ISSN (print) 2522-1906, ISSN (online) 2522-1914
FIZICNA REABILITACIA TA REKREACIJNO-OZDOROVCI TEHNOLOGII
Vol. 10 No. 3, 2025

Original Scientific Article DOI: 10.15391/prrht.2025-10(3).02

Effects of hippotherapy on gross motor activities and function performance of children with cerebral palsy: a pilot study

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Abstract

Purpose. Cerebral palsy a neurological condition affecting movement, postural abnormalities and cognitive issues affects 8,000-10,000 children annually. Hippotherapy enhances motor function and gross motor function in children. This study looked at how hippotherapy affected children with cerebral palsy's functional performance and gross motor function.

Material & Methods. In this study, 34 children between the ages of 3 and 12 were split into two groups: the conventional group and the experimental group. While the experimental group received hippotherapy for two sessions each week for eight weeks, the conventional group received two sessions of traditional physical therapy. The children's performance was measured using the Gross Motor Function Measure (GMFM) 66 and Paediatric Evaluation of Disability Inventory both before and after the 8-week intervention.

Results. In contrast to conventional physical therapy the study found that hippotherapy significantly improved functional performance and gross motor ability in children with cerebral palsy. Following the intervention, the experimental group had a substantial rise in their GMFM-66 and PEDI scores.

Conclusions. Hippotherapy had proven to be an effective treatment for children with cerebral palsy. Enhancing gross motor function and functional performance. According to the results hippotherapy can be used in rehabilitation programmes to help children with cerebral palsy develop their motor skills fully. There were no adverse events during the intervention.

Keywords: Cerebral palsy, Convention therapy, Gross motor, Hippotherapy, Paediatrics.

Introduction

The movements and postural disorders that limit activities are called "cerebral palsy" and are thought to result from non-progressive disruptions in the developing brain. Seizures, anomalies in sensation, cognition, communication, perception and mobility deficits are common in people with cerebral palsy (Bax et al., 2005). Cerebral palsy is diagnosed in 8,000 to 10,000 newborns and babies annually. Childhood cerebral palsy is the second most common neurological disorder. There are two to 2.5 cases of cerebral palsy for every 1000 live newborns. Half of all occurrences of cerebral palsy are spastic cerebral palsy making it more prevalent than the other forms (Alagesan et al., 2011). CP is often associated with cognitive, sensory and sensitive problems in addition to its effects on the motor system. Spasticity which limits a person's ability to move within their normal range of motion is one of the main symptoms of this condition (Krejci et al., 2015). For this reason a range of methods and procedures are used in the therapy process to improve the children's motor function. In addition to traditional physiotherapy, various rehabilitation methods are employed to enhance the healing process. One of these could be hippotherapy (Matusiak-Wieczorek et al., 2020). Hippotherapy is a form of physical, occupational and speech therapy that combines motor and sensory stimulation with the natural speed and movement of a horse. It is used to

treat both physical and mental disorders with a focus on enhancing the sensory and neurologic systems. It encourages programs for physical rehabilitation especially for those with disabilities (Meregillano et al., 2004, Koca et al., 2016, McGee et al., 2009). Heat transfer and the transfer of rhythmic impulses and three-dimensional movements from a horse to the patient's body are the two main active mechanisms of Hippotherapy (HPT). A smooth, rhythmic, repetitive movement that mimics the movement performed during human locomotion is produced by the patient's pelvis. This three-dimensional exercise improves balancing reflexes, trunk straightening and postural balance (De Guindos-Sanchez et al., 2020). When children with cerebral palsy are aware of the rhythmic movements of horses their dynamic postural stability increases, resulting in conscious and feedback control over their posture (Fízková et al., 2013). In the gross motor function of children is considered completely developed when they can sit, crawl, and walk without help. Children with cerebral palsy are known to have two primary issues: a lack of postural control and impaired gross motor function development (Salazar et al., 2019). A number of scales have been created to assess gross motor function. One instrument that is often used in clinical practice and research is the Gross Motor Function Measure (GMFM) The 88 components that comprise the GMFM are separated into five functional dimensions: GMFM-A (rolling and lying down), GMFM-B (sitting), GMFM-C (crawling and kneeling), GMFM-D (standing), and GMFM-E (walking, sprinting, and leaping) (Park et al., 2014). Previous research on the potential benefits of horseback therapy for improving motor skills in children with cerebral palsy has produced mixed findings. It has been demonstrated that horseback riding treatment improves postural consciousness, gait and mobility while also decreasing aberrant tone, increasing motor function and establishing symmetrical alignment (Ataç et al., 2024). Clinicians frequently suggest horseback riding therapy for children with cerebral palsy aimed enhancing their gross motor skills, despite the fact that there is little data to support this assertion. More proof is needed to back up this strategy. Additionally improving the functional performance among kids with cerebral palsy in everyday activities is the ultimate objective of therapy. However little research has been done on the precise impact on horseback therapy for functional performance. This study was carried out to ascertain the effects of hippotherapy on the gross motor abilities and functional abilities of children with cerebral palsy in day-to-day activities. There are a number of circumstances when determining the right sample size for pilot research necessitates using the available data. For these pilot studies it is recommended to use a sufficient number of participants 17 per group (Rule of Thumb for pilot sample size estimation). This sample size is supported by practical considerations, variance and mean accuracy and regulatory concerns. This is supported by the fact that future study will be planned using the data gathered in the pilot (Julious et al., 2005).

