International Journal of Contemporary Research In Multidisciplinary

Research Article

Comparative Study of PNF Versus Conventional Physiotherapy on Spasticity Reduction in Hemiplegia

Dr. Barnita Deb Bose (PT) [1*], Dr. Pratik Bose (PT) [2], Dr. Atanu Datta (PT) [3]

[1] Senior Associate Physiotherapist, Department of Physiotherapy and Rehabilitation Manipal Hospital, Salt Lake, Kolkata, West Bengal, India

[2] Executive Physiotherapist, Manipal Hospital Broadway, Kolkata, West Bengal, India

[3] Lecturer, Department of Physiotherapy, National Institute for Locomotor Disability, Bonhooghly, West Bengal, India

Corresponding Author: * Dr. Barnita Deb Bose (PT)

DOI: https://doi.org/10.5281/zenodo.22057615

Abstract

Background: Spasticity is one of the most disabling consequences of upper motor neuron injury following stroke, affecting nearly one-third of survivors and impairing functional recovery, activities of daily living, and quality of life. Proprioceptive Neuromuscular Facilitation (PNF) has been proposed as a superior alternative to conventional physiotherapy for spasticity management, yet comparative evidence remains limited and heterogeneous. **Objective:** This study aimed to compare the effectiveness of PNF techniques against conventional physiotherapy in reducing spasticity and improving functional independence among adults with post-stroke hemiplegia. Methods: A randomized controlled trial was conducted on 60 hemiplegic patients (age 40-65 years, minimum Grade 1 spasticity on the Modified Ashworth Scale) recruited from an outpatient neuro-rehabilitation unit. Participants were randomly allocated into two equal groups: the PNF group (n = 30), receiving PNF patterns including rhythmic initiation, slow reversal, and contract-relax techniques, and the conventional group (n = 30), receiving passive stretching, positioning, and range-of-motion exercises. Both groups trained five days a week for six weeks. Spasticity was measured using the Modified Ashworth Scale (MAS), functional independence using the Barthel Index (BI), and range of motion using goniometry, at baseline and post-intervention. Results: Both groups demonstrated statistically significant within-group improvement ($p < 0.05$). However, the PNF group showed significantly greater reduction in MAS scores and greater gains in Barthel Index scores compared to the conventional group ($p < 0.05$), with moderate-to-large effect sizes favoring PNF. Conclusion: PNF techniques produced superior reduction in spasticity and greater improvement in functional independence compared to conventional physiotherapy in hemiplegic patients, supporting its incorporation as a primary intervention strategy in neurorehabilitation protocols.

Manuscript Information

- **ISSN No:** 2583-7397
- **Received:** 11-07-2026
- **Accepted:** 19-08-2026
- **Published:** 22-08-2026
- **IJCRM:**5(4); 2026: 873-878
- **©2026, All Rights Reserved**
- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes

How to Cite this Article

Bose B D, Bose P, Datta A. Comparative Study of PNF Versus Conventional Physiotherapy on Spasticity Reduction in Hemiplegia. Int J Contemp Res Multidiscip. 2026;5(4):873-878.

Access this Article Online

www.multiarticlesjournal.com

KEYWORDS: Proprioceptive Neuromuscular Facilitation, Spasticity, Hemiplegia, Stroke Rehabilitation, Modified Ashworth Scale, Conventional Physiotherapy.

© 2026 Dr. Barnita Deb Bose (PT), Dr. Pratik Bose (PT), Dr. Atanu Datta (PT). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY NC ND).https://creativecommons.org/licenses/by/4.0/

1. INTRODUCTION

Stroke remains one of the leading causes of long-term adult disability worldwide, with survivors frequently experiencing residual motor impairment, spasticity, and reduced functional independence (Langhorne, Bernhardt, & Kwakkel, 2011). Spasticity, defined by Lance (1980) as a velocity-dependent increase in tonic stretch reflexes resulting from hyperexcitability of the stretch reflex, is one of the most common and disabling sequelae of upper motor neuron lesions. It develops in approximately 20-40% of stroke survivors within the first year and contributes to pain, contracture, abnormal posturing, impaired gait, and difficulty performing activities of daily living.

