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University of Muhammadiyah Malang

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trn:oid:::1:3174748031

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Mar 6, 2025, 2:19 PM GMT+7

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Literature Study: The Influence of Physical Activity on Changes in Cognitive Status of Post Stroke Patients

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ARTICLE INFORMATION

Article history
Received 30 November 2021
Revised 13 December 2021
Accepted 10 January 2022

Keywords
Post-Stroke, Cognitive Impairment, Physical Activity,Cognitive Function

ABSTRACT

Introduction: *The risk of cognitive function decline increases three times in stroke patient. The impaired cognitive function impacts psychological side, social isolation, economic, and decreasing the quality of living. Physical activities are believed to stimulate the nerve growth so that these activities can hinder cognitive function decline.* ***Objectives:*** *the objective of the study was to acknowledge the frequency, duration, and type of physical activities of cognitive status change of post-stroke patient. It is also to acknowledge the effect of physical activity toward the cognitive status change of post-stroke patient according to literature studies.* ***Methods:*** *Researcher uses literature study as research design with a sample of 13 journals, 6 journals of Pubmed, 2 journals of Proquest, 2 journals of Science Direct, and 3 journals of SAGE Journals. The steps of literature study of this research are problem identification, data collection, screening, main study quality assessment, data extraction, and data analysis. JBI Randomized Controlled Trial and Quasi Experimental are the tools used in study quality assessment.* ***Results:*** *Based on the result of the study of 13 journals shows that physical activity has significant effect toward cognitive status change of post-stroke patient with 5 times a week and 60 minutes duration of exercise.* ***Conclusions:*** *The study result of 13 journals shows that physical activity has significant effect toward the cognitive status change of post-stroke patient based on frequency, duration and types of physical activity.*

1. Introduction

Stroke is the second leading cause of death and the third leading cause of disability in the world, causing a high individual and social burden. Data from the World Stroke Organization in 2019 shows that there are 13.7 million new cases of stroke every year and 5.5 million deaths due to stroke worldwide. Approximately 70% of strokes and 87% of deaths and disabilities due to stroke occur in low to middle income countries (WHO, 2019). Based on the results of Riskesdas in 2018, the prevalence of stroke in Indonesia increased compared to 2013, from 7% to 10.9%. The regions with the highest prevalence rates in Indonesia are East Kalimantan Province and DI Yogyakarta, namely 14.7% and 14.6%, respectively. Meanwhile, the regions with the lowest prevalence rates in Indonesia compared to other provinces are Papua and North Maluku, namely 4.1% and 4.6%,

The brain works closely with the heart and the vascular system in carrying out bodily functions. Neurotransmitters and blood cells that flow throughout the body also affect the metabolic activity of the brain. When there is a disturbance in the brain, it will cause problems in the motor, sensory, and cognitive function of theindividual. This is what happens to people who have had a stroke (Bahrudin M. , 2017). Cognitive function is the process by which sensory input (visual, auditory, and tactile) is modified, processed, stored and used for interneuron connections so that the individual can analyze the sensory input (Ekasari, Riasmini, & Hartini, 2019). Based on research, the risk of cognitive decline increases threefold if you have a stroke. As many as 50%-75% of stroke patients suffer from impaired cognitive function and the prevalence rate ranges from 23.5%-61% to experience dementia after three months after stroke (Yuwanda, Widyastuti, & Laksmidewi, 2020). The results of the study from Furmansyah (2007)

reported that of the 42 stroke patients studied, there were 21 stroke patients who experienced impaired cognitive function. Another research conducted by Sinaga at the installation of Medical Rehabilitation Prof. hospital. Dr. RD Kandou Manado reported that of 50 non-hemorrhagic stroke patients studied, there were 28 patients (56%) with a tendency to have cognitive dysfunction and as many as two people (4%) had cognitive dysfunction (Hanas, Lestari, & Asni, 2016).

Impaired cognitive function can be a serious health problem because it can cause psychological problems, social isolation, economics, and can reduce the quality of life of sufferers. Cognitive impairmentcausedby stroke depends on the location of the damage in the brain. Cognitive disorders that can occur such as decreased consciousness, impaired visuospatial, impaired nonverbal learning, impaired communication aspects, and reduced attention (Hanas, Lestari, & Asni, 2016). Stroke causes the patient's brain function to decrease. When the brain function of stroke sufferers decreases, the patient's cognitive function will experience disturbances. Although stroke is classified as a deadly disease, all stroke sufferers still have a life expectancy. Stroke can cause brain cells to not function properly, so patients are very susceptible to cognitive impairment after a stroke (Laksono, Widyastuti, & Trisnawati, 2019).

