HABILITATING THE DEVELOPING BRAIN: A NARRATIVE REVIEW ON THE ROLE OF EARLY PHYSIOTHERAPY IN CEREBRAL PALSY AMONG INFANTS AGED 0–12 MONTHS

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Abstract

The most prevalent form of physical disability in children is cerebral palsy, which frequently coexists with prematurity or abnormal brain impairment in infants. Since the essential neuroplastic window extends throughout infancy, early physiotherapy can bring significant value to the motor and functional development. This review summarizes the data on the effects of physiotherapeutic interventions that are implemented in the first years of life in infants diagnosed with or at risk of CP. It studies the models, mechanisms of delivery, and outcomes, as well as effectiveness. A Structured narrative review was performed in which 396 articles were identified in databases with the help of Boolean operators. Following the application of the inclusion/exclusion criteria and constraints after screening, 20 studies were selected. The analysis and summary of interventions were done in terms of timing, modality, parent involvement, and motor outcomes. Studies demonstrated early physiotherapy's role in enhancing gross motor function, postural control, and movement quality in infants with or at risk for cerebral palsy. Therapist-led interventions emphasized neurodevelopmental principles, alignment strategies, and enriched sensorimotor play. While parent-mediated models supported continuity, the physiotherapist's role in goal setting and clinical calibration remained central. Starting physiotherapy during the first year of life has significant developmental benefits for infants who are at risk of CP. The facts advocated a change towards motor training integrated with environmental-enriched and cognitive stimulation, which are structured, family-based.

Keywords - Cerebral palsy, Early physiotherapy, Infant rehabilitation, Neurodevelopment, Gross motor function, Intervention models, Parent coaching

Introduction

Cerebral palsy (CP) is a collection of permanent and non-progressive neurodevelopmental disorders which are mostly related to movements and posture. [1] It is the most common cause of childhood motor disability and is estimated to occur worldwide on the order of 2 and 2.5 per 1,000 live births. [2] Although its etiologic background is heterogeneous, prematurity and neonatal brain injury prevail. Improved neonatal survival rates have ironically elevated the volume of babies, who are at greatest danger of CP, especially those born prior to 37 weeks of gestation. [3]

The brain of a newborn baby has a neuroplastic nature, particularly during the initial year of existence, and that is the period during which activities are essential to reorganization of the nerve cells in the head.[4] Interventions which have been implemented at this stage have the capacity to induce synaptic pruning, motor mapping and cortical rewiring.[5] This has instigated development of early physiotherapy as a pillar of neurorehabilitation in children.[6]

Active, goal-oriented and context-enriched interventions have replaced passive, therapist-driven and dwelling handling in contemporary physiotherapy paradigm.[7] Treatment models like Baby- Constraint-Induced Movement Therapy (Baby-CIMT), Small step, focus on parent delivered, task specific, motor learning combined with daily activities.[8] Another group, such as Sitting Together and Reaching to Play (START-Play) and Goals Activity Motor Enrichment (GAME), integrates motor and cognitive experience to increase embodied learning.[9]Although data on individual studies show promising results, there lacks consistency in content of an intervention, a means of delivery, and analysis of outcomes.[10]

The purpose of the narrative review is to synthesize the existing literature on physiotherapy interventions that linked to the introduction of these interventions within the first 12 months of life among infants with a diagnosis or risk of CP. It makes cross comparisons with the therapeutic modalities, summaries clinical results and forms identification gaps with the research and practice to draw the next generation of early intervention process.

