Quality of Life Domain | Before Median (minimum-maximum) | After Median (minimum-maximum) | Z value | P value |
|---|---|---|---|---|
| Physical Health Domain (7 item) | 56 (38-88) | 56 (44-75) | -0,891 | 0,373 |
| Psychologic Domain (6 item) | 50 (25-69) | 63 (44-82) | -5,669 | <0,001* |
| Social Domain (3 item) | 50 (25-81) | 69 (56-100) | -5,100 | <0,001* |
| Environment Domain (7 item) | 50 (31-81) | 69 (44-94) | -5,172 | <0,001* |

* Significant

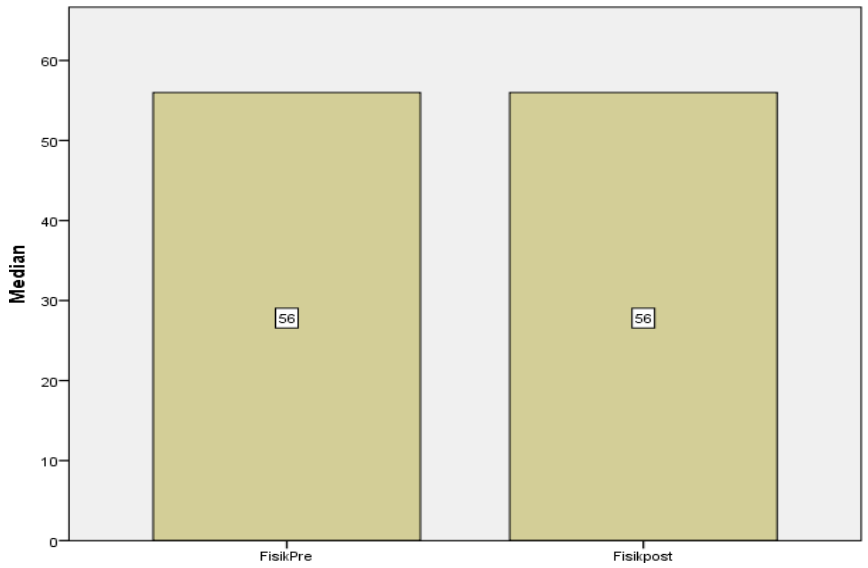


Figure 3. Comparison quality of life scores according to the physical domain, before and after treatment

Table 7
Effect of brain gym application and brain vitalization exercises in the motion of the Balinese Dance of the physical domain of quality of life after controlled with age, education, marital status, and employment variables

| Variable | Koef B | 95% CI | p |
|---|---|---|---|
| Balinese dance | -0,658 | -4,871-3,555 | 0,756 |
| Age | -0,061 | -0,617-0,495 | 0,828 |
| Education | 2,312 | -0,218-4,841 | 0,073 |
| Marital status | 8,774 | 2,365-15,183 | 0,008 |
| Employment | 1,223 | -1,482-3,928 | 0,370 |

* Significant


Figure 4. Comparison of life quality scores according to psychological domains, before and after treatment

Table 8
Effect of brain gym application and brain vitalization exercises in the Balinese Dance movement against welfare domains psychology of quality of life after controlled by age, education, marital status, and employment variables

| Variable | Koef B | 95% CI | p |
|---|---|---|---|
| Balinese dance | -14,079 | -18,244-(9,914) | 0,001 |
| Age | 0,092 | 0,458-0,641 | 0,740 |
| Education | 1,686 | -0,815-4,187 | 0,183 |
| Marital status | -2,908 | -9,245-3,429 | 0,363 |
| Employment | 0,871 | -1,804-3,545 | 0,518 |

