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The combined effect of rubber ball grip therapy and walking exercise on muscle strength in older adults with stroke: A quasi-experimental study

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Wulandari Nuriani[1], Dewi Hartinah[1], *Muhamad Jauhar[1]

[1]Faculty of Health Sciences, Universitas Muhammadiyah Kudus, Indonesia

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Abstract

Background: Stroke is one of the leading causes of impairment in the elderly, often resulting in decreased motor function and muscle strength. Effective rehabilitation strategies, including non-pharmacological interventions such as rubber ball grip therapy and walking exercises, are essential for improving independence and quality of life among elderly stroke patients.
Purpose: This study aimed to evaluate the effectiveness of combining walking exercises with rubber ball grip therapy to improve muscle strength in elderly patients who have experienced a stroke.
Methods: The study employed a pretest-posttest quasi-experimental design with a control group. Conducted in April 2025 at a social institution for the elderly in Central Java, the research employed a total sampling approach to recruit 26 respondents, with 13 in the intervention group and 13 in the control group. The intervention was administered four times per week over two weeks. Muscle strength was measured using an observation sheet in accordance with the Ministry of Health guidelines. Data were analyzed using the Wilcoxon Signed Rank Test and the Mann–Whitney U Test.
Results: The intervention group showed a significant increase in muscle strength after receiving the combined therapy ($p = .001$), whereas the control group showed no significant change ($p = 1.000$). The Mann–Whitney test indicated a significant difference between the two groups ($p < .001$), confirming the intervention's effectiveness.
Conclusion and Recommendation: The combination of walking exercises and rubber ball grip therapy effectively improves muscle strength in elderly stroke patients. This intervention is straightforward, low-cost, and can enhance independence, making it suitable for implementation in geriatric nursing practice. Future studies should consider larger sample sizes and longer intervention periods.

*Corresponding Author:
Muhamad Jauhar
Faculty of Health Sciences, Universitas Muhammadiyah Kudus, Indonesia
Email: muhamadjauhar@umkudus.ac.id

Introduction

Stroke is one of the leading causes of mortality and disability worldwide, representing a medical emergency that requires prompt intervention (Minardo et al., 2025; Wiyarta et al., 2024). Delays in treatment can worsen the patient's condition by causing additional nerve cell damage (Jia et al., 2024; Siswanti et al., 2021).

Each year, millions of individuals worldwide experience strokes, and the increasing incidence in recent decades has contributed to high rates of mortality, morbidity, and lasting functional impairments (Feigin et al., 2025; Simanullang et al., 2025; World Stroke Organisation, 2022). According to Sulaiman et al. (2025), this makes stroke a critical health issue that needs to be addressed through both prevention and rehabilitation efforts.

In Indonesia, stroke ranks among the top three diseases in terms of financing costs within the universal healthcare system, representing a significant financial burden (Masriana et al., 2021). Data indicate that, in 2023, 8.3 per thousand people over the age of 15 will suffer from a stroke, with the elderly population being at the greatest risk (Darmawati et al., 2024; Daulay et al., 2023). Stroke remains a major public health concern in Indonesia, particularly for the elderly. For instance, in Rembang Regency, there are 92.70 stroke cases per 100,000 population, indicating a persistent health crisis that requires serious attention (DKK Rembang Jawa Tengah 2024). Preliminary survey results from Margo Mukti RPSLU in Rembang revealed that 16.88% of elderly residents have experienced a stroke, underscoring the need for appropriate rehabilitation interventions. Risk factors such as smoking, hypertension, diabetes, advanced age, and gender significantly contribute to the high prevalence of stroke (Masriana et al., 2021; Zhao et al., 2024).

The effects of a stroke can vary depending on which area of the brain is affected. However, some of the most common consequences include motor deficits, such as hemiparesis (Gonzalez-Hoelling et al., 2022; Hanifah et al., 2024). Muscle weakness on one side of the body can hinder activities such as walking, eating, and self-care, ultimately affecting the patient's quality of life (Maljuliani et al., 2023). If not properly treated, this condition can lead to contractures, muscle atrophy, and even permanent paralysis (Nur et al., 2025). Therefore, effective rehabilitation is crucial for stroke patients, especially the elderly (Akbar & Sujati, 2025; Lee et al., 2022). However, the Range of Motion (ROM) exercises implemented at Margo Mukti RPSLU in Rembang have not produced optimal outcomes in enhancing functional capacity and muscular strength among the elderly.

