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A Comparison Between Brain Vitalization Gymnastics and Elderly Gymnastics to Improving Cognitive Function among Elderly

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Two of the most frequently elderly's health-associated problems are balanced disorder and cognitive decline. One of the solutions to prevent cognitive decline in the elderly is via performing brain vitalization gymnastics. According to these facts and arguments, the authors were interested in studying the effects of brain vitalization gymnastics performed twice every week for four weeks upon cognitive function in the elderly. This was a randomized pretest-posttest control group design study involving 38 elderly subjects who were registered in the geriatric subgroup of West Denpasar primary health care clinic. The subjects were equally divided into two groups, i.e., those who performed brain vitalization gymnastics and elderly gymnastics. Montreal Cognitive Assessment Indonesian Version(MoCA-Ina) score as tested with paired t-test among brain vitalization gymnastics and elderly gymnastics groups. Both groups before and after the exercise increased by 1.53 and 0.11 points, respectively. Furthermore, the brain vitalization gymnastics group had a statistically significant higher MoCA-Ina score as opposed to the elderly gymnastics group (p=0.047). This study had shown that brain vitalization gymnastics was more effective in increasing elderly's MoCA-Ina score as opposed to elderly gymnastics.

Keywords: Elderly, brain vitalization gymnastics, MoCA-Ina.

According to Indonesian's law (i.e., Undang-Undang Republik Indonesia Nomor 13 Tahun 1998), elderly is legally defined as an individual with a chronological age of 60 years or above. It is estimated that there will be 1.2 billion people with the age of 60 years or above by 2025, and the number increases to an estimated 2 billion people by 2050. As many as 80% of those people will reside in developing nations. In fact, the elderly population in Indonesia has increased steadily from 11.3 million people (6.29% of the total population) in 1990 with a life expectancy of 59.8 years to 23.9 (9.77%). 28.8 million people in 2010 and 2020, respectively, with a life expectancy of 67.4 and 71.1 years, apiece[1].

Elderly population growth in Indonesia can bring about multi-faced issues due to the aging process. Multiple bodily organs will functionally decline over time due to several factors such as reduced physical activities, cognition, and nutritional intake, as well as exposure to free radicals. These, in turn, will induce changes in the

brain's physiology and structure[2]. The brain, as a complex organ responsible for body regulation and cognitive center, is prone to aging and degenerative process[3]. Cognitive declines in several aspects will almost certainly occur as someone ages, for instance, difficulty in memory recall, a decrease in executive function, and reduced motoric speed and precision[4,5].

Furthermore, cognitive function is a human mental process comprising attention, perception, thinking process, knowledge, and memory. Besides, cognitive function can also be addressed as phases during processing information, such as perception, learning, memory, attention, problem-solving activities, and psychomotor functions (reaction timing, movement timing, and action speed)[6,7,8,9].

According to a study performed by Kanthamalee and Sripankew (2013), entitled "Effect of neurobic exercise on memory enhancement in the elderly with dementia," playing a physical activity such as neurobic exercise twice every week for four weeks was shown to increase the Mini-Mental State Examination (MMSE) score[10]. Furthermore, a study conducted by Ningsih (2015), which evaluated the effect of doing crosswords thrice a week for four weeks among the elderly, had shown an increase in the average MMSE score among treated subjects[11].

The elderly who experience severe cognitive decline will also be dependent on a caregiver for assisting their daily activities. It is therefore paramount to find and use the right methods to maintain the cognitive reserve, prevent its decline, or even increase cognition, particularly those using increasing brain stimulation[2].

Several ways to prevent cognitive decline can be employed. Among them are reading, listening to the news and story through media, or games that require concentration or attention, orientation to place, time, and situation), and memory. It is even better to make them a habit to stimulate cognitive function. Other measures to prevent cognitive decline is through performing a physical activity or exercise. There are two types of physical activities potentially useful for increasing cognitive function, i.e., by physical exercise and brain vitalization gymnastics[12].

Brain vitalization gymnastics is a type of exercise with a principal purpose to maintain brain health and prevent cognitive decline via actively moving body parts. Brain vitalization gymnastics consists of an effort to synchronize the movement, breathing, and cortical center for thinking (i.e., memory and imagination). Many changes performed during brain vitalization gymnastics can stimulate the brain to increase cognitive function while simultaneously harmonizing motoric and thinking abilities, optimizing the work of five senses, maintaining postural flexibility, and increasing memory[12].