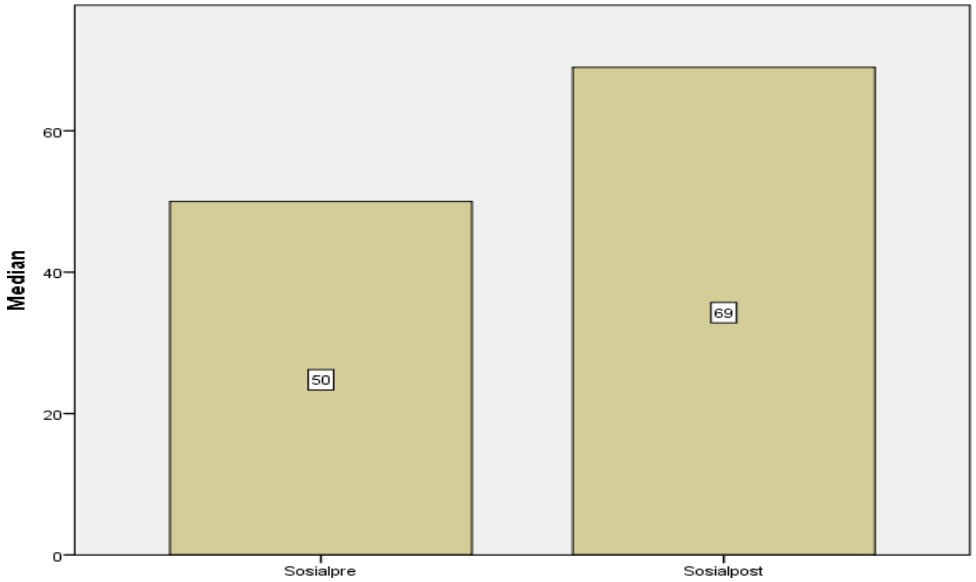

Figure 5. Comparison quality of life scores by domain social before and after treatment

Table 9
Effect of the application of brain gym and brain vitalization exercises in Balinese Dance motion on the social domain of quality of life controlled by variables of age, education, marital status, and employment

| Variable | Koef B | 95% CI | p |
|---|---|---|---|
| Balinese dance | -17,395 | -22,765-(-12,025) | <0,001* |
| Age | -0,360 | -1,068-0,349 | 0,315 |
| Education | 3,478 | 0,253-6,702 | 0,035 |
| Marital status | -4,033 | -12,203-4,136 | 0,328 |
| Employment | 1,049 | -2,399-4,497 | 0,546 |

*significant

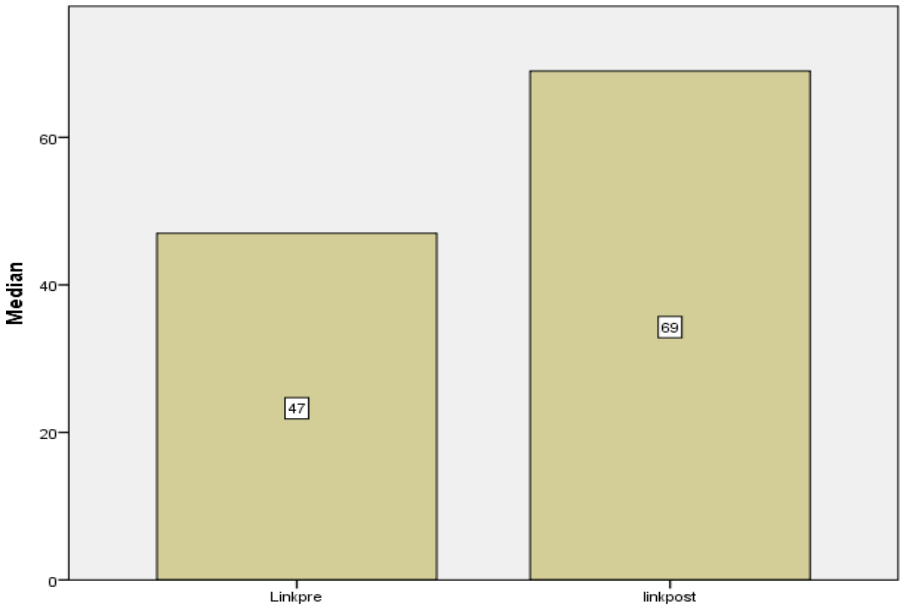


Figure 6. Comparison of quality of life scores by domain environment before and after treatment

