

ORIGINAL ARTICLE

Effect of Range of Motion Exercise With Rubber Balls on The Strength of Muscle Grasp in Non- Hemorrhagic Stroke Patients in Buleleng, Bali, Indonesia

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ABSTRACT

Introduction: A key issue for non-hemorrhagic stroke patients is motor impairments, particularly hand dysfunction, affecting 88% of survivors. Nursing assist non-hemorrhagic stroke sufferers in recovering movement frequently include rubber ball therapy. There is a lack of research isolating non-hemorrhagic stroke patients, who may have different muscle recovery patterns and neuroplastic responses. While grip-strength training and ROM exercises are common in stroke rehab, few studies examine rubber ball exercises specifically as the primary intervention. **Method:** This study involved 13 participants aged 55 to 69 and aimed to find effective strategies for recovery in Bali, Indonesia. It focused on how range of motion (ROM) exercises with rubber balls impact grip muscle strength. The research utilized a pre-experimental one-group pretest-posttest approach and analyzed results with the paired t-test. Data was collected using a Hand Grip Dynamometer and standardized observation forms, following an established standard operating procedure (SOP) that ensured consistent grip measurements and muscle strength ratings. The exercise protocol involved patients holding a rubber ball with their wrist at 45 degrees, performing maximal contractions for 5 seconds followed by a 5-second rest. Each patient completed two sessions a day over eight days, performing 14 repetitions daily. Therapists guided progressive overload, helping patients gradually increase grip strength while ensuring safety. **Results:** showed a significant improvement in muscle strength and functional hand movement, with p-values under 0.0001 confirming the effectiveness of the training program. **Conclusion:** Average grip strength increased significantly, demonstrating that structured ROM exercises with rubber balls are beneficial for stroke recovery. *Malaysian Journal of Medicine and Health Sciences* (2026) 22(SUPP9):49-52. doi:10.47836/mjmhs.22.s9.8

Keywords: ROM, Therapy Gripping A Rubber Ball, Muscle Strength, Non-Hemorrhagic Stroke, Stroke Rehabilitation

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INTRODUCTION

Stroke continues to be one of the major public health issues worldwide. It is identified as the second most common cause of death and the third most prevalent cause of both death and disability when assessed using disability-adjusted life-years (DALYs) (1,2). According to the World Health Organization and recent Global Burden of Disease studies, approximately 12.2 million people worldwide experience with stroke annually, resulting in 6.5 to 7.3 million deaths (3,4). The economic burden of stroke is staggering, with global costs exceeding US\$890 billion annually, representing approximately 0.66% of global GDP (1,2). From 1990 to 2021, incident of strokes increased by 70%, prevalent strokes by 85%, and deaths from stroke by 44%, with most of the burden

in low- and middle-income countries (3-5). Alarming, stroke incidence among young adults aged 18–44 years grew 14.6% between 2011–2013 and 2020–2022, largely due to rising obesity, diabetes, hypertension, and sedentary lifestyles (5,6). Pathological subtypes include hemorrhagic and non-hemorrhagic stroke, the latter accounting for 70–85% of cases and primarily caused by vascular obstruction or insufficient cerebral perfusion (3,7,8). Motor impairments, especially hand dysfunction, affect approximately 80–88% of stroke survivors, reducing autonomy and quality of life (7-9).

Upper extremity motor function recovery is a central focus in rehabilitation, given its impact on patient independence and capacity for daily activities (10,11). Upper limb impairments after stroke limit essential activities like feeding and dressing, leading to a poorer quality of life. Approximately 80% of individuals who have experienced an acute stroke and over 55% of those with a chronic stroke experience difficulties in using their upper limbs. About 30% of these patients

have challenges in managing precise movements. Because the upper limbs have extensive cortical nerve innervation, damage tends to be more severe and requires longer rehabilitation compared to the lower limbs (12). Effective, accessible rehabilitation strategies are critical, especially in resource-limited settings (7,13).

Exercises that involve gripping a rubber ball while focusing on range of motion (ROM) have become useful, affordable, and efficient methods to enhance grip strength and motor skills. These exercises help by encouraging the integration of sensory and motor functions and supporting neuroplasticity. Evidence suggests that these exercises facilitate cortical reorganization and can be implemented in various care settings with minimal equipment. When applied with gradual increases in difficulty and support from a therapist, rubber ball therapy has been proven to greatly enhance grip strength in individuals who have experienced a non-hemorrhagic stroke. (14-16).

