



## Electronic-Module Range of Motion on Family Caregivers in Increasing Muscle Strength in Stroke Sufferers

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### Abstract

The level of dependence of stroke sufferers on family caregivers will increase along with the complications experienced by stroke sufferers. The role of the family is to contribute to the rehabilitation process at home in the form of physical and psychosocial benefits. One effort can be made by providing Range of Motion exercises to stroke sufferers. Different family backgrounds and the importance of empowering the role of family caregivers require media that is informative and can be accessed anywhere. This study aimed to test the effectiveness of the Electronic-Module Range of Motion (E-ROM) for family caregivers in carrying out ROM and assessing muscle strength in stroke sufferers—a quasi-experimental research design with a pretest-posttest control group design. Research analysis used the Wilcoxon Test and Mann-Whitney Test. The sample consisted of 46 respondents for the treatment group and control group. The intervention provided E-Module ROM exercises were given to family caregivers, and assistance was provided. ROM exercises for stroke sufferers are carried out twice daily for two weeks. Health education with Electronic-Module Range of Motion (E-ROM) can increase muscle strength in stroke sufferers.

### Introduction

Sensory and motor disabilities are the main complications of stroke, which cause varying degrees of dependency in patients. These complications make it difficult, or even impossible for stroke patients to carry out daily activities (Ashghali Farahani *et al.*, 2021). Spasticity is a sequel of stroke. Stroke sufferers experience motor disorders such as decreased muscle strength and muscle atrophy (Adeel *et al.*, 2023). This disorder causes limitations in performing range of motion, where the joints cannot rotate optimally, which hinders carrying out daily activities. Stroke sufferers with spasticity will increase medical costs, reduce quality of life, and increase the burden on caregivers (Pop *et al.*, 2021; Wafa *et al.*, 2020). The medical team involved in treating stroke patients is currently less than optimal in preventing neurological complications. It is due to several things, including ineffective management protocols for stroke patients,

lagging behind recommended guidelines, lack of skilled human resources, inappropriate treatment methods, and diagnostics (Fekadu *et al.*, 2019).

Family caregivers are family members who provide physical, emotional, and instrumental support or assistance to individuals with illnesses that limit their lives (Van Driel *et al.*, 2021). Family caregivers providing care experience disturbances in emotions, physical health, social life, disruption of social relationships, spiritual stress, and tension. Role and financial crisis (Ashghali Farahani *et al.*, 2021); (Azizi *et al.*, 2020); (Choi & Seo, 2019). The role of the family as caregivers in the home care process is often carried out independently without any support from health workers, whether from nurses, doctors, physiotherapists, and other health workers (Azali *et al.*, 2021). This is the family caregiver burden, which is a multidimensional response and negative assessment in providing care to

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stroke patients. Therefore, the role of family members as caregivers is vital in reducing mortality and morbidity (Pedersen *et al.*, 2021).

Families can provide care to stroke sufferers at home by helping with ROM (Range of Motion) exercises. Range of motion training can be done actively, where the patient trains their range of motion independently, or passively, where the patient trains their range of motion with assistance. In a literature review regarding the effect of ROM exercise on muscle strength in stroke sufferers, it was also concluded that ROM exercise can increase muscle strength and joint movement ability in stroke sufferers. The level of dependence of stroke sufferers on family caregivers will increase along with the complications experienced by stroke sufferers (Hamre *et al.*, 2021; Tosun & Temel, 2017). The role of the family is to contribute to the rehabilitation process at home in the form of physical and psychosocial benefits that can be achieved by providing Range of Motion exercises to stroke sufferers. Besides that, family involvement requires policies and a supportive environment (Lawler *et al.*, 2019). Different family backgrounds and the absence of standard treatment given to stroke sufferers after hospital treatment. Such as assistance with Range of Motion exercises for family caregivers and empowering the role of other family caregivers. So, we need informative media that

can be accessed anywhere.

#### Method

The population of this study were all stroke sufferers in the Yogyakarta City area. The sampling technique in this research is consecutive sampling. The inclusion criteria are family caregivers who live in the same house as stroke sufferers and family caregivers as members of the nuclear family. The exclusion criteria for this study were stroke sufferers who received health care at home from professional health workers and stroke sufferers with normal dependency. These stroke sufferers received inpatient care at health services and family caregivers with a health education background. The analysis used the Wilcoxon test for the difference between two paired samples and the Mann-Whitney test for unpaired samples. All groups measured muscle strength using the Manual Muscle Test (MMT) method. Then, the intervention group was given an intervention by providing the E-ROM Module and was assisted by researchers to carry out ROM exercises. ROM exercises were carried out twice a day for two weeks. After two weeks, the intervention group and the control group had muscle strength measured. This study was approved by the ethical commission of The Faculty of Health, University of Jenderal Achmad Yani Yogyakarta, with letter number SKep/431/KEP/VIII/2023.

