REVIEW

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# Efficacy of motor relearning programme on rehabilitation of upper extremity function in stroke patients

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## ABSTRACT

**Background:** The most debilitating condition for stroke patients, impacting their quality of life, is motor impairment in the upper extremities. This study aimed to evaluate the impact of the Motor Relearning Programme (MRP) on enhancing stroke patient's upper limb motor function.

**Methods:** A systematic review using trial studies from an online journal database published from 2013 to 2023. The participants of this study are stroke patients. The utilization of the MRP is compared with an alternative intervention, with the study aiming to assess the motor function of the upper extremities as its primary outcome. The quality of the trial was assessed using the JBI checklist

**Results:** Eight studies, encompassing 279 stroke patients aged 35 to 70, were incorporated. These trials compared the MRP with various interventions, including mirror therapy, Constraint-Induced Movement Therapy (CIMT), bobath, progressive resisted exercise, thermal stimulation, and bilateral task-related training. The interventions spanned an average duration of 3-8 weeks, with sessions occurring 3-6 times per week and lasting between 30 and 120 minutes each. According to the Joanna Briggs Institute (JBI) assessment, all studies achieved a good quality rating, with total points ranging from 9-12. Notably, six studies demonstrated a significant improvement in upper extremity motor function with MRP, while one showed no significant difference. In contrast, one study indicated that CIMT demonstrated more effective results.

**Conclusion:** MRP significantly improves upper extremity function in stroke patients.

**Keywords:** Motor Relearning Programme, stroke rehabilitation, post-stroke, upper extremity motor function.
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## INTRODUCTION

Stroke stands as a significant global public health concern, ranking as the third most common cause of mortality and the primary contributor to disability.[1] Upper extremity motor impairment is a highly debilitating condition frequently observed in stroke patients. Approximately 85% of individuals recovering from a stroke encounter motor issues in their affected upper extremity, persisting in 55 to 75% of cases even six months post-stroke.[2] Complete recovery from arm weakness is rare, ranging from 5% to 20%. This weakness significantly hampers patients' daily activities, including reaching, grasping, and manipulating objects, impacting their independence and overall quality of life.[3] Simple tasks like grooming, eating, dressing, and undressing become challenging for stroke survivors with weakened upper limbs. Many stroke patients identify upper extremity weakness as their primary concern, correlating with a decline in subjective well-being. It is imperative to raise awareness about the difficulties linked to upper extremity motor impairment in stroke survivors and to formulate effective strategies to address these challenges.[4]

Rehabilitating the upper extremity poses challenges, encompassing diverse therapeutic approaches ranging from simple exercises to advanced electromechanical tools like splinting, electrical stimulation, neurodevelopmental technique (NDT), and biofeedback. The recent development of the Motor Relearning Programme (MRP) aims to address this challenge. Despite its introduction, determining the optimal method for enhancing upper extremity function remains uncertain. Carr and Shepherd introduced the MRP, emphasizing task-specific learning with efficient feedback and practice. Research indicates its effectiveness in improving motor function recovery for post-stroke paretic extremities. Numerous studies have affirmed that MRP contributes to restoring functionality of the upper limbs.[2,5]

The objective of this study was to assess the influence of the MRP on the recovery of upper limb functionality in stroke patients through a systematic review. These data are essential to determine whether there is a difference in the benefits and risks of various rehabilitation strategies for improving upper motor function.

## MATERIAL AND METHODS

### *Search Strategy*

This systematic review was conducted through an electronic search of Google Scholar, Pubmed, and Science Direct. The keywords utilized in the search were related to "Motor Relearning Program," "Motor Relearning Method," "stroke rehabilitation," "post-stroke," "upper extremity function," and "upper limb function" using Boolean operators AND and OR. We limited studies from 2013 until 2023 used in this study to ensure the source was updated and relevant to the current situation.

