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The Effect of Bilateral Range of Motion (ROM) on Increasing Upper Arm Muscle Strength in Stroke Patients

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Abstract

Introduction: In cases of stroke, there are several clinical manifestations, one of which is muscle weakness or hemiparesis. A rehabilitation program used to improve patient mobility involves exercise activities. Exercise therapy, such as range of motion (ROM) exercises, involves joint movements through their entire range in all appropriate directions. Objectives: This study aims to determine the effect of bilateral ROM on the improvement of upper limb muscle strength in stroke patients. Methods: This study employed a quantitative research design known as a one-group pre-test and post-test design. Twenty-four respondents were selected using purposive sampling technique at Dr. Sitanala Hospital, Tangerang. Data collection involved two instruments: Bilateral ROM Checklist and Muscle Strength Value Guide. Prior to intervention, respondents underwent muscle strength assessment. Following the intervention, on the fifth day, researchers conducted a post-test by re-measuring muscle strength. Data analysis utilized the paired t-test. Statistical analysis using the dependent t-test (Paired simple t-test) revealed that out of 24 respondents, the mean pre-test score was ± 3.38, and the mean post-test score was ± 4.50. Statistical results yielded a p-value of 0.000 ($\alpha < 0.05$), suggesting a significant effect of Bilateral Range of Motion (ROM) on muscle strength improvement. Results: There is a significant effect of Range of Motion (ROM) on muscle strength improvement in stroke patients. This study demonstrated that it took 5 days to increase muscle strength from a pre-intervention mean of 3.38 to 4.50 post-intervention. Conclusion: Range of Motion can increase muscle strength in stroke patients, it can be used as an adjunct to nonpharmacological therapy.

Keywords: Muscle Strength, Range of Motion; Stroke

INTRODUCTION

Stroke is a condition where the brain lacks sufficient oxygen and nutrients, leading to the death of brain cells. Accourding to American Heart Association (AHA) in 2023, globally, there were approximately 101.5 million people who experienced a stroke in 2019 (American Stroke Association, 2023). The Ministry of

Health of the Republic of Indonesia (2019) indicates that the prevalence of stroke in Indonesia has seen an increase in stroke incidence rates from 2013 to 2018, with 7 cases in 2013, and rising to 10.9% in 2018 (Kementrian Kesehatan RI, 2019).

Stroke is a condition in which the flow of oxygen and nutrients to the brain through arteries is obstructed by blockages or ruptures of blood vessels, resulting in parts of the brain experiencing a lack of blood supply and oxygen, leading to the death of brain cells (American Stroke Association, 2020).

Hemiparesis is a condition commonly caused by stroke, cerebral palsy, multiple sclerosis, brain tumors, and other nervous system disorders. Stroke, essentially, is a clinical syndrome that arises suddenly and progresses rapidly, causing focal neurological deficits lasting for 24 hours or more, or it can directly lead to death. Stroke is typically caused by non-traumatic disruptions in brain blood circulation (Halim et al., 2016). If movement limitations and muscle weakness are not promptly addressed, further complications may occur, such as contractures. Contractures are conditions where muscles or connective tissues undergo shrinkage and hardening, leading to joint movement restrictions. Therefore, it is important to provide comprehensive treatment, including rehabilitation therapy and medical interventions (Fitriani et al, 2022).

A rehabilitation program used to improve patient mobility involves exercise activities. Exercise therapy, such as Range of Motion (ROM) exercises, entails joint movements throughout their full range in all appropriate directions. Currently, ROM exercises tend to be focused only on the weak side of the body (unilateral), while the healthy side does not receive structured ROM exercises. The research findings by Cahyati et al. (2013), It was found that muscle strength increased after the implementation of ROM exercises, both bilaterally and unilaterally. However, there is a difference between unilateral and bilateral ROM exercises, where bilateral ROM exercises are considered more effective in improving muscle strength compared to unilateral ROM exercises (Cahyati et al., 2013).

Bilateral Range of Motion (ROM) exercises involve both limbs of the client, whether paralyzed or not. In stroke patients with hemiparesis, bilateral ROM exercises can include active ROM exercises for both the affected and unaffected limbs. Both types of exercises are performed simultaneously and symmetrically.

Currently, bilateral ROM exercises are mainly performed using passive ROM, while for patients who have already experienced muscle strength improvement, regular bilateral ROM exercises are rarely conducted, and the focus is more on the affected area only. Based on the phenomenon above, this research aims to determine whether bilateral ROM can influence or enhance muscle strength in stroke patients.

