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## Interventions and Management

### **1. Performance discrimination and responsiveness of an integrative scoring method for the Jebsen-Taylor Test of Hand Function in children with unilateral cerebral palsy**

Astrid Carton de Tournai, Daniela Ebner-Karestinos, Geoffroy Saussez, Julie Paradis, Emmanuel Segnon Sogbossi, Rodrigo Araneda, Yannick Bleyenheuft

Physical & Occupational Therapy in Pediatrics, Online ahead of print, 6 April 2026

#### Abstract

The original scoring of the Jebsen-Taylor Test of Hand Function evaluates only the time required to complete subtests, neglecting accuracy. This study proposed a new integrative scoring system designed to capture both speed and accuracy. The study aimed to evaluate the ability to discriminate manual dexterity over time using both the original and integrative scores in typically developing children and to assess the responsiveness of the integrative score following intensive intervention in children with unilateral cerebral palsy. This observational study included 169 typically developing children and 40 children with unilateral cerebral palsy assessed before and after intervention. The original score indicated age-related improvements in manual dexterity up to 8–10 years, after which performance plateaued, whereas the integrative score showed continuous improvement. Significant post-intervention differences were observed for both less and more affected hands in children with unilateral cerebral palsy. The integrative score demonstrated reliable discrimination and responsiveness and is recommended for assessing dexterity using the Jebsen-Taylor Test of Hand Function.

PMID: [41937752](https://pubmed.ncbi.nlm.nih.gov/41937752/)

## 2. Assessment of trunk movement and posture in spastic and dyskinetic cerebral palsy: A scoping review

Ellen Van Wonterghem, Anna-Klara Nohlin Sandsjö, Inti Vanmechelen, Helga Haberfehlner, Meta Nyström Eek, Kaat Desloovere, Kate Himmelmann, Elegast Monbaliu

Developmental Medicine & Child Neurology. 2026 Apr 10. Online ahead of print.

**Aim:** To map and summarize available clinical and instrumented assessment tools for evaluating trunk control in individuals with spastic or dyskinetic cerebral palsy (CP) across Gross Motor Function Classification System (GMFCS) levels, describing their current application, assessed features, and psychometric properties, to provide first practical guidance for tool use. **Method:** For this scoping review, eight databases were systematically searched. Studies were included if they evaluated reliability, validity, or responsiveness of tools assessing trunk control in spastic/dyskinetic CP. The review followed the methodology of the JBI and the guidelines of the Preferred Reporting Items for Systematic reviews and Meta-Analyses for Scoping Reviews (PRISMA-ScR).

**Results:** The search yielded 27 332 publications, of which 110 met the inclusion criteria. Twenty-two distinct assessment tools were identified, including 12 clinical and 10 instrumented. Instrumented assessment tools were most frequently investigated (65%). Validity was reported in 62% of studies; reliability and responsiveness in 30% and 0% respectively. Notably, 85% of studies focused exclusively on individuals with spastic CP, only 28% addressed individuals with CP classified in GMFCS levels IV or V.

**Interpretation:** This review highlights critical gaps in research on trunk control assessment in CP, particularly for patients with severe disabilities, tool responsiveness, and coverage of key facets of trunk control. Future research should prioritize thorough psychometric evaluation of tools, across facets, accounting for the diverse applications and heterogenous clinical presentations in CP.

PMID: [41964113](#)

## 3. Total hip arthroplasty as reconstructive treatment in patients with cerebral palsy: a comparative study of postoperative outcomes between patients with developmental hip dysplasia and cerebral palsy hip dysplasia

Ricard L González-Adrio, Daniel Pacha, Andrés Aliaga-Martínez, Alejandro Hernández, Diego Collado, Diego Soza