Hemiplegia, the paralysis of one side of the body typically resulting from a contralateral cortical or subcortical lesion, is commonly accompanied by spasticity affecting the flexor muscles of the upper limb and the extensor muscles of the lower limb. Left unmanaged, spasticity can progress to fixed contractures, further limiting rehabilitation potential and increasing caregiver burden. Consequently, spasticity management occupies a central position in post-stroke physiotherapy, and clinicians have explored a range of interventions, from pharmacological agents and botulinum toxin injections to physical modalities and therapeutic exercise-based approaches.

Conventional physiotherapy for spasticity typically comprises passive stretching, positioning, range-of-motion exercises, weight-bearing activities, and neurodevelopmental techniques aimed at normalizing tone through sustained mechanical and sensory input. While these methods are widely practiced and supported by decades of clinical use, their effect on spasticity reduction is often described as modest and short-lived, particularly when applied in isolation without a strong neurophysiological rationale.

Proprioceptive Neuromuscular Facilitation (PNF), first developed by Herman Kabat and refined by Margaret Knott and Dorothy Voss in the mid-twentieth century, is a therapeutic approach that uses diagonal and spiral movement patterns combined with proprioceptive, tactile, and verbal stimuli to facilitate neuromuscular responses (Adler, Beckers, & Buck, 2014). Techniques such as rhythmic initiation, slow reversal-hold-relax, and contract-relax are theorized to reduce spasticity through autogenic and reciprocal inhibition mediated by Golgi tendon organs and Ia afferent pathways, while simultaneously promoting motor learning and functional movement patterns. Because PNF integrates the antagonist-agonist relationship directly into functional diagonal patterns, it is hypothesized to offer an advantage over conventional, single-plane stretching approaches in both reducing hypertonicity and translating tone reduction into functional gains.

Despite considerable clinical enthusiasm for PNF, the existing literature comparing it directly against conventional physiotherapy for spasticity reduction in hemiplegia is limited in volume and methodological rigor, with small sample sizes, heterogeneous outcome measures, and variable intervention durations across studies. A clear, adequately powered comparative study is therefore warranted to inform evidence-based clinical decision-making. The present study was designed to address this gap by directly comparing the effects of a structured PNF protocol against a standard conventional physiotherapy protocol on spasticity, measured using the Modified Ashworth Scale, and on functional independence, measured using the Barthel Index, in patients with post-stroke hemiplegia.

2. LITERATURE REVIEW

Spasticity has long been recognized as a major barrier to functional recovery after stroke. Lance's (1980) classical definition situates spasticity within the broader upper motor neuron syndrome, characterized by hyperreflexia, clonus, and increased resistance to passive movement. Bohannon and Smith (1987) subsequently validated the Modified Ashworth Scale (MAS) as a clinically feasible, six-point ordinal measure of resistance to passive stretch, and it remains the most widely used clinical tool for grading spasticity due to its simplicity and acceptable inter-rater reliability.

Several trials have investigated PNF as a therapeutic strategy for post-stroke spasticity. A randomized controlled trial involving thirty stroke patients with at least Grade 1 spasticity compared four weeks of PNF against conventional physiotherapy and reported that the PNF group achieved a substantially larger reduction in Modified Ashworth Scale scores alongside greater gains in Barthel Index scores relative to the conventional group, suggesting that PNF confers additional benefit for both tone reduction and functional recovery within a relatively short intervention window. Similarly, a more recent randomized trial comparing PNF-based robot-assisted therapy with conventional treatment in individuals with stroke found that the PNF-augmented approach produced greater improvements in upper-extremity motor performance, spasticity, activities of daily living, and quality of life than conventional training alone, reinforcing the proposed neurophysiological advantage of diagonal, multi-joint facilitation patterns over isolated stretching.

A separate randomized controlled trial comparing PNF against muscle-setting exercises in post-stroke patients likewise concluded that PNF produced superior improvements in functional mobility, spasticity management, and motor control relative to more basic conventional rehabilitation modalities, and further suggested that combining PNF with simpler interventions may produce additive benefits, particularly in patients with greater initial impairment. However, a systematic review examining six studies on PNF and post-stroke spasticity found the overall body of evidence to be methodologically heterogeneous, with PEDro quality scores ranging from two to five, underscoring the need for better-designed, adequately powered trials before firm clinical recommendations can be made.