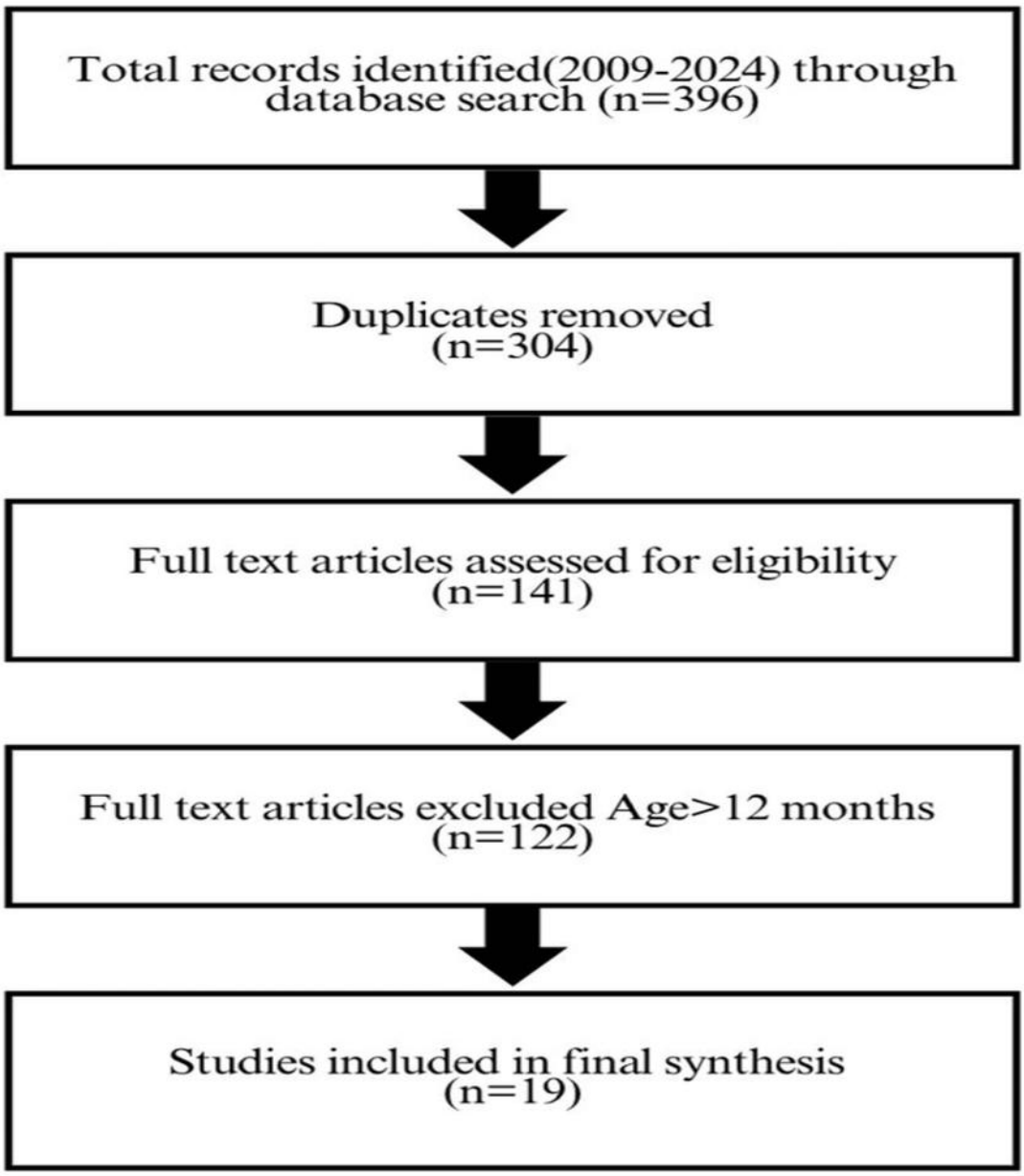
Methodology

This narrative review used a structured approach to search and consolidate supposedly identifying relevant literature that contained an evaluation on early physiotherapy intervention among children of 0-12 months with the condition of cerebral palsy (CP) or the presence of the probability of developing it. The search uses 4 databases including PubMed, Scopus, Cochrane library, and Google Scholar to cover the searches in the period 2009 to April 2024. The Boolean search term used was “infants OR neonates OR preterm” AND “physiotherapy OR rehabilitation OR early intervention” AND “cerebral palsy OR developmental delay” AND "motor outcomes OR GMFM OR intervention efficacy”. This generated one hundred and ninety-six records. Duplicates were removed, and the titles and abstracts were screened; 141 full-text articles were evaluated in detail.