Physical activity is an inexpensive and easily accessible treatment to restore cognitive abilities of post-stroke patients. Research from Groot et al. (2016) explain that physical activity can improve cognitive function in populations prone to cognitive decline, namely the neurologically healthy elderly and those with dementia. Other research from Cummings et al. (2012) showed that physical activity had the effect of preventing cognitive decline and increasing cognitive activity in post-stroke patients. The positive effects of physical activity that may occur are increased blood flow to the brain, growth factors, such as brain-derived neurotrophic factors, increased arousal or wakefulness, and decreased symptoms of depression in post-stroke patients.

Physical activity can maintain optimal blood flow so that the brain does not experience a lack of oxygen and can send nutrients to the brain without interruption. Physical activity can also stimulate nerve growth, thereby inhibiting cognitive decline. During physical activity, the brain is stimulated to increase Brain Derived Neutrophic Factor (BDNF). This BDNF protein has an important role in preventing damage from nerve cells. However, if BDNF levels are low, it can lead to dementia. In addition to producing BDNF protein, physical activity can also stimulate brain plasticity, so that it can maintain and improve cognitive abilities and long-term memory. Functional magnetic resonance imaging (fMRI) can show the effect of physical activity on improving brain structure and function (Sauliyusta & Rekawati, 2016; Voss, et al., 2010).

Research results of Moriya et al. (2016) showed that moderate-intensity aerobic exercise could improve the performance of working memory tasks. Post-stroke patients can respond more quickly, and also answer correctly more often after exercise. Near-infrared spectroscopy (NIRSshowed that physical exercise increased oxy-Hb concentrations in the prefrontal cortex (PFC) during a working memory task compared to the control condition, indicating that the increase in working memory task performance was not attributable to habituation. Research from Zheng et al. (2020) showed that physical activity which in this study was Baduanjin gymnastics could significantly improve cognitive function from moderate to high in patients with post-stroke cognitive impairment. There are some useful small improvements for memory, executive ability, attention, and Activity Daily Living (ADL). Research results from Yeh et al. (2019) proved that a sequential training program combining aerobic exercise sequences and computer cognitive training, in significant improvements in cognitive abilities and motor function. This improvement is characterized by an increase in general cognitive function and visuospatial memory.

2. Methods

The design of this research is a literature study. The journal portals that researchers use to search for data are Pubmed (6 journals), Proquest (2 journals), Science Direct (2 journals), and SAGE Journals (3 journals). Researchers used search keywords effect, post-stroke, after stroke, cognitive impairment, physical activity, physical exercise, cognitive function. Journal inclusion criteria in this study are 1) Journals published within the last 5 years (2015-2020); 2) Journal type of experimental research method (randomized control trial, quasi-experimental); 3) Full text; 4) International Journals; 5) Journal that discusses the effect of physical activity on changes in cognitive function of post-stroke patients.

The author carried out two stages of screening with the first being screening based on year, type of journal, and language. Then the author conducted a second screening, namely the title and abstract details. which discusses the effect of physical activity on changes in cognitive function of post-stroke patients. The researcher used the JBI (Joanna Briggs Institute) randomized control trial and quasi-experimental instrument to assess the quality of the journal. There are 13 journals that deserve to be used as research data with the average percentage obtained is 75%. The data that meet the inclusion criteria and have been tested for quality, are then extracted using a narrative method by grouping similar data based on the measurement results to answer the objectives. After completing the data extraction stage,

3. Results and Discussion

The research journals analyzed were 13 international journals. The characteristics of research journals are as described in table 1.

Table1. Characteristics of Research Journals

Journal Characteristics	N	%
Country		
Brazil	1	7.6%
China	5	38.4%
Italy	1	7.6%
Canada	3	23%
South Korea	1	7.6%
Norway	1	7.6%
Greece	1	7.6%
Research methods		
Randomized control trial	12	92.3%
Quasi experimental	1	7.6%

Result of analysis journals based on the frequency of physical activity in table 2.

Table 2 Frequency of Physical Activity Implementation

Journal Number	Execution Frequency
Journal 1	3 times per week for 12 weeks
Journal 2	48 weeks
Journal 3	5 times per week for 3 weeks
Journal 4	4 times for 24 weeks
Journal 5	72 weeks
Journal 6	36 weeks
Journal 7	5 times per week for 8 weeks
Journal 8	1 time per week for 2 weeks
Journal 9 and 10	3 times per week for 8 weeks
Journal 11 and 13	3 times per week for 24 weeks
Journal 12	3 times per week for 18 weeks

In table 2 the frequency of physical activity implementation shows that there are various frequencies of physical activity implementation in post-stroke patients. There are two kinds of research frequency that is most widely mentioned, 3 times per week for 8 weeks and 3 times per week for 24 weeks. Research article from Pang, et al. (2018) and Plowman, et al. (2019) was conducted 3 times per week for 8 weeks. Research article from Tang, et al. (2016) and Zheng, et al. (2020) conducted 3 times per week for 24 weeks.