Aim: The aim of the study is to analyse the effectiveness of hippotherapy among children with cerebral palsy on functional performance and gross motor function.

Research Question: The research question was confirmed with FINER Criteria (The study meets the FINER criteria as it is ***F***easible, requiring trained therapists and controlled settings; ***I***nteresting to pediatric rehabilitation experts; ***N***ovel, filling gaps in hippotherapy research; ***E***thical, ensuring safety and consent; and ***R***elevant, addressing motor function improvement in children with cerebral palsy) and Framed using PICO Criteria (Population, Intervention, Comparison, Outcome).

P – Children with cerebral palsy
I – Hippotherapy
C – Conventional Physical Therapy
O – Gross motor function and function performance

Objectives:

Primary: To determine the effectiveness of Hippotherapy on children with cerebral palsy.

Secondary: To compare the effectiveness conventional physical therapy and hippotherapy on children with cerebral palsy

Material and methods

Study's design

Ethical Clearance: This study was approved by the Institutional Scientific Review Board of Saveetha Institute of Medical and Technical Sciences, Chennai, India at ISRB number: 410/07/2024/ISRB/UGSR/SCPT.

Study guideline: The study followed CONSORT2010 statement: extension to randomized pilot and feasibility trials (Figure 1).

Participants

Inclusion criteria:

- Children suffering from cerebral palsy
- Weight less than 40 kg
- Gender: male and female
- Age: 3-12 years
- Level I-IV of the Gross Motor Function Classification System (GMFCS)

Exclusion criteria:

- Involuntary seizures,
- Low visual or auditory acuity,
- Children with cerebral palsy who are cate-