Several studies suggest that non-pharmacological treatments can serve as effective alternatives for improving muscle strength in stroke patients (Suci & Triyanto, 2023). For instance, rubber ball grip therapy has been shown to enhance hand muscle strength by promoting neuromuscular activation and coordination through repetitive muscle tension and relaxation (Saputra et al., 2022). Additionally, research by Erwin et al. (2022) reported improvements in dynamic balance and muscle strength following walking exercises, demonstrating their effectiveness in enhancing these aspects among older adults. Most studies, however, continue to examine these two therapies independently, indicating that further research is needed to integrate them more effectively.

The challenges faced in stroke rehabilitation highlight the necessity for more effective intervention strategies that utilise a variety of therapeutic modalities. This study proposes a combined approach of walking exercises and rubber-ball grip training to optimise muscle strength in older stroke patients. By investigating the synergistic effects of these two methods, this research aims to fill a significant gap in the existing literature. Additionally, it seeks to promote evidence-based geriatric nursing practices that enhance seniors' quality of life.

The primary objective of this study is to assess the effectiveness of integrating walking exercises with rubber ball grip therapy to improve muscle strength in elderly stroke patients at Margo Mukti RPSLU in Rembang. While previous studies have demonstrated that rubber ball grip therapy and walking exercises can independently increase muscle strength in stroke patients, most research has focused on these interventions in isolation. There is limited

evidence regarding the effectiveness of combining these two therapies into a unified intervention, especially for elderly stroke patients.

This gap is significant because stroke-related impairments often affect both the upper and lower extremities, necessitating a more comprehensive rehabilitation approach. Therefore, this study represents a novel contribution by evaluating the effectiveness of a combined intervention involving rubber ball grip therapy and walking exercises to enhance muscle strength in elderly stroke patients.

Methods

Research design

This study utilised a pretest-posttest, quasi-experimental design with a quantitative methodology and included a control group. Respondents were divided into two groups: the intervention group and the control group. The intervention group received rubber-ball grip treatment and walking exercises, while the control group continued routine care. Muscle strength tests were conducted before (pretest) and after (posttest) the intervention in both groups to assess the intervention's impact on muscular strength in older stroke patients.

To prevent any contamination between the intervention and control groups, respondents were managed separately throughout the study period. The intervention group received the combined therapy under direct supervision, ensuring they were not exposed to the control group's routine care. Additionally, the intervention was implemented in different sessions and closely monitored by the researchers, preventing any exchange of information or imitation between the groups.

Setting and samples

This study was conducted in April 2025 at two senior social care institutions in Central Java, Indonesia. The population consisted of elderly individuals who had been diagnosed with a stroke by medical personnel at the research sites. The research sample was derived from the entire population that met the inclusion criteria, using a total sampling technique (Rizal et al., 2024). The sample size in this study was relatively small (n = 26) because of the limited number of eligible participants in the study settings. Consequently, a total sampling technique was applied to include all available respondents. Although a formal power analysis was not conducted, the use of nonparametric statistical tests and a controlled design supports the validity of the findings. However, this limitation should be taken into account when generalising the results.

To be included in this study, elderly individuals with a stroke diagnosis needed to have a reduction in muscle strength of at least scale 3, be stable (not in the acute phase), have a handicap, and possess partial or total independence. Individuals who were uncooperative during the trial or had limb injuries that complicated rehabilitation were excluded from the study. These criteria were taken into account while recruiting respondents directly from the population at the research sites.

Intervention

The intervention group participated in a program combining walking exercises with rubber-ball grip therapy. This program was conducted four times a week for two weeks under the researchers' supervision. The walking exercises involved stepping in place to enhance lower limb strength and balance. The rubber ball grip therapy included repetitive handgrip exercises using a rubber ball to stimulate muscle contractions and improve hand muscle strength. Each

session followed standardised operating procedures (SOPs) to ensure consistency in the intervention. In contrast, the control group received only the routine care provided by the institution, without any additional interventions.