Conventional physiotherapy techniques, including passive stretching, positioning, and range-of-motion exercise, remain foundational to spasticity management because sustained stretch is known to produce short-term reductions in stretch reflex excitability and to counteract soft-tissue shortening. Nevertheless, these effects are frequently transient, and isolated stretching does not inherently address the disordered reciprocal inhibition between agonist and antagonist muscle groups that

© 2026 Dr. Barnita Deb Bose (PT), Dr. Pratik Bose (PT), Dr. Atanu Datta (PT). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY NC ND).https://creativecommons.org/licenses/by/4.0/

characterizes spastic hypertonia. This theoretical gap has motivated interest in facilitation-based techniques such as PNF, which explicitly incorporate reciprocal and autogenic inhibition mechanisms into functional movement patterns rather than relying on passive mechanical stretch alone.

Functional outcome measures such as the Barthel Index (Mahoney & Barthel, 1965) and the Fugl-Meyer Assessment (Fugl-Meyer, Jaasko, Leyman, Olsson, & Steglind, 1975) are commonly used alongside spasticity scales to capture the clinical relevance of tone changes, since a reduction in resistance to passive movement is only meaningful insofar as it translates into improved activity performance. Taken together, the existing literature suggests a plausible advantage for PNF over conventional physiotherapy in both spasticity reduction and functional gain, but calls for further controlled comparative research using standardized protocols and validated outcome measures, which the present study aims to provide.

3. AIM AND OBJECTIVES

The primary objective of this study was to compare the effect of a structured six-week PNF protocol against a matched conventional physiotherapy protocol on spasticity in the affected upper and lower limbs of patients with post-stroke hemiplegia, as measured by the Modified Ashworth Scale. The secondary objectives were to compare the two groups on functional independence, measured by the Barthel Index, and on passive range of motion at the elbow and knee joints, measured by universal goniometry.

4. MATERIALS AND METHODS

4.1 Study Design

This study employed a prospective, single-blind, parallel-group randomized controlled trial design, conducted over a period of six weeks at an outpatient neuro-rehabilitation department. Ethical approval was obtained from the Institutional Ethics Committee prior to recruitment, and the study was conducted in accordance with the ethical principles of the Declaration of Helsinki. All participants provided written informed consent before enrollment. The outcome assessor was blinded to group allocation to minimize detection bias.

4.2 Participants

Sixty patients diagnosed with post-stroke hemiplegia, confirmed by computed tomography or magnetic resonance imaging, were recruited through convenience sampling from the outpatient rolls of the rehabilitation department. Eligible participants were adults aged 40-65 years, with a first-ever unilateral ischemic or hemorrhagic stroke of at least three months' and no more than twelve months' duration, presenting with spasticity of at least Grade 1 on the Modified Ashworth Scale in the affected elbow flexors and/or knee extensors, and medically stable with the ability to follow simple verbal commands. Patients were excluded if they had a history of prior neurological or orthopedic conditions affecting the limbs, fixed joint contractures, cognitive impairment precluding participation in therapy, uncontrolled cardiovascular disease, or recent botulinum toxin injection within the preceding three months.

4.3 Randomization and Group Allocation

Following baseline assessment, participants were allocated to one of two groups using a computer-generated randomization sequence with allocation concealment achieved through sequentially numbered, opaque, sealed envelopes. Group A (n = 30) received the PNF intervention, and Group B (n = 30) received conventional physiotherapy. Both groups additionally received a standard background program of task-specific functional training and gait re-education to control for the general effects of therapist contact and general rehabilitation, ensuring that observed between-group differences could be attributed to the specific tone-modulation technique employed rather than to overall therapy exposure.

4.4 Outcome Measures

Spasticity was assessed using the Modified Ashworth Scale (MAS), a six-point ordinal scale (0, 1, 1+, 2, 3, 4) grading resistance to passive stretch, applied to the elbow flexors and knee extensors of the affected side. Functional independence was assessed using the Barthel Index (BI), a 100-point scale evaluating ten activities of daily living. Passive range of motion (PROM) at the elbow and knee joints was measured in degrees using a universal goniometer. All outcome measures were recorded at baseline (Day 0) and at the end of the sixth week of intervention by a physiotherapist blinded to group allocation.

4.5 Intervention Protocol - PNF Group

Participants in the PNF group received diagonal pattern exercises for the upper and lower extremities, incorporating rhythmic initiation, slow reversal-hold, and contract-relax/hold-relax techniques targeting the spastic muscle groups, guided by manual contacts, appropriate resistance, verbal commands, and stretch stimulus. Each session lasted 45 minutes, five days per week, for six consecutive weeks, and was delivered one-on-one by a qualified physiotherapist trained in PNF methodology.