Most available studies measure short-term improvement. There is a gap in understanding whether rubber-ball ROM exercises lead to sustained grip strength gains, functional improvements (ADLs), long-term neuro-motor improvement. Most existing studies on hand-grip rehabilitation involve mixed stroke populations or focus on hemorrhagic stroke. There is a lack of research isolating non-hemorrhagic stroke patients, who may have different muscle recovery patterns and neuroplastic responses. While grip-strength training and ROM exercises are common in stroke rehab, few studies examine rubber ball exercises specifically as the primary intervention. The effectiveness, optimal intensity, and frequency of this specific modality remain unclear.

Stroke continues to be a major reason for lasting disability, and one of the most frequent functional difficulties following a non-hemorrhagic stroke is reduced strength in muscle grasp. This limitation hinders self-sufficiency in everyday activities like using utensils, getting dressed, writing, and personal care. Although there is a significant demand for efficient rehabilitation methods, numerous patients, particularly in areas with limited resources, do not have access to sophisticated rehabilitation equipment.

There is an urgent need to identify low-cost, accessible, and easily implemented interventions that can be used both in clinical settings and at home to support functional recovery. Range of motion (ROM) exercises using rubber balls represent a simple tool, yet their specific effect on muscle grasp strength in non-hemorrhagic stroke patients is still understudied. With stroke incidence increasing and rehabilitation services often overwhelmed, establishing evidence-based, practical interventions is essential. This research is urgent because it seeks to: provide clinicians with immediate, low-cost rehabilitation options; improve patient outcomes through

early functional recovery; reduce long-term disability and dependence on caregivers; address the existing gap in rehabilitation protocols tailored specifically to non-hemorrhagic stroke patients.

The novelty of this study lies in its specific focus, methodology, and application, especially in areas where limited literature exists. Exclusive focus on non-hemorrhagic stroke patients, Most rehabilitation studies combine all stroke types or focus primarily on hemorrhagic stroke. This study isolates non-hemorrhagic stroke, offering new insights into a population with distinct neuro-motor recovery characteristics. Use of rubber ball based ROM exercises as the primary intervention. Previous studies often use general physiotherapy, hand putty, or resistance tools. This research specifically evaluates rubber ball ROM exercises as a targeted, standalone method an area with limited empirical evidence.

The study introduces a replicable, clearly defined exercise protocol (duration, intensity, frequency), which many previous studies lack. This adds methodological novelty and increases the study's potential for clinical adoption. Rather than assessing general functional recovery, the study produces quantitative, objective data on muscle grasp strength using validated instruments. This contributes precise, measurable outcomes to the field. Emphasis on a low-cost, scalable intervention, this research highlights a rehabilitation tool that is: affordable, widely accessible, practical for home-based therapy. Its novelty lies in generating evidence for an intervention that can be widely implemented, especially in low-resource healthcare environments. This study aims to evaluate the effects of a rigorously defined ROM protocol with rubber ball therapy on grip strength in non-hemorrhagic stroke patients in Bali, Indonesia.

MATERIALS AND METHODS

Samples

This pre-experimental study was conducted at Kertha Hospital Usada and included 13 non-hemorrhagic stroke patients selected via purposive sampling. The sample size was calculated with G*Power using an effect size of 1.15, including patients with motor and muscle strength disturbances (1,17).

Data Collection Instruments and SOP

Muscle strength was assessed using a Hand Grip Dynamometer and documented through observation sheets in a rigorously enforced standard operating procedure (SOP). The one-month study (October 2022) involved calibration of the dynamometer before each session, muscle strength scored on a 0–5 scale from no movement to full movement with resistance, and measurements recorded twice daily by trained therapists to ensure consistency (15,18).

ROM Exercise Protocol

The ROM intervention required patients to grip a rubber ball with the wrist aligned at approximately 45 degrees, fingers firmly around the ball. Each session consisted of seven repetitions of maximal voluntary contraction for five seconds followed by five seconds of relaxation; sessions were performed twice daily for eight days. The protocol incorporated progressive overload, allowing patients to increase gripping intensity within comfort, supervised by therapists to avoid strain (14-15).