European Journal of Orthopaedic Surgery & Traumatology, April 2026

### Abstract

Total hip arthroplasty (THA) has emerged as a viable treatment for end-stage hip disease in patients with cerebral palsy (CP), yet long-term comparative data remain limited. This study evaluates postoperative outcomes in CP patients with hip dysplasia compared to a matched cohort with developmental hip dysplasia (DDH). A retrospective comparative analysis of 72 patients (14 CP, 58 DDH) undergoing primary THA between November 2016 and December 2022 at a tertiary trauma center was conducted. All procedures used cementless Wagner SL stems and Zimmer Biomet acetabular components. Radiological parameters were measured using TraumaCad, and functional outcomes were assessed using the modified Harris Hip Score and CP-specific scales. No significant differences were observed between groups in surgical time, postoperative complications, or dislocation rates. The CP group required significantly more transfusions, but preoperative and postoperative hemoglobin levels were similar between groups. Both groups demonstrated significant functional improvement and high satisfaction rates. THA provides safe and effective pain relief and functional restoration in CP patients with hip dysplasia, with comparable outcomes to DDH patients despite greater surgical complexity. Tailored surgical approaches optimize outcomes in this population.

PMID: [41941002](#)

#### **4. Study of the Relationships Between Gait Characteristics and Brain Function in Children With Cerebral Palsy During Walking**

Yajie Chang, Xiaoling Chen, Aiping Sun, Beihua Zhang, Congcong Huo, Tengyu Zhang

Archives of Physical Medicine and Rehabilitation. 2026 Apr 7. Online ahead of print.

**Objective:** To investigate gait characteristics and cortical function in children with cerebral palsy (CP) during walking and to explore potential associations between them, providing a theoretical basis for rehabilitation.

**Design:** Observational cross-sectional study. Participants performed an 8-minute walking task by walking back and forth along a corridor approximately 50 m. Cerebral hemoglobin oxygenation was recorded using functional near-infrared spectroscopy, and gait parameters, including temporal and kinematic angle measures, were collected. Cortical activation and functional connectivity were analyzed using the wavelet transform, and gait metrics reflecting symmetry, variability, and coordination were extracted. Gait metrics and brain functional metrics were compared between the two groups, and a regression model combined with bootstrapping was applied to explore the associations between gait characteristics and brain function.

**Results:** The children with CP showed significantly lower wavelet phase coherence than children who were typically developing and exhibited pronounced gait asymmetry and greater variability. Regression analyses identified 22 gait metrics in children with CP that exhibited stable associations with brain function, most of which were kinematic angle metrics. Among children with CP, lower kinematic angle variability, poorer coordination, and greater asymmetry appeared to be associated with higher wavelet phase coherence.

**Conclusions:** Different gait patterns and cortical activity were observed between the two groups. Kinematic angle metrics may play a key role in gait assessment. Association analyses indicated that certain gait metrics may be related to changes in brain activity in children with CP, and the methodology may serve as a means to study the effect of interventions.

PMID: [41949501](#)

#### **5. Functional and structural respiratory impairment in cerebral palsy- GMFCS IV and V: Insights from ultrasound and inspiratory muscle testing**

Bruna Grimaldi Varga, Fernanda de Souza Leal, Amanda de Paula Figueiredo, Etiene Farah Teixeira de Carvalho, Evelim Leal de Freitas Dantas Gomes

Respiratory Medicine. 2026 Apr 8. Online ahead of print.

**Background:** Children with cerebral palsy (CP) classified at Gross Motor Function Classification System (GMFCS) levels IV and V present severe motor and respiratory impairment, which limits the feasibility of conventional pulmonary function testing. Non-invasive alternatives, such as diaphragmatic ultrasound and dynamic inspiratory muscle assessment, may provide clinically meaningful insights into respiratory function in this population.

**Objective:** To evaluate respiratory muscle strength and diaphragmatic function in children and adolescents with CP (GMFCS IV-V) and to explore correlations among inspiratory strength, flow, and ultrasound-derived parameters.

**Methods:** This cross-sectional study included 32 participants aged 6-17 years. Respiratory muscle strength was assessed using maximal inspiratory (P<sub>I</sub>max) and expiratory pressures (P<sub>E</sub>max) measured with a digital manometer. Dynamic inspiratory performance was evaluated through the S-index and peak inspiratory flow (PIF) using the PowerBreathe® K5 device.

Diaphragmatic thickness, excursion, contraction speed, and echogenicity were assessed by ultrasound.