Table 10
Effect of brain gym and brain vitalization exercises in the Balinese Dance movement against environmental domains of quality of life controlled by age variables, education, marital status, and employment

| Variable | Koef B | 95% CI | p |
|---|---|---|---|
| Balinese dance | -17,395 | -22,670-(12,120) | <0,001* |
| Age | 0,096 | -0,600-0,792 | 0,784 |
| Education | 4,488 | 1,321-7,655 | 0,006* |
| Marital status | -0,969 | -8,993-7,056 | 0,810 |
| Employment | 0,746 | 2,641-4,133 | 0,662 |

*significant

*3.2 Discussion*

Decreasing cognitive function is a challenge in health in people over 60 years. Many identified interventions can help older people maintain physical and cognitive functions so that they can continue to participate in social activities and maintain independence. Some previous studies have shown that aerobic exercise, muscle strengthening, and coordination activities improve cognitive abilities (Borhan et al., 2018). This study obtained an increase in the median Moca Ina score with a significant p-value <0.001 and Table 3 revealed that the application of Brain Gym and Brain Vitalization Exercises in the Balinese Dance Movement significantly increased the cognitive score of the elderly (p <0.001).

These results have the meaning that the application of Brain Gym and Brain Vitalization Exercises in the Bali Dance Movement plays a role in improving cognitive abilities of the elderly with cognitive impairment. The cognitive abilities in question include memory, intellect, learning ability, understanding, problem-solving, speed of decision-making, and motivation. In this Balinese Dance Movement movements are chosen which contain Brain Gym elements that are related to the 3 dimensions (functions) of the brain. The function of these movements is to stimulate the lateral dimension, lighten the focusing dimension and relax the dimension of concentration. The lateral dimension represents activities related to communication. The brain as the center of the body's activities will activate all organs and systems of the body through messages from nerve fibers, both conscious and unconscious. The left hemisphere will be active if the right side of the body is moved, and vice versa. This is the nature that allows the dominance of one side. The focus dimension plays a

role in the relationship between the area of the forebrain and the rear brain. This is related to the ability of understanding, define, and concentrate. The concentration dimension explains the relationship between the top and bottom of the brain. This dimension harmonizes emotions with rational minds (Dennison & Dennison, 2008).

The mechanism that occurs is through increased brain volume and blood flow in physical exercise that can improve brain function and maintain neuroplasticity. Physical exercise can reduce risk and slow down the decline in cognitive function in dementia patients (Laksmidewi et al., 2016). A specific pathway for improving cognitive function is demonstrated by the role of vascular endothelial growth factor (VEGF). The vascular endothelial growth factor is an angiogenesis factor with neurotropic, neuroprotective, and neuron proliferation effects. This factor can improve histological results and sensorimotor function in rodents and can increase vascular permeability which can overcome brain edema and recurrence of ischemia due to brain injury (Wang et al., 2019).

Another finding is that Irisin's role is a hormone such as myokin in improving cognitive function. As one of the pathways for neurotrophic factors, Irisin was found after exercise activities stimulated by PGC-1 alpha (Peroxisome proliferator-activated receptor 1 alpha gamma coactivator) (Chen et al., 2016). In the field of Physical Medicine and Rehabilitation, the application of Brain Gym and Brain Vitalization Exercises in the Bali Dance Movement is an innovative approach to handling cognitive disorders in the elderly. With this Balinese Dance Movement body structure & function, disability will cause limitations on activities and handicaps that affect the barriers to the participation of the elderly. This will be an alternative to Cognitive Therapeutic Exercise. In turn, the elderly will be able to improve their quality of life.