Ethical Clearance

Ethical approval was granted by the Registered Research Ethics Committee of Buleleng Health Sciences College (No. 836/EC-KEPK-SB/X/2023).

RESULTS

A total of 13 respondents participated in this study. The baseline demographic profile, including the distribution of age groups and gender among the stroke patients, is summarized in Table I. Of the 13 respondents, 76.9% were aged between 55 and 69 years. The mean grip muscle strength in non-hemorrhagic stroke patients prior to ROM training with a rubber ball was 8.46 (95% CI: 5.44–11.48; SD: 1.385). The minimum grip muscle strength rating was 2, while the maximum was 20.

After the ROM protocol, the mean grip muscle strength of non-hemorrhagic stroke patients following ROM exercises with rubber balls was 11.23 (95% CI: 8.32–14.14), with a standard deviation of 4.816. The minimum grip muscle strength number was 6, while the maximum was 23. The confidence interval indicates that there is a 95% confidence that the average grip muscle strength of non-hemorrhagic stroke patients lies between 8.32 and 14.14.

The results of the paired dependent t-test indicated a significant result (2-tailed) with a p-value of 0.0001. Since the research finding p-value is less than 0.05 ($p < 0.05$), the null hypothesis is rejected. It can be inferred that administering ROM training with a rubber ball significantly influences the muscle grip strength of non-hemorrhagic stroke patients. Comprehensive data points

matching pretest and posttest evaluations along with significance metrics are compiled in Table II.

Table II. Comparison of Grip Muscle Strength Before and After Intervention (N = 13)

Variable Timeframe	Mean	Min	Max	SD	95% CI	p-value*
Pretest (Before ROM Exercises)	8.46	2	20	1.385	5.44 – 11.48	< 0.0001
Posttest (After ROM Exercises)	11.23	6	23	4.816	8.32 – 14.14	

*Calculated using the paired dependent t-test.

DISCUSSION

Sample characteristics data were collected through direct measurements of respondents. The studied respondent characteristics were then distributed into the following distribution. Characteristics of research respondents based on age of non-hemorrhagic stroke patients based on age are that the majority of respondents are aged 55-69 years, 10 people (76.9%) and the lowest are aged 40-54 years, 3 people (23.1%). The characteristics of research respondents based on gender, the majority of respondents were male, 7 people (53.8%) and 6 people (46.2%) were female.

The results of this study demonstrate a significant improvement in grip muscle strength among non-hemorrhagic stroke patients following a structured ROM exercise protocol using a rubber ball. The increase in mean grip strength from 8.46 to 11.23, accompanied by a statistically significant p-value ($p = 0.0001$), underscores the effectiveness of the intervention. These results align with existing literature showing that targeted ROM exercises, especially those involving repetitive gripping actions with a rubber ball, can enhance muscle strength and functional hand use in post-stroke populations (14,15).

The observed improvements are clinically relevant, as increased grip strength is associated with better performance in activities of daily living and enhanced quality of life for stroke survivors (16). The high proportion of participants aged 55 to 69 years is consistent with the epidemiology of stroke, and the observed gains reflect the potential for neuroplasticity and muscle adaptation even among older adults (10,19). Previous research has further highlighted that such protocols are most effective when applied consistently, with progressive overload and therapist supervision (14,18).

Importantly, these findings support the use of simple, low-cost interventions like rubber ball ROM exercises as part of routine rehabilitation for non-hemorrhagic stroke patients, particularly in settings with limited resources or access to advanced technologies (15,19). The statistically robust results add to the evidence base

Table I. Demographic Characteristics of Respondents (N = 13)

Characteristic	Frequency (n)	Percentage (%)
Age Group		
40–54 years	3	23.1
55–69 years	10	76.9
Gender		
Male	7	53.8
Female	6	46.2
Total	13	100.0

for incorporating these practices into standard care, supporting their value for improving upper limb strength and functional independence in stroke populations (14,15,18).

CONCLUSION

Paired dependent t-test analysis revealed a highly significant difference following intervention. ROM exercises using a rubber ball, performed to an explicit, progressive protocol and monitored by trained therapists, positively impact muscle strengthening in non-hemorrhagic stroke patients. Such interventions represent valuable, practical approaches to restoring hand functionality in clinical and community settings.

ACKNOWLEDGEMENT

The authors extend their gratitude to STIKES Buleleng for research funding and institutional support.

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