Many movements performed during brain vitalization gymnastics can stimulate cooperation between two hemispheres and cortical centers so that blood circulation to the brain can be increased, which results in better nutritional intake among neurons, thus potentially improving brain structure, including cerebellum that is responsible for postural balance[12].

Brain vitalization gymnastics has been employed by the Center of Health Intelligence of the Indonesian Health Ministry for elderly groups in several regions of Indonesia. The concept was initially developed by Andre Mayza *et al*.[3]. A study was conducted by the center for health research Atma Jaya University which accommodates brain vitalization gymnastics twice per week for a year among the elderly. The treated group was shown to have better cognitive function and balance when compared to the control group[3].

There are several benefits acquired by the elderly by performing brain vitalization gymnastics if done routinely and correctly, such as preventing forgetfulness, thus increasing their productivity. Consequently, brain visualization gymnastics can be one of the alternatives in optimizing brain function and preventing cognitive decline among the elderly[13,14,15,16]. Moreover, physical exercise is regularly associated with neurobiology repetition and modification, which influence brain tissue synthesis via increasing angiogenesis, neurogenesis, synaptogenesis, and neurotransmitter synthesis on different brain structures, including cognitive function such as memory[17]. According to these facts and arguments, the authors were interested in studying the effects of brain vitalization gymnastics performed twice every week for four weeks upon cognitive function in the elderly.

SUBJECTS AND METHODS

It was an experimental study with a pretest-posttest control group design. The study was conducted in the geriatric subgroup of West Denpasar primary health care clinic from January to February 2017 period.

Inclusion criteria were elderly who were actively involved in the geriatric subgroup of West Denpasar primary health care clinic. Age 60 to 74 years old, elderly who performed brain vitalization gymnastics for the treatment group, and those who completed elderly gymnastics for the control group. The elderly who were able to speak Indonesian or Balinese (including written language), agreed to participate in the study after receiving adequate explanations regarding the purpose and detailed procedure of the study by signing the informed consent.Exclusion criteria include refusal to participate in the study, having a visual and auditory impairment that can potentially hamper effective communications, had any history of stroke, brain trauma, seizure/epilepsy, brain tumor, hypertension, diabetes mellitus, dyslipidemia, brain infection, elderly who were unable to walk, using a cane, or on a wheelchair. Drop out criteria for this study was elderly who did not come during the evaluation, those who were unreachable by phone, individuals who did not continuously perform the gymnastics for eight times per 4 weeks, those who died, or refused to continue implementing the gymnastics. These subjects will be excluded from the study, and their data will not be analyzed.

The diagnostic tool used for measuring cognitive function in this study was Montreal Cognitive Assessment Indonesian Version(MoCA-Ina), i.e., a test that evaluates several cognitive domains, including attention, concentration, orientation, memory, language, executive function, visuospatial, calculation, and conceptual thinking. The elderly who fulfilled eligibility criteria would then be randomized merely to divide the subjects into two groups, i.e., intervention and control group. Subjects within two groups would be interviewed using a questionnaire to evaluate MoCA-Ina and subsequently given brain vitalization gymnastics twice a week (treatment group) and elderly gymnastics (control group). Both exercises were prescribed twice a week for four weeks, with a duration of 20-30 minutes for each session. During this period, subjects who refused to continue the program,exercised on an irregular basis, or unreachable, would be excluded from the study. MoCA-Ina would be evaluated by the end of the week-4. This study had received a recommendation from the Ethics Committee on human research, Faculty of Medicine, Udayana University. Written consent was obtained from each subject after they understood the purpose and agreed to join the study.

The normality test performed using the Shapiro-wilktest.A paired t-test was conducted to determine to mean differences between matched groups, whereas the impact of two different types of gymnastics was measured using an independent t-test. Significance was estimated by the p-value of

Tabel 1. Subject's baseline characteristics

Variables	Control (n=19)	Treatment (n=19)	p-value
Average age (years)Mean±SD	66.74±4.51	66.00±4.93	0.838
Sex			
Male	9 (47.4%)	9 (47.4%)	1.000
Female	10 (52.6%)	10 (52.6%)	
Educational level			
less than Senior High School	7 (36.8%)	1 (5.3%)	0.151
Senior High School	4 (21.2%)	9 (47.4%)	
Academy/diploma/university	8 (42.1%)	9 (47.4%)	
Occupation			
Civil servant	9 (47.4%)	13 (68.4%)	0.047
Private employee	2 (10.5%)	4 (21.1%)	
Entrepreneur	3 (15.8%)	1 (5.3%)	
Miscellaneous	5 (36.3%)	1 (5.3%)	

less than 0.05. The obtained data were analyzed using SPSS 20.0 for Windows.

