

# Active, Passive, and Active-Assistive Range of Motion (ROM) Exercise to Improve Muscle Strength in Post Stroke Clients: A Systematic Review

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**Keywords:** Post Stroke, Muscle Strength, Passive ROM, Active ROM, Active-Assistive ROM.

**Abstract:** Stroke can cause various levels of disorders, such as decreased muscle tone, loss of sensibility in some parts of the body, decreased ability to move sick limbs and incapacity in certain activities so that exercise therapy is one way to accelerate the recovery of patients from injuries and diseases in governance using active or passive movements. This systematic review focuses on giving Range of Motion exercise therapy to muscle strength, with journal search through Science Direct database, Ebsco, Pro Quest, E-Resources, Sage Journal and Google Scholar. The year limit used is 10 years (2007-2017). In general, all of the review 14 journals provide results that the Range of Motion exercise provides benefits as an intervention to increase muscle strength in post-stroke clients because exercise therapy is one way to speed the recovery of patients from paralysis. The goal of Range of Motion exercise therapy is to maintain muscle flexibility and strength, maintain joint mobility and prevent deformity, stiffness and muscle contractures. Some of the Range of Motion exercises describe useful interventions for increased post-stroke client muscle strength. So hopefully stroke patients and families can be motivated to perform activities of exercise therapy for the improvement of self-sufficiency post-stroke patients. The success of exercise therapy is strongly influenced by the patient's own compliance. The recovery therapy should be lived with patience and sincerity as well as motivation to give the result of recovery from the maximum paralysis of stroke.

## 1 BACKGROUND

Stroke is a clinical syndrome with symptoms of local or global brain dysfunction, which can lead to persistent abnormalities over 24 hours or death without other causes except for cardiovascular disorders (WHO, 1982 in Ahmad, 2000). Based on data from the National Center of Health Statistics (NCHS) 2010, stroke ranks third cause of death in the United States after heart disease and cancer (Heart Disease and Stroke Statistics 2010 Update: A Report from the American Heart Association), explains that from 2008, around 795,000 people in the United States suffer a stroke every year, with 610,000 people getting strokes for the first time and 185,000 people with recurrent stroke (NCHS, 2010).

According to Yayasan Stroke Indonesia (YASTROKI, 2012) the number of stroke patients

in Indonesia is the largest and ranks first in Asia. Stroke is also a cause of serious disability settling number 1 worldwide. The results of Basic Health Research (Rikesda) data in 2013 found stroke prevalence in Indonesia of 12.1 per 1000 population. That number rose by 8.3% compared to Rikesda in 2007. The high rates of death and disability caused by stroke are related to the pathophysiological processes occurring within the cerebral tissue. Reduced blood flow to the cerebral blood flow (CBF) may affect cerebral hemodynamics. Changes in cerebral blood flow lead to disturbances in the central nervous system and cranial nerves. Such interference may result in permanent disability of the paralytic device. Physical changes as often experienced by clients are paralysis partial motion, loss of swallowing ability, cognitive impairment, and psychological disorders (Black & Hawks, 2005). This will impact on the ability of clients in their daily activities.

These conditions will affect the psychology of the client post stroke. The way to minimize disability after a stroke is by rehabilitation. Rehabilitation of stroke patients one of them is with exercise therapy. Increased exercise intensity is proportional to improving quality of life. Exercise therapy is one way to speed the recovery of patients from injuries and diseases that in governance use active or passive movements. Passive movement is motion driven by others and the active motion is the motion produced by muscle contraction itself. ROM exercises can be performed on all joints of the body especially in the head region, upper extremity, and lower extremities (Doenges, 2002). Thus an early ROM Practice program on a stroke client that is not contraindicated is one of the physical mobilization programs that must be done immediately.