METHOD

This study is quantitative research with a quasi-experimental design using a one-group pre-test and post-test design. The sample used in this study consisted of 24 respondents. The inclusion criteria included Non-Hemorrhagic Stroke Patients, experiencing Hemiparesis, never underwent ROM therapy, patients aged 45 – 85 years old, stroke patients with muscle strength values ranging from 3 – 4 on the scale. The exclusion criteria were: experiencing a decrease in consciousness, unstable hemodynamics, stroke patients who refused to participate as respondents, patients unable to perform ROM or experiencing pain. This research was conducted at Dr. Sitanala Hospital, Tangerang in March 2024. The instrument used in this study was an observation sheet for ROM Bilateral muscle strength scores, which was obtained by modifying a previous study (Cahyati et al., 2013) and (Sholihany et al., 2021).

In this study, the intervention was conducted in the morning and afternoon. Prior to this, the researcher demonstrated the intervention to be performed. Subsequently, the researcher measured the muscle strength scale before the intervention was given. The recommended intensity of ROM exercises showed quite varied results. In theory, there are no specific guidelines regarding the intensity of bilateral ROM exercises. However, various literature and research findings on the benefits of ROM exercises can be used as references in implementing ROM exercises as one of the interventions. For the respondents, bilateral ROM therapy will be provided twice a day for 5 days with a frequency of 10 repetitions for each movement. On the fifth day, the researcher conducted a post-test by measuring the strength of the upper limb muscles without intervention.

Data collection was carried out by the researcher when introducing themselves, explaining what the researcher would do, and obtaining informed consent. This study used univariate and bivariate analysis using SPSS. Ethical clearance for the study was obtained from Dr. Sitanala Hospital, Tangerang with Number: No.DP.02.01/XXXI.2.1.2/0014/2024.

RESULT

Based on Table 1, it is shown that some respondents are 60 years old, totaling 7 individuals (30.5%). In terms of gender characteristics, most respondents are male, with 14 individuals (58.3%). Regarding the history of diseases, the majority of respondents have a history of illness, totaling 16 individuals (66.7%).

Table 2 shows the average (mean) muscle strength before Range Of Motion (ROM) intervention for 24 respondents, with a mean of 3.38. The lowest muscle strength value is 3 and the highest is 4. Meanwhile, the average (mean) muscle strength after the ROM intervention for 24 respondents is 4.50, with the lowest muscle strength value being 4 and the highest being 5.

Before conducting bivariate analysis, a normality test was performed first. The normality test

was conducted to determine whether the data is normally distributed or not. This study used the Shapiro-Wilk test because the sample size in this study is 24 samples. Table 3 shows the results of the normality test on pre-test muscle strength data, which is normally distributed with a p-value of 0.052 > 0.05, and post-test muscle strength data with a p-value of 0.072 > 0.05, indicating normal data distribution for both. Therefore, it can be concluded that the data distribution is normal. Thus, the bivariate statistical test to be used in this study is the dependent t-test (paired sample t-test).

Table 4 presents the results of the statistical test using the dependent t-test (paired sample t-test), showing that out of 24 respondents, the mean pre-test value is ± 3.38 and the mean post-test value is ± 4.50. The statistical test results yielded a p-value of 0.000 (α < 0.05), indicating a significant difference before and after the intervention. Therefore, it can be concluded that the alternative hypothesis is accepted, meaning that there is an effect of Range Of Motion (ROM) on increasing muscle strength in stroke patients.

Table 1. Frequency Distribution of Respondent Characteristics Based on Age, Gender, Medical History (n=24_)

Characteristics	n	%
Age		
52 years	2	8,7%
53 years	1	4,3%
57 years	1	4,3%
58 years	3	13,0%
60 years	7	30,4%
70 years	3	13,0%
73 years	6	26,1%
Gender		
Male	14	58,3%
Female	10	41,7%
Medical History		
Yes	16	66,7%
No	8	33,3%

Source: Primary Data, 2024

Table 2. Distribution of Average Muscle Strength Before and After Range of Motion (ROM) Intervention.