Measurement and data collection

Standard operating procedures (SOPs) were used to guide the intervention, and an observation sheet was used to assess muscle strength. Muscle strength was measured using the Medical Research Council (MRC) scale, which grades muscle strength from 0 to 5. A score of 0 indicates no muscle contraction, while a score of 5 indicates normal muscle strength. The MRC scale is a widely used and clinically validated tool for assessing muscle strength (Kemenkes, 2022). Data were collected through direct observation during both the pretest (before the intervention) and posttest (after the intervention) phases. The researchers conducted the measurements to ensure consistency and accuracy. Before analysis, the collected data were edited, coded, and tabulated.

Data analysis

Both univariate and bivariate techniques were employed to analyse the data. Univariate analysis was used to describe the frequency distribution, percentages, means, and standard deviations of the respondents. To assess the impact of the intervention on muscular strength, bivariate analysis was conducted. Specifically, the Mann-Whitney Test was used to assess differences between the intervention and control groups, and the Wilcoxon Signed Rank Test was used to evaluate differences within each group before and after the intervention (Affattah et al., 2025; Nugroho et al., 2023). A p-value < 0.05 was set as the decision criterion.

Ethical considerations

The principles of beneficence and non-maleficence, data confidentiality, and respect for participants' rights were upheld throughout this study. Before the trial began, participants were required to sign an informed consent form indicating their willingness to participate. They were fully informed about the study's objectives, methods, benefits, and potential risks.

Results

Respondent Characteristics

Tables 1 show the characteristics of the respondents. Elderly people in the intervention group were 66.62±4.388 years old on average, compared to 67.15±3.602 years old in the control group. This suggests that the age features of both groups are somewhat similar.

Table 1. Respondent Characteristics by Age, Medical History, Gender, and Education (n=26)

Characteristics	Intervention (Mean±SD)	Median	Min–Max	Control (Mean±SD)	Median	Min–Max
Age	66,62±4,388	65	60–74	67,15±3,602	65	62–72
Characteristics			Intervention f	Control %	Characteristics	Intervention f
Disease History						
<6 Months			<6 Months	<6 Months	<6 Months	<6 Months
≥ 6 Months			≥ 6 Months	≥ 6 Months	≥ 6 Months	≥ 6 Months
Gender						
Male			Male	Male	Male	Male
Female			Female	Female	Female	Female
Education Level						
No schooling			No schooling	No schooling	No schooling	No schooling

Characteristics	Intervention (Mean±SD)	Median	Min–Max	Control (Mean±SD)	Median	Min–Max
Elementary school/equivalent			Elementary school/equivalent	Elementary school/equivalent	Elementary school/equivalent	Elementary school/equivalent
High school/equivalent			High school/equivalent	High school/equivalent	High school/equivalent	High school/equivalent
Total			Total	Total	Total	Total

In both the intervention and control groups, Table 1 shows that most respondents had experienced a stroke within the past six months. Additionally, the majority of respondents were female and had completed only elementary school or its equivalent.

Muscle Strength Overview

Table 2 illustrates the distribution of muscle strength both before and during the intervention. Before the intervention, most respondents in the control group were rated at scale 2, whereas most in the intervention group were rated at scale 1. After the intervention, the control group's muscle strength did not significantly change, whereas the intervention group improved to scale 3.

Table 2. Distribution of Muscle Strength Before and After the Intervention

Variable	Group	Median (IQR)	f (%)
Before Intervention	Intervention	1 (1–2)	Scale 1: 7 (53.8%) Scale 2: 6 (46.2%)
	Control	2 (2–2)	Scale 1: 5 (38.5%) Scale 2: 8 (61.5%)
After Intervention	Intervention	3 (2–3)	Scale 2: 5 (38.5%) Scale 3: 8 (61.5%)
	Control	2 (2–2)	Scale 1: 5 (38.5%) Scale 2: 8 (61.5%)

Differences in Muscle Strength

The Wilcoxon test revealed no significant difference in the control group (p=1.000), but there was a significant difference in the intervention group before and after treatment (p=0.001).

Table 3. Differences in Muscle Strength Before and After Intervention

Group	p-value
Intervention	0,001
Control	1,000

Effect of Intervention

The combination of walking exercise and rubber ball grip treatment significantly improved the muscular strength of older stroke patients, according to the Mann-Whitney test (p=0.000).