In this study, the results were different from the proposed research hypothesis, where BDNF levels decreased. The meaning of these results is that the Brain Gym Application and Brain Vitalization Exercises in the Bali Dance Movement cause a decrease in BDNF levels. Following previous studies reported serum BDNF levels were reduced in Alzheimer's, mild cognitive impairment (MCI), and major depression (Shimada et al., 2014).

The results of this study are different from other studies that showed an increase in BDNF after activity in the sample while other studies showed the opposite results, or in some studies showed no relationship. The Brain-Derived Nerve Neurotrophic Factor is associated with memory damage and is associated atrophy in the hippocampus. This study was conducted on many elderly people with cognitive impairment. Most likely there has been memory damage due to hippocampal atrophy. With hippocampal atrophy it will also affect BDNF levels, in this case, there will be a decrease in BDNF levels. Clinical studies that report lower serum BDNF levels are difficult to interpret because of limited confounding knowledge based on age and sex (Shimada et al., 2014). This can be caused also by the presence of other confounding factors in the elderly that cannot be controlled, such as the disease process. Some studies also found important effects on survival ability, where the effects of BDNF may depend on the presence of previous ischemic damage (Binder & Scharfman, 2004). The first study in Japan resulted in serum BDNF levels not increasing consistently in Japanese men given moderate-intensity training. These findings are most likely influenced by lifestyle factors and/or the Japanese male environment at that time (Goda et al., 2013).

Multivariate regression analysis showed that depreciation of BDNF levels was caused by several things including the use of non-fasting blood samples, longer blood storage, and heavy drinkers (Bus et al., 2011). Animal studies show that a positive neuroplasticity process can be mediated by the growth of new brain cells (neurogenesis) which is a reflection of peripheral blood concentration levels from BDNF biomarkers (Vaughan et al., 2014). As a group of Growth Hormones, BDNF in the elderly is quite difficult to be able to increase due to degeneration. This neurotrophic factor is highly related to the aging process which is also influenced by nutritional factors, metabolism, stress, and behavior (Budni et al., 2015).

Based on the above studies it is stated that the decrease in BDNF is caused by multi factors. In this study, BDNF decreased can be caused by several things and the presence of other confounding factors while cognitive increases can be caused by the role of several biomarkers other than BDNF and humoral circuits that are also involved.

This study found that the results of the comparison of quality of life in the physical domain showed a fixed score. These results mean that the Brain Gym and Brain Vitalization Exercises in the Balinese Dance Movement retain the elderly physically. Physical elderly are associated with pain and discomfort, energy and fatigue, sleep and rest, mobility, daily activities, dependencies on medication and treatment, and work

capacity. In the domain of psychological well-being, there was a significant increase in scores before and after the intervention with a value of p <0.001.

This means that the Brain Gym Application and Brain Vitalization Exercises in the Bali Dance Movement can improve psychological health/well-being. Psychological well-being includes positive effect, learning ability, thinking, memory and concentration, self-esteem, self-image and appearance, negative affect, and spirituality/ religion.

These results are following previous studies which found that psychological well-being, life satisfaction, and happiness, and quality of life are very important to reduce psychiatric disorders. One study found a significant relationship between psychological well-being and quality of life in the elderly (Jena et al., 2018). In this study, it was found that the dimensions of social relations experienced a significant increase in scores before and after the intervention with a value of p<0.001. The meaning of this result is that the Brain Gym and Brain Vitalization Exercises in the Bali Dance Movement can improve social relations/relationships in the elderly. This social relationship is related to personal relations, social support, and sexual relations. Cognitive enhancement affects the confidence of the elderly, especially in social interaction both in the family and society so that the elderly feel not isolated and remain useful (Dwi Rosita et al., 2012).