### *Study eligibility*

We integrated a study into our analysis, utilising specific eligibility criteria shown in Figure 1 through a PRISMA diagram. Initially, we conducted a literature screening on the online database using specified search strategy keywords. Any studies considered irrelevant or duplicated were excluded during this initial screening phase. After that, in the second step, we analysed the abstracts and full-text versions of the selected studies, assessing whether they aligned with the predetermined eligibility criteria. The inclusion requirements are as follows: (1) Population: studies involving individuals who have a stroke with impairments in upper extremity motor function; (2) Intervention: using MRP; (3) compared with another intervention (4) Outcomes: evaluate upper extremity motor function. (5) Study design: only randomized control trials (RCT) to maintain the quality of this study. In contrast, the exclusion criteria were a study published in non-peer-reviewed journals, lack of an abstract, an animal study, a study not available in full text, and not using English or Bahasa Indonesia language.

### *Data gathering*

Three reviewers collected information to identify a study aligning with our eligibility criteria. The chosen research underwent scrutiny for its supporting evidence and underwent additional analysis. A detailed reading of all studies was conducted to refine the fundamental concepts from the literature.

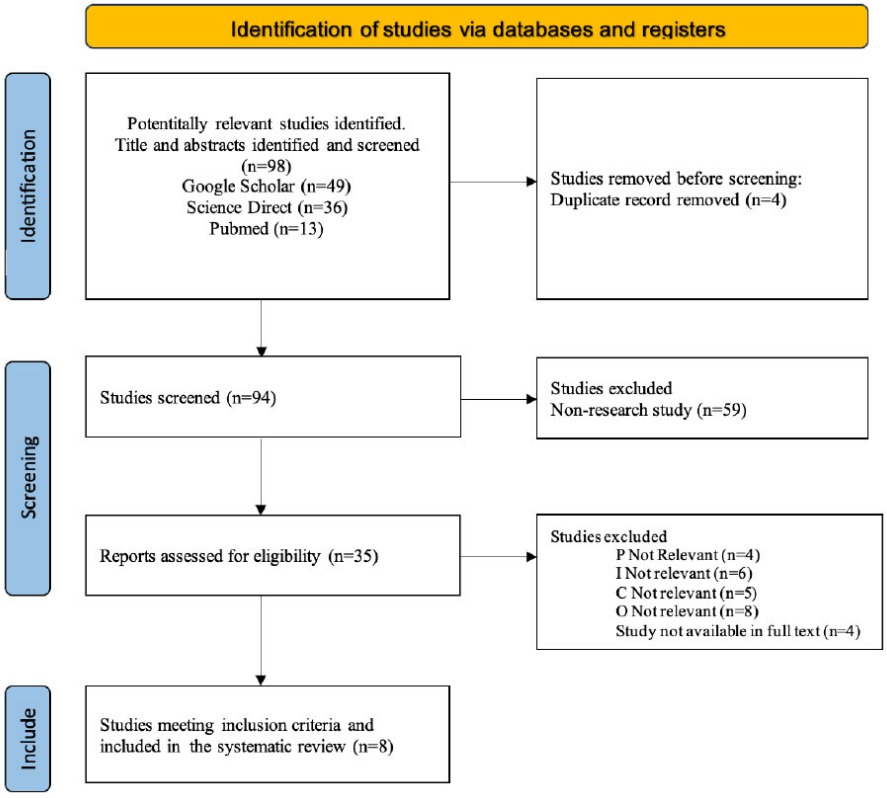


**Figure 1.** The PRISMA diagram of literature selection of this study.

### *Study quality assessment*

The study's quality was evaluated using the Joanna Briggs Institute critical appraisal checklist. Tailored checklists corresponding to each study design were engaged, with each checklist item carrying a single point. A study is considered good if its score equals or surpasses half of the maximum total points [13].

### *Data synthesis*

For a narrative synthesis, we included all relevant studies on MRP's impact on upper extremity function rehabilitation in stroke patients. This systematic review, being a qualitative report, sought to collect data about MRP's impact on the rehabilitation of upper extremity function in stroke patients. We systematically performed the narrative synthesis to deduce the feasibility and efficacy of MRP in improving upper extremity motor function in stroke patients.