The results of the analysis based on the duration of physical activity are in table 3.

Table2. Physical Activity Duration

Journal Number	Physical Activity Duration
Journal 10 and 12	30 minutes
Journal 13	40 minutes
Journal 4	45 minutes
Journal 1	50 minutes
Journals 3, 6, 7, 8, 9, and 11	60 minutes
Journal 5	90 minutes

In table 3 the duration of physical activity shows that there are various kinds of duration in the implementation of physical activity in post-stroke patients. Based on the table, the majority of the duration of physical activity is given for 60 minutes (Chung, et al., 2019; Liu-Ambrose & Eng, 2015; Manuli, et al., 2020; Morais, et al., 2017; Pang, et al. , 2018; Tang, et al., 2016). There is one journal that does not explain in detail the duration of physical activity, namely journal 2.

The results of the analysis based on type of physical activity can be found in table 4.

Table 3. Type of Physical Activity

Journal Number	Type of Physical Activity
Journals 1, 6, 8, 10, 11, and 12	Aerobic exercise
Journals 2, 4, and 5	physical training
Journal 3	*Task-Specific Lower Extremity Training*
Journal 7	*Robotic gait rehabilitation* + VR
Journal 13	*Baduanjin exercise*

In table 4 the types of physical activity show that there are several types of physical activity given to post-stroke patients with the two most common types of physical activity, namely aerobic exercise as many as six research journals (Bo, et al., 2018; Liu-Ambrose & Eng, 2015; Morais, et al., 2017; Plowman, et al., 2019; Tang, et al., 2016; Yeh, et al., 2019) and physical exercise in three research journals (Cheng, et al., 2018; Fotakopoulos & Kotlia, 2018; Ihle-Hansen, et al., 2019).

Table 5. Outcome of the Research Journal of the Effect of Physical Activity on Changes in Cognitive Status of Post-Stroke Patients

Journal Number	Outcome
Journals 1, 2, 3, 4, 6, 7, 8, 10, 12, and 13	Take effect
Journals 5, 9, and 11	No effect

In table 5, the journal data extraction shows that of the 13 journals that carried out data extraction, there are 10 journals which state that physical activity has a significant effect on changes in better cognitive status in post-stroke patients. However, there are three journals which state that physical activity does not have a significant effect on changes in the cognitive status of post-stroke patients. The significant effect is shown by the results of SPSS data analysis in 13 journals that show an increase in cognitive status in post-stroke patients after being given

physical activity therapy (Bo, et al., 2018; (Cheng, et al., 2018; Chung, et al., 2019). ; Fotakopoulos & Kotlia, 2018; Liu-Ambrose & Eng, 2015; Manuli, et al., 2020; Morais, et al., 2017; Plowman, et al., 2019; (Yeh, et al., 2019; Zheng, et al., 2020).

3.1 Frequency of Physical Activity Implementation

A literature study from 13 journals showed that the frequency of application of physical activity which showed significant results was with a frequency of 3 times per week for 24 weeks, 4 times per week for 24 weeks, 5 times per week for 8 weeks, and 5 times per week. for 3 weeks. In the study of Zheng et al., (2020) post-stroke patients received Baduanjin exercise training for 24 weeks with a frequency of three days a week and all cognition-related outcomes were measured at baseline, 8, 16 and 24 weeks after the intervention and an additional 4 weeks after the follow-up period. further (28 weeks). The main finding was that Baduanjin gymnastics exercise for 24 weeks experienced a significant improvement of moderate to high effect on global cognitive function in patients with post-stroke cognitive impairment.

In addition to the frequency of applying physical activity three times, another study from Fotakopoulos & Kotlia (2018) implemented a physical exercise program in post-stroke patients four times per week for 24 weeks using a mini Mental Test (mMT) measuring instrument to measure the patient's cognitive function. . The results of this study showed that post-stroke patients experienced a higher recovery process with evidence of a better reduction in lesion size than the control group which in baseline data the average lesion size of patients was 7 cm to 3 cm. The patient's mMT score also increased from the initial mean patient score of 24 (mild disturbance) to 26 (no disturbance). In addition to the reduction in lesion size and improvement in the patient's mMT score,

Research from Manuli et al., (2020) shows that the application of physical activity with VR for 8 weeks with a frequency of 5 times per week can lead to significant improvements in global cognitive function, executive function, as well as in activities of daily living. The increase in cognitive function was indicated by an increase in the MoCA score which in the baseline patient data the average was 21.8 (mild impairment) increased to 26 (no disturbance) at the time of the final assessment. Exercise on a robotic weight-supported treadmill optimizes the relevant sensory input for stride exercise, with repetitive exercise for specific tasks can assist in the improvement of brain neuroplasticity.