4.6 Intervention Protocol - Conventional Physiotherapy Group

Participants in the conventional group received passive stretching of spastic muscle groups (each stretch held for 30 seconds, repeated ten times), positioning techniques to inhibit abnormal tone, active-assisted and active range-of-motion exercises, and weight-bearing activities on the affected limb. Sessions were matched for duration (45 minutes) and frequency (five days per week for six weeks) to control for total therapist contact time between groups.

4.7 Statistical Analysis

Data were analyzed using SPSS software (version 25.0). Descriptive statistics (mean and standard deviation) were computed for all outcome variables. The Shapiro-Wilk test was used to assess normality of data distribution. Within-group pre-to-post changes were analyzed using paired t-tests (or Wilcoxon signed-rank test where data were non-normally distributed), and between-group comparisons of change scores were analyzed using independent-samples t-tests (or Mann-Whitney U test as appropriate). A p-value of less than 0.05 was considered statistically significant. Effect sizes were calculated using

© 2026 Dr. Barnita Deb Bose (PT), Dr. Pratik Bose (PT), Dr. Atanu Datta (PT). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY NC ND).https://creativecommons.org/licenses/by/4.0/

Cohen's d, with values of 0.2, 0.5, and 0.8 interpreted as small, medium, and large effects, respectively.

5. RESULTS

Sixty patients completed the study with no dropouts in either group. Baseline characteristics, including age, sex distribution, side of hemiplegia, and duration since stroke onset, did not differ significantly between the two groups ($p > 0.05$), confirming successful randomization and comparability of groups at baseline.

Both the PNF group and the conventional group demonstrated statistically significant within-group reductions in Modified Ashworth Scale scores from baseline to the end of six weeks ($p < 0.001$ for both groups), indicating that both interventions were effective in reducing spasticity to some degree. However, the magnitude of improvement differed markedly between groups. The PNF group's mean MAS score decreased from 2.43 ± 0.50 at baseline to 1.17 ± 0.38 post-intervention, a mean reduction of 1.26 points, whereas the conventional group's mean MAS score decreased from 2.40 ± 0.49 to 1.83 ± 0.38, a mean reduction of 0.57 points. The between-group difference in MAS change scores was statistically significant in favor of the PNF group ($p < 0.001$), with a large effect size (Cohen's d = 1.42).

Functional independence, as measured by the Barthel Index, similarly improved significantly in both groups ($p < 0.001$), but to a greater extent in the PNF group. Mean Barthel Index scores in the PNF group rose from 54.3 ± 7.5 at baseline to 84.6 ± 5.9 post-intervention, an increase of 30.3 points, compared with an increase from 53.1 ± 6.9 to 78.4 ± 6.7 (a rise of 25.3 points) in the conventional group. The between-group difference favored the PNF group and was statistically significant ($p = 0.012$), with a moderate effect size (Cohen's d = 0.68).

Passive range of motion at the elbow and knee joints likewise improved in both groups, with the PNF group showing significantly greater gains in elbow extension range of motion (mean gain of 18.4° versus 11.2° in the conventional group, $p = 0.008$) and knee extension range of motion (mean gain of 14.9° versus 9.6°, $p = 0.021$). These results collectively indicate that while conventional physiotherapy produced measurable improvement, the PNF protocol was associated with significantly larger and more clinically meaningful gains across all three outcome domains within the same six-week treatment period.

Table 1. Comparison of Modified Ashworth Scale (MAS) and Barthel Index (BI) scores between PNF and Conventional Physiotherapy groups (Mean ± SD)

Outcome Measure	Group	Baseline	Post-Intervention (Week 6)	Mean Change	p-value (Between-Group)
MAS (0-4)	PNF (n=30)	2.43 ± 0.50	1.17 ± 0.38	1.26	< 0.001*
MAS (0-4)	Conventional (n=30)	2.40 ± 0.49	1.83 ± 0.38	0.57	
Barthel Index (0-100)	PNF (n=30)	54.3 ± 7.5	84.6 ± 5.9	30.3	0.012*
Barthel Index (0-100)	Conventional (n=30)	53.1 ± 6.9	78.4 ± 6.7	25.3	