## RESULTS

Initially, 35 works of literature regarding MRP for rehabilitating upper extremity motor function in stroke patients were identified. However, 27 of them still need to meet our inclusion criteria. The other four are only available in partial text. Finally, only 8 full-text studies were retrieved to know about the effect of MRP on improving upper extremity motor function in stroke patients.

The included studies are 8 randomized controlled trial studies. Research has been conducted in various nations, including India and Pakistan, involving a combined sample size of 279 individuals who have experienced strokes. MRP was compared with an alternative intervention in each trial. The trials were conducted within rehabilitation hospital settings, with participants' average age ranging from 35 to 70 years. Table 1 provides a comprehensive overview of the study's detailed characteristics.

The evaluation of study quality was conducted using the Joanna Briggs Institute checklist, specifically following the criteria for a randomized clinical trial design. Each item on the checklist was assigned one point, and a study was deemed of high quality if it scored half or more of the maximum total points. Conversely, studies with less than half of

**Table 1. Characteristic of study**

| Study | Sample | Stroke duration | Comparison | Outcome | Duration | Conclusion |
|---|---|---|---|---|---|---|
| Jan et al, 2019[6] | 66 | N/A | Mirror Therapy | MAS | Time: 2h/d, 3d/w, for 6 weeks | MRP was significantly more effective than MT (p value < 0.001) |
| Batool et al, 2015[9] | 42 | Two weeks – three months post stroke | CIMT | MAS | Time: 2h/d, 6d/w, for 3 weeks | CIMT group showed more significant improvement in motor function of hemiplegic upper extremity compared to MRP group (p value < 0.05) |
| Annethattil et al, 2017[10] | 30 | N/A | Bobath | MAS, STREAM, and FMA | Time: 45m/d, 5d/w, for 4 weeks | MRP was more effective than Bobath, showed a significant changes in the functional recovery of the upper limb in right MCA stroke (p value < 0.005) |
| Santhosh et al, 2023[11] | 30 | Two months | PRE | FMA and MESUPES | Time: 1h/d, 5d/w, for 6 weeks | MRP is more significant than PRE in improving upper limb functional performance in subacute MCA stroke survivors (p value < 0.001) |
| Paul, Jibi, 2014[12] | 20 | Six weeks to six months | Thermal Stimulation | MAS and STREAM | Time: 30m/d, 5d/w, for 6 weeks | MRP showed significantly effective to improve the upper limb motor function with mild to moderate impairment in right MCA stroke (p value < 0.001) |
| Kaur et al, 2020[13] | 16 | Two weeks – sixteen weeks post stroke | Bilateral Task-Related Training | FMA and ARAT | Time: 30m/d, 5d/w, for 4 weeks | MRP showed better efficacy compared to BAT in distal parts of the upper extremities (wrist and hand) (p value < 0.05) |
| Rauf et al, 2021[7] | 30 | N/A | Mirror Therapy | FMA | Time: 40m/d, 5d/w, for 6 weeks | No significant difference between MRP and MT in the effectiveness of these techniques (p value < 0.005) |
| Narang et al, 2023[8] | 45 | One to six months. | Mirror Therapy | NIHSS | Time: 1h/d, 5d/w, for 8 weeks | MRP is more effective than MT in enhancing neurological function in upper extremity in post-stroke patients (p value < 0.0001) |

**Abbreviations:** MRP, motor relearning program; MAS, motor assessment scale; MT, mirror therapy; CIMT, constraint induced movement therapy; STREAM, stroke rehabilitation assessment of movement; FMA, Fugl-Meyer assessment; PRE, progressive resistive exercise; MESUPES, motor evaluation scale of upper extremity in stroke; ARAT, action research arm test; MCA, middle cerebral artery; BAT, bilateral arm training; NIHSS, National Institutes of Health Stroke Scale.

the top total points were considered low quality. The scoring range was 0-13 points. To ensure impartiality, three reviewers assessed the study quality. All eight studies received a good quality classification, with total points ranging from 9 to 12.