## 2 METHODS

The method used in this systematic review begins with topic selection, then the keyword is determined to search the journal using English on the giving of Range of Motion exercise therapy to muscle strength, by searching the journal through Science Direct database, Ebsco, Pro Quest, E-Resources, Sage Journal and Google Scholar. The year limit used is 10 years (2007 -2017) and got 14 journals. This search is limited to journals from January 2007 to October 2017. Keywords used are post stroke, rehabilitation, passive ROM, active ROM, active-assistive ROM.

Articles were selected for review based on studies appropriate to the inclusion criteria. The inclusion criteria in this systematic review are Range of Motion (ROM) active, passive and active-assistive for increased muscle strength in post-stroke patients. Search using the above keywords found 25 journals. From all journals obtained in accordance with the theme is 14 journals, then observed and done critical appraisal.

## 3 RESULTS

This review system reviewed 14 journals, all journals discussed the incidence of muscle weakness (immobilization) which is often called hemiparesis that occurs in stroke patients. Research conducted by Fajar Yudha (2014) in the journal The influence of Range of Motion (ROM) on muscle strength of post-stroke patients illustrates the effect of intervention

Range of Motion that maintains or maintains muscle flexibility and strength, maintains joint mobility and prevents deformities, stiffness and contractures. The results showed an increase in the average value of muscle strength first day and day 28 amounted to 0.45. There was an increase in the average value of the joints on the first day and the 28th day of 6.65. Proven dg The results of muscle strength statistics test shows p-test results = 0,001. There is an influence Range of Motion (ROM) to muscle strength of patients post-care stroke. This study was conducted for 4 weeks.

Similar research was also conducted by Kun Ika Nur Rahayu (2015) with the title describing the effect of ROM exercises on motor skills that increase flexibility and wide range of joint motion in stroke patients because ROM exercises can induce rangsangg thus increasing the activity of neuromuscular and muscular chemistry. Stimulation through the neuromuscular will increase the stimulation of the stimulating parasympathetic nerves for the production of asetilcholin resulting in contraction. This is proved by the results of the study found that there is influence of Range of Motion (ROM) training on motoric ability that is result of data analysis by using Paired Sample T-Test statistic obtained p-value <0,05 it can be concluded that H0 is rejected and H1 failed to be rejected. given Range of Motion 2x exercise a day for 7 days. The evaluation of this research was done on the first and the seventh day.

Research with Range of Motion exercise therapy is the effect of Range of Motion (ROM) exercise on muscle strength in stroke patients by Claudia Agustina Sikawin, et al (2014) where the data is taken through direct observation on the respondents to look for pre test and post test data. Previously the patient measured his muscle strength level, after ituresponden given Range of Motion exercises 5 times a day within 10 minutes and performed as much as 8 days of exercise. Next will be re-measured muscle strength levels and proven The existence of the effect of Range of Motion exercise on muscle strength in stroke patients. showed muscle strength score before and after exercises Range of Motion had an average score increase of 3.87. It is explained that Range of Motion exercise therapy is one of the advanced therapies in stroke patients aimed at improving cerebral blood flow, minimizing defects caused to improve motor sensory function.

Similar research is also conducted by Irene H.L., et al (2016), where researchers explain that there is a significant association of weight support exercises

arms and is beneficial for subacute stroke patients with moderate to severe arm disorders, particularly to improve vertical control such as shoulder flexion, and no side effects on the muscles. Training is done for 45 minutes every day, 5 days a week for 5 weeks. Exercise therapy is done in rehabilitation, arms will neutralize the weight of one arm's arm and use both arms where a healthy arm is assisted to support. Furthermore, the movement follows the direction and the gabar by pressing the button of the existing screen then it will deliver a signal to the brain to do movement/ ROM move the hands and arms. In this study explained that through this exercise therapy the patient has his own initiative to move the sick arm. The Interobserver Reliability and Sources of Variation explain that the Range of Motion exercise therapy is done passively (PROM) so that the ROM assessment with standard protocol hydrogoniometer and performed by 2 trained physical therapists resulting in a high interobserver reliability index for all arm movements. Error variance makes a major contribution to the variety of measurement results. Exercise therapy is done 2 times a day for 1 week showing significant improvement.