*Statistically significant at $p < 0.05$

Table 2. Comparison of Passive Range of Motion (PROM) gains between groups (Mean ± SD, in degrees)

Joint Motion	PNF Group Gain	Conventional Group Gain	p-value
Elbow extension	18.4° ± 4.2°	11.2° ± 3.8°	0.008*
Knee extension	14.9° ± 3.9°	9.6° ± 3.5°	0.021*

*Statistically significant at $p < 0.05$

6. DISCUSSION

The results of this study demonstrate that while both PNF and conventional physiotherapy produced statistically significant reductions in spasticity and improvements in functional independence over six weeks, PNF conferred significantly greater benefit across every outcome measure examined. These findings are consistent with prior comparative research reporting superior reductions in Modified Ashworth Scale scores and greater functional gains with PNF relative to conventional physiotherapy in stroke patients with hemiplegia, and align with reports that PNF-based approaches, including PNF-augmented robot-assisted therapy, outperform conventional training on measures of spasticity, motor performance, and activities of daily living.

The superior effect of PNF observed in this study may be explained through several complementary neurophysiological mechanisms. First, techniques such as contract-relax and hold-relax exploit autogenic inhibition mediated by Golgi tendon organs, producing a reflexive reduction in motor neuron excitability of the spastic muscle following isometric contraction, an effect that isolated passive stretching does not directly elicit. Second, the reciprocal patterns inherent to PNF diagonals engage reciprocal inhibition between agonist and antagonist muscle groups, which may help normalize the disordered co-contraction frequently observed in spastic hemiplegia. Third, because PNF patterns are multi-joint, multi-planar, and functionally oriented, they may promote more effective carryover into activities of daily living than single-joint conventional stretching, which could account for the larger between-group difference observed in Barthel Index scores relative to the difference in Modified Ashworth Scale scores alone.

The greater gains in passive range of motion in the PNF group further support the hypothesis that facilitation-based neuromuscular re-education, rather than mechanical stretch alone, more effectively addresses the combined neural and biomechanical contributors to reduced joint mobility in spastic hemiplegia. Increased range of motion achieved through neurophysiological tone reduction, as opposed to purely passive elongation of soft tissue, may also be more durable, although the present study did not include a follow-up period to test retention of gains after intervention withdrawal.

© 2026 Dr. Barnita Deb Bose (PT), Dr. Pratik Bose (PT), Dr. Atanu Datta (PT). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY NC ND).https://creativecommons.org/licenses/by/4.0/

It is also noteworthy that the conventional physiotherapy group demonstrated meaningful and statistically significant improvement in its own right, reinforcing existing evidence that structured passive stretching, positioning, and range-of-motion exercise remain a valuable and effective foundation of spasticity management, even where a more specialized technique such as PNF may confer additional benefit. This suggests that PNF should be considered a valuable adjunct or upgrade to, rather than a wholesale replacement for, foundational physiotherapy practice, particularly in settings where specialized PNF training or increased one-on-one therapist time is not readily available.

These findings carry several clinical implications. Given the relatively short six-week intervention window used in this study, incorporating PNF techniques early in the post-stroke rehabilitation trajectory may accelerate spasticity reduction and functional recovery, potentially shorten the overall rehabilitation timeline and reducing the risk of secondary complications such as contracture. However, because PNF requires a higher level of therapist training, one-on-one contact time, and manual skill compared with conventional stretching protocols, resource and training implications should be considered when translating these findings into routine clinical practice, particularly in low-resource rehabilitation settings.

7. Limitations of the Study

This study has several limitations that warrant consideration. The sample size, while adequate to detect between-group differences on the primary outcomes, was drawn from a single center using convenience sampling, which may limit generalizability. The absence of a long-term follow-up period precludes conclusions regarding the durability of spasticity reduction and functional gains after intervention withdrawal. Blinding of participants and treating therapists to group allocation was not feasible given the nature of the interventions, introducing a potential source of performance bias, although the outcome assessor remained blinded. Finally, the study focused on upper- and lower-limb spasticity in a relatively homogeneous subacute-to-chronic stroke population; findings may not directly generalize to acute-phase patients or to hemiplegia arising from non-stroke etiologies such as traumatic brain injury or cerebral palsy.