The inclusion criteria necessitated that studies include infants whose corrected age is below 12 months, diagnosed with, or are at risk of developing CP. Available studies were required to apply physiotherapy, neuro- and/or motor-based interventions and to report their results with using standardized measures including the Gross Motor Function Measure (GMFM), Peabody Developmental Motor Scales (PDMS-2), Gross Motor Performance Measure (GMPM), Alberta Infant Motor Scale (AIMS), Bayley Scales of Infant Development (Bayley-III), or parent-reported outcome measures. Only randomized trials, cohort studies, or highly organized intervention schemes, including a minimum of 10 participants, were considered. Studies were excluded when interventions were initiated later than 12 months of age or the study was not published in English language or it was a review study, commentary, and/or lacked primary empirical data, animal models, and/or the study was reported as a case report. Of the 19 finally included in final synthesis, their inclusion was arrived at after applying these eligibility criteria. These included 13 randomized controlled trials or pilot RCTs, three, structured intervention protocols, two prospective cohort studies and a national survey of early intervention practices. The Physiotherapy Evidence Database (PEDro) scale, which was used to evaluate the quality of the methodology, is a validated and freely available publicly available, free of charge tool used in research and clinical purposes by the PEDro team (www.pedro.org.au). It did not need any other licensing fee. Primary information of every research (such as the authorship, year of publication, sample description, type of intervention, mode of delivery, outcome measures and predominant results), was methodically lifted into evidence perceptual tables. The synthesis of the narrative then made comparisons and contrasts of these therapy models on the based on type, the mode of delivery, type of caregiver participation, time of treatment, as well as claimed outcomes of these kinds of therapy in respective clinical areas.

Quality and Methodological evaluation

The quality of methodology of included studies was assessed using PEDro scale of included randomized and quasi random experiments, and risk of bias was used to evaluate the included non-randomized and observational studies qualitatively. Most of their trials had a high degree of methodological quality as PEDro scores were between 7 and 9, representing a low potential bias.The designs were robust, consisting of concealed allocation and blinded assessors and an intention to treat analysis, and interventions included parent-led physiotherapy, motor training, or enriched environment. In comparison, quasi-experimental and non-randomized studies had moderate or high risk of bias rating with lower PEDro score (3-6) because of weaknesses such as failure of blinding and random allocation concealment. Observational surveys had no points awarded on the PEDro scale, but they did offer a great deal of contextual information on early intervention practitioners.



Flow of Research Methodology

Results

Picked 19 studies were sampled between 2009 and 2024 similarly representing various healthcare realities in both high-income and low-income settings. The age of the participants in the intervention was between 34 weeks PMA and 9 months corrected age. Most of them were concentrated on babies with abnormal neuroimaging, the lack of fidgety movements, or neurodevelopment risk at a high level. The evaluations of gross motor effect were mostly quantitated by GMFM-66 or GMFM-88, whereas movement quality and fine motor functioning were evaluated by GMPM, PDMS-2, HAI, AIMS and Bayley Scales.

Table 1: Summary of Included Studies

S.no	Author	Year	Sample Size	Age Group at Intervention	Intervention	Outcome Measures	Main Findings
1	Ustad et al. [2]	2009	20	2–9 months	Intensive NDT blocks	GMFM-66, GMFM-88 [21]	Significant motor gains during intensive therapy
2	Lucas et al. [3]	2024	153	0–4 months corrected	Ultra-early parent coaching	AIMS, Bayley-IV [24,25]	Feasible delivery; no statistical difference
3	Benfer et al. [4]	2024	86	0–9 months corrected	LEAP-CP peer-led home program	PEDI-CAT, HINE, DASS [27,28,29]	Improved mobility in GMFCS I–II group
4	Mohamed et al. [5]	2020	60	<12 months	Physio + Conductive Education	Developmental Quotient (DQ) [30]	Strongest gains in early-intervention group
5	Eliasson et al. [6]	2018	32	3–6 months	Baby-CIMT vs. massage	HAI, AHA [31,32]	Improved unimanual hand use
6	Dina & Pavel [7]	2023	40	3–10 months	DinaCord therapist–parent model	Therapist rating, compliance	Enhanced outcomes through parent–therapist engagement
7	Boyd et al. [8]	2017	NA	3–9 months	REACH trial protocol (Baby mCIMT vs.	Mini-AHA, GMFM, Bayley	Protocol phase; comparative limb training planned