In this study, from the environmental dimension,there was a significant increase in scores before and after the intervention with a value of p<0.001. These results indicate that the Brain Gym and Brain Vitalization Exercises in the Balinese Dance Movement improve the environmental dimensions of the elderly. The environmental dimension includes financial resources, freedom, physical safety and security, health care and social care, home environment, the opportunity to get a variety of new information and skills, participation andopportunities to carry out recreational activities or fun,physicalenvironment, and transportation (Sekarwiri, 2008). In one study it was found that elderly who lived in their homes had higher QOL than those living in nursing homes (Crespo et al., 2013). This is following the environment of all samples in this study.

This finding is very important information because in this study a Balinese Dance gymnastic was composed of basic elements of Balinese Dance based on the Brain Gym and Brain Vitalization Exercises application. This Balinese Dance Gymnastics is an aerobic exercise, lasting 11 minutes with 2 minutes warm-up detail, 7 minutes core movement, and 2 minutes cooling and performed 3 times a week for 8 weeks. This Balinese Dance Gymnastics is proven to improve cognitive function and quality of life in elderly people with cognitive impairment.

## 4 Conclusion

Based on the results of the research that has been one, it can be concluded that the application of Brain Gym and Brain Vitalization Exercises in the Balinese Dance movement is proven to improve cognitive function in the elderly. The Brain Gym and Brain Vitalization Exercises in the Balinese Dance movement are proven to improve the quality of life of the elderly in the domain of psychological, social, and environmental well-being. Brain Gym and Brain Vitalization Exercises in the Balinese dance movement lowers the Brain-Derived Neurotrophic Factor in elderly blood serum.

*Suggestion*

Based on the results obtained from this study, the researcher can provide suggestions as follows: The results of this study have an impact on changes in the handling of cognitive disorders, especially in non-pharmacological forms, so that more severe cognitive disorders can be prevented. This indicates that the application of Brain Gym and Brain Vitalization Exercises in the Balinese Dance movement can beused as an alternative therapeutic non-pharmacologicalcognitive disorder in the elderly. This finding is interesting when a significant increase in cognitive scores and quality of life is not followed by a significant increase in serum BDNF levels in the elderly. Factors that influence the increaseand decrease in BDNF are multifactorial. There are several biomarkers and other circuits that need to be studied in cognitive enhancement that occur. These results will also stimulate further research in the area of handling cognitive disorders and relationships that are produced by neuroplasticity, the presence of a control group, and a longer time. The use of more accurate

and sophisticated measuring instruments such as MRI and PET scans will help to see changes that occur in the central nervous system sothat the changes caused by this Balinese dance movement can also be explained neuroimaging.

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## References


Antunes, H. K., Santos, R. F., Cassilhas, R., Santos, R. V., Bueno, O. F., & de Mello, M. T. (2006). Reviewing on physical exercise and the cognitive function. *Rev Bras Med Esporte*, *12*(2), 97-103.

Astuti, G.A. (2000). *Gerak-gerak tari Bali.* Denpasar. Kantor Dokumentasi Budaya Bali.

Binder, D. K., & Scharfman, H. E. (2004). Brain-derived neurotrophic factor. *Growth factors (Chur, Switzerland)*, *22*(3), 123.

Borhan, A. S. M., Hewston, P., Merom, D., Kennedy, C., Ioannidis, G., Santesso, N., ... & Papaioannou, A. (2018). Effects of dance on cognitive function among older adults: a protocol for systematic review and meta-analysis. *Systematic reviews*, *7*(1), 1-5.

Bourassa, M. W., Alim, I., Bultman, S. J., & Ratan, R. R. (2016). Butyrate, neuroepigenetics and the gut microbiome: can a high fiber diet improve brain health?. *Neuroscience letters*, *625*, 56-63. https://doi.org/10.1016/j.neulet.2016.02.009

Bressler, R., & Bahl, J. J. (2003, December). Principles of drug therapy for the elderly patient. In *Mayo Clinic Proceedings* (Vol. 78, No. 12, pp. 1564-1577). Elsevier. https://doi.org/10.4065/78.12.1564

Budni, J., Bellettini-Santos, T., Mina, F., Garcez, M. L., & Zugno, A. I. (2015). The involvement of BDNF, NGF and GDNF in aging and Alzheimer's disease. *Aging and disease*, *6*(5), 331.