Table 1. Characteristics of Family Caregivers Based on Gender, Education, Occupation, and Relationship with Sufferers

Characteristics of Family Caregivers	Treatment Group (n=23)		Control Group (n=23)	
	n	%	n	%
Gender				
Male	5	21.7	7	30.4
Female	18	78.3	16	69.6
Education				
Illiterate	0	0	2	8.7
Elementary school	4	17.4	6	26.1
Junior High School	6	26.1	7	30.4
Senior High School	11	47.8	5	21.7
Bachelor	2	8.7	3	13
Occupation				
Unemployment	3	13	6	26.1

Laborer	9	39.1	7	30.4
Farmer	1	4.3	6	26.1
Enterprenur	3	13	3	13
Private employe	7	30.4	1	4.3
Relation to patient				
Husband	13	56.5	14	60.9
Wife	4	17.4	6	26.1
Children	5	21.7	1	4.3
Son in law	1	4.3	2	8.7

Table 2 Characteristics of Family Caregivers Based on Age and Length of Time Caring for Stroke Sufferers

Characteristics of Family Caregivers	Treatment Group (n=23)			Control Group (n=23)		
	Min	Max	Median $\pm$ SD	Min	Max	Median $\pm$ SD
Age	35	79	53.09 $\pm$ 9.534	30	69	53.52 $\pm$ 10.937
Length of time caring	1	120	33.61 $\pm$ 30.714	1	60	25.11 $\pm$ 18.695

Table 3 Differences in Muscle Strength in Stroke Sufferers

Variabel	Treatment Group (n=23)			Control Group (n=23)			P
Muscle strength	Min	Max	Median $\pm$ SD	Min	Max	Median $\pm$ SD	
Before	1	4	3.22 $\pm$ 0.902	1	5	3.3 $\pm$ 0.876	0.707b 0.499b
After	1	4	3.43 $\pm$ 0.945	2	5	3.35 $\pm$ 0.885	
P	0.025a			0.317a			

\*a Wilcoxon

b Mann-Whitney U

## Result And Discussion

Based on Table 1 regarding the characteristics of respondents, most of the respondents were female (treatment group 78.3% and control group 69.6%), labor occupation (treatment group 39.1% and control group 30.4%), and relationship with sufferers. as husband (treatment group 56.5% and control group 60.9%). For educational characteristics, the highest number was high school at 47.8% in the treatment group and junior high school at 30.4% in the control group.

Based on Table 2, the average age was higher in the control group at 53.52 years, and the average length of care in the treatment group was 33.61 months. Based on Table 3, the

muscle strength of stroke sufferers shows that in the treatment group, there was a difference in mean muscle strength before treatment and after treatment with a p-value of 0.025; however, muscle strength in the control group showed no difference in mean with a P value of 0.317. There was no difference in mean muscle strength before the treatment and control groups with a P value of 0.707, and muscle strength after treatment was found to have no difference with a P value of 0.499. However, based on the data, the difference between the mean in the control and treatment groups is more significant in the treatment group (0.21) than in the control group (0.05). Range of Motion (ROM) shows that it is easier for patients and families to learn

and remember with digital and video facilities. Still, for older family caregivers, sometimes attached poster media must be included. This is due to a need for more exposure to technology. The characteristics of the respondents in this study were that the average age was 53 years, so an extraordinary approach was needed to assist.

Electronic-Module Range of Motion (E-ROM) is an external resource as a medium that is expected to reduce the workload of family caregivers and increase efficiency in caring for stroke patients. This finding is consistent with previous research, which revealed that supportive educational group interventions can reduce the burden (Deepradit *et al.*, 2023). Apart from that, this electronic digital media will reduce obstacles in terms of travel, time, and costs, although it is considered lacking in terms of closeness of communication with health workers (Appireddy *et al.*, 2019; Chan-Nguyen *et al.*, 2022). However, there is research in critical care that shows no difference in satisfaction or decision-making between virtual and face-to-face family meetings (De Havenon *et al.*, 2015). This research could be an alternative to stroke rehabilitation at the family level. Our analysis provides positive values regarding the feasibility and effectiveness of Electronic-Module Range of Motion (E-ROM) media in stroke care.

The media used in this research is digital module media, which contains the basic concepts of ROM, leaflets on how to do ROM, and ROM help videos. Electronic digital media helps family caregivers remember what they have learned in the range of motion training program so that, in the long term, these skills can become media that can be opened at any time. This measure has the potential to alleviate the challenges experienced by family caregivers. This finding aligns with the research conducted by Wu *et al.*, (2020), showing the provision of healthcare education, knowledge, and psychological support potentially mitigates stress levels and enhances the overall well-being of individuals affected by stroke and their family caregivers. ROM is a low-cost nursing intervention that can be implemented by stroke sufferers and the families who care for them. ROM can increase joint flexibility and range of motion in stroke sufferers by increasing

neuromuscular and muscle chemical activity. Neuromuscular stimulation increases the excitability of parasympathetic fibers, which then produce acetylcholine, which causes contractions. The muscle mechanism in the smooth muscles of the extremities will increase mitochondrial metabolism to create ATP, which will be utilized by the extremity muscles to contract and increase smooth muscle tone. ROM can increase blood circulation and oxygen supply, thereby optimizing metabolism (Nissa & Sari, 2022).

