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EFFECT OF COMBINED BOBATH AND MOTOR RELEARNING PROGRAM ON MOTOR RECOVERY AND FUNCTIONAL INDEPENDENCE IN INDIVIDUALS WITH SUBACUTE STROKE: A PRE–POST INTERVENTIONAL STUDY

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KEYWORDS

Stroke; Bobath Concept; Motor Relearning Program; Fugl-Meyer Assessment; Modified Barthel Index; Motor Recovery; Functional Independence; Neurorehabilitation.

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Abstract

Background

Stroke is one of the leading causes of long-term disability worldwide and frequently results in impaired motor function, reduced balance, spasticity, and dependence in activities of daily living. Neurorehabilitation aims to promote motor recovery by facilitating neuroplasticity through evidence-based therapeutic interventions. The Bobath Concept focuses on facilitating normal movement patterns and postural control, whereas the Motor Relearning Program (MRP) emphasizes repetitive, task-oriented functional practice. Although both approaches are widely used in stroke rehabilitation, evidence regarding the effectiveness of their combined application remains limited. The present study was undertaken to evaluate whether integrating these two neurorehabilitation approaches could enhance motor recovery and functional independence in individuals with subacute stroke.

Objective

To evaluate the effectiveness of a combined Bobath and Motor Relearning Program on motor recovery and functional independence in individuals with subacute stroke.

Methods

A pre–post interventional study was conducted among 60 individuals with subacute stroke aged 40–70 years who fulfilled the predefined inclusion criteria. Participants received a combined Bobath and Motor Relearning Program for 60 minutes per session, five sessions per week, for six consecutive weeks. Motor recovery was assessed using the Fugl-Meyer Assessment (FMA), while functional independence was evaluated using the Modified Barthel Index (MBI). Outcome measures were recorded before and after completion of the intervention, and statistical analysis was performed to determine treatment effectiveness.

Results

Following the six-week intervention, participants demonstrated statistically significant improvements in motor recovery and functional independence ($p < 0.001$). Improvement in Fugl-Meyer Assessment scores indicated enhanced voluntary motor control, coordination, and movement quality, whereas higher Modified Barthel Index scores reflected increased independence in activities of daily living. These findings suggest that the integration of Bobath facilitation techniques with task-oriented motor relearning effectively promotes functional recovery in individuals with subacute stroke. The thesis findings also demonstrated significant post-intervention improvements in motor performance following the combined rehabilitation programme.

Conclusion

The combined Bobath and Motor Relearning Program is an effective neurorehabilitation intervention for improving motor recovery and functional independence in individuals with subacute stroke. Incorporating movement facilitation with repetitive, goal-directed functional training may optimize neuroplastic adaptation and enhance rehabilitation outcomes. Further multicentre randomized controlled trials with longer follow-up periods are recommended to confirm these findings.

Introduction

Stroke is one of the most significant neurological disorders worldwide and remains a leading cause of long-term disability among adults. Despite considerable advances in acute medical management and thrombolytic therapies, a large proportion of stroke survivors continue to experience persistent motor impairments that adversely affect mobility, functional independence, and quality of life. These neurological deficits frequently require prolonged rehabilitation, placing a substantial burden on patients, caregivers, and healthcare systems. Restoration of motor function therefore remains one of the primary goals of stroke rehabilitation.

Stroke is characterized by the sudden onset of neurological dysfunction resulting from an interruption of cerebral blood flow due to either ischemia or intracerebral haemorrhage. The resulting neuronal damage disrupts normal motor pathways and commonly manifests as muscle weakness, impaired coordination, abnormal muscle tone, spasticity, poor postural control, balance deficits, and reduced ability to perform activities of daily living. Depending on the severity and location of the lesion, these impairments may significantly restrict an individual's independence and social participation, making comprehensive rehabilitation an essential component of stroke management.