					BIM)	[21,32,25]	
8	Sgandurra et al. [9]	2018	NA	<9 months	CareToy-Revised (tele-rehab tech)	IMP, PDMS-2, Bayley [34,25]	Protocol stage; expected gains in posture and coordination
9	Zhang et al. [10]	2015	48	<6 months	Comprehensive rehab (PT/OT/massage/TCM)	GMFM, FMFM, Gesell DQ [21,30]	Milder baseline cases showed fastest gains
10	Harbourne et al. [11]	2021	112	6–12 months	START-Play (motor–cognition)	GMFM-66, Bayley-III [21,25]	Best suited for infants with low motor baseline
11	Eliasson et al. [12]	2016	NA	3–6 months	Small Step protocol	PDMS-2, AIMS, HAI [31]	Structured home plan; protocol stage
12	Morgan et al. [13]	2016	30	3–6 months	GAME intervention	PDMS-2, GMFM, COPM [21,37]	Significant motor/cognitive gains
13	Morgan et al. [14]	2014	NA	<6 months	GAME protocol paper	Bayley, AHEMD [25]	Framework for enrichment + coaching
14	Meena et al. [15]	2012	100	NICU discharge (34–36 wks PMA)	NICU-based developmental physiotherapy	DDST, Amiel-Tison exam [33]	Reduced delays at 6 months follow-up
15	Blauw-Hospers et al. [16]	2011	46	≤6 months corrected	COPCA vs. TIP	IMP, PEDI, Bayley [26,25]	COPCA yielded better functional process outcomes
16	Hielkema et al. [17]	2020	43	<5 months corrected	COPCA vs. TIP	PEDI, FES, ITQOL [35]	Greater empowerment/ QoL for parents in COPCA group
17	Holmström et al. [18]	2019	39	4–9 months	Small Step full RCT	PDMS-2, GMFM, PEDI	Greatest benefits in low-baseline infants

						[21,27]	
18	Gmmash AS et al. [19]	2019	269 (therapists)	NA (survey of EI practice)	National EI survey	Use of GMA, HINE, COPM tools [36,37,38]	Tool usage and goal setting inconsistent across centers
19	Skanika et al. [20]	2024	20	NICU discharge to age 5	Long-term Bobath-based therapy	GMFM-88, GMPM [21]	EI group outperformed in mobility + movement quality

Table 2: Summary of Intervention Models

Therapy Modality	**Number of Studies**	**Common Techniques**
Neurodevelopmental Treatment (NDT)	6	Postural control, facilitation, trunk alignment, tone modulation, reflex integration
Constraint-Induced Movement Therapy (CIMT/mCIMT)	3	Restraint of unaffected limb, unimanual task training, repetition, structured feedback
Goal-Directed Enriched Therapy (e.g., GAME, START-Play)	4	Play-based problem solving, cognitive-motor coupling, affordance-rich environments, motor planning
Traditional Infant Physiotherapy (TIP)	2	Handling-based, positioning, passive movement sequences based on NDT principles
Technology-Assisted Interventions	2	Sensorized platforms (e.g., CareToy), remote coaching, activity tracking, telehealth feedback
Parent-Coached Family-Centered Therapy	7	Home-based task training, caregiver empowerment, daily motor routines, parent-led goal setting
Peer-Delivered or Community-Based Therapy	1	Trained peer facilitators, goal mapping, simplified home programs, environmental support
Comprehensive Multimodal Programs	2	Physical + occupational + speech therapy, TCM (massage, steaming), hyperbaric O_2, electrical stimulation