RESULTS

Subjects were derived from the geriatric subgroup of West Denpasar primary health care clinic, Bali. A sample size of this study had fulfilled the minimal amount of sample size with additional samples to anticipate drop out. There were 38 subjects involved in this study and allocated equally to both groups (i.e., 19 subjects within each group). Age ranged from 60 to 74 years old. Selected subjects received an adequate explanation regarding the purpose and impact of the study to their cognitive function before signing the informed consent as an agreement to participate in the study. Subjects in both groups received either brain vitalization gymnastics or elderly gymnastics for eight times within a 4-week period. Cognitive function was then measured twice, which is before and after the 4-week gymnastics courses using the MoCA-Ina instrument. Both groups were homogenous concerning baseline characteristics to avoid potential bias (Tabel 1).

The impact of brain vitalization gymnastics on cognitive improvement among the elderly was measured by comparing the mean score of MoCA-Ina between the treatment and control groups after a 4-week period. Results of the analysis were displayed in table 2 and 3 as follows:

According to table 2, the mean increase of the MoCA-Ina score was different between groups. It was apparent that the treatment group had a higher mean increase of MoCA-Ina score when compared to the control group (i.e., 1.53 vs. 0.11).

According to table 3, there was an increment of cognitive function score within the brain vitalization gymnastics group when compared with the elderly gymnastics group. The increased MoCA-Ina score among the treatment group differed significantly from the control group.

DISCUSSION

In this study, we had successfully obtained 38 subjects, which consist of 18 (94.8%) males and 20 females (102.6%). The average age of the subjects within both groups was 67.00±4.66 years old, with the average age between both groups were not statistically different (p=0.838). The average age of brain vitalization gymnastics and elderly gymnastics groups were 66.00±4.93 and 66.74±4.51 years old, respectively. According to a study done by Rohana (2011), the average age

Table 2. Comparision of Mean MoCA-Ina Score before and after Exercise on each Group

Groups	Mean MoCA-Ina (beginning)	Mean MoCA-Ina (end)	Mean increase of MoCA-Ina (95% CI)	p-value
Brain vitalization gymnastics	25.79±2.46	27.36±2.18	1.53 (0.766-2.286	0.001*
Elderly gymnastics	25.16±2.29	25.26±2.68	0.11 (-1.117-1.328)	0.858

MoCa-Ina: Montreal Cognitive Assessment Indonesian Version; CI: Confidence Interval; *statistically significant

Table 3. Mean Increase of MoCA-Ina between Brain Vitalization Gymnastics and Elderly Gymnastics

Groups	Average Increase of MoCA-Ina	p-value
Brain vitalization gymnastics	1.53±1.58	0.047*
Elderly gymnastics	0.11±2.54	

MoCa-Ina: Montreal Cognitive Assessment Indonesian Version;*statistically significant

of subjects in the brain vitalization group was 65.96±4.80 years old, whereas those in the elderly gymnastics group were 67.04±4.57 years old. According to a study done by Aziz *et al*.(2016), the highest age distribution among treatment and control groups were 70-79 (46.15%) and 60-69 (53.85%) years old, respectively. It can be concluded that most of the elderly who performed the brain vitalization and elderly gymnastics were above 65 years old. It demonstrated that age is not a barrier for older adults to perform physical activities. There were several changes in the cognitive domain as people age, for instance, information retrieval function, learning speed, speed to process new information, and reaction speed towards simple or complex stimulation[18,19].

All of the subjects were educated, ranging from junior high school to university, with most of them graduated from academy/diploma/university, followed by senior high school. The highest proportion of educational level was from academy/ diploma/university (89.5%), followed by senior high school (68.6%). Most of the subjects (115.8%) were civil servants.