The muscle strength of stroke sufferers showed that in the treatment group, there was a difference in the average muscle strength before treatment and after treatment, with a p-value of 0.025. However, muscle strength in the control group did not show a mean difference with a P value of 0.317. It can be confirmed because the control group did not receive optimal and regular ROM training, so there was no increase in flexibility. Weak muscles exhibit alterations in mechanical characteristics associated with muscle fiber dimensions due to sarcomere depletion, differences in collagen content, and distribution of tendon fibers. The structural alterations lead to contractures and shortening, which disrupt muscle function and cause functional impairments in individuals who have experienced a stroke (Galvão *et al.*, 2024). Apart from that, there are other influencing factors, namely lesions and the size of the lesions in the brain of stroke sufferers (Pradines *et al.*, 2022).

The application of ROM exercises needs to be adapted to the condition of stroke sufferers, using either passive ROM or active ROM. ROM exercises must be done twice daily, and each movement must be repeated eight times. Repeated therapy sessions are necessary to restore lost movement regarding range and joint strength (Hussain *et al.*, 2017). This focused ROM exercise will increase chemical, muscle, and neuromuscular activity in the recovery of stroke sufferers (Syahrim *et al.*, 2019). However, when this exercise is not carried out routinely on limbs that experience paresis, it will result in a decrease in the number of motor units recruited in spastic muscles during voluntary movements. After the first attack, muscle strength can be lost by up to 73%, leading to

a poor prognosis in the chronic phase (Galvão *et al.*, 2024). Several respondents in the study stated that they felt pain in areas experiencing weakness. This could be due to increased lactate concentration in the blood compared to healthy individuals (Klaer *et al.*, 2017). Anaerobic glycolysis produces lactic acid, which is the result of spastic muscles' incapacity to keep oxidative function in their muscle fibers. This results in an accumulation of hydrogen ions and increased muscular acidosis, which causes tiredness. It is caused by a decrease in the recruitment of type I fibers and an increase in the recruitment of type II fibers. According to research, baseline lactate levels in people who have had a stroke are 18.5% higher than in people in the same age group who are in good health (Dos Santos *et al.*, 2017). In addition, inflammatory alterations resulting from spastic muscles and the glenohumeral joint, as well as muscle exhaustion, can also induce discomfort (Das Neves *et al.*, 2024).

ROM exercises can also improve primary muscle coordination. A stroke rehabilitation program in the first three months after a stroke can increase the chance of more optimal motor recovery than the expected natural recovery process. This period is considered a favorable time to carry out rehabilitation (Pallarés *et al.*, 2021). If weakness on one side of the body is not treated correctly, it can cause complications such as muscle tone disorders, deep vein thrombosis, and contractures. Stroke sufferers experience paralysis due to loss of nerve supply to muscles due to disturbances in the lobes of the brain. So, the muscle does not receive contraction signals to maintain standard muscle size. Muscle fibers will be damaged and replaced by fibrous tissue and fatty tissue. The fibrous tissue that functions as a replacement tends to shorten, resulting in decreased joint activity and ending in joint stiffness. Lack of activity over a long period causes muscle atrophy and decreased joint range of motion (Hall & Hall, 2020).

Limited local blood supply and the build-up of free fatty acids due to a restricted range of motion in the joint can also lead to discomfort, early tiredness, muscular weakness, and decreased muscle flexibility (Das Neves *et al.*, 2016). Contractures manifest in individuals

who have experienced a stroke as a result of a confluence of vascular and metabolic alterations, alongside modifications in the structural properties of spastic muscles. These alterations encompass the presence of collagen fibers and the build-up of fibrous tissue, accompanied by a gradual decline in muscle fibers (Lee *et al.*, 2015). A vicious cycle of alterations, including modifications to peripheral soft tissues that lessen the potentiation of reflex mechanisms and spasticity, can be triggered by immobility. In the end, muscle fibrosis and a reduced range of motion and function are caused by these peripheral alterations (Rao *et al.*, 2021). To maximize recovery and prevent stroke complications and repeated stroke attacks, early stroke care management is essential (Darussalam *et al.*, 2022), because 20%–40% of stroke survivors develop spasticity, which can raise treatment costs to four times, range of motion training is therefore necessary (Sankaran & Raj, 2022).

## Conclusion

Health education with E-Module Range of Motion (E-ROM) can increase muscle strength in stroke sufferers. The study suggests implementing ROM exercises is very important to optimize recovery and avoid stroke complications.

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