The authors explicitly described the intervention of MRP in 8 of the trials. Interventions in the comparator groups included mirror therapy neurorehabilitation treatments[6,7,8], Constraint Induced Movement Therapy (CIMT)[9], Bobath[10], progressive resisted exercise[11], Thermal stimulation[12], and bilateral task-related training.[13] Regarding the dosage of the interventions, six reports performed five sessions per week, one study by Batool *et al* reported a frequency of six times per week, and a study by Jan *et al* performed three sessions per week. The duration of each treatment session ranged between 30 and 120 minutes per session. The duration of the intervention protocol varied between 3 and 8 weeks. Physiotherapists generally carried out the interventions.

## DISCUSSION

Stroke patients often experience impairments in their upper extremities, and rehabilitation experts prioritize the restoration of upper limb movements due to their crucial role in nearly all daily activities.[14] The recovery of upper extremity function holds significant importance in achieving independence in daily living tasks, leading to an enhanced quality of life.[15] Various rehabilitation techniques and physical therapy methods are employed to regain upper limb function in stroke patients. Among these approaches, the motor relearning program is a rehabilitative strategy primarily applied to the post-stroke population.[16]

From our analysis in this study of systematic review, six studies showed significant improvement in the upper motor function using MRP.[6,8,10,11,12,13] A study by Jan *et al* and Narang *et al* showed that MRP was more effective ($p<0.05$) significantly than mirror therapy in enhancing neurological function and reducing the degree of disability in the upper extremity in post-stroke patients.[6,8] Other studies from Santhosh *et al,* Jibi, and Kaur *et al* indicated a significantly higher effectiveness of the MRP in enhancing the upper extremity motor function than PRE, thermal stimulation, and BAT in subacute MCA stroke patients.[12,13] Previous studies showed the same significant results by using MRP, compared to other methods. As an illustration, Chan et al. conducted a study where conventional therapy served as the control group. The results indicated that the MRP led to a substantial

improvement (p<0.001) in functional recovery, encompassing enhanced balance functions, performance in self-care, instrumental activities of daily living, and community integration.[17]

A separate study by Annethattil *et al.* affirmed the superior effectiveness of the MRP compared to Bobath. Notably, the combined intervention of both techniques demonstrated greater efficacy than each alone. It resulted in a noteworthy improvement in the functional rehabilitation of the upper limb, particularly in right Middle Cerebral Artery (MCA) strokes.[10] In a prior study conducted by Satwinder *et al.*, it was revealed that the MRP proves more productive than the Bobath in enhancing functional mobility among hemiplegic patients (p<0.001). Throughout this training, participants were encouraged to assess the deficient component, contemplate potential corrective actions, and engage in task-specific planning. This specialized training facilitated improved motor planning and relearning, potentially leading to the selective recruitment of motor units specifically essential for the given task.[18] Research conducted by Gajanan *et al.* similarly concurred that the MRP demonstrated significant efficacy, surpassing the effectiveness of the Bobath, particularly in the initial improvement of daily activities and walking abilities in the early stages of stroke rehabilitation (p>0.05). The prompt improvements observed in MRP could be attributed to early intervention and the incorporation of a regular daily routine. Actively engaging in and relying on oneself facilitated learning movement patterns in various contexts and tasks. The successful execution of functional activities hinges on the interaction between an individual's abilities and the demands of the environment. MRP emphasizes training task performance within the context of the environment.[19]

MRP encompasses numerous elements from motor learning theory and offers practical directives for retraining functional skills. Emphasizing task-specific learning, MRP utilizes constructive feedback and facilitates the development of active movement control through purposeful practice.[20] During the early rehabilitation stage, engaging actively and relying on oneself proved beneficial for learning the movement pattern within a specific context and task.[19] Per the principles of motor learning theory, motor patterns can be acquired and altered through experiential learning, including observations and repetitive practice.[21] Contemporary ideas about Brain Plasticity propose that our experiences can reshape cortical connections in the neuronal pathways. In line with the neuroplasticity theory, the nervous system's dynamic nature allows for adaptability and changes in response to environmental demands, new learning, developmental processes, and diverse experiences.[22]