Discussion

Intervention models and motor sensory outcomes

Therapist-Guided Interventions for Motor Facilitation: Therapist-guided physiotherapy remains a cornerstone of early intervention for infants with cerebral palsy, particularly those requiring active facilitation to initiate and refine foundational movement patterns. These interventions often structured around neurodevelopmental principles include postural transitions, trunk alignment, and limb coordination through tactile cueing and graded sensory stimulation. Studies such as those by Ustad et al., Zhang et al., and Mohamed et al. demonstrated measurable improvements in gross motor function using techniques that allow therapists to adjust biomechanics in real time and personalize progression based on infant response. However, while several trials referenced outcomes related to movement quality including aspects like symmetry, coordination, and stability the evidence remains limited, variably defined, and largely reliant on subjective interpretation. Tools such as the Gross Motor Performance Measure (GMPM), Hand Assessment for Infants (HAI) and Mini Assisting Hand Assessment (AHA) offer structured formats, but cross-study comparison is challenged by inconsistent use and lack of standardization. Thus, although qualitative motor gains are often clinically observed during therapist-led sessions, the current literature provides only modest empirical support for these improvements. Importantly, therapist involvement continues to play a critical role not only in clinical delivery but also in goal setting, caregiver education, and follow-through planning—bridging the gap between early intervention principles and sustained home-based application. Strengthening objective measurement of movement quality in future research will be key to validating these therapeutic contributions more robustly.

Enriched and Task-Specific Approaches Drive Quality Gains

Apart from achieving milestones, a key role of early physiotherapy is to optimize a baby's movement. Studies using instruments such as Gross Motor Performance Measure (GMPM) , Assisting Hand Assessment (HAI), and Mini-Assisting Hand Assessment (Mini-AHA) showed that interventions targeting movement quality – including Baby-CIMT (Constraint Induced Movement Therapy for infants) and domain-focused task training (e.g., Small Step) – resulted in improvements in coordination, symmetry, alignment, and friendliness. The inclusion of such qualitative components is critical for mobility and participation in adult years and further support for the incorporation of qualitative measures into childhood physiotherapy protocols.

In fact, treatments that combined cognitive and motor skills (e.g., START-Play, GAME) clearly double-dipped improving both motor skill acquisition and problem-solving, joint attention, and receptive communication. This embodiment framework represented a new paradigm for neurodevelopmental therapy that acknowledges the inter-relation of sensorimotor and cognitive organs systems in early infancy.

Family-Centered, Parent-Delivered Models Enhance Impact

Family-centered, parent-delivered physiotherapy models—such as COPCA (Coping with and Caring for Infants with Special Needs), Small Step, and START-Play—represent a paradigm shift from conventional therapist-led sessions to home-based, caregiver-empowered interventions. These approaches positioned parents not just as participants but as primary facilitators of daily motor practice, with therapists serving as coaches, guides, and problem-solving partners. For example, the COPing and CAring for infants with special needs (COPCA) model emphasized parental coaching over direct handling, encouraging infant-led movement exploration embedded within daily routines. Therapists

provided feedback via home visits and video reviews, enabling parents to adapt tasks based on their child's abilities.

The Small Step Program divided intervention into structured domains (hand use, mobility, and communication) and offered biweekly coaching. Parents were trained to set short-term goals, scaffold movement through play, and adjust activities based on developmental cues—facilitating 35 weeks of personalized motor training. In START-Play, parents were taught to promote embodied cognition by integrating toys, positioning strategies, and problem-solving tasks that linked physical movement with early cognitive skills. Coaching sessions empowered them to interpret their child's responses and shape play-based routines accordingly. Studies by Dina & Pavel and Skanika et al. further reinforced the importance of strong therapist–parent communication. In DinaCord, detailed verbal guidance, trust-building, and shared decision-making improved parental compliance and consistency in daily exercises. Skanika et al. documented how sustained parental involvement—starting from NICU discharge and continuing through early childhood—led to superior GMFM and GMPM outcomes, emphasizing alignment, stability, and coordination.

Timing and Dose as Critical Determinants- The majority of these studies highlighted the neuroplastic window of 0–6 months corrected age as a critical window of opportunity for the start of PT. Interventions initiated in this particular period (e.g., GAME, Small Step, Baby-CIMT) had higher potential to bring about objectively assessable changes in gross motor function (e.g., PDMS-2, GMFM-66) and motor planning. Zhang et al. and Meena et al. also provided evidence that the earlier the intervention was started, the better the neurodevelopmental and motor outcomes, especially in the mature patients and in those with initial moderate deviation and a GMFCS level of I–II. Notably, there are some studies (e.g., Harbourne et al., Holmström et al. observed divergent changes by pre-existing motor status. For babies with mild delays, intervention with care as usual (CAU) or low-intensity therapy produced similar results, suggesting the feasibility of stratified intervention intensity targeted at higher versus lower-risk presentations.