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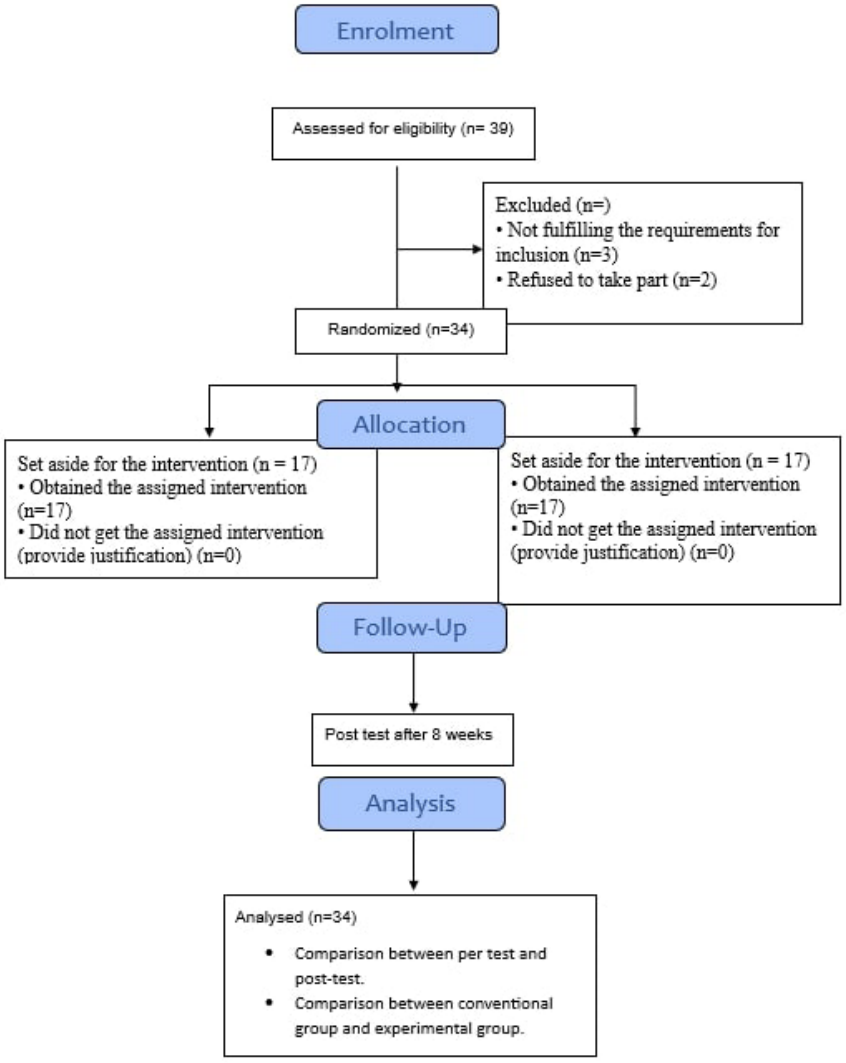

Figure 1. **CONSORT Flow chart of the study.**

gorised as GMFCS Level V

because their significant motor deficits prevent them from

- Participating in hippocampal treatment
- Prior experience with therapeutic horseback riding (THR) or hippotherapy
- Those with moderately to severe intellectual disabilities

Study Settings, Sampling Technique and Group Allocation

This experimental study was approved by the Institutional Scientific Review Board (Approval No.: 410/07/2024/ISRB/UGSR/SCPT) and was conducted at the Physiotherapy Department, Saveetha Hospital, Chennai, India, from the first week of November 2024 to the fourth week of December 2024. A total of 39 children from the Child Development Centre of Saveetha Institute were initially recruited through convenient sampling method. Of these, two children withdrew due to unforeseen medical conditions unrelated to the study and three did not meet the inclusion criteria after failing the Gross Motor Function Measure (GMFM) screening. This left 34 eligible participants between the ages of 3 and 12 years with a male-to-female ratio of 15:19. After obtaining written informed consent from their parent's participants were randomly assigned to one of two groups using a lottery method with 17 children in each group. The experimental group received hippotherapy sessions twice a week for eight consecutive weeks, each session lasting 45 minutes. The conventional group received standard physiotherapy with the same frequency and duration. Gross motor function was assessed using GMFM-66 and GMFM-88, while functional performance was evaluated using the Paediatric Evaluation of Disability Inventory – Functional Skills Scale (PEDI-FSS). These assessments were conducted both before and after the intervention period. Demographic and baseline clinical data were collected prior to the initiation of therapy (Table 1) and detailed information about the study and interventions was explained to the parents before consent was obtained.

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Table 1. Demographic and Baseline measurement

Age	Number of Children with CP	CP Subtype	GMFCS Level	Sensory/Motor/ Vestibular Disorders	Muscle Tone (MAS)	ROM / Joint Mobility
4–6	12	Spastic Diplegia	Level II	Mild motor delay	1+	Mild ankle tightness
7–9	10	Ataxic	Level I	Vestibular dysfunction	0	Full ROM
10–12	12	Spastic Hemiplegia	Level III	Moderate sensory impairment	2	Limited wrist ROM

Conventional group

The 17 participants in the conventional group receive Conventional Physical Therapy for 2 sessions per week for continuously 8 weeks. Total treatment time – 45 minutes.

Session Structure:

Warm-Up Phase (5-10 minutes): Stretching and basic range-of-motion exercises.