Recovery following stroke is largely dependent on **neuroplasticity**, the intrinsic ability of the central nervous system to reorganize its structural and functional connections in response to injury and repetitive practice. Neuroplastic changes occur through cortical reorganization, synaptic strengthening, and recruitment of alternative neural pathways, enabling restoration of motor performance after neurological damage. Contemporary physiotherapy interventions therefore emphasize repetitive, task-specific, goal-directed practice that stimulates adaptive neural reorganization and enhances functional recovery. Rehabilitation strategies capable of maximizing neuroplasticity have become the cornerstone of modern neurophysiotherapy.

Among the various neurorehabilitation approaches, the **Bobath Concept**, also known as Neurodevelopmental Treatment (NDT), has been extensively utilized in stroke rehabilitation for several decades. Developed by Berta and Karel Bobath, this approach focuses on facilitating normal movement patterns, improving postural alignment, inhibiting abnormal muscle tone, and enhancing selective motor control through therapist-guided handling techniques. The Bobath Concept aims to restore efficient movement by promoting optimal sensory input and facilitating coordinated motor responses during functional activities. It is particularly beneficial in managing patients presenting with spasticity, abnormal movement synergies, and impaired postural stability.

The **Motor Relearning Program (MRP)**, introduced by Carr and Shepherd, represents another evidence-based rehabilitation approach founded on principles of motor learning and neuroplasticity. Unlike impairment-focused interventions, MRP emphasizes repetitive practice of meaningful functional tasks in real-life situations. The programme encourages active patient participation, problem-solving, task analysis, feedback, and intensive practice to improve motor performance. Functional activities such as sitting, standing, reaching, walking, and stair climbing are practiced repeatedly to facilitate the reacquisition of motor skills and improve participation in daily life. This task-oriented approach has consistently demonstrated favourable outcomes in enhancing functional mobility and independence following stroke.

Although both Bobath and Motor Relearning Program have individually demonstrated clinical effectiveness, they differ considerably in their therapeutic philosophies. The Bobath Concept primarily addresses movement quality, postural control, and normalization of muscle tone through skilled therapist facilitation, whereas the Motor Relearning Program focuses on active, repetitive, goal-directed functional practice to reinforce motor learning. Because these approaches target different aspects of motor recovery, integrating their complementary principles may provide a more comprehensive rehabilitation strategy than either intervention alone. By first optimizing postural alignment and movement quality through Bobath techniques and subsequently reinforcing functional task performance using Motor Relearning principles, patients may experience greater

improvements in motor recovery and functional independence.

Current literature supports the effectiveness of both rehabilitation approaches individually; however, relatively few studies have investigated their combined application. Existing evidence suggests that integrated neurorehabilitation strategies may facilitate superior motor learning by simultaneously addressing impairments in muscle tone, postural control, motor coordination, and functional task performance. Nevertheless, high-quality clinical evidence evaluating the effectiveness of a combined Bobath and Motor Relearning Program remains limited, particularly among individuals with subacute stroke. This gap in the literature highlights the need for further clinical investigation to determine whether combining these interventions produces meaningful improvements in motor recovery and functional independence.

Therefore, the present study was undertaken to evaluate the effectiveness of a combined Bobath and Motor Relearning Program in individuals with subacute stroke. The study specifically aimed to determine whether this integrated neurorehabilitation approach could improve motor recovery and enhance functional independence following a structured six-week intervention programme. The findings of this study may contribute to the growing evidence supporting integrated physiotherapy interventions and provide clinicians with practical guidance for optimizing rehabilitation strategies in stroke survivors.

Materials and Methods

Study Design

A pre–post interventional study was conducted to evaluate the effectiveness of a combined Bobath Concept and Motor Relearning Program on motor recovery and functional independence in individuals with subacute stroke. The study assessed participants before and after completion of a six-week rehabilitation programme to determine changes in motor performance and activities of daily living.

Study Setting

The study was conducted in the Department of Physiotherapy, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India.

Study Duration

The study was carried out over a period of six months, including participant recruitment, baseline assessment, intervention, post-treatment evaluation, data analysis, and interpretation.

