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Muscle strength after elastic resistance band exercise and hand massage in stroke patients

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Abstract

Background: Stroke commonly causes upper-extremity weakness that can limit independence. Progressive resistance exercise may support motor recovery, while hand massage may provide complementary sensory stimulation and relaxation.

Purpose: To compare short-term changes in upper-extremity muscle strength between patients with stroke receiving combined elastic resistance band exercise and hand massage and those receiving standard hospital care.

Method: This quasi-experimental pretest-posttest study included 40 patients with stroke, with 20 in the intervention group and 20 in the control group. Allocation was non-random and based on odd/even identifiers. The intervention group received combined elastic resistance band exercise and hand massage for 10–15 minutes daily over 8 sessions, while the control group received standard hospital care. Upper-extremity muscle strength was assessed using Manual Muscle Testing (MMT). Wilcoxon signed-rank tests assessed within-group changes, and the Mann-Whitney U test compared post-test scores between groups.

Results: Upper-extremity muscle strength improved significantly in the intervention group ($p < 0.001$), while no significant change was observed in the control group ($p = 0.083$). At posttest, the intervention group had significantly higher muscle strength scores than the control group ($p = 0.006$).

Conclusion: Combined elastic resistance band exercise and hand massage were associated with greater short-term improvement in upper-extremity muscle strength than standard hospital care. Because allocation was non-random, the finding should be interpreted cautiously.

Keywords: Elastic Resistance Band Exercise; Hand Massage; Manual Muscle Testing; Muscle Strength; Stroke.

INTRODUCTION

Stroke is a major cause of death and long-term disability worldwide. In 2021, an estimated 93.8 million people were living with stroke and 11.9 million new strokes occurred worldwide (Feigin, Brainin, Norrving, Martins, Pandian, Lindsay, Grupper, & Rautalin, 2025). In Indonesia, stroke remains an important health problem, and Central Java continues to report substantial numbers of hospitalized stroke cases (Ministry of Health of the Republic of Indonesia, 2022; Central Java Provincial Health Office, 2023).

Hemiparesis and upper-extremity weakness are common after stroke and can limit grasping, reaching, self-care, and other activities of daily living. Persistent impairment and post-stroke spasticity may further restrict function and quality of life (Schinwelski, Sitek, Wąż, & Sławek, 2019; Huang, Ji, Liang, Zhang, Sun, Yan, & Xing, 2022; Doumen, Sorba, Feys, & Tedesco Triccas, 2023). Rehabilitation evidence supports intensive, repetitive, task-oriented upper-limb practice, while effects vary according to intervention type and dose (Pollock, Farmer, Brady, Langhorne, Mead, Mehrholz, & van Wijck, 2014; Veerbeek, van Wegen, van Peppen, van der Wees, Hendriks, Rietberg, & Kwakkel, 2014).

Progressive resistance exercise can increase muscle strength after stroke, although evidence regarding transfer to activity and optimal timing remains heterogeneous (Ada, Dorsch, & Canning, 2006; Morris, Dodd, & Morris, 2004; Wist, Clivaz, & Sattelmayer, 2016; Salter, Musovic, & Taylor, 2016; Dorsch, Ada, & Alloggia, 2018; Veldema & Jansen,

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2020; Saunders, Sanderson, Hayes, Johnson, Kramer, Carter, Jarvis, Brazzelli, & Mead, 2020; Harris & Eng, 2010). Elastic bands provide a portable form of progressive resistance and have been studied in stroke rehabilitation (An & Kang, 2020). Massage may provide complementary sensory stimulation and relaxation; systematic-review evidence suggests possible improvements in selected post-stroke outcomes when massage is added to rehabilitation, although the evidence is heterogeneous (Cabanas-Valdés, Calvo-Sanz, Serra-Llobet, Alcoba-Kait, González-Rueda, & Rodríguez-Rubio, 2021).

Hospital records indicated 102 patients with stroke during the three months preceding the study. A preliminary survey of 10 patients identified reduced upper-extremity muscle strength: six were at MMT grade 2, three at grade 3, and one at grade 4. This study therefore compared short-term changes in upper-extremity muscle strength between patients receiving combined elastic resistance-band exercise and hand massage and those receiving standard hospital care.

RESEARCH METHOD

This quantitative quasi-experimental study used a pretest-posttest design with a control group and was conducted at Graha Husada Hospital Jepara, Central Java, Indonesia. Hospital records indicated 102 patients with stroke during the preceding three months. The analyzed sample comprised 40 patients who met the stated inclusion criteria and were enrolled through total sampling. The source manuscript did not specify the calendar period of participant recruitment.

Participants were allocated non-randomly: odd-numbered identifiers were assigned to the intervention group and even-numbered identifiers to the control group, with 20 participants in each group. Inclusion criteria were a diagnosis of stroke, decreased upper-extremity muscle strength, adequate consciousness to follow instructions, and stable hemodynamic status.

The intervention group received a combination of elastic resistance band exercises and hand massage for 10–15 minutes daily over 8 sessions. The control group received standard hospital care. Detailed band resistance/progression, repetitions, massage technique, and the components of standard hospital care were not fully reported in the source manuscript.

Upper-extremity muscle strength was assessed before and after treatment with Manual Muscle Testing (MMT) on a 0–5 ordinal scale, with labels: Trace, Poor, Fair, Good, and Normal. MMT is widely used clinically but has recognized limitations as a screening measure and depends on standardized examiner technique (Bohannon, 2005; Cuthbert & Goodheart, 2007).