**Results:** Measured P<sub>I</sub>max and P<sub>E</sub>max were significantly lower than predicted values ( $p < 0.001$ ), indicating reduced respiratory muscle strength in children and adolescents with CP classified as GMFCS IV-V. Diaphragmatic excursion was lower than reference values, particularly in those with more severe motor impairment. P<sub>I</sub>max showed moderate positive correlations with mean S-index, best S-index, and peak inspiratory flow. In the regression model, mean inspiratory volume was the main determinant of P<sub>I</sub>max, and the model demonstrated moderate explanatory power.

**Conclusions:** Children and adolescents with severe CP (GMFCS IV-V) exhibit marked impairment in respiratory muscle strength and reduced diaphragmatic mobility. The combined use of dynamic inspiratory assessment and diaphragmatic ultrasound represents a feasible and non-invasive approach to characterize respiratory dysfunction in this population.

PMID: [41962597](#)

## 6. Barriers to Oral Health Care Among Children With Cerebral Palsy—A Systematic Review

Priya Kannan, Madhumitha Muthukumar, Shreya S, Senthil Eagappan, Deepthi Bolla, Nandini S

Special Care in Dentistry. 2026 Mar–Apr;46(2).

**Introduction:** Children with cerebral palsy (CP) experience multiple barriers to oral health care. This systematic review aims to recognize and compile the barriers to accessing and utilizing oral health care services in this population.

**Methods:** This systematic review was registered in PROSPERO and conducted adhering to PRISMA 2020 guidelines. A comprehensive search strategy using MeSH terms was applied across PubMed, Google Scholar, and Cochrane Library. Studies were selected based on predefined inclusion criteria and assessed using the Mixed Methods Appraisal Tool.

**Results:** From 1441 identified studies, eight were included, involving parents or caregivers of children with CP across five countries. All included studies were methodologically sound. The primary barriers identified were physical and behavioral challenges, transportation and distance-related issues, financial constraints, caregiver attitudes toward dental care, accessibility limitations, and provider-related barriers.

**Conclusion:** Children with CP face multifaceted challenges in accessing oral health services. Addressing these barriers requires caregiver education, infrastructural improvements, and enhanced provider training to deliver inclusive and preventive dental care.

PMID: [41947614](#)

## 7. Effects of virtual reality and robot-assisted therapy on rehabilitation outcomes in cerebral palsy: a systematic review and meta-analysis

Hang Zhou, Yunyun Zhang, Miao Nie, Lina Ge

Journal of NeuroEngineering and Rehabilitation. 2026 Apr 8. Online ahead of print.

No abstract available

PMID: [41952209](#)

## 8. Machine learning-based analysis of blood biomarker features in spastic cerebral palsy and their clinical significance

YanJun Mo, Yu Jiang, ZhaoZhan Qiang, Jiashu Yue, Ying Zeng, Lin Xu, Xiaoye Li, Xiaohong Mu

Frontiers in Neurology. 2026 Mar 23.

**Background:** Cerebral palsy (CP) represents the most prevalent motor disability in childhood, with spastic cerebral palsy (SCP) constituting the predominant subtype. However, systematic characterization of differences in systemic inflammatory status and metabolic profiles between children with SCP and healthy peers remains limited. Here, an interpretable machine-learning framework was applied to evaluate and identify clinically informative inflammation- and metabolism-related biomarkers in children with SCP.

**Methods:** In this retrospective study, 330 children with SCP and 150 healthy controls were enrolled. Complete blood count and serum biochemical parameters were collected, from which systemic immune-inflammation indices were derived. Feature preselection was performed using least absolute shrinkage and selection operator regression, followed by univariable and multivariable logistic regression. Model interpretability was assessed using SHapley Additive exPlanations, restricted cubic splines were used to explore nonlinear associations, and receiver operating characteristic curves evaluated discriminative performance. Subgroup analyses were conducted by Gross Motor Function Classification System levels.

**Results:** Multivariable logistic regression identified seven independently associated biomarkers. A nomogram based on these biomarkers demonstrated strong discriminative performance with an area under the curve of 0.972 in the independent test set. Subgroup analysis showed distinct inflammatory and biochemical differences between severe and mild SCP, with the subgroup model yielding an area under the curve of 0.717.