Bus, B. A. A., Molendijk, M. L., Penninx, B. J. W. H., Buitelaar, J. K., Kenis, G., Prickaerts, J., ... & Voshaar, R. O. (2011). Determinants of serum brain-derived neurotrophic factor. *Psychoneuroendocrinology*, *36*(2), 228-239. https://doi.org/10.1016/j.psyneuen.2010.07.013

Carchi, J. A. Y. ., Catagua, T. C. M. ., Rivera, D. G. B. ., Mera, V. B. ., & Rosario, M. del . (2021). From beginner to expert, experience of the rotating nursing intern in pre-professional practice. *International Journal of Health Sciences*, *5*(2), 111-117. https://doi.org/10.29332/ijhs.v5n2.1291

Chang, C., Zhang, L., Zhou, J., Zhang, L., & Kennedy, J. F. (2010). Structure and properties of hydrogels prepared from cellulose in NaOH/urea aqueous solutions. *Carbohydrate Polymers*, *82*(1), 122-127. https://doi.org/10.1016/j.carbpol.2010.04.033

Chen, N., Li, Q., Liu, J., & Jia, S. (2016). Irisin, an exercise-induced myokine as a metabolic regulator: an updated narrative review. *Diabetes/metabolism research and reviews*, *32*(1), 51-59.

Cotman, C. W., & Berchtold, N. C. (2002). Exercise: a behavioral intervention to enhance brain health and plasticity. *Trends in neurosciences*, *25*(6), 295-301. https://doi.org/10.1016/S0166-2236(02)02143-4

Crespo, M., Hornillos, C., & de Quirós, M. B. (2013). Factors associated with quality of life in dementia patients in long-term care. *International Psychogeriatrics*, *25*(4), 577.

Dennison, P. E., & Dennison, G. E. (2008). The Comprehensive Guidance Book of Brain Gym Jakarta: Grasindo.

Dwi Rosita, M., Widodo, A., Kep, A., & Purwanti, O. S. (2012). *Hubungan Antara Fungsi Kognitif Dengan Kemampuan Interaksi Sosial Pada Lansia Di Kelurahan Mandan Wilayah Kerja Puskesmas Sukoharjo* (Doctoral dissertation, Universitas Muhammadiyah Surakarta).

Goda, A., Ohgi, S., Kinpara, K., Shigemori, K., Fukuda, K., & Schneider, E. B. (2013). Changes in serum BDNF levels associated with moderate-intensity exercise in healthy young Japanese men. *Springerplus*, *2*(1), 1-6.

Greenwood, C. E., & Winocur, G. (2005). High-fat diets, insulin resistance and declining cognitive function. *Neurobiology of aging*, *26*(1), 42-45. https://doi.org/10.1016/j.neurobiolaging.2005.08.017

Hajjar, E. R., Cafiero, A. C., & Hanlon, J. T. (2007). Polypharmacy in elderly patients. *The American journal of geriatric pharmacotherapy*, *5*(4), 345-351. https://doi.org/10.1016/j.amjopharm.2007.12.002

Haris, E. R., Steven, R., & Handajani, Y. S. (2014). Kualitas Hidup pada Lansia dengan Gangguan Kognitif dan Mental: Studi Cross Sectional Di Kelurahan Kalianyar, Jakarta Barat. *Damianus Journal of Medicine*, *13*(2), 117-127.

Hernanta, I. (2013). Ilmu kedokteran lengkap tentang neurosains. *Yogyakarta: D-Medika*, 150-161.