Variable	Mean	Std.Deviasi	Min-Max	95%CI
Pre-Test	3,38	0,495	3-4	3,17-3,58
Post-Test	4,50	0,511	4-5	4,28-4,72

Source: Primary Data, 2024

Table 3. Normality Test of Muscle Movement Strength before and after Bilateral Range of Motion (ROM) Intervention

Muscle Movement Strength	Statistic	Sig.
Pre-Test	0,918	0,052
Post-Test	0,924	0,072

Source: Primary Data, 2024

Table 4. Comparison of the Average Increase in Muscle Movement Strength Before and After Bilateral Range of Motion (ROM) Intervention

Muscle Movement Strength	Mean	Std. Deviasi	p-value
Pre-Test	3,38	0,495	0,000

Post-Test	4,50	0,511

Source: Primary Data, 2024

DISCUSSION

Hemiparesis is a condition where muscle strength is reduced on one side of the body. Hemiparesis involves weakness, but not complete loss of motor function. Conversely, there is some retention of movement capability on the affected side, although with varying degrees of weakness. (Retnaningsih, 2023).

In stroke patients experiencing muscle weakness and not receiving Range of Motion (ROM) exercises, contractures may occur, leading to muscle weakness, contractures, and decreased skeletal muscle function. Therefore, it is important for stroke patients to perform movements on their limbs at least twice a day to improve their motor strength and accelerate the healing process, thus reducing their dependence on others. Each movement will cause the muscles to work and tense, which can help restore muscle function and increase strength for contraction. This indicates that Range of Motion (ROM) exercises are an effective method in restoring muscle strength in stroke patients. (Wulan & Wahyuni, 2022).

In this study, it was found that there is an influence of Range of Motion on the increase in muscle strength in stroke patients. Essentially, ROM exercises can generate stimulation, thereby enhancing activation of chemical, neuromuscular, and muscular processes. Stimulation through neuromuscular pathways will enhance the nerve fibers of the limb muscles, particularly the parasympathetic nerves that stimulate acetylcholine production, resulting in muscle contractions. (Hall, 2019).

The recommended intensity of ROM exercises shows varied results. In this study, it took 5 days to increase muscle strength from a pre-intervention mean of 3.38 to 4.50 post-intervention. In theory, specific guidelines regarding the intensity and frequency of ROM exercises are not mentioned. However, all indicate an increase in muscle strength capacity after ROM exercises. The results of a study conducted by Cahyanti (2013) showed that ROM was performed twice a day for 7 days with an intensity of 10 repetitions for each movement (Ariyanti et al., 2013) It mentions that both unilateral and bilateral ROM were performed in the study for 5 days with twice-daily treatment. The research results indicate that the respondents experienced improvement in range of motion activity function.

Bilateral ROM exercises are expected to yield more optimal results compared to unilateral hand exercises. This is because unilateral exercises only stimulate one side of the brain, whereas bilateral exercises involve both hemispheres of the brain. In a different manner, during unilateral approach exercises, movements only engage one side of the brain. Meanwhile, exercises performed bilaterally produce better results because both hemispheres of the brain remain active and motor strength in both hands can be maintained (Cahyati et al., 2013).

Bilateral ROM exercises, also known as the Neuro Developmental Approach (NDA), are a training method applied to both sides of the body, including the affected and unaffected sides. Bilateral exercises can improve hand function in patients with paresis, which can be explained through the transcallosal mechanism. When performing bilateral exercises and monitoring with transcranial magnetic stimulation, it was found that the activity of both brain hemispheres decreased in Intra-Cortical Inhibition (ICI). These exercises lead to improved skills in both brain hemispheres and indicate that after bilateral training, Intra-Cortical Inhibition (ICI) decreases and Intra-Cortical Function (ICF) increases on both sides of the brain (Hutagalung. M Siregar, 2021).

CONCLUCION

In conclusion, it was found that this exercise has an effect on Range of Motion in increasing muscle strength in stroke patients. Based on the research results, the mean muscle strength before bilateral Range of Motion exercises for 24 respondents was 3.38, with a minimum muscle strength of 3 and a maximum of 4. After undergoing Range of Motion exercises, the mean muscle strength was 4.50, with a minimum muscle strength of 4 and a maximum of 5.

For future research, additional variables could be added, such as a comparison between unilateral and bilateral exercises. The research focus should preferably be on non-hemorrhagic stroke types with a longer duration of study, corresponding to the recovery time of hemorrhagic stroke patients, such as for one month.

Conflict of Interest

There are no conflicts of interest among the authors.

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