Implementation Challenges and Research Gaps- Despite evidence of the feasibility and effectiveness of early intervention, various obstacles remain. Our own clinical environment does not always have predictive tools such as the General Movement Assessment (GMA) or Hammersmith Infant Neurological Examination (HINE), as indicated by Gmmash & Effgen. In addition, modalities and frequency of therapy, and therapist training is a barrier to consistent delivery of care. Several of these interventions are labour intensive and may not be feasible in low-resource settings. However, research such as that from Learning through Everyday Activities with Parents of infants at risk of Cerebral Palsy(LEAP-CP) remains to show how peer-delivered goal-directed programming may be feasible even in low-resource environments, such that community-enabled pathways might help fill the access gap.Lastly, variability in outcome measures and follow-up times hinders the ability to directly compare results across studies. Trials rarely exceed 18–24 months CP at follow-up and few report follow-up in the longer term or quality of life.

Conclusion

The combined results of this review emphasize a number of important priorities. There are two key time periods for intervention, where the greatest improvements are observed when physiotherapy is initiated before 6 months of corrected age. Equally important is the focus on specific qualitative aspects of motor development—such as coordination, symmetry, and postural stability—which should be addressed alongside the achievement of developmental milestones to optimize long-term functional outcomes. Therapist-guided interventions offer distinct advantages, as they enable precise motor facilitation, real-time postural adjustment, and individualized progression based on the infant's evolving neuromotor

profile. Unlike parent-led or self-administered activities, therapist-delivered therapy provides biomechanical accuracy and tailored sensory-motor stimulation—especially critical in infants with complex presentations or asymmetric tone. The physiotherapist's ability to interpret subtle movement patterns, set targeted goals, and modulate input responsively ensures higher fidelity and therapeutic depth across sessions. While parent-mediated programs are invaluable for daily continuity and engagement, the therapist's clinical expertise remains central to both assessing motor behavior and equipping families with safe, effective routines. Integrating both approaches under coordinated supervision will be key to delivering optimal early rehabilitation. In parallel, there is a pressing need to disseminate scalable and culturally adaptable physiotherapy models, particularly in resource-constrained settings. Parent-mediated, goal-directed programs einforced through expert coaching and contextualized practice—continue to demonstrate meaningful gains across both motor and psychosocial domains, reaffirming the centrality of family involvement in early rehabilitation. Looking forward, multicenter longitudinal trials with robust methodology and sustained follow-up will be vital to evaluating the lasting impacts of early diagnosis and therapy.

References

1. Weindling AM, Hallam P, Gregg J, Klenka H, Rosenbloom L, Hutton JL: A randomized controlled trial of early physiotherapy for high-risk infants. ActaPaediatr. 1996, 85:1107 1113. 10.1111/j.1651- 2227.1996.tb14226.x
2. Ustad T, Sorsdahl AB, Ljunggren AE: Effects of intensive physiotherapy in infants newly diagnosed with cerebral palsy. Dev Neurorehabil. 2009, 12:88-95. 10.1097/PEP.0b013e3181a3429e
3. Lucas BR, Bowen J, Morgan C, et al.: The Best Start Trial: A randomised controlled trial of ultra-early parent-administered physiotherapy for infants at high risk of cerebral palsy or motor delay. Dev Med Child Neurol. 2024, 66:186-195. 10.1016/j.earlhumdev.2024.106111
4. Benfer KA, Whittingham K, Ware RS, et al.: Efficacy of early intervention for infants with cerebral palsy in an LMIC: an RCT. Pediatrics. 2024, 153:2023063854. 10.1542/peds.2023-063854
5. Mohamed SH, Fahmy SA, Mohamed AG, El-Sabbagh MH: Efficacy of physiotherapy and conductive education in improving motor skills and mental function in children with cerebral palsy. Open J Pediatr. 2020, 10:274-285. 10.4236/ojped.2020.102038
6. Eliasson AC, Nordstrand L, Ek L, et al.: The effectiveness of Baby-CIMT in infants younger than 12 months with clinical signs of unilateral cerebral palsy: an explorative study with randomized design. Res Dev Disabil. 2018, 72:191-201. 10.1016/j.ridd.2017.11.006
7. Dina AM, Pavel V: The influence of physical therapist approach in the parent's compliance of infantile cerebral palsy diagnosed children. Open J Pediatr. 2023, 13:155-166. 10.24193/subbeag.68(2).11
8. Boyd RN, Ziviani J, Sakzewski L, et al.: REACH: study protocol of a randomised trial of rehabilitation very early in congenital hemiplegia. BMJ Open. 2017, 7:017204. 10.1136/bmjopen-2017-017204
9. Sgandurra G, Beani E, Giampietri M, Rizzi R, Cioni G: CareToy-R Consortium. Early intervention at home in infants with congenital brain lesions with CareToy revised: a RCT protocol. BMC Pediatr. 2018, 18:150. 10.1186/s12887-018-1264-y
10. Zhang H, Zhang B, Jia F, et al.: The effects of motor and intellectual functions on the effectiveness of comprehensive rehabilitation in young children with cerebral palsy. Exp Ther Med. 2015, 9:233-238. 10.1177/0300060514558897