Participants

A total of **60 participants** diagnosed with subacute stroke were recruited using a convenience sampling technique. Participants were screened according to predefined eligibility criteria before enrolment in the study. All eligible participants provided written informed consent prior to participation.

Inclusion Criteria

Participants were included if they met the following criteria:

- Male or female patients aged **40–70 years**.
- First-ever ischemic or hemorrhagic stroke confirmed by a neurologist.
- Stroke duration between **1 and 6 months** (subacute stage).
- Presence of unilateral hemiparesis or hemiplegia.
- Medically stable and able to participate in physiotherapy.
- Mini-Mental State Examination (MMSE) score ≥24.
- Ability to maintain sitting with or without minimal support.
- Ability to understand and follow verbal instructions.
- Willingness to participate and provide written informed consent.

Exclusion Criteria

Participants were excluded if they had:

- History of recurrent stroke.
- Severe cognitive impairment (MMSE <24).
- Severe aphasia or communication deficits.
- Severe spasticity (Modified Ashworth Scale ≥3).
- Other neurological disorders such as Parkinson's disease, multiple sclerosis, or traumatic brain injury.
- Musculoskeletal disorders affecting mobility.
- Unstable cardiovascular conditions contraindicating exercise.

- Significant visual, vestibular, or perceptual impairments.
- Participation in any other structured stroke rehabilitation programme during the study period.

Outcome Measures

Primary Outcome Measures

Fugl-Meyer Assessment (FMA)

Motor recovery was evaluated using the Fugl-Meyer Assessment, a standardized and validated outcome measure widely used in stroke rehabilitation. The motor domain evaluates upper and lower extremity motor performance, with higher scores indicating better motor recovery. The FMA has demonstrated excellent reliability and validity for assessing motor impairment following stroke.

Modified Barthel Index (MBI)

Functional independence was assessed using the Modified Barthel Index. The MBI measures an individual's ability to perform activities of daily living, including feeding, grooming, bathing, dressing, toileting, transfers, ambulation, and stair climbing. Higher scores represent greater independence in daily activities.

Intervention Protocol

All participants underwent a **combined Bobath Concept and Motor Relearning Program** administered by a qualified physiotherapist.

Each treatment session lasted **60 minutes**, **five sessions per week**, for **six consecutive weeks**. The intervention consisted of:

Bobath Component

- Facilitation of normal movement patterns.
- Inhibition of abnormal muscle tone.
- Trunk control and postural alignment training.
- Weight-shifting activities.
- Selective movement facilitation.
- Balance and postural stability exercises.

Motor Relearning Program Component

- Task-oriented functional training.
- Repetitive practice of sitting-to-standing.
- Walking and gait re-education.
- Functional reaching activities.
- Stair negotiation.
- Upper limb functional task practice.
- Repetitive practice of activities of daily living with therapist feedback.

The combined intervention was designed to improve movement quality through Bobath facilitation while reinforcing functional motor learning through repetitive task-specific practice.

Procedure

Baseline demographic information and clinical characteristics were recorded before commencement of the intervention. Motor recovery and functional independence were assessed using the Fugl-Meyer Assessment and Modified Barthel Index. Following six weeks of rehabilitation, all outcome measures were reassessed using identical assessment procedures by the same evaluator to ensure consistency.

Statistical Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for demographic and clinical variables. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The normality of the data was assessed prior to inferential analysis. Pre- and post-intervention outcome measures were compared using the paired t-test. A p-value of <0.05 was considered statistically significant.

RESULTS

Participant Characteristics

A total of 60 individuals with subacute stroke completed the study. Participants were equally distributed across the three age groups, with 20 (33.3%) participants each in the 41–50, 51–60, and 61–70 year age categories. There were 31 males (51.6%) and 29 females (48.4%). With respect to residence, 30 participants (50%) were from urban areas and 30 participants (50%) were from rural areas. The most common occupation was housewife (36.6%), followed by job holders (15%), businessmen (13.3%), retired individuals (13.3%), others (13.3%), farmers (5%), and unemployed participants (3.3%). The baseline Mini-Mental State Examination (MMSE) score was 27.7 ± 2.5, indicating that participants had adequate cognitive function to participate in the rehabilitation programme.