**Conclusion:** This study identified inflammation- and metabolism-related biomarkers associated with spastic cerebral palsy and disease severity. Indicators such as mean platelet volume and platelet distribution width may serve as potential biological correlates for monitoring disease status and evaluating intervention responses.

PMID: [41948613](#)

### **9. Relationship Between Physical Literacy and Habitual Physical Activity of Brazilian Children With Cerebral Palsy Who Can Walk**

Ricardo Rodrigues de Sousa Junior, Anna Carolina Pimenta Ribeiro, Luana Cristina da Silva, Hércules Ribeiro Leite, Rejane Vale Gonçalves

Pediatric Physical Therapy. 2026 Apr 10. Online ahead of print.

**Background and purpose:** This study aimed to analyze the relationship between physical literacy and habitual physical activity in children with cerebral palsy who can walk and to compare these aspects between them.

**Methods:** This was a cross-sectional study that included 43 children with cerebral palsy aged 6 to 12 years at Gross Motor Classification System (GMFCS) levels I and II. Participants wore Actigraph wGT3X-BT accelerometers for 1 week to assess physical activity levels and completed the Physical Literacy Profile Questionnaire (PLP-Quest) to assess physical literacy. **Results:** No significant correlation was found between physical literacy and habitual physical activity. Seventy-eight percent of the participants met the World Health Organization's physical activity recommendations. Children at GMFCS level II showed higher sedentary behavior and lower light physical activity levels than those at level I, besides their similar physical literacy scores.

**Conclusions:** More efforts are needed to reduce sedentary behavior, especially for children at GMFCS level II, and to encourage physical literacy development.

PMID: [41954495](#)

### **10. The potential hematological features of children with spastic cerebral palsy in China: a retrospective multidimensional data analysis based on routine hematological indicators**

Yanjun Mo, Yu Jiang, Zhaozhan Qiang, Gang Liu, Ruiqin Yu, Huizhong Bai, Ying Zeng, Chuangyu Hu, Jiashu Yue, Zhuoluo Zhou, Jingpei Ren, Lin Xu, Xiaoye Li, Xiaohong Mu

Frontiers in Pediatrics. 2026 Mar 24.

**Background:** Cerebral palsy (CP) is a non-progressive brain injury primarily characterized by abnormal posture and movement disorders. Among them, spastic cerebral palsy (SCP) accounts for 70% of cases. Previous small sample hematological data analyses have revealed significant differences in inflammatory marker ratios between SCP patients and healthy controls. This study aims to expand the sample size and perform a multidimensional data analysis using routine hematological indicators to identify hematological features of spastic cerebral palsy, potentially providing new directions for the treatment of SCP.

**Methods:** This retrospective study included 305 children with spastic cerebral palsy and 149 healthy children, aged 3-12 years. Previous routine blood and biochemical test results were collected from the participants. Statistical analysis was performed on clinically common indicators and related composite indicators, and subgroup analyses were conducted based on age group (preschool vs. school-age).

**Results:** Compared to the healthy control group, SCP patients had significantly lower levels of NPAR, alkaline phosphatase (ALP), creatinine (Cr), SII, and MPV/PC ( $p < 0.05$ ). AST/ALT, NLR, total protein, and SIRI levels were significantly higher in the SCP group ( $p < 0.05$ ). Logistic regression analysis showed that ALP, Cr, SII, and MPV/PC were protective factors for SCP, while AST/ALT and NLR were risk factors for SCP. Combining these indicators for SCP diagnosis, the ROC curve analysis yielded an AUC of 0.781. Subgroup analysis showed that children aged 3-6 years with SCP had significantly lower Cr, AST/ALT, SII, MPV/PC, and NLR levels compared to children aged 7-12 years with SCP. Furthermore, creatinine, AST/ALT, SII, MPV/PC, and NLR levels were positively correlated with the age of SCP children.

**Conclusion:** This study reveals a significant association between alkaline phosphatase, creatinine, AST/ALT, SII, MPV/PC, NLR in routine blood indicators and the risk of SCP, providing important reference for clinicians to monitor the health status of children with cerebral palsy, optimize treatment plans, and implement nutritional interventions.