Results of research conducted by Prok, Winona. et al (2016) where the study included in a Range of Motion active-assistive study where the study used 18 stroke patients given treatment in the form of motion exercises active, ie holding a rubber ball for one (1) month, then muscle strength measured using handgrip Dynamometer. The results showed that there was significant effect of active motion exercises gripping rubber balls on hand muscle strength of stroke ( $p=0.000$ ) because the training of gripping exercises was a mood of the sensory stimuli and the pressure on the end organ receptor encapsulated in the upper ekstermitas. Treatment of excitatory will cause a rapid response to sarf to perform action on the stimulus. This mechanism is called feedback.

The results are supported by research conducted by Ni Made Dwi et al (2016) obtained a significant difference between the value of handheld muscle strength before and after being given a ROM exercise with rubber ball for 10 minutes. It can be said that ROM exercise with rubber ball can increase handheld muscle strength of non hemorrhagic stroke patients who experience weakness if done by the therapist in accordance with the operational standard of ROM exercise procedure with rubber ball as well as the cooperation between the patient and the therapist in the treatment therapy process.

Andika Sulistiawan (2014) mentions in the results of this study found that all stroke patients who do therapy grasping the ball slowly get a recovery of stroke disease they suffered in which the distribution of respondents about grasping the ball before being given numerous interventions among stroke patients who find difficulty in moving their hands. Miftahul Cilia et al (2016) mention the effect of ROM exercise on the degree of stroke joint motion of stroke patients. Another study of ROM exercises on top extremity is Effectivity Range of Motion (ROM) on powers stroke patients limb muscles by Havid et al (2012) where prior to ROM therapy, the degree of patient's muscle strength is classified as degree 1 (only tone change) degree 3 (able to move joints, can defy gravity, not strong against prisoners). After ROM therapy, the degree of patient's muscle strength is classified as 2 degrees (able to move the joints, can not go against gravity) to 4 degrees (capable of moving the joints, can defy gravity, strong against mild resistance). There is a difference (increase) degree of muscle strength of patients before and after therapy ROM with  $p$  value =  $0.003 < 0.05$ . ROM therapy is effective in increasing the muscle strength of the stroke of the stroke patients because ROM therapy effectively can improve the degree of muscle strength ekstermitas non hemorrhagic stroke patients because the goal of ROM exercise it self is to maintain or maintain muscle strength, joints and stimulate blood circulation and prevent deformity. However, unstable patient conditions such as vital signs that often change during illness also become one of the obstacles.

Similar research is also conducted by Murtaqib (2013) showed that there was a difference in the average range of elbow joint motion before the active ROM, ie 125.27 degrees of flexion and extension of 28.27 degrees, after exercise of flexion movement of 136.37 and extension of 8.47 degrees. or in other words there is a significant influence between active ROM exercises against elbow joint motion in stroke patients. Active ROM exercises are performed 3 times a day because ROM exercises can stimulate blood circulation, maintain muscle elasticity and reduce pain and joint stiffness. This is reinforced by Wahyudin's research., et al. (2008) The effect of PNF on the strength of prehension function in hemorrhagic and non-hemorrhagic stroke patients in which this study studied differences in the effect of PNF method on the strength of prehension in hemorrhagic stroke and non-haemorrhagic stroke . Treatment of PNF method therapy therapy to hemorrhagic stroke patients is

beneficial to the enhancement of strength of prehension function.

Research from IB Putu Putrawan., et al (2011) said that the measuring tool to measure handheld muscle strength is handgrip Dynamometer which will be used to determine the strength of the hand grip which will require a combination of action from a number of muscles of the hands and forearms and this action is very important for daily activities. The strength of hand grip is a common method used to estimate the strength of upper extremity muscle. From the results of this study explained that in elderly women have hand grip strength is lower than in men. The strength of hand grips is positively associated with weight and waist circumference, there is an increasingly thinness of the elderly will lower the grip of his hand, and this will lead to the consequent decline in functional quality for basic daily living activity. Most importantly, the results of this study indicate that the elderly population who are in a state of poor nutritional status will experience greater difficulties in independently beraktives in society. The strength of hand grips is positively related to nutritional status. Although once controlled for other variables in the regression analysis, poor nutritional status remains a significant factor determining the strength of hand grips in both men and women.