Core Session (30-40 minutes): Activities to improve strength, posture and functional performance. Examples:

- Static and dynamic balance exercises (e.g., standing on one leg, balance board).
- Core strengthening exercises (e.g., therapy ball activities).
- Sit-to-stand transitions.
- Gait training using parallel bars or a treadmill.
- Walking over obstacles to improve coordination.
- Functional activities like picking up objects or climbing stairs.
- Cool-Down Phase (5–10 minutes): Relaxation exercises (Julious et al., 2004; Sri Lekha et al., 2025).

Experimental group:

The 17 participants in the experimental group receive the hippotherapy for 2 sessions per week for continuously 8 weeks. Total treatment time 45 minutes.

Activities:

- Sitting upright without support.
- Holding different positions (e.g., kneeling, side-sitting).
- Weight-shifting exercises.
- Performing trunk rotations and arm movements.

Progression: As the child improves, horse movement speed may increase and complexity of activities adjusted (e.g., removing support, engaging both upper limbs) (Park et al., 2014).

Outcome measures

Gross Motor Function: Measured at the starting point to eight weeks after the intervention using the Gross Motor Function Measure (GMFM-66). The Gross Motor Function Measure (GMFM) consists of five domains: A-rolling and laying, D-standing and walking, E-running and leaping, C-crawling and kneeling, and B-sitting. A 4-point grading method is used to provide grades once the processes have been seen. A 4-point grading method is used to provide grades once the processes have been seen. After the test is finished, the scores of each item are plotted using the Gross Motor Ability Estimator (GMAE) software version 2 which converts the data into a scale from 0 to 100 (Ataç T et al., 2024).

Secondary Outcome

Utilizing the Paediatric Evaluation of Disability Inventory (PEDI) functional performance is assessed. A standardized instrument for evaluating functional capabilities in children aged six months to 7.5 years including older children with disabilities is the Paediatric Evaluation of Disability Inventory (PEDI). Three factors' adaptations, carer support and functional skills are used to assess social functioning, mobility and self-care. Physician evaluation, parent interviews or observation are the methods used to conduct PEDI. Ability and support needs are evaluated using a scoring system. It is trustworthy for tracking progress directing therapy and assessing assistance eligibility (Haley et al., 1992).

Statistical analysis

All of the data sets were analysed using SPSS version 27. The Wilcoxon test was administered to groups A and B and the Mann-Whitney U test was used to compare between two groups.

Results

34 children between the ages of 3 and 12 (M: F=15:19) were enlisted. Participants would be divided into two groups: the Experimental group which includes 17 patients receiving hippotherapy and the Conventional group which includes 17 individuals receiving traditional physical therapy (Table 1).

Table 1. Age and sex distribution

Age (yrs)	Conventional group			Experimental group		
	Male	Female	Total	Male	Female	Total
4-6	2	3	5	4	3	7
7-9	4	4	8	0	2	2
10-12	2	2	4	3	5	8
Total	8	9	17	7	10	17

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Table 2. Comparison of GMFM-66 within group A and group B

Group	Pre-test Mean±SD	Post-test Mean±SD	Z Value	p-value
Conventional group (n=17)	41.71±7.423	43.76±7.496	−2.991	0.003
Experimental group (n=17)	46.88±3.655	82.12±5.073	−3.624	<0.001

Table 3. Comparison of PEDI within group A and group B

Group	Pre-test Mean±SD	Post-test Mean±SD	Z value	p-value
Conventional group (n=17)	85±17.965	96.94±29.712	−2.274	0.023
Experimental group (n=17)	85±17.965	151.94±25.592	−3.621	<0.001

Table 4. Comparison of GMFM-66 between group A and B

Test	Mean±SD	Z value	W	U	p-value	r-values
Pretest	45.09±7.103	−2.622	221.5	68.5	0.008	0.45
Post-test	63.06±20.519	−4.979	153.0	91.50	<0.001	0.85

According to a Wilcoxon signed-rank test participants with cerebral palsy received hippotherapy shown a statistically significant changes in their Gross Motor Function Measure 66 (Figure 1) following an 8-week interventional therapy course that was given twice a week (Z=−3.624, p=<0.001). participants with cerebral palsy who received the conventional treatment course twice a week shown a statistically significant changes in their Gross Motor Function Measure-66 (Table 2) (Z=−2.991, p=0.003).