Table 1. Baseline Characteristics of Participants

(n = 60)

Variable	Value
Age 41–50 years	20 (33.3%)
Age 51–60 years	20 (33.3%)
Age 61–70 years	20 (33.3%)
Male	31 (51.6%)
Female	29 (48.4%)
Urban	30 (50%)
Rural	30 (50%)
Baseline MMSE	27.7 ± 2.5

Effect on Motor Recovery

Motor recovery was assessed using the Fugl-Meyer Score (FMS). The mean pre-treatment score was 35.7 ± 6.4, which increased to 44.4 ± 6.2 after completion of the six-week intervention. Statistical analysis using the paired *t*-test demonstrated a highly significant improvement (t = 31.1, p = 0.0001), indicating that the combined Bobath Concept and Motor Relearning Program produced a substantial enhancement in motor recovery among individuals with subacute stroke.

Table 2. Comparison of Pre- and Post-intervention Fugl-Meyer Scores (n = 60)

Outcome	Pre-treatment (Mean ± SD)	Post-treatment (Mean ± SD)	t-value	p-value
Fugl-Meyer Score (FMS)	**35.7 ± 6.4**	**44.4 ± 6.2**	**31.1**	**0.0001**

Effect on Spasticity

Muscle spasticity was evaluated using the Modified Ashworth Scale (MAS). The mean MAS score significantly decreased from 2.4 ± 0.5 before intervention to 1.6 ± 0.4 after intervention. The reduction in MAS score was statistically significant (t = 17.1, p = 0.0001), indicating that the intervention effectively reduced muscle spasticity in the study participants.

Table 3. Comparison of Pre- and Post-intervention Modified Ashworth Scale Scores (n = 60)

Outcome	Pre-treatment (Mean ± SD)	Post-treatment (Mean ± SD)	t-value	p-value
Modified Ashworth Scale	**2.4 ± 0.5**	**1.6 ± 0.4**	**17.1**	**0.0001**

Overall Treatment Effect

Following six weeks of rehabilitation, statistically significant improvements were observed in both primary outcome measures. Motor recovery improved significantly, as evidenced by the increase in Fugl-Meyer Score from 35.7 ± 6.4 to 44.4 ± 6.2 (p = 0.0001). Similarly, muscle spasticity showed significant reduction, with Modified Ashworth Scale scores decreasing from 2.4 ± 0.5 to 1.6 ± 0.4 (p = 0.0001). These findings demonstrate that the combined Bobath Concept and Motor Relearning Program was effective in enhancing motor recovery while reducing spasticity in individuals with subacute stroke.

Figure 1. Age Distribution (n = 60)

Age distribution of participants

Distribution of participants across age groups.

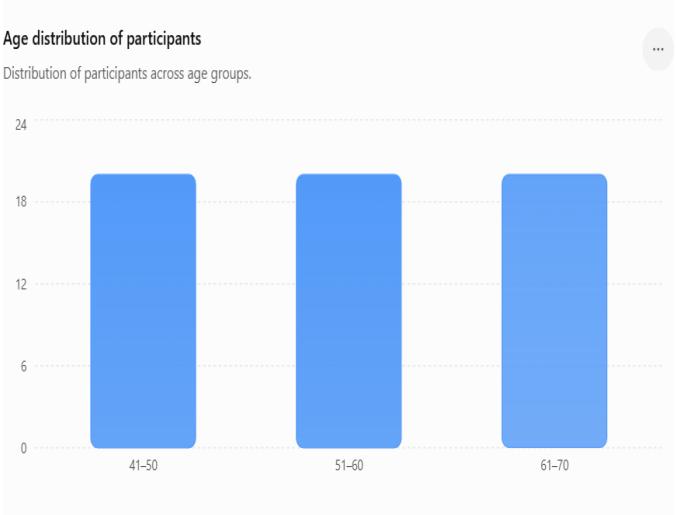


Figure 2. Gender Distribution (n = 60)

Gender distribution

Proportion of male and female participants.