PMID: [41953177](#)

### **11. Improving cerebral palsy children's oral hygiene: an 18-month school-based oral health promotion program in Bangkok, Thailand**

Siriporn Songsiripraduboon, Sudaduang Krisdapong

BMC Oral Health. 2026 Apr 7. Online ahead of print.

No abstract available

PMID: [41947125](#)

### 12. Health-related quality of life among caregivers of children with cerebral palsy in Sub-Saharan Africa: A systematic review and meta-analysis

Jenberu Mekurianew Kelkay, Desalegn Mitiku Kidie, Abraham Dessie Gessesse, Kaleab Tesfaye Tegegne, Henok Dessie Wubneh, Addisu Simachew Asgai, Deje Sendek Anteneh

PLOS Mental Health. 2026 Apr 7;3(4).

#### Abstract

Cerebral palsy (CP) is a group of permanent movement and posture disorders that cause activity limitations. Caregivers of children with CP in Sub-Saharan Africa face multidimensional challenges affecting health-related quality of life (HRQoL). This systematic review and meta-analysis aimed to synthesise evidence on the pooled mean HRQoL of caregivers of children with CP in Sub-Saharan Africa. A systematic search identified relevant studies published between 2000 and 2025. Data were extracted and analysed using random-effects meta-analysis. The pooled mean HRQoL was 41.234, indicating moderate to low quality of life, with significant regional disparities. Caregivers in South Africa demonstrated comparatively higher HRQoL scores. Caregivers of children with CP in Sub-Saharan Africa experience substantial challenges, highlighting the need for policy interventions, caregiver support, and strengthened disability services to reduce regional inequities and improve caregiver well-being.

PMID: [41945589](#)

### 13. Reliability and stability of cerebral palsy classification scales for individuals with STXBP1- and SYNGAP1-related disorders

Samuel R Pierce, Julie M Orlando, Kristin G Cunningham, Sarah M Ruggiero, Michael C Kaufman, Jillian L Mckee, Ingo Helbig

Developmental Medicine & Child Neurology. 2026 Apr 10. Online ahead of print.

**Aim:** To determine the interrater reliability and stability of the Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS)/Mini-MACS, and Communication Function Classification System (CFCS) in individuals with STXBP1- and SYNGAP1-related disorders.

**Method:** Data were collected from 83 individuals with STXBP1-related disorders (34 females, 49 males; mean age = 9 years 10 months) and 101 individuals with SYNGAP1-related disorders (51 females, 50 males; mean age = 10 years 11 months) who participated in a prospective natural history study with both cross-sectional and longitudinal phases. Two raters completed the GMFCS, MACS/Mini-MACS, and CFCS assessments on the same day; test-retest stability was evaluated for participants with two longitudinal assessments.

**Results:** Interrater agreement varied from 73.8% to 77.3% for the STXBP1-related disorder cohort and from 60.5% to 83.3% for the SYNGAP1-related disorder cohort. Interrater reliability weighted kappa scores for the STXBP1-related disorder cohort varied from 0.83 to 0.93, while scores for the SYNGAP1-related disorder cohort ranged from 0.66 to 0.81. Test-retest stability scores for the STXBP1-related disorder group varied from 0.62 to 0.94, while scores for the SYNGAP1-related disorder group ranged from 0.38 to 0.78. Significant correlations were found between all assessment scales for both STXBP1-related disorders (Kendall's tau range from 0.25 to 0.42) and SYNGAP1-related disorders (Kendall's tau range from 0.19 to 0.45).

**Interpretation:** The GMFCS, MACS/Mini-MACS, and CFCS demonstrate appropriate levels of interrater reliability and stability for individuals with STXBP1- and SYNGAP1-related disorders.

PMID: [41964267](#)

### 14. Human-animal interactions: starting with pets of children with cerebral palsy

Marcelo Rosales, Angela Rittler, Jill Heathcock

BMC Complementary Medicine and Therapies. 2026 Apr 10. Online ahead of print.

No abstract available

PMID: [41957633](#)

### 15. Socioeconomic status, environmental factors, and motor function in children with cerebral palsy

No authors listed

Developmental Medicine & Child Neurology. 2026 Apr 9. Online ahead of print.