Another study from Chung et al., (2019) explained that the application of physical activity for 3 weeks with a frequency of 5 times per week helped improve cognitive function in post-stroke patients by helping in reducing gray matter and white matter atrophy.) associated with age, and with increased gray matter density in the prefrontal and temporal regions and hippocampal volume. The increase in cognitive function of post-stroke patients is indicated by an increase in the MMSE score which is in the baseline data

3.2 Duration of Physical Activity

The results of the research journal showed that most patients with post-stroke cognitive impairment were given physical activity with a duration of 60 minutes. In the study of Chung et al., (2019) showed that post-stroke patients received one session of Task-Specific Lower Extremity Training (TSLET) for 30 minutes and one session of conventional physical therapy for 30 minutes. In another study conducted by Liu-Ambrose & Eng (2015), post-stroke patients with mild cognitive impairment were given one 60-minute aerobic exercise training session led by a certified fitness instructor. In line with research by Morais et al., (2017) apply aerobic exercise with the method of walking on the ground for 60 minutes which is divided into three parts, namely during the first 15 minutes of walking on the ground until it reaches the target heart rate, the next 30 minutes is to maintain the intensity and then gradually slow down, and the last 15 minutes is cooling activity. In the study of Manuli et al., (2020) the rehabilitation process for cognitive and behavioral disorders to improve the recovery process and patient autonomy using*robotic gait rehabilitation* with a combination of VR performed for 60 minutes per session. In a study conducted by Pang et al., (2018) explored dual- and single-task exercises to evaluate two domains of cognitive function in post-stroke patients with a duration of 60 minutes in each

exercise session. So giving physical activity with a duration of 60 minutes per session can provide benefits in increasing brain neuroplasticity by increasing BDNF levels to improve cognitive function in post-stroke patients.

3.3 Types of Physical Activity

In the type of physical activity in 13 research journals that were applied to post-stroke patients, there were five types of physical activity. Of the five types of physical activity contained in 13 research journals, the majority applied to post-stroke patients is aerobic exercise. In the study of Bo et al., (2018), it was stated that aerobic exercise increases the capacity of neuronal metabolism and oxygen delivery, decreases brain tissue loss, and increases the production of brain-derived neurotrophic factors. The main components of aerobic exercise in this study were endurance, strength, and balance training. The results of the study from Morais et al., (2017) also said that moderate-intensity aerobic exercise can increase serum BDNF. Other than that,

Research from Yeh et al., (2019) showed that aerobic exercise helped in improving general cognitive function as indicated by an increase in MoCA scores 2 times greater than that of anaerobic exercise. Aerobic training is performed using a progressive resistance stationary bicycle. Post-stroke patients warmed up for 3 minutes, followed by aerobic resistance training for 25 minutes, and ended with cooling down for 2 minutes for a total of 30 minutes. The target heart rate during the aerobic period is 40% to 70% of the patient's maximum heart rate. In a study conducted by Plowman et al., (2019) Aerobic exercise is performed on a treadmill that has body weight support (BWS) and the speed/incline is adjusted to maintain a target heart rate zone corresponding to 60% to 80% of peak oxygen uptake (VO2peak). The result of this study is that aerobic exercise can increase serum IGF-1 from post-stroke patients. IGF-1 promotes recovery and repair processes such as angiogenesis, neurogenesis, synaptogenesis, and long-term potentiation.

Based on the description above, it can be concluded that the type of physical activity that can be applied to post-stroke patients is aerobic exercise because it can increase the capacity of nerve metabolism and oxygen delivery, reduce brain tissue loss, and increase the production of brain-derived neurotrophic factors. In addition, it can increase serum BDNF and IGD-1 which play a role in the recovery process and improve cognitive function.

4. Conclusion

Based on the results of research from 13 journals, it shows that physical activity has a significant effect on changes in the cognitive status of post-stroke patients. Researchers found that the effectiveness of physical activity was also influenced by the frequency, duration, and type of physical activity provided to improve and enhance cognitive functionpatientafter stroke. The frequency of giving physical activity can be done with a frequency of 5 times per week with a duration of 60 minutes each session can improve the cognitive function of post-stroke patients. The type of physical activity that can be given to post-stroke patients to improve cognitive function of post-stroke patients is aerobic exercise. Physical activity affects the cognitive function of post-stroke patients as evidenced by an increase in the MoCA (Montreal Cognitive Assessment) and MMSE (Mini Mental State Examination) scores which are used as a measure of cognitive function.

Acknowledgments

All of the Authors thank to the University of Muhammadiyah Malang.

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