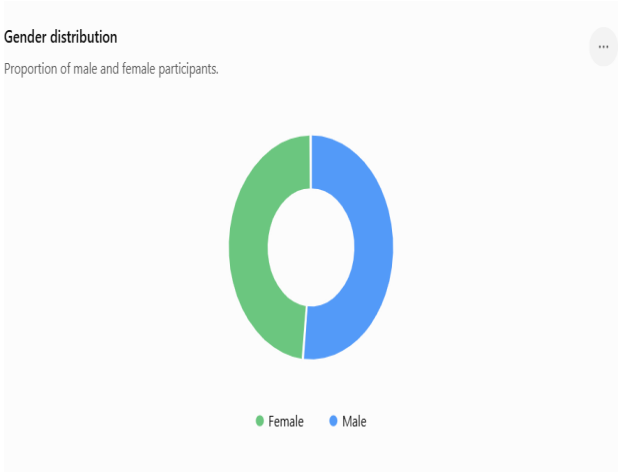


Figure 3. Pre- and Post-intervention Fugl–Meyer Score

Fugl–Meyer Score before and after intervention

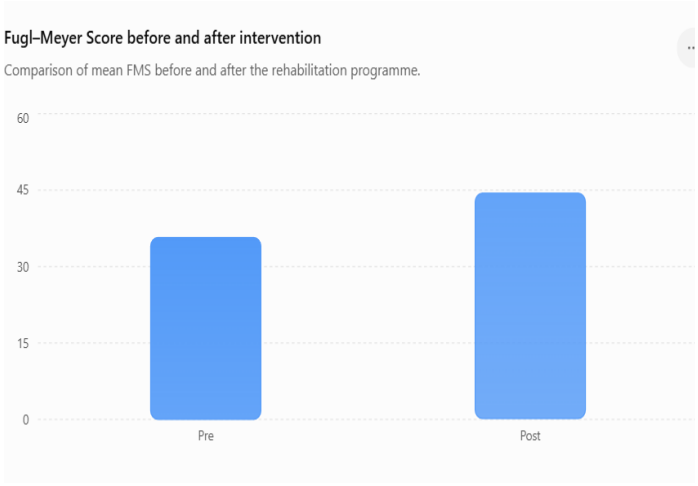
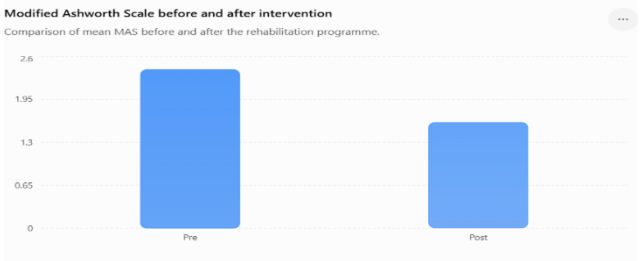


Figure 4. Pre- and Post-intervention Modified Ashworth Scale

Modified Ashworth Scale before and after intervention

Comparison of mean MAS before and after the rehabilitation programme.



Discussion

The present study evaluated the effectiveness of a combined Bobath Concept and Motor Relearning Program in improving motor recovery and reducing muscle spasticity among individuals with subacute stroke. Following six weeks of intervention, statistically significant improvements were observed in both outcome measures. The mean Fugl–Meyer Score (FMS) increased significantly from 35.7 ± 6.4 to 44.4 ± 6.2 (t = 31.1, p = 0.0001), while the Modified Ashworth Scale (MAS) score decreased significantly from 2.4 ± 0.5 to 1.6 ± 0.4 (t = 17.1, p = 0.0001). These findings indicate that the combined rehabilitation programme was effective in enhancing motor recovery and reducing spasticity in patients with subacute stroke.