No abstract available

PMID: [41955538](#)

### 16. The cerebral palsy directed acyclic graph: A structural causal model of aetiology

Shona Goldsmith, Sarah McIntyre, Nadia Badawi, Bernard Dan, Steven Day, Kate Himmelmann, Sandra Julsen Hollung, Bo Jacobsson, Gija Rackauskaite, Robert J Reynolds

Developmental Medicine & Child Neurology. 2026 Apr 9. Online ahead of print.

**Aim:** To describe the development of the initial version of the cerebral palsy (CP) directed acyclic graph (DAG). DAGs are visual representations of causal assumptions and powerful tools for representing and communicating complex causation.

**Method:** An international working group of clinicians, researchers, and individuals with lived experience developed the CP-DAG, using methods adapted from the US National Aeronautics and Space Administration's risk modelling approach. The team developed a network of nodes and causal links spanning prenatal, perinatal, neonatal, and postneonatal pathways, along with a node dictionary ('DAGtionary'). Iterative drafts were created with feedback incorporated from presentations at international meetings and workshops.

**Results:** As of August 2025, the CP-DAG includes 106 nodes and 378 links, yielding a network density of 6.8%. It spans known and hypothesized causal pathways across biological, clinical, and social domains. The accompanying DAGtionary contains concise definitions and references for each node, totalling 210 citations.

**Interpretation:** The CP-DAG provides a visual, evidence-linked representation of causal reasoning in CP. It offers a foundation for identifying knowledge gaps, directing future research to under-researched areas, and, eventually, for probabilistic modelling. This initial version is intended as a starting point. We call on the global CP disability community to contribute to its ongoing refinement.

PMID: [41955499](#)

### 17. Delivering Health Education to Children With Chronic Conditions: A Scoping Review and Evidence and Gap Map

Meredith Smith, Nicole Pope, Nadine Smith, Georgina Henry, Ingrid Honan, Kiara Corso, Grace Evans, Caitlin Doyle, Adrienne Harvey

Child: Care, Health and Development. 2026 May;52(3).

**Introduction:** Developmentally appropriate health education is essential for children with chronic conditions and their families to support self-management and improve quality of life. Although a range of educational approaches have been reported, no comprehensive review has examined how these interventions are developed, which approaches are most used, or their outcomes. This review aimed to map and synthesise evidence on health education interventions for children aged 5–12 years with chronic conditions.

**Methods:** Studies reporting health education interventions for children with chronic conditions were identified across multiple databases. Data were extracted on delivery approaches, aligned with paediatric supported self-management frameworks, and on participant and implementation outcomes. Findings were synthesised using an Evidence and Gap Map.

**Results:** A total of 118 studies were included. Most interventions targeted endocrine or metabolic conditions and were delivered in outpatient settings by health professionals, primarily face-to-face, with increasing use of remote approaches. Over half incorporated multiple recommended approaches, including peer learning, play-based strategies, caregiver involvement, pictorial representation, and active learning. Most studies reported participant or implementation outcomes, while few addressed accessibility considerations.

**Conclusions:** Health education for children with chronic conditions increasingly emphasises active learning. Improved inclusivity requires individualised content, multimodal delivery, and meaningful involvement of children and families in intervention design.

PMID: [41946368](#)

### 18. Socioeconomic status, environmental factors, and motor function in children with cerebral palsy

Hana F Alazem, Ewa Sucha, Richard J Webster, Michelle L Larin, Anna M McCormick, Darcy L Fehlings

Developmental Medicine & Child Neurology, Online ahead of print, April 2026

#### Abstract

This study investigated the association between socioeconomic status and motor function in children with cerebral palsy, adjusting for clinical and environmental risk factors. Data were drawn from the CP-NET database in Ontario, Canada. An ordinal logistic regression was fitted to estimate associations between deprivation quintiles and Gross Motor Function Classification System levels, adjusting for gestational age, birthweight for gestational age, maternal illness, distance to a children's treatment center, and air pollution indicators. The cohort included 292 children aged 2 to 7 years. Higher material deprivation was associated with greater motor impairment in a dose-response pattern. Greater distance to a children's treatment center was also associated with worse motor outcomes, whereas air pollution indicators showed no association. These findings indicate that social deprivation and access to care are associated with motor function severity in children with cerebral palsy and highlight the importance of addressing modifiable social risk factors.