Categorical variables were summarized using frequencies and percentages. Mean ± sample standard deviation was calculated from the reported MMT category counts. Wilcoxon signed-rank tests assessed within-group pretest-posttest changes, and the Mann-Whitney U test compared post-test scores between groups. Statistical significance was set at $p < 0.05$.

RESEARCH RESULTS

Table 1. Characteristics of patients with stroke (N = 40)

Variable	Intervention (n = 20)	Control (n = 20)
Age, years, mean ± SD (range)	**57.8 ± 6.40 (44–64)**	**59.2 ± 5.93 (45–66)**
Age (n/%)		
44–49 years	2/10.0	1/5.0
50–59 years	12/60.0	11/55.0
60–66 years	6/30.0	8/40.0

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Gender		
Male	12/60.0	13/65.0
Female	8/40.0	7/35.0
Education Level		
Senior high school	9/45.0	7/35.0
Higher eduction	2/10.0	1/5.0
Occupation		
Unemployed	10/50.0	12/60.0
Farmer	1/5.0	1/5.0
Private-sector employee	6/30.0	4/20.0
Civil servant	1/5.0	1/5.0
Self-employed	2/10.0	2/10.0
Systolic blood pressure, mean (range),	109.5 (90–130)	109.5 (90–130)
Diastolic blood pressure, mean (range)	86.0 (80–90)	86.5 (80–90)

As presented in Table 1, mean age was 57.8 ± 6.40 years in the intervention group and 59.2 ± 5.93 years in the control group. Men accounted for 12 participants (60.0%) in the intervention group and 13 participants (65.0%) in the control group. Senior high school was the most frequent educational attainment in the intervention group, whereas junior high school and senior high school were equally frequent in the control group.

Table 2. Upper-extremity muscle strength before and after treatment (N = 40)

Group/time	Mean ± SD	Poor	Fair	Good	Normal	Within-group *p* value
Intervention pretest	3.00 ± 0.73	5/25.0	10/50.0	5/25.0	0/0.0	< 0.001
Intervention posttest	4.00 ± 0.86	1/5.0	4/20.0	9/45.0	6/30.0	
Control pretest	2.90 ± 0.64	5/25.0	12/60.	3/15.0	0/0.0	0.083
Control posttest	3.05 ± 0.76	4/20.0	12/60.0	3/15.0	1/5.0	

As presented in Table 2, mean MMT score in the intervention group increased from 3.00 ± 0.73 at pretest to 4.00 ± 0.86 at posttest ($p < 0.001$). In the control group, the mean increased from 2.90 ± 0.64 to 3.05 ± 0.76, but the change was not statistically significant ($p = 0.083$). Posttest muscle strength differed significantly between groups; reanalysis from the reported category frequencies yielded Mann–Whitney $U = 83.5$ and $p < 0.001$.

DISCUSSION

The principal finding was a greater short-term increase in upper-extremity muscle strength in the intervention group than in the control group. Most intervention participants shifted from the fair category at baseline toward good or normal strength after 8 sessions, whereas the control group changed only modestly.

The observed improvement is compatible with evidence that strengthening can increase muscle force after stroke. Earlier systematic reviews and meta-analyses have generally reported gains in strength after progressive resistance training, although transfer to activity and optimal treatment dose remain uncertain (Ada et al., 2006; Morris et al., 2004; Wist et al., 2016; Dorsch et al., 2018; Veldema & Jansen, 2020; Harris & Eng, 2010). Broader rehabilitation evidence also supports repeated, task-oriented practice and adequately dosed exercise (Pollock et al., 2014; Veerbeek et al., 2014; Saunders et al., 2020).

Elastic bands offer a practical method of applying external resistance during repeated movement (An & Kang, 2020). Hand massage may have provided complementary sensory stimulation and relaxation before exercise, but the present design cannot

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separate the contribution of massage from that of resistance exercise (Cabanas-Valdés et al., 2021). Three participants reportedly experienced fatigue, and pain was also reported in some participants during intervention sessions, requiring brief pauses; this supports individualized monitoring of exercise tolerance.

The between-group posttest difference (reanalysis from the reported category frequencies: Mann–Whitney U = 83.5, $p < 0.001$) should be interpreted cautiously. Allocation was based on odd/even identifiers rather than randomization, formal baseline homogeneity testing was not available, and the control condition was not described in sufficient detail. These factors limit attribution of the observed difference solely to the combined intervention.

Several limitations should be considered. The study was conducted at a single hospital with a small sample and non-random allocation. Exclusion criteria, allocation concealment, assessor blinding, and detailed intervention procedures were not fully documented. Follow-up ended after 8 sessions, so durability of strength gains is unknown. Muscle strength was measured using an ordinal MMT scale, and the study did not report functional independence outcomes. The original Mann-Whitney U statistic and an effect-size estimate were also unavailable.

CONCLUSION

Combined elastic resistance band exercise and hand massage were associated with greater short-term improvement in upper-extremity muscle strength than standard hospital care among the patients studied. The intervention group improved significantly within-group, and post-test strength differed significantly between groups (reanalysis from the reported category frequencies: Mann–Whitney U = 83.5, $p < 0.001$). Because the allocation was non-random and key protocol details remain incomplete, the findings should be interpreted with caution.

SUGGESTION

Future studies should use randomized or concealed allocation, larger multicentre samples, blinded strength assessment, and fully standardized intervention protocols specifying band resistance, progression, repetitions, massage technique, and control treatment. Longer follow-up and functional outcomes should be included, along with complete reporting of the Mann-Whitney U statistics and an effect size estimate.

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