Inoue, H., Fujiki, A., Origasa, H., Ogawa, S., Okumura, K., Kubota, I., ... & Kamakura, S. (2009). Prevalence of atrial fibrillation in the general population of Japan: an analysis based on periodic health examination. *International journal of cardiology*, *137*(2), 102-107. https://doi.org/10.1016/j.ijcard.2008.06.029

Jena, N., Das, S., & Deo, H. K. (2018). Quality of life, psychological well-being and depression among elderly: a co relational study. *Global Journal of Intellectual & Developmental Disabilities*, *4*(2), 39-44.

Keefe, R. S., Eesley, C. E., & Poe, M. P. (2005). Defining a cognitive function decrement in schizophrenia. *Biological psychiatry*, *57*(6), 688-691. https://doi.org/10.1016/j.biopsych.2005.01.003

Kusumajaya, A. A. N. (2021). Individual and social environmental factor as risk factor of BMI-for-age in school children. *International Journal of Health Sciences*, *5*(2), 89-98. https://doi.org/10.29332/ijhs.v5n2.1242

Ladwig, K. H., Marten-Mittag, B., Erazo, N., & Gündel, H. (2001). Identifying somatization disorder in a population-based health examination survey: psychosocial burden and gender differences. *Psychosomatics*, *42*(6), 511-518. https://doi.org/10.1176/appi.psy.42.6.511

Laksmidewi, A. A. P., Sudewi, A. R., Mach-foed, M. H., & Astawa, I. N. M. (2016). The Decrease of Amyloid-Beta Deposit, Increase of Brain-Derived Neurotrophic Factor and Decrease of C-Reactive Protein Levels in the Rat Model of Dementia, Related to the Physical Exercises. *BAOJ Neuro*, *2*, 015.

Lumbantobing, P. A. (2020). The Contribution of Lecturer Pedagogical Competence, Intellectual Intelligence and Self-Efficacy of Student Learning Motivation. *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, *3*(1), 564-573.

Martono, H., & Pranarka, K. (2009). Buku Ajar Boedhi-Darmojo: Geriatri (Ilmu Kesehatan Usia Lanjut).

Notaras, M., Hill, R., & Van den Buuse, M. (2015). A role for the BDNF gene Val66Met polymorphism in schizophrenia? A comprehensive review. *Neuroscience & Biobehavioral Reviews*, *51*, 15-30. https://doi.org/10.1016/j.neubiorev.2014.12.016

Sekarwiri, E. (2008). Hubungan antara kualitas hidup dan sense of community pada warga DKI Jakarta yang tinggal di daerah rawan banjir. *Skripsi, Universitas Indonesia). Diunduh dari http://lib. ui. ac. id/125243-362.2. pdf*.

Shimada, H., Makizako, H., Yoshida, D., Tsutsumimoto, K., Anan, Y., Uemura, K., ... & Suzuki, T. (2014). A large, cross-sectional observational study of serum BDNF, cognitive function, and mild cognitive impairment in the elderly. *Frontiers in aging neuroscience*, *6*, 69.

Silakarma, D. (2018). Peningkatan denyut nadi pada wanita lansia setelah diberikan intervensi gerak tari Bali. Penelitian Pendahuluan. Denpasar. *Unpublished.*.

Vaughan, S., Wallis, M., Polit, D., Steele, M., Shum, D., & Morris, N. (2014). The effects of multimodal exercise on cognitive and physical functioning and brain-derived neurotrophic factor in older women: a randomised controlled trial. *Age and ageing*, *43*(5), 623-629.

Wang, Y., Hoeppner, L. H., Angom, R. S., Wang, E., Dutta, S., Doeppler, H. R., ... & Mukhopadhyay, D. (2019). Protein kinase D up-regulates transcription of VEGF receptor-2 in endothelial cells by suppressing nuclear localization of the transcription factor AP2β. *Journal of Biological Chemistry*, *294*(43), 15759-15767. https://doi.org/10.1074/jbc.RA119.010152

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