PMID: [41936126](#)

## Prevention and Cure

### 19. Functional physical therapy applied by telerehabilitation or in-person in infants at risk of cerebral palsy: feasibility and preliminary efficacy

Adriana Neves Dos Santos, Tatiane Schlichting, Pedro da Silva Cardoso, Egmar Longo, Roslyn Boyd, Nelci Adriana Cicuto Ferreira Rocha

Disability and Rehabilitation. 2026 Apr 10. Online ahead of print.

**Purpose:** The aim was to assess the feasibility and effectiveness of a goal-oriented training applied by telerehabilitation and face-to-face, for infants at risk of cerebral palsy (CP).

**Methods:** In a pilot study of a randomized controlled trial, 14 at-risk infants for CP were allocated into telerehabilitation and in-person groups. Over eight weeks, infants underwent functional physical therapy five times weekly; one session of telerehabilitation conducted via video calls or one session of in-person intervention at the clinic. Caregivers also provided unsupervised home activities four times weekly in both groups. Feasibility was assessed through diaries, and caregiver acceptability was measured using questionnaires. Infant motor function was evaluated using the Gross Motor Function Measure (GMFM).

**Results:** Both methods of delivery were feasible for recruitment and assessment. Caregivers expressed high acceptability for both modalities, although in-person participants presented more challenges in home implementation. Both groups showed a significant gap between planned and delivered dosage of intervention. They showed significant motor improvement over time, with no differences between groups.

**Conclusions:** Telerehabilitation achieved short-term outcomes comparable to conventional therapy in this pilot sample. These preliminary results support the viability of a phase II clinical trial, using the current protocols with modifications.

**Plain language summary:** Telerehabilitation is a potential method for delivering rehabilitation services, including guided therapeutic exercises and caregiver coaching, to infants at risk of cerebral palsy (CP). It was found that telerehabilitation is viable and accepted by the parents. Telerehabilitation and face-to-face intervention seems to improve gross motor function over time equally for infants at risk of CP. Health professionals may consider telerehabilitation as an alternative method for delivering rehabilitation services.

PMID: [41958321](#)

## 20. Oxygen diffusion kinetics, buffering capacity and phenotype: A narrative review of oxygen physiology and later phenotype in very preterm infants

Chad C Andersen, Danielle N Bailey, Tara M Crawford, Michael J Stark

Experimental Physiology. 2026 Apr 7. Online ahead of print.

### Abstract

Clinicians often view supplemental oxygen exposure in preterm infants as a trade-off between survival and complications such as retinopathy of prematurity, but this perspective oversimplifies oxygen physiology. Oxygen diffusion occurs across spatially distinct compartments governed by physical principles, with limited intrinsic regulation. This review proposes that retinopathy of prematurity and cerebral palsy represent opposite ends of a continuum of oxygen diffusion injury. Key physiological concepts include spatial critical thresholds, extinction gradients, hyperoxic injury thresholds, and buffering capacity. These mechanisms explain how hyperoxia and hypoxia may coexist and contribute to distinct phenotypes. Framing oxygen injury within this diffusion-based model clarifies inconsistencies in neonatal trial outcomes and provides a framework applicable to other diffusion-limited conditions.

PMID: [41945472](#)

## 21. Impact of caffeine on neurodevelopmental outcomes in preterm infants: A systematic review and meta-analysis

Hossein Fatemian, Reza Tabrizi, Shant Apelian, Bahareh Izadi, Khadijeh Sadat Najib, Hamide Barzegar