11. Harbourne RT, Dusing SC, Lobo MA, et al.: START-Play physical therapy intervention impacts motor and cognitive outcomes in infants with neuromotor disorders: a multisite randomized clinical trial. PhysTher. 2021, 101:135. 10.1093/ptj/pzaa232
12. Eliasson AC, Holmström L, Aarne P, et al.: Efficacy of the Small Step Program in a randomized controlled trial for infants below age 12 months with clinical signs of CP: a study protocol. BMC Pediatr. 2016, 16:71. 10.1186/s12887-016-0711-x
13. Morgan C, Novak I, Dale RC, Guzzetta A, Badawi N: Single blind randomized controlled trial of GAME (Goals-Activity-Motor Enrichment) in infants at high risk of cerebral palsy. J Clin Med. 2016, 5:52. 10.1016/j.ridd.2016.04.005
14. Morgan C, Novak I, Dale RC, Guzzetta A, Badawi N: GAME (Goals-Activity-Motor Enrichment): protocol of a single blind randomized controlled trial. BMC Neurol. 2014, 14:203. 10.1186/s12883-014-0203-2
15. Meena N, Kurup VKM, Ramesh S, Sathyamoorthy R: Impact of early physiotherapy intervention on neurodevelopment in preterm low birth weight infants. Int J TherRehabil. 2012, 19:460-466. 10.5005/ijopmr-24-1-3
16. Blauw-Hospers CH, Dirks T, Hulshof LJ, Bos AF, Hadders-Algra M: Pediatric physical therapy in infancy: from nightmare to dream? A two-arm randomized trial. PhysTher. 2011, 91:1321-1333. 10.2522/ptj.20100205
17. Hielkema T, Boxum AG, Hamer EG, et al.: LEARN2MOVE 0-2 years, a randomized early intervention trial for infants at very high risk of cerebral palsy: family outcome and infant's functional outcome. ClinRehabil. 2020, 34:527-539. 10.1080/09638288.2019.1610508
18. Holmström L, Eliasson AC, Almeida R, Furmark C, Weiland AL, Tedroff K, Löwing K: Efficacy of the Small Step Program in a randomized controlled trial for infants under 12 months old at risk of cerebral palsy and other neurological disorders. J Clin Med. 2019, 8:1016. 10.3390/jcm8071016
19. Gmmash AS, Effgen SK: Early intervention therapy services for infants with or at risk for cerebral palsy: a national survey of practice patterns. PediatrPhysTher. 2019, 31:66-72. 10.1097/PEP.0000000000000619
20. Skanika K, Tzitiridou-Chatzopoulou M, Papadopoulou O, et al.: Effect of physiotherapy on preterm neonates and its results on five-year-old children, according to GMFM - GMPM evaluation scales. Maedica :273-282. 10.26574/maedica.2024.19.2.273
21. Choi J. Y. (2024: Motor Function Measurement in Children: Gross Motor Function Measure (GMFM) . Annals of rehabilitation medicine, 48, 301-304.
22. Boyce, W. F., Gowland, C., Rosenbaum:: The Gross Motor Performance Measure: validity and responsiveness of a measure of quality of movement. Physical therapy. 75:603-613.
23. Valentini, N. C., & Zanella, L. W. (2022: Peabody Developmental Motor Scales- 2: The Use of Rasch Analysis to Examine the Model Unidimensionality, Motor Function, and Item Difficulty. Frontiers in pediatrics.10:852732.
24. Eliks, M., & Gajewska, E. (2022: The Alberta Infant Motor Scale: A tool for the assessment of motor aspects of neurodevelopment in infancy and early childhood. Frontiers in neurology. 13:927502.
25. Balasundaram P, Avulakunta ID: Bayley Scales Of Infant and Toddler Development. [Updated 2022 Nov 21]. In. StatPearls [Internet, Treasure Island (FL): StatPearls Publishing; 2025.
26. Moseley, A. M., Elkins, M. R., (2020: Using research to guide practice: The Physiotherapy Evidence Database (PEDro). Brazilian journal of physical therapy. 24:384-391.