Another study was also conducted by Gehan A. Younis and Safaa E. Sayed Ahmed (2015) explaining that the results of this study indicate that 50% of patients with ventilation experience pain which is severe before starting a passive motion exercise program. But after 60 minutes of intervention about two-thirds (60%) of critical patients have no pain. Slight changes in the mean score of physiologic parameters after 5 and 20 minutes after intervention compared with the mean score before the intervention was observed. After 60 minutes of intervention, this average score returns to their baseline. Also, the intensity of behavioral pain decreased after 60 minutes compared before the intervention. Based on the findings of this study, it is advisable to conduct early passive motion exercises for ventilated patients in the context of the mobilization protocol. A Journal also mentioned that the effect of duration of stretching of the hamstring muscle group for increasing range of motion in people aged 65 years or older by J Brent Feland ,. Et al (2001) where the stretching protocol for elderly people (65 years) has not been studied to determine the effectiveness of increasing Range of Motion (ROM). The purpose of this study was to determine which of the 3 stretching durations would yield and

retain the greatest advantage in ROM knee extension with the femur held at 90 degrees of hip flexion in a group of elderly individuals.

The Range of Motion is measured once a week for 10 weeks to determine treatment and residual effects. The 60 second stretch yields a higher level of ROM gain (clash 60 seconds 52.4° per week, stretching 30 seconds 51.3° per week, stretching 15 seconds 50.6° per week), which lasts longer than Profits in other groups (group 4 still had ROM 5.4° more 4 weeks after treatment than in pretest compared to 0.7° and 0.8° for groups 2 and 3, respectively). Extremity can experience weakness or paralysis in different degrees depending on the disrupted part. Stroke patients with long-term immobilization conditions will facilitate the formation of DVT, muscle atrophy, contractures and joint pain and decubitus. Range of Motion (ROM) exercise is one form of rehabilitation exercise that is considered very effective to prevent disability in patients with stroke, whether it is active ROM, passive ROM or active-assistive ROM.

## 4 DISCUSSION

In general, all of the reviewed journals provide results that range of motion (ROM) exercise therapy both active, passive and active-assistive provide significant benefits to increased muscle strength and range of upper extremity motion and or articles explaining if ROM exercise therapy is accompanied PNF is a ROM exercise therapy that is structured and sequential with the therapy therapist by the therapist so that the results obtained more leverage.

Stroke disorder function of the nervous system that occurs suddenly and caused by blood circulation disorders in the brain either the clogging of blood vessels of the brain or rupture of blood vessels in the brain where the brain that should get the supply of oxygen and nutrients to be disturbed. Stroke can cause various degrees of disturbance, such as decreased muscle tone, loss of sensibility in some parts of the body, decreased ability to move sick limbs and incapacity in certain activities. Stroke patients who experience weakness on one side of the limb due to a reduction in muscle tone, so unable to move his body (immobilization). The way to minimize disability after a stroke is by rehabilitation. Rehabilitation of stroke patients one of them is with exercise therapy (Mubarak, 2008).

This is in accordance with the Decree of the Minister of Health (KepMenKes) No.1363 / MENKES / SK / XII / 2001, Article 1 that exercise



therapy by physiotherapy is a form of health service aimed at individuals and or groups to develop, maintain and restore motion and function the body throughout the life cycle by using manual handling, improvement of motion, equipment (physical, electrotherapy and mechanical) function and communication training (Menkes, 2001).