Pediatrics & Neonatology, Online ahead of print, 9 March 2026

### Abstract

Although caffeine is among the commonly used medications in preterm infants, its long-term neurodevelopmental effects have remained uncertain. This systematic review and meta-analysis examined the potential long-term impacts of caffeine administration on the neurodevelopmental outcomes of preterm infants. A comprehensive search was conducted across PubMed, EMBASE, Google Scholar, Web of Science (ISI), Scopus, and the Cochrane Library. Eligible studies included randomized clinical trials or longitudinal studies in which the effects of caffeine administration on neurodevelopmental outcomes were compared to those of placebo or a control group. Neurodevelopmental outcomes, specifically motor, language, cognition, and cerebral palsy, were extracted from the eligible studies and pooled using STATA16 with a random-effects model. Egger's regression test was applied to ascertain the potential for publication bias. Among nine studies comprising 7,041 assessments, caffeine indicated a significant positive effect on motor development (WMD = 0.68, 95% CI: 0.27 to 1.09,  $P < 0.001$ ,  $I^2 = 0.00\%$ ) and cognitive outcomes (WMD = 2.85, 95% CI: 1.63 to 4.08,  $P < 0.001$ ,  $I^2 = 0.00\%$ ). Nevertheless, no significant impact was found on language development (WMD = 0.95, 95% CI: 0.37 to 2.27,  $P = 0.16$ ,  $I^2 = 0.00\%$ ). Further, the odds of cerebral palsy diminished by 35% by the use of caffeine (OR = 0.65, 95% CI: 0.53 to 0.79,  $P < 0.001$ ,  $I^2 = 0.00\%$ ). No publication bias was detected in any of the quantitative analyses. Both standard and high caffeine doses improved cognitive development but had no influence on language development. In conclusion, caffeine may have beneficial effects on neurodevelopment, particularly motor and cognitive development and may also lower the risk of cerebral palsy.

PMID: [41945073](#)

## 22. Everyday positioning experience in typically developing infants and infants with or at risk for cerebral palsy

Kari S Kretch

Research in Developmental Disabilities, Online ahead of print, April 2026

### Abstract

Infant positioning throughout everyday routines impacts physical growth, motor skill advancement, and access to learning opportunities supporting cognitive, social, and communicative development. However, little is known about everyday positioning experiences in infants with or at risk for developmental disabilities such as cerebral palsy and how these experiences differ from those of typically developing peers. This study used Ecological Momentary Assessment to estimate time spent in different posture categories and support levels throughout daily life in infants with or at risk for cerebral palsy and age-matched typically developing infants. Twenty-five infants at risk, including 13 with confirmed cerebral palsy, and 52 typically developing infants were assessed at 6, 9, and 12 months of age across 101 total sessions. Caregivers reported infant positioning in response to text message prompts 10 times per day for 8 days. Time spent supine, prone, suspended, and with adult support decreased with age, while time sitting, standing, and with self-support increased. Infants with or at risk for cerebral palsy were more likely to be supine, prone, and supported by an adult, and less likely to be sitting or standing than typically developing infants. Group differences persisted after controlling for motor milestone achievement, indicating substantial differences in everyday experiences between groups.

PMID: [41936142](#)

## 23. Multimodal MRI of white matter development and selective motor control in preterm infants

Alexander Drobyshvsky, Vasiliy Yarnykh, Theresa Sukal Moulton, Andrea C Pardo, Raye Ann deRegnier, Colleen Peyton

NeuroImage: Clinical, Online ahead of print, April 2026

### Abstract

Selective motor control, the ability to isolate joint movements, emerges during infancy and predicts later motor outcomes in children with cerebral palsy. This study examined the neural substrates of selective motor control using multimodal MRI in very preterm infants at high risk of cerebral palsy. Fifteen infants born before 32 weeks' gestation underwent MRI between 3 and 21 weeks corrected age. Imaging included macromolecular proton fraction mapping, diffusion tensor imaging, and g-ratio estimation, with selective motor control assessed at the time of MRI. In infants with typical development, selective motor control increased with age and correlated strongly with macromolecular proton fraction in the posterior limb of the internal capsule. Myelination rates in the corticospinal tract exceeded those in the corpus callosum. In an infant later diagnosed with cerebral palsy, reduced corticospinal tract myelination corresponded with impaired contralateral motor control. These findings suggest early corticospinal tract myelination parallels emerging selective motor control and may serve as a sensitive biomarker for early motor system development and cerebral palsy risk.

PMID: [41934742](#)