27. Haley, S. M., Coster, W. J., Dumas, (2011: Accuracy and precision of the Pediatric Evaluation of Disability Inventory computer-adaptive tests (PEDI-CAT). Developmental medicine and child neurology. 53:1100- 1106.
28. Hay, K., Nelin, M., Carey, H., (2018: Hammersmith Infant Neurological Examination Asymmetry Score Distinguishes Hemiplegic Cerebral Palsy From Typical Development. Pediatric neurology. 87:70-74.
29. Ali, A. M., Alkhamees, A. A., (2021: The Depression Anxiety Stress Scale 21: Development and Validation of the Depression Anxiety Stress Scale 8-Item in Psychiatric Patients and the General Public for Easier Mental Health Measurement in a Post COVID-19 World. International journal of environmental research and public health, 18, 10142.
30. Brown, K. A., Parikh, S., & Patel, D. R. (2020). Understanding basic concepts of developmental diagnosis in children. *Translational pediatrics*, *9*(Suppl 1), S9–S22. https://doi.org/10.21037/tp.2019.11.04
31. Ryll, U. C., Krumlinde-Sundholm, L., Verhage, (2021: Predictive validity of the Hand Assessment for Infants in infants at risk of unilateral cerebral palsy. Developmental medicine and child neurology. 63:436-443.
32. Krumlinde-Sundholm, L., Holmefur, M., (2007: The Assisting Hand Assessment: current evidence of validity, reliability, and responsiveness to change. Developmental medicine and child neurology. 49:259- 264. 10.1111/dmcn.14739
33. Shahshahani, S., Vameghi, R., Azari, (2010: Validity and Reliability Determination of Denver Developmental Screening Test-II in 0–6-Year-Olds in Tehran. Iranian journal. 20:313-322.
34. Machado, L. R., da Silva, C. F. R., (2022: Psychometric properties of the Infant Motor Profile (IMP): A scoping review protocol. PloS one, 17, e0277755.
35. Raat, H., Landgraf, J. M., Oostenbrink, (2007: Reliability and validity of the Infant and Toddler Quality of Life Questionnaire (ITQOL) in a general population and respiratory disease sample. Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation, 16, 445-460. https://doi.org/10.1007/s11136-006-9134-8.
36. Kapil, N., Majmudar-Sheth, B., & Johnson, T. (2024: Hammersmith Infant Neurological Examination Subscores Are Predictive of Cerebral Palsy. Pediatric neurology. 151:84-89.
37. Kadam, A. S., Nayyar, S. A., Kadam, (2022: General Movement Assessment in Babies Born Preterm: Motor Optimality Score-Revised (MOS-R), Trajectory, and Neurodevelopmental Outcomes at 1 Year. The journal of pediatrics: X, 8, 100084.
38. Enemark Larsen A. (2020: The Canadian Occupational Performance Measure (COPM): a valuable tool for children with cerebral paresis. Developmental medicine and child neurology. 62:1115. 10.1111/dmcn.1461