The other two studies showed the other way. A study by Rauf *et al* proved no significant difference was present between MRP and MT using the FMA outcome measurement. Both MRP and MT are effective in treating stroke patients' upper extremity motor function.[7,11] One study stated that CIMT is more effective than MRP, and another study showed no significant difference between MRP and MT. Batool et al. conducted a study that revealed enhancements in the MRP and CIMT groups. However, the CIMT group exhibited more significant advancement in the motor function of the paralyzed upper extremities, as assessed by the MAS scales.[7] The mechanisms underlying improvement through CIMT still need to be understood. CIMT is based on the idea of 'learning non-use,' derived from studies with monkeys. Scientists noted that after the interruption of upper limb nerves, monkeys chose not to use their affected limb, even though they had nearly normal motor skills. Consequently, the theory of learned 'non-use' posits that individuals post-stroke possess greater movement capabilities than demonstrated in their daily activities. If accurate, constraining the unaffected arm could prove beneficial in unleashing this latent ability during everyday tasks. The functional improvements induced by CIMT coincide with plastic brain reorganization, linking noticeable changes in the brain to available enhancements associated with CIMT and an increased engagement of neuronal networks in the ipsilesional somatosensory cortex.[23,24]

The current study has certain limitations. The difficulty of access to contact the researchers of each study reviewed, secondary data sources obtained from the results of previous studies are not original research data that is open to the public, making it difficult to detect bias in data analysis. In addition, the critical appraisal process is carried out by researchers using the JBI checklist, which allows bias because the assessment may be subjective. The size of the study sample was limited, and the duration of the treatments was brief.

## CONCLUSION

Our systematic review reveals that MRP intervention significantly improved the upper extremity motor, while one study showed CIMT showed more significant results. Although there were improvements, it can be concluded that there was not enough evidence and need for more multicentred randomized control regarding the efficacy of MRP on rehabilitation of upper extremity function in stroke patients that should be done. These will better determine the effectiveness of the MRP in rehabilitating upper extremity function among stroke patients and help us to obtain more reliable and conclusive results with minimal bias.

## CONFLICT OF INTEREST

We assert that there are no conflicts of interest in this study.

## ETHICAL CONSIDERATION

Ethical clearance was waived due to the nature of this study and already following COPE and ICMJE protocols regarding the publication ethics.

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## AUTHOR CONTRIBUTION

IMDD, DS, and MYAD participate in the study, from conceptualizing the study framework, data collection, and analysis to reporting the study results.