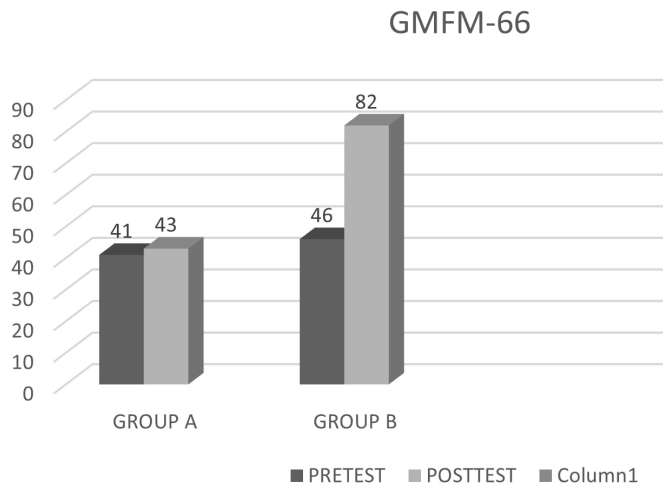

Figure 1. Comparison of GMFM-66 within group A (Conventional Group) and group B (Experimental Group).

A statistically significant rise in the Paediatric Evaluating of Disabilities Inventory (PEDI) (Figure 2) for participants with cerebral palsy was seen throughout an 8-week of hippotherapy course, administered twice a week, according to a Wilcoxon signed-rank test (Z=−3.621, p<0.001). For those with cerebral palsy the conventional treatment regimen, which was similarly given twice a week resulted in a statistically significant improvement in the Paediatric Evaluation of Disability Inventory (Table 3) (Z=−2.274, p=0.023).

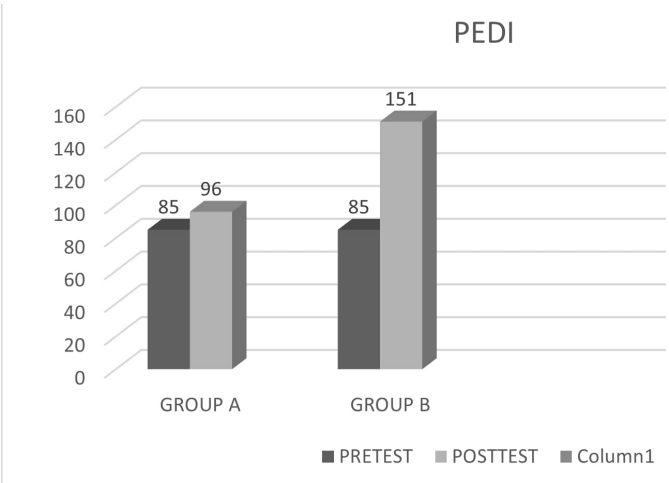

Figure 2. Comparison of PEDI within group A (Conventional group) and group B(Experimental group).

On the GMFM-66 (Table 4) there was an significant difference between groups A and B on the pretest (U=91.50, p=<0.001), while the Mann-Whitney U test indicated a significantly greater difference on the post-test. Since the p-value is less than it used to the alpha level of 0.05, the hypothesis of null effect is rejected, suggesting that the treatment strategy had a substantial impact on cerebral palsy. The calculated r value for the pre-test is around 0.45, indicating a relatively medium effect size. The calculated post-test r value, however, is nearly 0.85, indicating a significant larger effect size.

Table 5. Comparison of PEDI between group A and B

Test	Mean±SD	Z value	W	U	p-value	r-value
Pretest	85±17.691	0	297.5	144.5	1.000	0
Posttest	124.4±39.0	–4.394	170.0	17.0	<0.001	0.75

The Mann-Whitney U test revealed a significantly difference between Group A and the group B's outcomes following the test on the PEDI (Table 5) (U=17.00, p<0.001). Since the p-value is below the 0.05 alpha criterion, the study rejected the null hypothesis, indicating that the treatment approach significantly affected cerebral palsy. The calculated r value of about 0 for the pre-test indicates a very small effect size. The calculated posttest r value, however, is about 0.75, indicating a significant larger effect size.