Table 4. Effect of Intervention on Muscle Strength

Variable	p-value
Intervention vs. Control	0,000

Discussion

This study demonstrates that walking exercise combined with rubber ball grip therapy significantly improves muscular strength in older individuals affected by stroke. These results align with the study's goal of assessing the impact of the intervention on muscular strength. Most participants were over 60 years old, which increases the risk of stroke due to physiological impairments in blood vessels and muscle function (Indriwati, 2023; Margiyati et al., 2022). Decreased muscle strength in the elderly is also influenced by the ageing process and by a lack of physical activity (Munifah et al., 2024). Additionally, the postmenopausal decline in

estrogen, which contributes to cardiovascular protection, may be linked to the majority of female participants (Anwar, 2020).

The findings indicated that most respondents exhibited mild muscular weakness prior to the intervention. This is consistent with other studies showing that damage to the central nervous system following a stroke results in motor disabilities (Pomalango, 2023). After the intervention, muscle strength improved in the intervention group, demonstrating the efficacy of the combined therapy. Rubber ball grip therapy enhances muscle strength primarily through neuromuscular adaptation, including increased motor unit recruitment and improved coordination resulting from repetitive muscle contractions (Kusuma et al., 2022). Conversely, walking exercise enhances balance and coordination by integrating the motor and sensory systems (Erwin et al., 2022). When these two treatments are combined, the results are more comprehensive than when they are applied separately.

Moreover, repetitive motor activities such as handgrip exercises and walking training may stimulate neuroplasticity, the brain's ability to reorganise and form new neural connections after injury. This process is particularly vital in stroke rehabilitation, as it supports the recovery of motor functions through continuous sensory and motor stimulation. The integration of upper-limb (handgrip) and lower-limb (walking) exercises may further enhance this process by providing comprehensive stimulation to both motor and sensory pathways, thereby promoting optimal functional recovery.

These findings are consistent with other research indicating that rubber ball grip therapy effectively improves muscular strength in stroke patients (Munifah et al., 2024; Sari et al., 2021). In contrast, the control group showed no discernible improvement, as they were given only mild exercise with insufficient resistance stimulation, which hindered their ability to achieve optimal muscular adaptation (Feng et al., 2024; Lyu et al., 2023). Therefore, by gradually increasing physical activity and neuromuscular stimulation, the two therapies work together to enhance muscle strength. These findings suggest that the intervention not only improves muscle strength but also facilitates functional recovery through underlying neurophysiological mechanisms.

Implication and limitations

The findings of this study have practical implications for geriatric nursing and rehabilitation practices. The combined intervention of walking exercises and rubber ball grip therapy can be implemented as a simple, low-cost rehabilitation program in various settings, including nursing homes, community health centres, and home-based care.

Nurses and caregivers can easily incorporate this intervention into daily care routines by guiding elderly stroke patients to perform structured handgrip exercises and supervised walking activities for approximately 10 to 15 minutes per session, four times a week. This approach may help improve muscle strength and support functional independence in daily activities.

In community settings, such as elderly health posts and rehabilitation programs, this intervention can be delivered during group exercise sessions under the supervision of healthcare workers. Additionally, family members can be educated to assist with and monitor exercises at home, ensuring continuity of care and maximising rehabilitation outcomes.

Conclusion

This study demonstrates that a combination of walking exercise and rubber-ball grip treatment significantly increases muscular strength in older stroke patients. The study's goals have been achieved, reinforcing the idea that straightforward, non-pharmacological therapies can be effective rehabilitation methods. This combination therapy simultaneously stimulates

both the upper and lower extremities, providing more comprehensive benefits than traditional exercises like Range of Motion (ROM) alone.

This approach decisively advances evidence-based nursing practice, especially in geriatric care. The intervention is readily implemented across diverse healthcare settings and communities, effectively promoting independence and enhancing quality of life for older stroke patients. Its cost-effectiveness and straightforward application further ensure practical benefits.

Despite limitations, this study clearly indicates the need for further research with larger sample sizes, longer intervention periods, and stricter control over external factors. Future studies must rigorously examine the intervention's effectiveness across varying stroke severities and integration with other rehabilitation techniques to strengthen its contribution to nursing practice.

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Author contribution

All authors made substantial contributions to the research process and manuscript preparation. The first author was responsible for research planning, data collection, data analysis, and drafting the initial manuscript. The second and third authors supervised the project, ensured methodological rigor, and provided critical revisions. All authors reviewed and approved the final manuscript and accept responsibility for its accuracy and integrity.

Conflict of interest

The author declares that there is no conflict of interest in the research.

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