## REFERENCES


1. Lerma Castaño PR, Rodríguez Laiseca YA, Montealegre Suárez DP, Castrillón Papamija DB, Losada Urriago GE. Effects of kinesiotaping combined with the motor relearning method on upper limb motor function in adults with hemiparesis after stroke. J Bodyw Mov Ther. 2020;24(4):546–53.
2. Ullah I, Arsh A, Zahir A, Jan S. Motor relearning program along with electrical stimulation for improving upper limb function in stroke patients: A quasi experimental study. Pak J Med Sci Q. 2020;36(7):1613–7.
3. Doyle S, Bennett S, Fasoli SE, McKenna KT. Interventions for sensory impairment in the upper limb after stroke. Cochrane Database Syst Rev. 2010;2010(6):CD006331.
4. Yavuzer G, Selles R, Sezer N, Sütbeyaz S, Bussmann JB, Köseoğlu F, et al. Mirror therapy improves hand function in subacute stroke: a randomized controlled trial. Arch Phys Med Rehabil. 2008;89(3):393–8.
5. Pan JX, Chen YP, Wei NN. [Improvement of Upper Limb and Hand Functions of Stroke Patients by Balancing Acupuncture Combined with Motor Relearning Training]. Zhen Ci Yan Jiu. 2018;43(2):123–6.
6. Jan S, Arsh A, Darain H, Gul S. A randomized control trial comparing the effects of motor relearning programme and mirror therapy for improving upper limb motor functions in stroke patients. J Pak Med Assoc. 2019;69(9):1242–5.
7. Rauf R, Rashad A, Noreen A, Intikhab R, Suleman TA, Mughal S. Comparison of mirror therapy and motor relearning program in improving the upper limb motor function of patients with stroke. PAFMJ. 2021;71(4):1364–7.
8. Narang A, Arora R, Arora L. Effect of motor relearning programme on neurological functions and level of disability on upper limb activity in post-stroke patients. World Journal of Advanced Research and Reviews. 2023;18(3):007–15.
9. Batool S, Soomro N, Amjad F, Fauz R. To compare the effectiveness of constraint induced movement therapy versus motor relearning programme to improve motor function of hemiplegic upper extremity after stroke. Pak J Med Sci Q. 2015;31(5):1167–71.
10. Annethattil A, Paul J, Sebastian J. Combined effect of Bobath technique and Motor Relearning Program (MRP) over its individual effects to improve upper limb functions in stroke patients. International Journal of Medical and Exercise Science. 2017;3(4):435-42.
11. Santhosh S, Suma NV. To compare the effect of motor relearning programme and progressive resisted exercise for upper-extremity functions in subacute MCA stroke survivors. Int J Phys Educ Sports Health. 2023;10(2):107–12.
12. Paul J. Comparative study on the effect of task oriented motor relearning program and thermal stimulation over upper limb motor function among stroke subjects. Int J Physiol Pathophysiol Pharmacol. 2014;227–32.
13. Kaur G, Kulkarni PS, Hazari A. Comparison of motor relearning program with bilateral arm training on upper-extremity control in subacute stroke survivors. Crit Rev Phys Rehabil Med. 2019;31(4):353–61.
14. Raghavan P. Upper Limb Motor Impairment After Stroke. Phys Med Rehabil Clin N Am. 2015;26(4):599–610.
15. Franceschini M, La Porta F, Agosti M, Massucci M, ICR2 group. Is health-related-quality of life of stroke patients influenced by neurological impairments at one year after stroke? Eur J Phys Rehabil Med. 2010;46(3):389–99.
16. Pollock A, Farmer SE, Brady MC, Langhorne P, Mead GE, Mehrholz J, et al. Interventions for improving upper limb function after stroke. Cochrane Database Syst Rev. 2014;2014(11):CD010820.
17. Chan DYL, Chan CCH, Au DKS. Motor relearning programme for stroke patients: a randomized controlled trial. Clin Rehabil. 2006;20(3):191–200.
18. Satwinder Singh RA. Effect of Motor Relearning Programme Versus Bobath Approach on functional mobility in hemiplegic patients – a randomized clinical trial. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS). 2022;21(7):01–6.
19. Gajanan B, Vivek K, Chandali D, Savita R, Ashok S, Parag S. Comparison of motor relearning program versus bobath approach at every two weeks interval for improving activities of daily living and ambulation in acute stroke rehabilitation. International Journal of Basic and Applied Medical Sciences. 3(3):70–7.
20. André K, Laurette Brigelia N, Fatouma MAL, Betty Chancelle N, Idriss MW, Wilfrid Jean MM, et al. Effect of physical treatment on the physicochemical, rheological and functional properties of yam meal of the cultivar "ngumvu" from dioscorea alata l. of congo. International Journal of Recent Scientific Research. 10(11):35809–15.
21. Shumway Cook H, Woollacatt. Motor Control-translating Research into Clinical Practice. 4th edition. Wilkins LW&: 2012.
22. Yin Y, Gu Z, Pan L, Gan L, Qin D, Yang B, et al. How does the motor relearning program improve neurological function of brain ischemia monkeys? Neural Regeneration Res. 2013;8(16):1445–54.
23. Kwakkel G, Veerbeek JM, van Wegen EEH, Wolf SL. Constraint-induced movement therapy after stroke. Lancet Neurol. 2015;14(2):224–34.
24. Corbetta D, Sirtori V, Castellini G, Moja L, Gatti R. Constraint-induced movement therapy for upper extremities in people with stroke. Cochrane Database Syst Rev. 2015;2015(10):CD004433.