Discussion

The conventional group received physical therapy for 8 weeks, while the experimental group received hippotherapy. Performance was assessed using GMFM-66 and GMFM-88 before treatment. The results of the study suggest that hippotherapy might be a helpful supplemental intervention for enhancing gross motor and functional performance. This study reveals that hippotherapy is an effective adjunctive treatment for cerebral palsy. By enhancing gross motor function and functional performance, it promotes better balance, coordination and cognitive engagement. There is no fellow up and the number of participants was quite small, although it can be expanded in future research. The study found that children with cerebral palsy who received hippotherapy a therapeutic form of horseback riding practice, had better cognitive abilities, particularly memory and concentration (Krejci et al., 2017). According to the study physiotherapy is a crucial component of a multidisciplinary approach needed for children with cerebral palsy (CP) to have effective rehabilitation. Enhancing functional independence controlling muscle tone, reducing musculoskeletal issues and improving motor control are the primary objectives. Long-term success requires goal-oriented treatment, education and family participation. Children with cerebral palsy benefit from physiotherapy as it helps them adjust more easily to adolescence and adulthood (Günel et al., 2009). This comprehensive study from 2024 looks into how hippocampal treatment affects motor performance in kids with cerebral palsy (CP). According to the review, hippotherapy dramatically enhances muscle strength, balance, coordination, gait and gross motor skills. The horse's rhythmic motions help with postural stability and motor control by triggering neuromuscular reactions. Although successful, the review points out shortcomings in the existing research, including small sample sizes and uneven protocols, indicating the need for more study to develop uniform treatment approaches and evaluate long-term advantages (Plotas et al., 2024). Hippotreatment has been shown to significantly improve the balancing, posture and coordination of children with cerebral palsy. The neuromuscular responses facilitated by the rhythmic movements aid in the recovery of motor function. More study is recommended by the authors for standardised treatment protocols and long-term effectiveness (Koca et al., 2016). A systematic review of the impact of hippocampal treatment on motor function in people with Down syndrome was carried out. The evaluation showed little evidence of hippotherapy-induced improvements in motor function mostly because of uneven trial protocols and methodological problems. The authors stressed that in order to more accurately evaluate the efficacy of hippocampal treatment for this population higher-quality research using standardized methodologies is required (Miguel et al., 2018, Divya et al., 2018). According to a comprehensive study hippotherapy improves motor function, balance, posture and muscular tone, which is a major advantage for children with cerebral palsy. Additionally, it improves social interaction, motivation, attention and psychological well-being. The scientists did point out certain drawbacks, though, including the lack of uniform procedures in previous research and limited sample numbers. They suggest further excellent study to validate its efficacy and provide standardized treatment protocols (Menor-Rodríguez et al., 2021, Murphy et al., 2008, Peia et al., 2023, Meera et al., 2018, Kim et al., 2020, Sivalingam et al., 2025; Nagaraj et al., 2025; Vellaiperumal et al., 2024).

Limitations

- Small sample size (34 participants) limits the generalizability of findings.
- The study duration was only 8 weeks and long-term effects were not assessed.
- Individual variations in responses to hippotherapy were not accounted for.
- External factors such as the skill of the horse trainer and the horse's behaviour could have influenced results.

Recommendations

- Conduct studies with larger sample sizes to validate findings.
- Extend the study duration to evaluate long-term benefits.
- Implement standardized protocols for hip-

potherapy to ensure consistent outcomes.

• Assess cognitive and psychosocial benefits in addition to motor improvements.

• Include follow-up evaluations to track progress after the therapy ends.

Conclusions

Hippocampus therapy is a beneficial intervention for kids with cerebral palsy. Improvement in the gross motor function and functional performance lead to improved coordination, balance and cognitive engagement. The findings imply that hippotherapy may be incorporated into rehabilitation plans to maximise the growth of motor skills in kids with cerebral palsy.

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Supplementary Information

Article details

The online version available at
https://doi.org/10.15391/prrht.2025-10(3).02

Acknowledgement
I extend my sincere gratitude to Saveetha College of Physiotherapy for their support in conducting this research. I deeply appreciate the guidance of my mentors and the contributions of my research team. My heartfelt thanks to the participants and their families for their cooperation. Lastly, I acknowledge the encouragement from my peers and well-wishers throughout this study.

Conflict of Interest Statement
The authors declare that there is no conflict of interest.

Funding Statement
This research received no external funding.

Received: February 24, 2025; Accepted: June 18, 2025
Published: June 30, 2025

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