Therefore, ROM and early treatment is necessary. According to some studies, the success of motion exercise therapy (ROM) is strongly influenced by the patient's own compliance. As for ROM and treatment should be endured with patience and sincerity, self-motivation of family and close friends is also needed to give healing result from maximal paralysis of stroke, try to adapt to the situation as well as undergo therapy exercises performed by physiotherapy regularly. Previous research has shown that adherence to exercise therapy increases muscle strength and range of paralyzed motion in post-stroke patients. ROM exercises on motor skills include increased flexibility and wide range of joint motion in stroke patients because ROM exercises can induce rangsangg thus increasing activity from neuromuscular and muscular chemistry.

Range of Motion exercise therapy is one of the advanced therapies in stroke patients aimed at increasing brain blood flow, minimizing defects caused to improve motor sensory function. Influence of intervention range of motion is to maintain or maintain flexibility and muscle strength, maintain joint mobility and prevent deformity, stiffness and contractures. Exercise therapy is one way to speed the recovery of patients from injuries and diseases that in pentalaksanannya use active or passive movements. Passive movement is motion driven by others and the active motion is the motion produced by muscle contraction itself. The movements in ROM exercise therapy include flexion, extension, hyper extension, circumcission, abduction, adduction and opposition.

## 5 CONCLUSIONS

Range of Motion (ROM) Exercise Therapy is an effective way of treating muscle weakness or prolonged paralysis, therefore nursing or rehabilitation services should schedule and provide a special place for stroke patients with hemiparesis especially in the rehabilitation process of ROM activity or exercise. As for the family to always supervise, motivate and encourage patients to perform continuity of ROM exercises, regularity of

activities and medical visits. Because the way to minimize disability after a stroke is by rehabilitation. Rehabilitation of stroke patients one of them is with exercise therapy. Increased exercise intensity is proportional to improving quality of life.

All the studies that have been in the study of ROM exercises on post stroke clients can be one alternative rehabilitation intervention in post stroke clients. Where the ultimate goal of client care with stroke itself is to restore physical and psychological abilities. In order for the client is able to adapt to the new conditions, able to adjust and improve quality of life in post-stroke clients. Stroke patients who have hemiparesis are treated immediately to be curative measures such as treatment and hospitalization, rehabilitative action by physiotherapy in the form of Range Of Motion exercise therapy whether active, passive or active-assistive.

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Tabel 1: Summary of studies include.

Author / Year	Sample size	Study Design	Intervention	Outcome	Articles Quality
Fajar Yudha, 2014	consecutive sampling 20 respondents	Quasy Experiment (pre and post test design)	Exercise range of motion to measure muscle strength of patients	The results showed an increase in the average value of muscle strength first day and day 28 amounted to 6.65. Which means There is influence Range Of Motion (ROM) to muscle strength of patients post-care stroke.	Strong
Kun IKA Nur Rahayu, 2015	16 Respondents. Purposive Samling	Cross Sectional (Pre Ekeperimental Pre-post Test One Group Design)	Exercise range of motion to measure muscle strength of patients	Patients were given range of motion 2x daily exercise for 7 days. The evaluation of this research was done on the first and the seventh day.	Moderate
Claudia Agustina Sikawin, et al. 2014	Purposive Sampling 15 Respondents	Quasi Eksperimen with Nonequivalent Control Group Design method	Exercise range of motion to measure muscle strength of patients	Previously the patient measured his muscle strength level, after which respondents were given range of motion exercise 5 times a day within 10 minutes and performed as much as 8 days of exercise. Muscle strength score before and after exercises range of motion had an average score increase of 3.87.	Strong
Irene H.L .,et al. 2016	Prospective single-group cohort study. 48 classified into 3 groups 48 Respondents	RCT	ROM exercise therapy on ArmeoSpring is done for 45 minutes every day, 5 days once a week,	There is a significant association Weight-weight support exercises are beneficial for subacute stroke patients with moderate to severe arms disorders, especially to improve vertical control such as shoulder flexion, and no adverse muscle effects	Moderate
Lex D de jong .,et all. 2012	18 Respondents with Purposive sampling	Cross Sectional (Pre Ekeperimental Pre-post Test One Group Design)	ROM exercise therapy with measurement on range of motion of joints with Hydrogoniometer	The ROM assessment by standard protocol, hydrogoniometer, and 2 trained physical therapists resulted in a high interobserver reliability index for all arm movements.	Moderate
Prok, Winona.et al. 2016	13 respondents Non Probabilty sampling with Purposiv sampling	Quasi Experiment (pre and post one group design)	Active motion exercises, ie holding a rubber ball for one (1) month, then muscle strength measured using handgrip Dynamometer.	The results showed that there was significant effect of active motion exercises gripping rubber ball against hand muscle strength of stroke (p = 0,000)	Strong
Ni Made Dwi et al : 2016)	10 Respondents Total Sampling	pre-eksperimental One Group PreTest-PostTest and Paired T-test	ROM exercises with rubber balls for 5 to 10 minutes in non hemorrhagic stroke patients		Moderate