Improvement in motor recovery observed in the present study can be explained by the complementary mechanisms of the Bobath Concept and the Motor Relearning Program. The Bobath Concept focuses on facilitating normal movement patterns, improving postural control, and inhibiting abnormal muscle tone through therapist-guided handling. In contrast, the Motor Relearning Program emphasizes repetitive, task-specific practice that promotes motor learning and neuroplasticity. The integration of these approaches provides both movement facilitation and functional task practice, thereby enhancing voluntary motor control and improving movement quality.

The significant improvement in Fugl–Meyer Scores is consistent with the principles of neuroplasticity, which suggest that repetitive, meaningful movement practice stimulates cortical reorganization and facilitates recovery of motor function after stroke. Intensive task-oriented rehabilitation encourages the formation of new neural connections, enabling patients to regain voluntary movement and improve functional performance.

The findings of the present study are supported by Carr and Shepherd, who proposed that repetitive task-oriented training is fundamental to motor recovery following stroke and that functional practice improves movement efficiency and independence. Similarly, Rensink et al. reported

that task-oriented rehabilitation significantly improves mobility, balance, upper limb function, and activities of daily living compared with traditional rehabilitation approaches. Their systematic review emphasized that meaningful repetitive practice should form the basis of stroke rehabilitation programmes.

The present findings also agree with Veerbeek et al., whose large systematic review and meta-analysis concluded that intensive, high-repetition, task-specific physiotherapy interventions produce consistent improvements in motor recovery following stroke. They reported that greater practice intensity was associated with superior functional outcomes and highlighted the importance of evidence-based, task-oriented rehabilitation strategies in promoting neuroplasticity.

Reduction in muscle spasticity observed in the present study may be attributed to repeated weight-bearing activities, postural alignment exercises, stretching, and active functional movements incorporated throughout the rehabilitation programme. These interventions improve reciprocal muscle activation, enhance sensorimotor integration, and reduce abnormal reflex activity, leading to decreased muscle tone. Improved postural control achieved through the Bobath Concept may also contribute to normalization of muscle activity and more efficient movement patterns.

The findings are further supported by Ada et al., who demonstrated that strengthening and active rehabilitation interventions significantly improve motor performance without increasing spasticity following stroke. Their review suggested that appropriately prescribed strengthening and functional exercises can safely improve motor recovery while minimizing abnormal muscle tone.

Although the present study demonstrated significant improvements following the combined intervention, it employed a single-group pre–post design without a comparison group. Consequently, while the observed improvements are encouraging, it is not possible to determine whether the combined Bobath and Motor Relearning Program is superior to either intervention delivered individually or to other contemporary rehabilitation approaches. Future randomized controlled trials comparing combined therapy with individual treatment protocols are required to establish comparative effectiveness.

Overall, the findings suggest that integrating movement facilitation techniques with repetitive task-oriented practice represents a clinically effective strategy for stroke rehabilitation. The combination of the Bobath Concept and Motor Relearning Program addresses both impairment-level deficits and functional performance, thereby supporting motor recovery and reducing spasticity in individuals with subacute stroke. These results contribute to the growing body of evidence supporting comprehensive, neuroplasticity-based physiotherapy interventions in stroke rehabilitation.

Strengths of the Study

The present study has several strengths that enhance its clinical relevance. First, it employed standardized and validated outcome measures, namely the **Fugl–Meyer Score (FMS)** and the **Modified Ashworth Scale (MAS)**, which are widely accepted for evaluating motor recovery and spasticity following stroke. Second, the intervention integrated two evidence-based neurorehabilitation approaches—the Bobath Concept and the Motor Relearning Program—allowing participants to benefit from both facilitation techniques and repetitive task-oriented training. Third, all participants completed the six-week intervention programme, resulting in a complete dataset without attrition. Finally, the study focused on individuals in the subacute stage of stroke, a critical period during which neuroplasticity is most responsive to rehabilitation interventions.