8. CONCLUSION

This randomized controlled trial demonstrates that Proprioceptive Neuromuscular Facilitation produces significantly greater reductions in spasticity and significantly greater improvements in functional independence and passive range of motion compared with conventional physiotherapy in patients with post-stroke hemiplegia over a six-week intervention period. While conventional physiotherapy remains an effective foundational approach, the incorporation of PNF techniques appears to offer meaningful additional clinical benefit and should be considered for integration into standard neurorehabilitation protocols, particularly where trained personnel and adequate therapy time are available. Future multi-center trials with larger samples, long-term follow-up, and standardized PNF dosing protocols are recommended to further strengthen the evidence base and to determine the optimal timing, intensity, and duration of PNF intervention following stroke.

9. Declarations

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Adler SS, Beckers D, Buck M. PNF in practice: an illustrated guide. 4th ed. Berlin: Springer; 2014.
2. Bohannon RW, Smith MB. Interrater reliability of a modified Ashworth scale of muscle spasticity. Phys Ther. 1987;67(2):206-207.
3. Fugl-Meyer AR, Jaasko L, Leyman I, Olsson S, Steglind S. The post-stroke hemiplegic patient: a method for evaluation of physical performance. Scand J Rehabil Med. 1975;7(1):13-31.
4. Kabat H. Proprioceptive facilitation in therapeutic exercise. In: Licht S, editor. Therapeutic exercise. 2nd ed. Baltimore: Waverly Press; 1965.
5. Lance JW. Symposium synopsis. In: Feldman RG, Young RR, Koella WP, editors. Spasticity: disordered motor control. Chicago: Year Book Medical Publishers; 1980. p. 485-494.
6. Langhorne P, Bernhardt J, Kwakkel G. Stroke rehabilitation. Lancet. 2011;377(9778):1693-1702.
7. Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. Md State Med J. 1965; 14:61-65.
8. Mamipour H, Hoseini SA, Negahban H, Moradi A, Hojjati A, Rezaeitalab F, et al. The effect of using the hip exoskeleton assistive (HEXA) robot compared to conventional physiotherapy on clinical functional outcomes in stroke patients with hemiplegia: a pilot randomized controlled trial. BMC Musculoskelet Disord. 2024; 24:11293188.
9. Saddique I, et al. A randomized controlled trial comparing the efficacy of proprioceptive neuromuscular facilitation (PNF) vs muscle setting exercises for improving motor recovery in post-stroke patients. ResearchGate [Internet]. 2025.
10. Effectiveness of proprioceptive neuromuscular facilitation on spasticity in hemiplegia: randomised controlled trial. ResearchGate; 2017.
11. The efficacy of proprioceptive neuromuscular facilitation-based robot-assisted therapy in individuals with stroke: a randomized controlled trial. Arch Phys Med Rehabil. 2026.

© 2026 Dr. Barnita Deb Bose (PT), Dr. Pratik Bose (PT), Dr. Atanu Datta (PT). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY NC ND).https://creativecommons.org/licenses/by/4.0/

12. Pandian S, Arya KN. Motor impairment of the ipsilesional body side in patients with stroke. Top Stroke Rehabil. 2014;21(4):292-299.
13. Voss DE, Ionta MK, Myers BJ. Proprioceptive neuromuscular facilitation: patterns and techniques. 3rd ed. New York: Harper & Row; 1985.
14. World Health Organization. Stroke, cerebrovascular accident: fact sheet. Geneva: World Health Organization; 2023.

Creative Commons (CC) License

This article is an open-access article distributed under the terms and conditions of the Creative Commons Attribution–Non-Commercial–No Derivatives 4.0 International (CC BY-NC-ND 4.0) license. This license permits sharing and redistribution of the article in any medium or format for non-commercial purposes only, provided that appropriate credit is given to the original author(s) and source. No modifications, adaptations, or derivative works are permitted under this license.

About the Corresponding Author

Dr. Barnita Deb Bose (PT) is a Senior Associate Physiotherapist in the Department of Physiotherapy and Rehabilitation at Manipal Hospital, Salt Lake, Kolkata, West Bengal, India. Her professional interests include physiotherapy and rehabilitation, with a focus on patient-centred care, functional recovery, and evidence-based rehabilitation practices.

© 2026 Dr. Barnita Deb Bose (PT), Dr. Pratik Bose (PT), Dr. Atanu Datta (PT). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY NC ND).https://creativecommons.org/licenses/by/4.0/