The initial cognitive score of brain vitalization and elderly gymnastics groups were 25.76±2.46 and 25.16±2.29, respectively. These initial mean average scores were similar to those conducted by Rohana (2011), which were 19.07±3.61 and 21.48±3.8 before performing the brain vitalization and elderly gymnastics, respectively. The cognitive improvement, as measured by MoCA-Ina, was visible after the subjects had completed the exercise for four weeks with a different increase in mean MoCA-Ina score within each group. The average increase of cognitive function (MoCA-Ina) before and after treatment in the brain vitalization gymnastics group was 1.52 (95% CI 0.766-2.286; p=0.001), whereas, in the control group, the average increase of cognitive function was 0.11 (95% CI -1.117-1.328; p=0.858) with normally distributed data. The percentages of cognitive improvement (MoCA-Ina) among treatment and control groups were 6.09% and 0.39%, respectively. The average increase of MoCA-Ina before and after exercise among the treatment group was higher than the control group, i.e., 1.53 vs. 0.11. Furthermore, the independent t-test was performed to determine the efficacy of brain vitalization gymnastics and elderly gymnastics on improving cognitive function. There was a mean increase of 1.53±1.58 among the treatment group as opposed to 0.11±2.54 among the control group with p=0.047 ($p<0.05$). It can thus be concluded that brain vitalization gymnastics was more effective than elderly gymnastics in improving cognitive function among the elderly. The results obtained from this study were similar to those obtained by Rohana (2011) that there was a statistically significant improvement in cognitive function among older who performed brain gymnastics activity in Banten province ($p<0.05$). This finding was also following Puspita *et al*. (2015), who found a significant difference in MoCA-Ina score among those treated with brain visualization gymnastics versus control with a mean of 20.05±3.223 and 17.26±3.679, (p=0.018, respectively). A similar study had also been performed by the center for health research Atma Jaya University, wherein elderly who performed brain visualization gymnastics demonstrated better cognitive and balance function when compared with control[3]. This finding was also similar to those found by Hanafi (2014), in which cognitive function was significantly improved among ten subjects who performed daily brain visualization gymnastics as opposed to control (p=0.038). Moroever, Setiawan (2014) discovered that brain visualization gymnastics conducted once every two days for 10-15 minutes on each session for three weeks could significantly improve cognitive performance among the elderly with dementia.

As someone ages, cognitive decline due to the reduced amount of neurons will almost certainly follow. A decrease in both the types and intensity of performing physical activities is one of the many underlying reasons for the reduced neuron number. Physical exercise is thus one of the most effective solutions to prevent cognitive decline. One of the potential actions that could be performed is brain vitalization gymnastics. The movements performed during brain visualization gymnastics are useful to stimulate cooperation between different brain hemispheres. All of the brain regions and cerebellum functions will be increased, similar to the increased blood flow to the corresponding areas. Also, the movements performed during this activity will minimally affect heart workload as it can be adjusted with the breathing rhythm. Oxygen uptake will increase

linearly as someone breathes deeply, which may assist in brain repair function[14].

The link between physical activity and increased cognitive function can be explained by muscle contraction, which will influence the brain via muscle spindle pathway. Wherein stimuli received by the Golgi tendon will be transmitted to the central nervous system via multiple tracts which receive sensory information from the peripheral, visual and vestibular system, as well as proprioception. These impulses will be processed and integrated into all levels of the nervous system. In this study, MoCA-Ina was evaluated twice, i.e., before and after the 4-week course of the gymnastics. Also, pre- and post-test analyses of the MoCA-Ina score were performed to acquire more valid data regarding the difference prior and after completing the exercise.

Neva *et al*. (2014) concluded that physical exercise could significantly improve cognitive function by exerting positive effects on each of the cognitive domains, including memory, attention, and executive function. A study done by Paillard (2015) discovered that regular aerobic exercise could slow down cognitive decline because it can stimulate specific brain areas, particularly the temporal lobe, prefrontal cortex, and hippocampus[20,21,22]. However, we did not find any statistically significant difference between the study groups' cognitive score improvement. This was probably due to the short treatment period (4 weeks), thus may require prolongation of exercise course to gain remarkable results on each of the cognitive domains.

The weakness this study was the inability to monitor subject's activity during the 24-hour period, ergo, it could not be explicitly concluded that brain vitalization gymnastics could be solely responsible for the cognitive improvement for those who practiced it.

Nevertheless, the strength of this study was the relatively homogenous samples, strict eligibility criteria, and randomization, so that potential bias and the impact of confounding variables could be minimized.

CONCLUSION

According to this study, brain vitalization gymnastics could significantly improve cognitive function in the elderly when compared to elderly gymnastics.

Competing interests

The authors declare that they have no competing interests.

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