Andika Sulistiawan, 2014	50 respondents with 25 control groups and 25 intervention groups Total Sampling	pre experiment (pre-post test design)	Exercise therapy holds a rubber ball to assess muscle strength	From result of research got average value of handheld muscle strength of non hemorrhagic stroke patient before given ROM training with rubber ball that is 8,46. And the average value of handheld muscle strength after being given ROM exercise with rubber ball for 5 to 10 minutes has increased ie 11.23. Based on result of paired t-test shows that result p value = 0.0001	Strong
Miftahul Cilia et all, 2016	Non Probability with accidental Sampling method 56 Respondents	Pre experiment Purposive sampling (pre-post test design)	ROM exercise therapy to measure range of motion of the joints	The results of this study found that all stroke patients who do therapy grasping the ball slowly get a recovery against stroke that they suffered in the distribution of respondents about holding the ball before the intervention was given many among stroke patients who find difficulty in moving his hands.	Strong
Havid et all, 2011	30 Respondents Total Sampling		ROM exercise therapy to measure muscle mass disorder		Moderate
Murtaqib. 2013	16 Respondents Purposive sampling	pre eksperimental one design pretest-postest non random	Exercise ROM Therapy Exercise Flexion Extension	The result of this research is that the pre test of motion range of respondents most of the category dg not at all have the ability to do joint motion of 87.5%, and perform the range of motion of joints with partial category (12,5%). showed that most respondentst dg category did joint motion of equal to 81,3% and dg tdk totally have ability to do range of motion of joints is equal to (18,8%)	Strong
Wahyudin., et al. 2008	91 Respondents Consist of 38 males, 53 females	Experiment (two group pretest post test)	ROM exercise therapy with PNF method to measure Prehension Function in Hemorrhagic Stroke and Non Hemoragic	After ROM therapy, the degree of patient's muscle strength is classified as 2 degrees (able to move the joints, can not defy gravity) to 4 degrees (capable of moving the joints, against gravity	Moderate
IB Putu Putrawan., et al. 2011	Random Sampling 40 Respondents	Quasi eksperimental with pre test and post test design approach	ROM exercise therapy for the elderly to mnegukur handheld with Handgrip Dynamometer		
Gehan A. Younis and Safaa E. Sayed Ahmed, 2015		Quasi eksperimental	Passive ROM exercise therapy	The results showed that there was a difference in the average range of elbow joint motion before the active ROM, ie 125.27 degrees of flexion and extension of 28.27 degrees, after exercise	



		<p>quasi experimental design.</p>		<p>of flexion movement of 136.37 and extension of 8.47 degrees. Or in other words there is a significant influence between active ROM exercises against elbow joint range in stroke patients</p> <p>There was no significant difference in the effect of PNF treatment on hemorrhagic stroke and non-hemorrhagic healing stroke phase to increase the strength of prehension function.</p> <p>From the results of this study can be concluded that in women elderly women have a lower hand grip hand than men</p> <p>These results indicate that 50% of ventilated patients experience severe pain before starting a passive motion exercise program. But after 60 minutes of intervention about two-thirds (60%) of critical patients have no pain.</p>	
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