Clinical Implications

The findings of the present study have important implications for neurological physiotherapy practice. The significant improvement in motor recovery and reduction in spasticity suggest that combining the Bobath Concept with the Motor Relearning Program can be an effective rehabilitation strategy for individuals with subacute stroke. Integrating facilitation techniques with repetitive functional task practice may help optimize motor relearning, improve movement quality, and enhance patient participation during rehabilitation.

Physiotherapists may consider incorporating this

combined approach into routine stroke rehabilitation programmes to promote functional recovery. The intervention requires minimal specialized equipment, making it practical for implementation in hospitals, rehabilitation centres, and outpatient physiotherapy settings. Furthermore, emphasizing repetitive, goal-directed activities may improve patient motivation and encourage active involvement throughout the rehabilitation process.

Limitations

Despite the encouraging findings, the study has several limitations.

- The study employed a **single-group pre–post design** without a control or comparison group, limiting the ability to attribute improvements solely to the intervention.
- The sample size was relatively small (**n = 60**), which may limit the generalizability of the findings to the broader stroke population.
- The intervention period was limited to **six weeks**, and long-term follow-up was not performed to determine whether the observed improvements were maintained over time.
- Participants were recruited from a single rehabilitation centre, which may reduce the external validity of the findings.
- Only motor recovery and spasticity outcomes were analysed; additional measures of quality of life, participation, and community reintegration were not evaluated.

Future Recommendations

Future research should include randomized controlled trials with larger sample sizes to compare the combined Bobath Concept and Motor Relearning Program with individual rehabilitation approaches and other evidence-based interventions. Multicentre studies involving diverse patient populations would improve the generalizability of the findings.

Long-term follow-up assessments are recommended to determine the sustainability of treatment effects. Future studies should also evaluate additional outcomes such as gait performance, balance, functional independence, quality of life, and community participation. Incorporating objective assessment tools, including motion analysis systems and wearable movement sensors, may provide a more comprehensive understanding of motor recovery following stroke rehabilitation.

Conclusion

The present study demonstrated that a six-week programme combining the **Bobath Concept** and the **Motor Relearning Program** produced significant improvements in motor recovery and reductions in muscle spasticity among individuals with subacute stroke. Fugl–Meyer Scores improved significantly from **35.7 ± 6.4** to **44.4 ± 6.2**, while Modified Ashworth Scale scores decreased from **2.4 ± 0.5** to **1.6 ± 0.4**, indicating enhanced motor function and reduced spasticity following rehabilitation.

The findings support the use of an integrated rehabilitation approach that combines movement facilitation with repetitive task-specific practice to promote neuroplasticity and improve motor performance after stroke. Although the study design limits conclusions regarding comparative effectiveness, the observed improvements indicate that this combined intervention may represent a valuable physiotherapy strategy during the subacute phase of stroke recovery. Further well-designed randomized controlled trials with larger samples and long-term follow-up are warranted to confirm these findings and establish the role of combined Bobath and Motor Relearning interventions in evidence-based stroke rehabilitation.

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Ethical Approval

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Ethical approval was obtained from the Institutional Ethics Committee of Pacific Medical University, Udaipur, Rajasthan, before commencement of the study. Written informed consent was obtained from all participants prior to enrolment in the study.

Informed Consent

Written informed consent was obtained from all participants before inclusion in the study. Participants were informed about the objectives, procedures, potential benefits, and possible risks of the study, and their confidentiality was maintained throughout the research.

Author Contributions

Aditi Pallavi: Conceptualization, Methodology, Investigation, Data Collection, Formal Analysis, Writing – Original Draft.

Dr. Shubham Menaria: Supervision, Methodology, Validation, Writing – Review & Editing.

Abbreviations

Abbreviation	Full Form
FMS	Fugl–Meyer Score
MAS	Modified Ashworth Scale
MMSE	Mini-Mental State Examination
MRP	Motor Relearning Program
ADL	Activities of Daily Living
ROM	Range of Motion
CNS	Central Nervous System
SD	Standard Deviation
WHO	World Health Organization

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